Table of Contents

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

x **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2018

OR

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from _____ to _____.

Commission File Number: 001-36042

INTREXON CORPORATION

(Exact name of registrant as specified in its charter)

Virginia	**26-0084895**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification Number)**
20374 Seneca Meadows Parkway Germantown, Maryland	**20876**
(Address of principal executive offices)	**(Zip Code)**

Registrant's telephone number, including area code (301) 556-9900

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	**Name of each exchange on which registered**
Intrexon Corporation Common Stock, No Par Value	**Nasdaq Global Select Market**

Securities registered pursuant to Section 12(g) of the Act: None

Table of Contents

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes x No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No x

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes x No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes x No ☐

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	x	Accelerated filer	☐
Non-accelerated filer	☐	Smaller reporting company	☐
Emerging growth company	☐		

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No x

As of June 30, 2018, the aggregate market value of the registrant's common stock held by non-affiliates based upon the closing price of such shares on the New York Stock Exchange on such date was approximately $959.4 million.

As of February 15, 2019, 160,408,958 shares of common stock, no par value per share, were issued and outstanding.

DOCUMENTS INCORPORATED BY REFERENCE: Portions of the registrant's Definitive Proxy Statement for its 2019 Annual Meeting of Shareholders are incorporated by reference in Part III of this Annual Report on Form 10-K where indicated. Such proxy statement will be filed with the Securities and Exchange Commission within 120 days of the registrant's fiscal year ended December 31, 2018.

TABLE OF CONTENTS

Intrexon®, Trans Ova Genetics®, EnviroFlight®, Oxitec®, Arctic®, ActoBiotics®, ViaGen®, Okanagan Specialty Fruits®, RheoSwitch®, UltraVector®, Design-Build-Test-Learn®, AquAdvantage®, RTS®, and RheoSwitch Therapeutic System® are our and/or our affiliates' registered trademarks in the United States and AquaBounty™, GenVec™, Precigen™, AdenoVerse™, ActoBio Therapeutics™, Progentus™, AttSite™, LEAP™, Florian™ and Precigen Therapeutics™ are our and/or our affiliates' common law trademarks in the United States. This Annual Report on Form 10-K, or Annual Report, and the information incorporated herein by reference contain references to trademarks, service marks and trade names owned by us or other companies. Solely for convenience, trademarks, service marks and trade names referred to in this Annual Report and the information incorporated herein, including logos, artwork, and other visual displays, may appear without the ® or ™ symbols, but such references are not intended to indicate, in any way, that we will not assert, to the fullest extent under applicable law, our rights or the rights of the applicable licensor to these trademarks, service marks and trade names. We do not intend our use

or display of other companies' trade names, service marks or trademarks to imply a relationship with, or endorsement or sponsorship of us by, any other companies. Other trademarks, trade names and service marks appearing in this Annual Report are the property of their respective owners. Unless the context requires otherwise, references in this Annual Report to "Intrexon", "we", "us", and "our" refer to Intrexon Corporation.

Special Note Regarding Forward-Looking Statements

This Annual Report contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, which statements involve substantial risks and uncertainties. All statements, other than statements of historical facts, included in this Annual Report regarding our strategy, future events, future operations, future financial position, future revenue, projected costs, prospects, plans, objectives of management and expected market growth are forward-looking statements. The words "anticipate", "believe", "estimate", "expect", "intend", "may", "plan", "predict", "project", "would", and similar expressions are intended to identify forward-looking statements, although not all forward-looking statements contain these identifying words. These forward-looking statements include, among other things, statements about:

- our strategy and overall approach to our business model;
- our ability to successfully enter new markets or develop additional products, whether independently or with our collaborators;
- our ability to successfully enter into optimal strategic relationships with our subsidiaries and operating companies that we may form in the future;
- competition from existing technologies and products or new technologies and products that may emerge;
- actual or anticipated variations in our operating results;
- our current and future joint ventures, or JVs, exclusive channel collaborations, or ECCs, license agreements and other collaborations;
- developments concerning our collaborators and licensees;
- actual or anticipated fluctuations in our competitors' or our collaborators' and licensees' operating results or changes in their respective growth rates;
- our cash position;
- market conditions in our industry;
- our ability to protect our intellectual property and other proprietary rights and technologies;
- our ability to adapt to changes in laws, regulations and policies;
- our ability and the ability of our collaborators and licensees to adapt to changes in laws, regulations and policies and to secure any necessary regulatory approvals to commercialize any products developed by us or under our ECCs, license agreements and JVs;
- the ability of our collaborators and licensees to protect our intellectual property and other proprietary rights and technologies;
- our ability and the ability of our collaborators and licensees to develop and successfully commercialize products enabled by our technologies;
- the rate and degree of market acceptance of any products developed by us, our subsidiaries, a collaborator under an ECC or through a JV or license under a license agreement;
- our ability to retain and recruit key personnel;

- the result of litigation proceedings or investigations that we face currently or may face in the future;
- our expectations related to the use of proceeds from our public offerings and other financing efforts; and
- our estimates regarding expenses, future revenue, capital requirements and needs for additional financing.

Forward-looking statements may also concern our expectations relating to our subsidiaries and other affiliates. We caution you that the foregoing list may not contain all of the forward-looking statements made in this Annual Report.

We may not actually achieve the plans, intentions or expectations disclosed in our forward-looking statements, and you should not place undue reliance on our forward-looking statements. Actual results or events could differ materially from the plans, intentions and expectations disclosed in the forward-looking statements we make. We have included important factors in the cautionary statements included in this Annual Report, particularly in Item 1A, "Risk Factors," that could cause actual results or events to differ materially from the forward-looking statements that we make. Our forward-looking statements do not reflect the potential impact of any future acquisitions, mergers, dispositions, JVs or investments that we may make.

You should read this Annual Report, the documents that we reference in this Annual Report, the audited consolidated financial statements and related notes thereto included in this Annual Report and the documents that we have filed as exhibits to our filings with the Securities and Exchange Commission, or SEC, completely and with the understanding that our actual future results may be materially different from what we expect. We do not assume any obligation to update any forward-looking statements, whether as a result of new information, future events or otherwise, except as required by law.

PART I

Item 1. Business

We believe we are a leader in the field of synthetic biology, focusing on programming biological systems to alleviate disease, remediate environmental challenges, and provide sustainable food and industrial chemicals. At present rates of global industrialization and population growth, food and energy supplies and environmental and healthcare resources are becoming more scarce and/or costly. We believe it is not a viable option for mankind to continue on this path — new solutions will be necessary to preserve and globally expand a high quality of life. We believe that synthetic biology is a solution.

Synthetic biology is a rapidly evolving discipline that applies engineering principles to biological systems to enable rational, design-based control of cellular function for a specific purpose. Using our suite of proprietary and complementary technologies, we design, build and regulate gene programs, which are DNA sequences that consist of key genetic components. A single gene program or a complex, multi-genic program is fabricated and stored within a DNA vector. Vectors are segments of DNA used as a vehicle to transmit genetic information. DNA vectors can, in turn, be introduced into cells in order to generate a simple or complex cellular system, which are the basic and complex cellular activities that take place within a cell and the interaction of those systems in the greater cellular environment. It is these genetically modified cell systems that can be used to produce biological effector molecules, or be employed directly to enable the development of new and improved products and manufacturing processes across a variety of end markets, including health, food, energy, and environment. Our synthetic biology capabilities include the ability to precisely control the amount, location and modification of biological molecules to control the function and output of living cells and optimize for desired results at an industrial scale.

Working with our subsidiaries, JVs, and collaborators, we seek to create more effective, less costly and more sustainable solutions than can be provided through current industry practices. Our technologies combine the principles of precision engineering, statistical modeling, automation and production at an industrial scale. We efficiently engineer precise and complex gene programs across many cell types. We apply the engineering principle of a ***design-build-test-learn*** continuum, through which we accumulate knowledge about the characteristics and performance of gene programs and cell lines. This process of continuous learning allows us to enhance our ability to design and build improved and more complex gene programs and cellular systems.

While the field of synthetic biology is still emerging, the addressable markets that may benefit from this approach are large and well-established. In health, synthetic biology may provide new approaches to treating diseases, as well as improvements to the manufacture of existing products. It is estimated that in 2018 the global biopharmaceuticals market was over $237 billion. While genetically modified salmon or tilapia may be considered new products, the global market for aquaculture was estimated at more than $170 billion in 2017. Genetically modified agricultural plants are already grown on approximately 180 million hectares around the world and have a global market value greater than $15 billion. In energy, we are working to create novel, highly engineered bacteria that utilize specific energy feedstocks, typically pipeline grade natural gas, to synthesize commercial end products, such as isobutanol for gasoline blending, 2,3 Butanediol for conversion to synthetic rubber and 1,4 Butanediol for polyester. In aggregate, the value of such fuel and chemical products are significant, representing the potential of billions of dollars in estimated market opportunity.

We believe our technologies are broadly applicable across many diverse end markets. Historically, we built our business primarily around the formation of ECCs. An ECC is an agreement with a collaborator to develop products based on technologies in a specifically defined field. Through our ECCs, we provide expertise in the engineering of gene programs and cellular systems, and our collaborators are responsible for providing market and product development expertise, as well as sales and marketing capabilities. In addition, we have sometimes executed a research collaboration to develop an early-stage program pursuant to which we received reimbursement for our development costs but the exclusive commercial rights, and related access fees, were deferred until completion of an initial research program.

Over time, our strategy has evolved away from ECC-type collaborations to relationships and structures that provide us with more control and ownership over the development process and commercialization path. In these new relationships and structures, we bear more of the responsibility to fund the projects and execute on product candidate development. For example, in October 2018, through our wholly owned subsidiary, Precigen Therapeutics, Inc., or Precigen, we entered into a license agreement, the ZIOPHARM License Agreement, with ZIOPHARM Oncology, Inc., or ZIOPHARM, which terminated and replaced the terms of an ECC with ZIOPHARM. The ZIOPHARM License Agreement gives us development and commercialization control over certain products previously licensed to ZIOPHARM. Additionally, in December 2018, we reacquired the rights to use Chimeric Antigen Receptor T-cell (CAR-T) technologies that were previously licensed to Ares Trading S.A., a wholly owned subsidiary of Merck KGaA, collectively Merck KGaA. See "Notes to the Consolidated Financial Statements - Note 5" appearing elsewhere in this Annual Report for further discussion.

In certain strategic circumstances, we may enter into a JV with a third-party collaborator whereby we may contribute access to our technology, cash or both into the JV, which we will jointly control with our collaborator. Pursuant to a JV agreement, we may be required to contribute additional capital to the JV, and we may be able to receive a higher financial return than we would normally receive from an ECC, to the extent that we and our collaborator are successful in developing one or more products. Additionally, we are increasing the resources that we are expending internally on early-stage proof-of-concept programs where we believe we can leverage our competitive edge in gene program creation and host cell and genome expertise. We are also seeking to partner our more mature programs and capabilities or later-stage assets. In this way, we endeavor to leverage our capital resources and ultimately hope to realize significant value from our mature assets.

As we consider the broad potential applications of our synthetic biology technologies, and consistent with the evolution of our business strategy, we have acquired a number of ventures that are already enabling products that benefit from the application of synthetic biology. Our strategy contemplates the continued acquisition of product-focused companies that we believe may leverage our technologies and expertise in order to expand their respective product applications. We believe that the acquisition of these types of companies allows us to develop and commercialize innovative products and create significant value.

Consistent with the ongoing evolution of our strategy, we routinely consider ways to organize our business and the grouping of our assets to facilitate strategic opportunities.

What is synthetic biology?

History

Synthetic biology entails the application of engineering principles to biological systems for the purpose of designing and constructing new biological systems or redesigning/modifying existing biological systems. Biological systems are governed by DNA, the building blocks of gene programs, which control cellular processes by coding for the production of proteins and other molecules that have a functional purpose and by regulating the activities of these molecules. This regulation occurs via complex biochemical and cellular reactions working through intricate cell signaling pathways, and control over these molecules modifies the output of biological systems.

In the early 1970s, scientists utilized basic tools and procedures for transferring DNA from one organism to another. Foundational tools included: gene programs contained in vectors; enzymes that could cut DNA at specific sites; and enzymes that could "glue" two complementary segments of DNA together. Developments between 1980 and the end of the 20th century advanced the field of genetic engineering, including automated DNA sequencing, DNA amplification via polymerase chain reaction and the creation of genetically modified organisms, or GMOs. However, the simplistic "cut-and-paste" nature of the available tools and the absence of genomic sequence information significantly restricted the scope of early synthetic biology efforts.

More recently, synthetic biology has been enabled by the application of information technology and advanced statistical analysis, also known as bioinformatics, to genetic engineering, as well as by improvements in DNA synthesis. Synthetic biology aims to engineer gene-based programs or codes to modify cellular function to achieve a desired biological outcome. For example, applications may include the replacement of a defective protein with a functional protein to treat a broad range of human and animal disease states or the production of multiple proteins through the regulation of several genes in a cell to produce petrochemicals.

Our approach

The essence of our approach is to apply synthetic biology by using an iterative process in which we:

- ***Design*** genes of interest and gene programs utilizing knowledge of cellular pathways and protein function;
- ***Build*** biological molecules, gene programs and their variants to optimize performance of the biological system;
- ***Test*** gene programs by inserting them into cellular systems and comparing the result(s) to the intended effects; and
- ***Learn*** by utilizing information gained in our iterative processes to create better gene programs and cellular systems using a more informed and efficient process to achieve improved outcomes.

As a result of our approach, we have developed extensive knowledge about many classes of DNA components and the rules governing their expression and activity. We have also assembled an inventory of these DNA components that we can use to

rationally construct unique vectors with predictable outcomes. The knowledge embedded in our DNA database allows us to create single gene and highly complex multigenic gene programs (an individual gene program containing multiple genes).

To support our approach, we have developed, acquired, and integrated a unique suite of technologies, and we continue to expand upon their capabilities. These technologies are complementary in nature and share some or all of the following key characteristics:

- **Platform neutral — outcome oriented.** We can work across different cell types with the objective of achieving the intended biological outcome allowing for product development across a broad spectrum of end markets.
- **Knowledge driven.** We use statistical modeling tools and computational analysis to continually acquire more knowledge about biological systems and their design to continually improve our ability to develop new and improved products and processes.
- **Rationally designed.** Our knowledge of biological systems and components allows us to design, build and select gene programs.
- **Capable of complexity.** Our technologies enable the design and precise control of complex biological molecules and multigenic gene programs.
- **Industrial scale.** We use engineering principles and automation to enable products based on synthetic biology that are commercially viable.

Our competitive strengths

We believe that our technologies, our ability to work across multiple host systems and our approach to synthetic biology — ***design-build-test-learn*** — give us a competitive advantage over traditional industrial processes as well as current approaches to synthetic biology.

We believe that we have the following competitive strengths:

We have a suite of proprietary and complementary technologies

We have built a suite of proprietary and complementary technologies that provides us with a comprehensive ability to design, create, modify and regulate gene programs and cellular systems across multiple host systems (human, animal, insect, plant, fungi, and bacteria). By virtue of the complementary nature of our technologies, we are able to provide our subsidiaries, JVs, and collaborators with a diverse array of capabilities to potentially develop and commercialize new and differentiated products enabled by synthetic biology.

Our design-build-test-learn continuum allows us to design and build improved and more complex gene programs

We have developed a core expertise and technologies to ***design***, ***build*** and ***test*** complex gene programs, as well as technologies to isolate cells that best express the desired biological output. We have also developed an extensive bioinformatic software platform that combines information technology with advanced statistical analysis for DNA design and genetic engineering, enabling us to continually ***learn*** and create optimal conditions for our gene programs. Our approach allows us to build improved and more complex gene programs.

We believe we are a leader in synthetic biology

We believe we are the first company focused exclusively on applying synthetic biology across a broad spectrum of end markets and have been working in the field since 1998. Over the last 21 years, we have accumulated extensive knowledge and experience in the design, modification and regulation of gene programs. We believe all of these factors, coupled with our suite of proprietary and complementary technologies, provide us with advantages in synthetic biology.

We serve large and diverse end markets with high built-in demand

A vast number of products consumed globally are or can be produced using biologically-based processes. Natural resources are becoming more scarce as demand exceeds supply, creating unmet needs for improvements in development and manufacturing. As a result, the need for complex biologically engineered molecules such as those enabled by our synthetic biology

technologies is large and spans multiple industries, including health, food, energy, and environment. Each of these markets faces unique challenges, however all have unmet needs for improvements in product development and manufacturing that can result in savings of both cost and time as compared to traditional means of industrial design and production. Because synthetic biology has the potential to deliver against these unmet needs, we believe that significant demand already exists for improved products enabled by synthetic biology. Additionally, there are markets utilizing traditional industrial processes that have failed to recognize the significant improvement in performance that could be achieved using synthetic biology.

Our evolving business strategy allows us to leverage the broad potential of synthetic biology

We believe our ECC business model was a capital efficient and rapid way for us to initiate our participation in a diversified range of product opportunities and industrial end markets, including health, food, energy, and environment. While our ongoing ECCs continue to allow us to participate in the potential upside from products that are enabled by our technologies across a range of industries, we believe that we are now capable of recognizing additional benefit from the product candidates enabled by our technologies through the formation of a variety of business structures, including operating subsidiaries and JVs. The flexibility of this approach, we believe, will enable us to maximize the value we receive for each particular opportunity within various industries in which we operate.

Our suite of proprietary and complementary technologies

We apply the potential of synthetic biology through our suite of proprietary and complementary technologies that combine the principles of precision engineering, statistical modeling, automation and production at an industrial scale. This enables us to engineer precise and complex gene programs across many cell types.

In order to create a highly functional biological system, we recognize the complexity of cellular processes and the necessity to construct an optimized gene program in conditions reflective of the natural environment to allow for the creation of the optimal biological product. This requires a rigorous understanding of cell signaling pathways as well as the interactions that influence the expression of protein. This knowledge is captured in our advanced Cell Systems Informatics, which uses statistical modeling and other analytic frameworks to determine the most efficient pathways for an intended biochemical result, and also plays a critical role in our research and development as this database of information allows us to explore new targets of potential interest to our current or future subsidiaries, JVs, and collaborators. Moreover, our bioinformatics and computational modeling platform is central to our Protein Engineering, which focuses on designing enhanced and/or novel protein functionalities, including stability, localization, and catalytic activity.

In addition to creating optimized gene programs via the most efficient cell signaling pathways and in the relevant cellular environments, we have a growing library of genetic components with our UltraVector platform that enable design and assembly of gene programs that facilitate control over the quality, function, and performance of living cells. Our RheoSwitch inducible gene switch provides quantitative dose-proportionate regulation of the amount and timing of target protein expression, thereby providing another mechanism to closely control activity of a newly constructed gene program. Further, our AttSite Recombinases allow for stable, targeted gene integration and expression. Once cells have been engineered for the desired biological output, the LEAP automated platform can be used to identify and purify cells of interest, such as antibody expressing cells and stem cells. Furthermore, our ActoBiotics platform allows for targeted *in situ* expression of proteins and peptides from engineered microbes. Finally, our AdenoVerse technology platform is comprised of engineered adenovector serotypes that alone and in conjunction with our ability to further manipulate and improve the platform permits greater tissue specificity and target selection. We believe this platform will deliver a gene capacity exceeding 30kb which is three to six times greater than current viral delivery methods.

Our markets

Synthetic biology has applicability across many diverse end markets. Our goal is to be a leader in the application of synthetic biology for products currently utilizing biologically-based processes, and a leader in the replacement of conventional processes and products with biologically-based substitutes. Through the application of our suite of proprietary and complementary technologies, we believe we can create optimized biological processes and create substitutes for traditional industrial techniques, leading to improved products that are developed and manufactured faster and more cost-effectively.

Human Health

It is estimated that in 2018 the global biopharmaceuticals market was over $237 billion and is projected to reach greater than $388 billion by 2024. We believe that the unreliable, costly discovery and development process for new medicines is being replaced by the engineering of biology at the genetic, molecular, and cellular level. Our ability to regulate complex gene

programs and cellular systems by applying the principles of science, engineering, and computational bioinformatics with proprietary technologies is being utilized to design new therapies for humans and animals. We are applying our approach to develop targeted gene therapy applications and novel solutions within oncology, rare diseases, active pharmaceutical ingredients, ocular diseases, and infectious diseases, as well as autoimmune, metabolic, and gastrointestinal disorders. All of our human therapeutic product candidates are in the drug discovery, preclinical, or clinical stages of development.

Food and Agriculture

The Food and Agriculture Organization of the United Nations predicts that by 2050 the world's population will grow to almost 10 billion, global demand for food and other agricultural products is expected to increase 50 percent, and global demand for livestock products will increase by 70 percent. We are focused on enabling efficient, high-quality food production that sustainably supports the necessities of our growing population. By applying our suite of technologies, we aim to facilitate development of agricultural, livestock and aquaculture resources that deliver innovative approaches and superior production yields in an environmentally responsible manner.

Energy and Chemicals

Biological production via precise enzymatic conversion represents a promising approach for the efficient production of important energy products. Despite this promise, current attempts to produce "clean" energy are expensive to implement and operate at near break-even yields despite government assistance. Additionally, many alternative energy initiatives start from food sources, such as corn and sugarcane. As a result, these low efficiency processes also compete for arable land and water with the agriculture industry. Using our cellular engineering experience and suite of technologies, we have developed microbial cell lines for bioconversion of methane to higher carbon content compounds. We believe this proprietary platform holds the potential to modernize the existing gas-to-liquids industry by generating important fuels and chemicals at a fraction of the cost of traditional conversion methods. Our bioconversion approach also is being designed to reach an overall balance between sustainable productive yields and attractive economic returns.

To date we have accomplished biological production on a non-commercial scale of six fuel and chemical products that have promise in valuable and relatively large markets. These product opportunities are isobutanol for gasoline blending, 2,3 Butanediol and isoprene for conversion to synthetic rubber, 1,4 Butanediol for polyester, farnesene for diesel fuel and lubricants and isobutyraldehyde for acrylics. In aggregate, the value of such fuel and chemical products are significant, representing the potential of billions of dollars in estimated market opportunity.

Environment

Increased globalization has facilitated the spread of pests that affect human and environmental health by carrying disease and damaging crops. In addition, increasing agriculture outputs and employing more industrialized processes to meet the demands of a rapidly growing global population can impact natural resources and affect the environment. We seek to engineer biological solutions that are designed to protect, preserve or restore the environment and promote sustainability of natural resources. These biological approaches may replace products and processes that present an environmental hazard. Examples of products under development include biologically-based approaches that displace petroleum-derived ingredients and polymers, reduce the wasteful practices associated with extracting compounds that occur in limiting amounts in plants and animals, enable toxin-free, species-specific insect control with methods that do not persist in the environment, and facilitate improved sustainability in food systems.

Our business strategy

We believe our technologies are broadly applicable across many diverse end markets, including some end markets that have failed to recognize the applicability of synthetic biology or failed to efficiently utilize biologically-based processes to produce products. To enable us to maximize the number of these markets we could address, we devised a strategy that allowed us to focus on our core expertise in synthetic biology while developing many different commercial product candidates via collaborations in a broad range of industries or end markets. We built our business primarily around the formation of ECCs, as well as certain research collaborations.

Over time, our strategy has evolved away from ECC-type collaborations to relationships and structures that provide us with more control and ownership over the development process and commercialization path. In these new relationships and structures, we bear more of the responsibility to fund the projects and execute on product candidate development.

For example, effective January 1, 2018, we transferred certain of our gene and cell therapy assets for human health to our wholly owned subsidiary, Precigen. As a further part of this strategic evolution, in October 2018, we entered into the ZIOPHARM License Agreement, which terminated and replaced the terms of an ECC with ZIOPHARM. The ZIOPHARM License Agreement gives us development and commercialization control over certain products previously licensed to ZIOPHARM. Finally, in December 2018, we reacquired the rights to use Chimeric Antigen Receptor T-cell (CAR-T) technologies that were previously licensed to Merck KGaA.

We have acquired a number of ventures that are already enabling products that benefit from the application of synthetic biology. Our strategy contemplates the continued acquisition of product-focused companies that we believe may leverage our technologies and expertise in order to expand their respective product applications. We believe that the acquisition of these types of companies allows us to develop and commercialize innovative products and create significant value.

In certain strategic circumstances, we may enter into a JV with a third party collaborator where we may contribute access to our technology, cash or both into the JV that we will jointly control with our collaborator. Pursuant to a JV agreement, we may be required to contribute additional capital to the JV, and we may be able to receive a higher financial return than we would normally receive from an ECC to the extent that we and our collaborator are successful in developing one or more products. Our gas-to-liquid platform for bioconversion of methane to higher carbon content compounds, which we refer to as our methane bioconversion platform, or MBP, is an example of our implementation of a JV approach. Based on our internally developed work on our MBP technology, we have executed two JV arrangements with related parties for specific end products.

Our operating subsidiaries

To derive value from the broad potential applications of our synthetic biology technologies, and consistent with the evolution of our business strategy, we routinely consider ways to organize our business to facilitate strategic opportunities. For example, we have acquired a number of ventures that are already enabling products that benefit from the application of synthetic biology and that we now operate as subsidiaries. Our strategy contemplates the continued formation and acquisition of such operating subsidiaries. As these enterprises develop, we will determine whether to maintain full ownership, introduce investors via either private or public financing, or seek strategic options to partner or divest the businesses.

Primary wholly owned operating subsidiaries

Precigen, Inc.

Precigen is a dedicated discovery and clinical stage biopharmaceutical company advancing the next generation of gene and cellular therapies using precision technology to target urgent and intractable diseases in immuno-oncology, autoimmune disorders, and infectious diseases. Precigen's technologies and technologies licensed from Intrexon enable Precigen to find innovative solutions for affordable biotherapeutics in a controlled manner. Precigen operates as an innovation engine, progressing a preclinical and clinical pipeline of well-differentiated unique therapies toward clinical proof-of-concept and commercialization.

ActoBio Therapeutics, Inc.

ActoBio Therapeutics, Inc., or ActoBio, is pioneering a new class of microbe-based biopharmaceuticals that enable expression and local delivery of disease-modifying therapeutics. The ActoBiotics platform produces biologics through oral or topical administration with treatment applications across many diseases including oral, gastrointestinal, and autoimmune/allergic disorders. This approach is being developed to provide safer and more efficacious treatments than injectable biologicals. ActoBio, both independently and through an ECC, has a strong research and development pipeline with the latest stage candidate in Phase 2b clinical trials and an extensive portfolio of candidates ready for clinical development across a number of potential indications.

Trans Ova Genetics, L.C.

Trans Ova Genetics, L.C., or Trans Ova, is internationally recognized as a provider of industry-leading bovine reproductive technologies. Intrexon and Trans Ova are building upon Trans Ova's original platform with a goal of achieving higher levels of delivered value to dairy and beef cattle producers. Progentus, L.C., or Progentus, a wholly owned subsidiary of Trans Ova, is a provider of bovine embryos. ViaGen, L.C., or ViaGen, a wholly owned subsidiary of Trans Ova, is a provider of cloning technology for livestock species. Exemplar Genetics, LLC, or Exemplar, a wholly owned subsidiary through the combined ownership of Trans Ova, ViaGen and us, is committed to enabling the study of life-threatening human diseases through the

development of miniswine research models and services, as well as enabling the production of cells and organs in its genetically engineered swine for regenerative medicine applications.

Okanagan Specialty Fruits, Inc.

Okanagan Specialty Fruits, Inc. and its affiliates, or Okanagan, is the pioneering agricultural company behind the world's first non-browning apple without the use of any artificial additives. Okanagan is scaling up its commercial supplies of non-browning apples and developing new commercial tree fruit varieties intended to provide benefits to the entire supply chain, from growers to consumers.

Oxitec Limited

Oxitec Limited, or Oxitec, is a pioneering company in biological insect control solutions. Oxitec is developing products that use genetic engineering to control insect pests that spread disease and damage crops. Among the applications of its platform, which uses advanced genetics and molecular biology, Oxitec has developed innovative solutions for controlling *Aedes aegypti*, a mosquito that is a known vector for the transmission of infectious disease including dengue fever, chikungunya, and Zika and, in conjunction with its collaborators, is pursuing solutions that target certain agricultural crop pests. Oxitec is pursuing regulatory and commercial approvals for its insect solutions in a number of countries, including the United States.

Primary majority-owned operating subsidiary

AquaBounty Technologies, Inc.

AquaBounty Technologies, Inc., or AquaBounty, is focusing on improving productivity in commercial aquaculture, including the development of the AquAdvantage Salmon, or AAS, an Atlantic salmon that has been genetically enhanced to reach market size in less time than conventionally farmed Atlantic salmon and approved by the Food and Drug Administration, or FDA. As of December 31, 2018, we owned approximately 55 percent of AquaBounty. In the future, our ownership stake in AquaBounty may drop below 50 percent, which may result in our deconsolidating AquaBounty.

Joint ventures

The following represent our significant JVs as of December 31, 2018:

Intrexon Energy Partners

In March 2014, we and certain investors, or the IEP Investors, including affiliates of Third Security, LLC, or Third Security, a related party, entered into a Limited Liability Company Agreement that governs the affairs and conduct of business of Intrexon Energy Partners, LLC, or Intrexon Energy Partners, a JV formed to optimize and scale-up our MBP technology for the production of certain fuels and lubricants. We also entered into an ECC with Intrexon Energy Partners providing exclusive rights to our technology for the use in bioconversion, as a result of which we received a technology access fee of $25 million while retaining a 50 percent membership interest in Intrexon Energy Partners. The IEP Investors made initial capital contributions, totaling $25 million in the aggregate, in exchange for pro rata membership interests in Intrexon Energy Partners totaling 50 percent. We committed to make additional capital contributions of up to $25 million, and the IEP Investors, as a group and pro rata in accordance with their respective membership interests in Intrexon Energy Partners, have committed to make additional capital contributions of up to $25 million, at the request of the Intrexon Energy Partners' board of managers, or the Intrexon Energy Partners Board, and subject to certain limitations. Intrexon Energy Partners is governed by the Intrexon Energy Partners Board, which has five members. Two members of the Intrexon Energy Partners Board are designated by us and three members are designated by a majority of the IEP Investors. We and the IEP Investors have the right, but not the obligation, to make additional capital contributions above the initial limits when and if solicited by the Intrexon Energy Partners Board.

Intrexon Energy Partners II

In December 2015, we and certain investors, or the IEPII Investors, entered into a Limited Liability Company Agreement that governs the affairs and conduct of business of Intrexon Energy Partners II, LLC, or Intrexon Energy Partners II, a JV formed to utilize our MBP technology for the production of 1,4-butanediol, an industrial chemical intermediate used to manufacture spandex, polyurethane, plastics, and polyester. We also entered into an ECC with Intrexon Energy Partners II providing exclusive rights to our technology for use in the field, as a result of which we received a technology access fee of $18 million while retaining a 50 percent membership interest in Intrexon Energy Partners II. The IEPII Investors made initial capital

contributions, totaling $18 million in the aggregate, in exchange for pro rata membership interests in Intrexon Energy Partners II totaling 50 percent. In December 2015, the owners of Intrexon Energy Partners II made a capital contribution of $4 million, half of which was paid by us. We committed to make additional capital contributions of up to $10 million, and the IEPII Investors, as a group and pro rata in accordance with their respective membership interests in Intrexon Energy Partners II, have committed to make additional capital contributions of up to $10 million, at the request of the Intrexon Energy Partners II's board of managers, or the Intrexon Energy Partners II Board, and subject to certain limitations. Intrexon Energy Partners II is governed by the Intrexon Energy Partners II Board, which has five members. One member of the Intrexon Energy Partners II Board is designated by us and four members are designated by a majority of the IEPII Investors. We and the IEPII Investors have the right, but not the obligation, to make additional capital contributions above the initial limits when and if solicited by the Intrexon Energy Partners II Board.

EnviroFlight

In February 2016, we entered into a series of transactions involving EnviroFlight, LLC, or Old EnviroFlight, Darling Ingredients Inc., or Darling, and a newly formed venture between us and Darling, or New EnviroFlight. This series of integrated transactions resulted in us acquiring substantially all of the assets of Old EnviroFlight and contemporaneously contributing all of these assets, with the exception of certain developed technology, and $3 million of cash to New EnviroFlight in exchange for a non-controlling, 50 percent membership interest in New EnviroFlight. Our contributions to New EnviroFlight included an exclusive license to the developed technology that was retained by us. Darling received the remaining 50 percent membership interest in New EnviroFlight as consideration for terminating rights previously held in the developed technology with Old EnviroFlight. New EnviroFlight was formed to generate high nutrition, low environmental impact animal and fish feed, as well as fertilizer products, from black soldier fly larvae.

See "Notes to the Consolidated Financial Statements - Note 5" appearing elsewhere in this Annual Report for a discussion of significant collaborations between us and our JVs.

Our ECCs

Although our strategy has evolved away from a focus primarily on ECCs, we remain party to a number of such collaborations, and we may, in the future, elect to enter into additional ECCs or expand one or more of our existing ECCs. An ECC is an agreement with a collaborator to develop products based on our technologies in one or more specifically defined fields. These fields may be narrowly defined (representing, for example, a specific therapeutic approach for a single indication) or may be broad (representing, for example, an entire class of related products). In each case, we and the collaborator precisely define the field based on factors such as the expertise of the collaborator, the relative markets for the prospective products, the collaborator's resources available to commit to the ECC and our expectations as to other prospective ECCs in related areas. Regardless of the size of the field, under each ECC we grant the collaborator exclusive rights to our services and certain of our technologies to commercialize products within the field.

We may realize four general categories of revenue under our ECCs: (i) technology access fees upon signing; (ii) reimbursements of costs incurred by us for our research and development and/or manufacturing efforts related to specific applications provided for in the collaboration; (iii) milestone payments upon the achievement of specified development, regulatory and commercial activities; and (iv) royalties on sales of products arising from the collaboration. We may receive equity in lieu of cash for technology access fees and milestones and also may participate in capital raises to allow earlier-stage collaborators to focus their resources on product development.

Generally, each of our ECCs is designed to continue in perpetuity unless terminated. Each of our collaborators, however, retains the right to terminate the ECC for any reason by providing us written notice a certain period of time prior to such termination, generally ninety days. The ECC is also terminable by either party upon the other party's breach of material provisions of the ECC. The failure of our collaborator to exercise diligent efforts to develop products within the field of the ECC constitutes such a breach.

In the event one of our ECCs terminates, we are entitled to immediately pursue a collaboration with a different counterparty within the field of the terminated ECC. Moreover, technologies and product candidates in a relatively early stage of development revert to us, along with data, materials and the rights to applicable regulatory filings related to the reverted products, enabling us to develop those product candidates ourselves or incorporate them into a future collaboration. Product candidates that are at a more advanced stage of development, such as those already generating revenue or being considered for approval by an applicable regulatory body at the time of the ECC's termination are retained by the former collaborator. The collaborator has the right to commercialize such retained products although we are entitled to the royalties or other

compensation to which we would be entitled as if the ECC were still in effect. Upon termination, we generally retain any technology access fees or other payments to which we are entitled through the date of termination.

In our ECCs, we retain rights to our existing intellectual property and generally any intellectual property developed using, or otherwise incorporating, our technologies. In addition, we are generally responsible for controlling the prosecution and enforcement of this intellectual property with the exception of the enforcement of patents directed solely and specifically to products developed within the field of each ECC.

Each of our ECCs requires the collaborator to indemnify us for all liability related to products produced pursuant to the ECC and to obtain insurance coverage related to product liability.

See "Notes to the Consolidated Financial Statements - Note 5" appearing elsewhere in this Annual Report for a discussion of the key financial terms of our significant ECCs.

Mergers, acquisitions, and technology in-licensing

We may augment our suite of proprietary technologies through mergers or acquisitions of technologies, which would then become available to new or existing ventures, including operating subsidiaries, JVs, and collaborations. Among other things, we may pursue technologies that we believe will be generally complementary to our existing technologies and also meet our desired return on investment and other economic criteria. In certain cases, such technologies may already be applied in the production of products or services and in these cases we may seek to expand the breadth or efficacy of such products or services through the use of our technologies. See "Notes to the Consolidated Financial Statements - Note 3" appearing elsewhere in this Annual Report for further discussion of mergers, acquisitions or significant technology in-licensing activities.

Competition

We believe that we are a leader in synthetic biology. We do not believe that we have any direct competitors who provide similar technologies that fully enable the commercialization of products developed using synthetic biology across a broad spectrum of biologically-based industries. As a result, we believe our competition is more indirect and general in nature and falls into three broad categories:

- **Synthetic biology service providers**. There are companies that have competing technologies for individual pieces of our suite of complementary technologies. For example, there are companies that can synthesize DNA, and there are companies that can develop monoclonal antibodies. One portion of our proprietary technology related to DNA synthesis and assembly includes the ability to *de novo* synthesize DNA. We believe the following companies engage in the manufacture of DNA componentry: ATUM, Inc.; Blue Heron Biotech, LLC (a subsidiary of OriGene); Integrated DNA Technologies, Inc. (IDT); GenScript USA, Inc.; Life Technologies Corporation, now part of Thermo Fisher Scientific Inc.; and Twist Bioscience Corporation.

- **Industrial companies who may develop their own approach to synthetic biology**. Rather than becoming a collaborator with us, potential collaborators may decide to invest time and capital to internally develop their own synthetic biology capabilities. For example, large biopharmaceutical companies, energy companies, and ag-bio companies may pursue a proprietary synthetic biology strategy.

- **Industrial companies who may develop competing products using other technologies**. Products enabled by our synthetic biology will face competition in the market, including from products that have been developed using other industrial technologies. For example, large biopharmaceutical companies pursue other technologies for drug development, and large ag-bio companies pursue other technologies for the development of genetically modified crops. The rapidly evolving market for developing genetically engineered, or GE, T-cells in particular is characterized by intense competition and rapid innovation. Genetically engineering T-cells faces significant competition in the chimeric antigen receptor, or CAR, technology space from multiple companies and their collaborators, such as Novartis/University of Pennsylvania, Bluebird Bio/Celgene/Juno Therapeutics, Gilead/Kite Pharma, Cellectis, Allogene Therapeutics, Adaptimmune/GSK, Autolus Therapeutics, and Bellicum Pharmaceuticals. We face competition from non-cell based treatments offered by other companies such as Amgen, AstraZeneca, Bristol-Myers Squibb, Incyte, Merck, and Roche.

Intellectual property

As we advance technologies across multiple platforms and synthetic biology areas, correspondingly, we apply a multilayered approach for protecting intellectual property relating to the inventions we have developed internally as well as those we have acquired from third parties, such as by assignment or by in-license. We seek patent protection in the United States and in other countries for our inventions and discoveries, and we develop and protect our key know-how and trade secrets relating to our platform technologies as well as to the products we are developing with our subsidiaries, JVs, and collaborations.

We seek patent protection for our platform technologies, including but not limited to our (i) switch technology; (ii) activator ligands for our switch technology; (iii) portfolio around various genetic componentry such as vectors, cells and organisms containing these genetic componentry; and (iv) cell identification and selection platform. In addition, we seek patents covering specific collaborator's products.

Through the use of our various platform technologies we seek to design and build proprietary compounds, vectors, methods and processes across a variety of end markets. In particular, we focus our intellectual property on synthetic biology technologies that provide platforms for the design and creation of cells, vectors and components for our subsidiaries, JVs, and collaborations. In addition, we may pursue intermediate and product-specific patents associated with our subsidiaries', JVs', and collaborations' lead programs.

Our success depends, in part, upon our ability to obtain patents and maintain adequate protection for our intellectual property relating to our technologies and products and potential products. We have adopted a strategy of seeking patent protection in the United States and in other jurisdictions globally as we deem appropriate under the circumstances, with respect to certain of the technologies used in or relating to our products and processes. For instance, where we believe appropriate, we have also filed counterpart patents and patent applications in other jurisdictions, including Australia, Argentina, Brazil, Canada, China, Europe, Hong Kong, India, Indonesia, Israel, Japan, Korea, Mexico, New Zealand, Philippines, Russia, Singapore, South Africa and Taiwan. In the future we may file in these or additional jurisdictions as deemed appropriate for the protection of our technologies.

As of December 31, 2018, we owned at least 55 issued United States patents and 55 pending United States patent applications relating to certain aspects of our technologies, and we have pursued counterpart patents and patent applications in other jurisdictions around the world, as we have deemed appropriate. We continue to actively develop our portfolio through the filing of new patent applications, provisional and continuations or divisionals relating to our technologies, methods and products as we and our collaborators deem appropriate.

We have strategic positioning with respect to our key technologies including our owned patent portfolios directed to: our switch technology covering aspects of our switches and gene modulation systems, with a last to expire patent currently in 2032; our portfolio around various genetic componentry, such as vectors, cells and organisms containing these genetic componentry, and their use, with a last to expire patent in 2034; our activator ligand technology covering aspects of our activator ligands and their use, with a last to expire patent in 2034; and our cell identification and selection technology covering aspects of our cell identification and selection platform, including our cell purification, isolation, characterization and manipulation technologies, with a last to expire patent in 2031. Although we cannot be assured that these patents may not be subject to challenge in the future, as of this filing, there are currently no material contested proceedings and/or third party claims with respect to any of these patent portfolios.

Additionally, we complement our intellectual property portfolio with exclusive and non-exclusive patent licenses and options for licenses to third-party technologies.

A principal component of our strategy is maximizing the value of our ECCs through our intellectual property that covers our technologies, which is accentuated by intermediate and program-specific intellectual property protections. In addition to owned and in-licensed patents, we solidify our intellectual property protection through a combination of trade secrets, know-how, confidentiality, nondisclosure and other contractual provisions, and security measures to protect our confidential and proprietary information related to each platform and collaborator program. We regularly assess and review the risks and benefits of protecting our developments through each aspect of intellectual property available to us.

Because we rely on trade secrets, know-how and continuing technological advances to protect various aspects of our core technology, we require our employees, consultants and scientific collaborators to execute confidentiality and invention assignment agreements with us to maintain the confidentiality of our trade secrets and proprietary information. Our confidentiality agreements generally provide that the employee, consultant or scientific collaborator will not disclose our confidential information to third parties. These agreements also provide that inventions conceived by the employee, consultant

or scientific collaborator in the course of working for us will be our exclusive property. Additionally, our employees agree to take certain steps to facilitate our assertion of ownership over such intellectual property. These measures may not adequately protect our trade secrets or other proprietary information. If they do not adequately protect our rights, third parties could use our technologies, and we could lose any competitive advantage we may have. In addition, others may independently develop similar proprietary information or techniques or otherwise gain access to our trade secrets, which could impair any competitive advantage we may have.

Regulatory environment

Regulations affecting Intrexon

With our diverse portfolio of proprietary and complementary technologies cutting across human health, animal health, public health and energy sectors, we are subject to significant and diverse regulations governing research, operations and product approval. Regulatory compliance is critical to our ability to operate, our management of potential liabilities and ultimately, our freedom to sell our products. Moreover, and as discussed below and in "Risk factors - Risks associated with our business strategy," the products produced by us and our collaborators enabled by our technology platforms are subject to extensive regulation. While we and our subsidiaries maintain regulatory compliance practices, we rely on our collaborators' compliance with laws and regulations applicable to the products they produce. We do not independently monitor whether our collaborators comply with applicable laws and regulations. Please see the risk factor entitled "Markets in which we, our JVs, and collaborators are developing products using our technologies are subject to extensive regulation, and we rely on our JVs and collaborators to comply with all applicable laws and regulations."

Environmental regulations affecting Intrexon, our JVs and our collaborators

We, as well as our JVs and collaborators, are subject to various federal, state and local environmental laws, rules and regulations, including those relating to the discharge of materials into the air, water and ground, the generation, storage, handling, use, transportation and disposal of hazardous materials and the health and safety of employees with respect to laboratory activities required for the development of products and technologies. These laws and regulations require us and our JVs and collaborators to obtain environmental permits and comply with numerous environmental restrictions. These laws and regulations also may require expensive pollution control equipment or operational changes to limit actual or potential impacts to the environment.

Our laboratory activities and those of our JVs and collaborators inherently involve the use of potentially hazardous materials, which are subject to health, safety and environmental regulations. We design our infrastructure, procedures and equipment to meet our obligations under these regulations. We perform recurring internal and third-party audits and provide employees ongoing training and support, as required. All of our employees must comply with safety instructions and procedures, which are codified in our employment policies. Federal and state laws and regulations impose requirements on the production, importation, use and disposal of chemicals and genetically-modified microorganisms, or GMMs, which impact us and our JVs and collaborators. Our, our JVs' and our collaborators' processes may contain GE organisms which, when used in industrial processes, are considered new chemicals under the Toxic Substances Control Act, or TSCA, program of the United States Environmental Protection Agency, or EPA. These laws and regulations would require us, our JVs and collaborators to obtain and comply with the EPA's Microbial Commercial Activity Notice process to operate. In the European Union, we and our JVs and collaborators may be subject to a chemical regulatory program known as REACH (Registration, Evaluation, Authorization and Restriction of Chemical Substances). Under REACH, companies are required to register their products with the European Commission, and the registration process could result in significant costs or delay the manufacture or sale of products in the European Union.

Regulations affecting us and our collaborators

Human therapeutics regulation

Government authorities in the United States, at the federal, state and local level, and in other countries extensively regulate, among other things, the research, development, testing, manufacture, including any manufacturing changes, packaging, storage, recordkeeping, labeling, advertising, promotion, distribution, marketing, import and export of pharmaceutical products such as those being developed by our collaborators. The processes for obtaining regulatory approvals in the United States and in foreign countries, along with subsequent compliance with applicable statutes, regulations, and requirements imposed by regulatory agencies, require the expenditure of substantial time and financial resources.

In the United States, pharmaceuticals must receive approval from the FDA before being marketed. The FDA approves drug products other than biological products through its authority under the Federal Food, Drug, and Cosmetic Act, or FDCA, and

implementing regulations. The FDA licenses biological drug products, or biologics, through its authority under the Public Health Service Act, or PHSA, and implementing regulations. The development processes for obtaining FDA approval for a non-biological drug product under the FDCA and for biologic licensure under the PHSA are generally similar, but have product-related differences reflected in regulations and in FDA guidance documents.

United States pharmaceutical development process

The process required by the FDA before a pharmaceutical product candidate may be marketed generally involves the following:

- completion of preclinical laboratory tests and *in vivo* studies in accordance with the FDA's current Good Laboratory Practice regulations and standards, and other applicable requirements;
- submission to the FDA of an Investigational New Drug application, or IND, for human clinical testing, which must become effective before human clinical trials commence;
- performance of adequate and well-controlled human clinical trials according to the FDA's Good Clinical Practices, or GCP, regulations, and any additional requirements for the protection of human research subjects and their health information, to establish the safety and efficacy of the proposed product candidate for each intended use;
- preparation and submission to the FDA of an application for marketing approval that includes substantial evidence of safety, purity and potency for a biologic, or of safety and efficacy for a non-biologic drug, including from results of nonclinical testing and clinical trials;
- satisfactory completion of an FDA inspection of the manufacturing facility or facilities where the product candidate is produced to assess compliance with current Good Manufacturing Practice, or cGMP, and to assure that the facilities, methods and controls are adequate to preserve the product candidate's identity, safety, strength, quality, potency and purity;
- potential FDA inspection of the nonclinical and clinical trial sites that generated the data in support of the application; and
- FDA review and approval of the application.

Human clinical trials under an IND

Clinical trials involve administering the product candidate to healthy volunteers or patients under the supervision of qualified investigators. Clinical trials must be conducted and monitored in accordance with the FDA's regulations. Further, each clinical trial must be reviewed and approved by an Institutional Review Board, or IRB, at or servicing each institution at which the clinical trial will be conducted. An IRB is charged with protecting the welfare and rights of trial participants and considers, among other things, whether the risks to individuals participating in the clinical trials are minimized and are reasonable in relation to anticipated benefits. Clinical trials involving recombinant DNA at institutions that receive any funding from the National Institutes of Health, or NIH, also must be reviewed by an institutional biosafety committee, an institutional committee that reviews and oversees basic and clinical research that utilizes recombinant DNA at that institution.

Human clinical trials typically are conducted in three sequential phases that may overlap or be combined:

- *Phase 1*. The product candidate is introduced into healthy human subjects and tested for safety, dosage tolerance, absorption, metabolism, distribution, excretion and, if possible, to gain early understanding of its effectiveness. For some product candidates for severe or life-threatening diseases, especially when the product candidate may be too inherently toxic to ethically administer to healthy volunteers, the initial human testing is often conducted in patients with the targeted disease.
- *Phase 2*. The product candidate is administered and evaluated in a limited patient population to identify possible adverse effects and safety risks, to evaluate preliminary efficacy evidence for specific targeted diseases and to determine dosage tolerance, optimal dosage and dosing schedule.
- *Phase 3*. The product candidate is administered to an expanded patient population, often at geographically dispersed clinical trial sites, in adequate and well-controlled clinical trials to generate sufficient data to evaluate the safety and

efficacy of the non-biologic drug, or the safety, purity, and potency of the biologic. These clinical trials are intended to establish the overall risk/benefit ratio of the product candidate and provide an adequate basis for product labeling.

Post-approval clinical trials, sometimes referred to as Phase 4 clinical trials, may be conducted, or may be required to be conducted, after initial approval to further assess the risk/benefit profile of the product and to gain additional experience from treatment of patients in the intended indication, including for long-term safety follow-up.

Additional regulation for gene therapy clinical trials

Additional standards apply to clinical trials involving gene therapy. The FDA has issued guidance documents regarding gene therapies, which relate to, among other things: preclinical assessments; chemistry, manufacturing and controls, or CMC, information that should be included in an IND application; the proper design of tests to measure product potency in support of an application; and measures to observe delayed adverse effects in subjects exposed to investigational gene therapies when the risk of such effects is high.

Compliance with cGMP requirements

Drug and biologics manufacturers must comply with applicable cGMP regulations. Manufacturers and others involved in the manufacture and distribution of such products also must register their establishments with the FDA and certain state agencies. Both domestic and foreign manufacturing establishments must register and provide additional information to the FDA upon their initial participation in the manufacturing of drugs. Establishments may be subject to periodic, unannounced inspections by the FDA and other government authorities to ensure compliance with cGMP requirements and other laws. Discovery of problems may result in a government entity placing restrictions on a product, manufacturer or holder of an approved product, and may extend to requiring withdrawal of the product from the market.

United States review and approval processes

The results of the preclinical tests and clinical trials, together with detailed information relating to the product's CMC and proposed labeling, among other things, are submitted to the FDA as part of an application requesting approval to market the product for one or more uses, or indications. For gene therapies, selecting patients with applicable genetic defects is often a necessary condition to effective treatment and may require diagnostic devices that the FDA has cleared or approved prior to or contemporaneously with approval of the gene therapy.

Under the Pediatric Research Equity Act, or PREA, marketing applications generally must contain data to assess the safety and effectiveness of the biologic product candidate for the claimed indications in all relevant pediatric subpopulations and to support dosing and administration for each pediatric subpopulation for which the product candidate is safe and effective. The FDA may grant deferrals for submission of data or full or partial waivers. Unless otherwise required by regulation, PREA does not apply to any product candidate for an indication for which orphan designation has been granted.

On the basis of the marketing application and accompanying information, including the results of the inspection of the manufacturing facilities, the FDA may issue an approval letter or a complete response letter. An approval letter authorizes commercial marketing of the drug with specific prescribing information for specific indications. A complete response letter generally outlines the deficiencies in the submission and may require substantial additional testing or information for the FDA to reconsider the application. If those deficiencies have been addressed to the FDA's satisfaction in a resubmission of the application, the FDA may issue an approval letter.

If a product candidate receives regulatory approval, the approval may be significantly limited to specific diseases and dosages or the indications for use may otherwise be limited. Further, the FDA may require that certain contraindications, warnings or precautions be included in the product labeling. The FDA may impose restrictions and conditions on product distribution, prescribing or dispensing in the form of a Risk Evaluation and Mitigation Strategy, or REMS, or otherwise limit the scope of any approval. In addition, the FDA may require post-marketing clinical trials designed to further assess a non-biologic drug's safety and effectiveness, or a biologic's safety, purity, and potency, and testing and surveillance programs to monitor the safety of approved products that have been commercialized.

Orphan Drug Designation in the United States

Under the Orphan Drug Act, the FDA may grant orphan drug designation to drugs and biological products intended to treat a "rare disease or condition," which generally is a disease or condition that affects fewer than 200,000 individuals in the United States. Orphan drug designation must be requested before submitting a marketing application or supplement seeking approval

for the orphan indication. After the FDA grants orphan drug designation, the common identity of the therapeutic agent and its potential orphan use are publicly disclosed by the FDA.

Orphan drug designation does not—by itself—convey any advantage in, or shorten the duration of, the regulatory review and approval process. If a product that has an orphan drug designation subsequently receives the first FDA approval for that drug or biologic for the indication for which it has been designated, the product is entitled to an orphan exclusivity period in which the FDA may not approve any other applications to market the same drug or biologic for the same indication for seven years.

Exceptions to the seven-year exclusivity period may apply in limited circumstances, such as where the sponsor of a different version of the product is able to demonstrate that its product is clinically superior to the approved orphan drug product. This exclusivity does not prevent a competitor from obtaining approval to market a different product that treats the same disease or condition, or the same product to treat a different disease or condition. The FDA can revoke a product's orphan drug exclusivity under certain circumstances, including when the holder of the approved orphan drug application is unable to assure the availability of sufficient quantities of the drug to meet patient needs. Orphan exclusivity operates independently from other regulatory exclusivities and other protections against generic or biosimilar competition.

A sponsor of a product application that has received an orphan drug designation is also granted tax incentives for clinical research undertaken to support the application. In addition, the FDA will typically coordinate with the sponsor on research study design for an orphan drug and may exercise its discretion to grant marketing approval on the basis of more limited product safety and efficacy data than would ordinarily be required, based on the limited size of the applicable patient population.

Fast Track Designation

The FDA has a number of expedited review programs for drugs that are intended for the treatment of a serious or life-threatening condition. As one example, under the agency's Fast Track program, the sponsor of a new drug candidate may request the FDA to designate the product for a specific indication as a Fast Track product concurrent with or after the filing of the IND for the product candidate. The FDA must determine if the product candidate qualifies for Fast Track designation within 60 days after receipt of the sponsor's request.

In addition to other benefits, such as the ability to have more frequent interactions with the FDA, the agency may initiate review of sections of a Fast Track product's marketing application before the application is complete. This rolling review is available if the applicant provides and the FDA approves a schedule for the submission of the remaining information and the applicant pays applicable user fees. However, the FDA's review period for a Fast Track application does not begin until the last section of the marketing application is submitted. In addition, the Fast Track designation may be withdrawn by the FDA if the agency believes that the designation is no longer supported by data emerging in the clinical trial process.

Post-approval requirements

Rigorous and extensive FDA regulation of drugs and biologics continues after approval, including requirements relating to recordkeeping, periodic reporting, product sampling and distribution, adverse experiences with the product, cGMP, and advertising and promotion. Changes to the manufacturing process or facility often require prior FDA approval before being implemented and other types of changes to the approved product, such as adding new indications and additional labeling claims, are also subject to further FDA review and approval. Failure to comply with the applicable requirements may result in administrative, judicial, civil or criminal actions and adverse publicity. These include refusal to approve pending applications or supplemental applications, withdrawal of approval, clinical hold, suspension or termination of clinical trial, warning or untitled letters, product recalls, product seizures, total or partial suspension of production or distribution, injunctions, fines or other monetary penalties, refusals of government contracts, mandated corrective advertising or communications with healthcare providers, debarment, restitution, disgorgement of profits or other civil or criminal penalties.

Regulatory Exclusivity and Biosimilar Competition in the United States

In 2010, the federal Biologics Price Competition and Innovation Act, or BPCIA, was enacted, creating a statutory pathway for licensure, or approval, of biological products that are biosimilar to, and possibly interchangeable with, reference biological products licensed under the Public Health Service Act.

Under the BPCIA, innovator manufacturers of original biological products are granted 12 years of exclusive use after first licensure before biosimilar versions of such products can be licensed for marketing in the United States. This means that the FDA may not approve an application for a biosimilar product that references data in an innovator's Biologics License

Application, or BLA, until 12 years after the date of approval of the reference biological product, with a potential six-month extension of exclusivity if certain pediatric studies are conducted and the results are reported to the FDA. A biosimilar application may be submitted four years after the date of licensure of the reference biological product, but the FDA cannot approve the application until the full exclusivity period has expired. This 12-year exclusivity period operates independently from other protections that may apply to biosimilar competitors, including patents that are held for those products. Additionally, the BPCIA establishes procedures by which the biosimilar applicant must provide information about its application and product to the reference product sponsor, and by which information about potentially relevant patents is shared and litigation over patents may proceed in advance of approval. The BPCIA also provides a period of exclusivity for the first biosimilar to be determined by the FDA to be interchangeable with the reference product.

Under the Best Pharmaceuticals for Children Act, which was subsequently made applicable to biological products by the BPCIA, the FDA may also issue a Written Request asking a sponsor to conduct pediatric studies related to a particular active moiety; if the sponsor agrees and meets certain requirements, the sponsor may be eligible to receive an additional six months of marketing exclusivity for its drug product containing such active moiety.

Other regulatory exclusivity may be granted to drugs, including, but not limited to, three-year and five-year exclusivity granted to non-biologic drugs under the Drug Price Competition and Patent Term Restoration Act of 1984, also referred to as the Hatch-Waxman Amendments.

Depending upon the timing, duration and specifics of FDA approval of product candidates, some of a sponsor's United States patents may be eligible for limited patent term extension under the Hatch-Waxman Amendments. The Hatch-Waxman Amendments permit a patent restoration term of up to five years as compensation for patent term lost during product development and the FDA regulatory review process. However, patent term restoration cannot extend the remaining term of a patent beyond a total of 14 years from the product's approval date. The United States Patent and Trademark Office, or USPTO, in consultation with the FDA, reviews and approves the application for any patent term extension or restoration. Only one patent applicable to an approved biologic product is eligible for the extension and the application for the extension must be submitted prior to the expiration of the patent.

Foreign regulation of human therapeutics

In addition to regulations in the United States, our subsidiaries, such as Precigen and ActoBio, and our collaborators that are focused on the development of human therapeutic products will be subject to a variety of foreign regulations governing clinical trials and commercial sales and distribution of the products enabled by our technologies. Whether or not the developer obtains FDA approval for a product, they must obtain approval by the comparable regulatory authorities of foreign countries or economic areas, such as the European Union, before they may commence clinical trials or market products in those countries or areas. The approval process and requirements governing the conduct of clinical trials, product licensing, pricing and reimbursement vary greatly from place to place, and the time may be longer or shorter than that required for FDA approval.

Regulation of animal based technologies

The development, movement and commercialization of animal based products (genetically modified animals) is governed globally by either technology- or product-based laws and regulations specific to each country. In the majority of our target markets, the relevant regulatory pathway for animal based products is distinct from those governing human pharmaceutical products although the risk assessment parameters and agencies with jurisdiction may be consistent. In each case, product evaluation and approval requires the development of data to demonstrate human/animal safety, environmental safety and effectiveness. In the United States, the FDA's Center for Veterinary Medicine regulates certain GE animals as 'animal drugs' as well as animal feed products. The United States Department of Agriculture, or USDA, regulates veterinary vaccines and other biologics, and the EPA regulates certain animals, such as genetically modified insects with pesticidal properties, as biopesticides. Regulatory oversight and jurisdiction within the United States is based on either the nature of the product and/or product end use. For example, the FDA has historically regulated genetically modified animals as animal drugs on the basis that the rDNA construct in a GE animal is an article intended to affect the structure or function of the body of the animal and, in some cases, intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in the animal. However, the FDA recently clarified that certain genetically modified animals will not be regulated as animal drugs based on their ultimate end use. Specifically, products intended to reduce the population of mosquitoes (for example, by killing them at some point in their life cycle, or by interfering with their reproduction or development) are regulated as pesticides by EPA.

Specific statutes and regulations also define standards and data requirements that we and our collaborators must satisfy. While regulatory oversight may vary globally, animal based products generally must undergo regulatory review and approval prior to their movement and commercial introduction internationally. These regulations also require the development and submission of

data to demonstrate product efficacy as well as evaluate potential risk to human/animal health and the environment. For drugs administered to animals, extensive regulatory requirements exist often including evaluation by the same (or similar) authorities as human pharmaceuticals. For example, a new animal drug is deemed "unsafe" and, therefore, may not be introduced into commerce in the United States unless: the FDA has approved a new animal drug application, or NADA, for its intended use; the drug is only for investigational use and conforms to specified exemptions for such use under an Investigational New Animal Drug, or INAD, exemption; or the drug conforms to certain FDA regulations. The NADA approval process is in many ways similar to the approval process for human drugs and requires a demonstration of the drug's safety and efficacy for its proposed conditions of use. Actions on INADs may require preparation of an environmental assessment, or EA, and a finding of no significant impact, or FONSI. Through the preparation of an EA/FONSI or an Environmental Impact Statement, the FDA will examine the potential for environmental impacts, including the potential for inadvertent release or escape of the animal with an intentionally altered genome and/or its products into the environment, and whether certain measures may mitigate any potential significant impacts that would adversely affect the human environment.

The complex, multi-faceted regulation of genetically modified animals as "animal drugs" is exemplified by the regulatory approval of AquaBounty's AAS, the first genetically modified animal ever approved by the FDA. For such bioengineered animals, the United States and Canada have established regulatory processes led by the FDA and Health Canada/Canadian Food Inspection Agency, or CFIA, respectively, while other countries, such as Brazil and Argentina among others, are using existing authorities for the evaluation of genetically modified organisms for the advancement and regulation of novel genetically modified animal technologies. In December 2012, the FDA published an EA for AAS along with its FONSI in the Federal Register, confirming that an approval of the pending NADA would not have an adverse effect on the environment and opened up a 60 day period for public comment. In February 2013, the FDA extended the period for public comment by an additional 60 days, which expired in April 2013. Prior to the publication of the EA and FONSI, in September 2010, the FDA held a public meeting of its Veterinary Medicine Advisory Committee to review its findings regarding AAS. The conclusion of its panel of experts was that AAS is indistinguishable from other farmed Atlantic salmon, is safe to eat and does not pose a threat to the environment under its conditions of use. Subsequently, the FDA initiated an EA in compliance with its obligations under the National Environment Policy Act, or NEPA, which requires that all federal agencies consider the possible environmental impacts of any action that they authorize. Subsequently, in November 2015, the FDA approved the NADA for the production, sale and consumption of AAS. AquaBounty is subject to on-going post approval responsibilities as detailed in the FDA letter of approval and summarized in the EA dated in November 2015. In the event that AquaBounty seeks to modify or expand its production sites and methods, such would require further regulatory approvals.

In May 2016, Health Canada concluded its review of AAS and approved it for commercial sale in Canada, and the Animal Feed Division of the Animal Health Directorate of CFIA authorized AAS for use in livestock feeds.

In April 2016, the FDA issued Import Alert 99-40 in response to a law passed by Congress, which states that the FDA may not allow the introduction or delivery for introduction into interstate commerce any food that contains GE salmon, until final labeling guidelines for informing consumers of such content are published. In December 2017, the FDA approved a supplementary NADA for an additional grow out facility for AAS located in Albany, Indiana. However, the FDA considers salmon eggs to meet the definition of food and its import alert to mean that AquaBounty cannot import AAS, including its eggs or any food from the salmon, into the United States.

Global regulations continue to evolve for gene-edited animal technologies where precise genetic additions or deletions are introduced into an animal's genome. On January 10, 2017, the FDA released a draft Revised Guidance for Industry which, when finalized, will represent the FDA's current thinking on the regulation of intentionally altered genomic DNA in animals. Although the USDA recently issued a statement indicating that in large part it would not regulate gene-edited plants as GMO crops, the FDA's guidance reiterates the FDA's historic position that it maintains oversight of gene-edited animals as "animal drugs". However, there is a growing global trend to significantly reduce the regulatory burden for gene-edited animals in other countries, such as Argentina and Brazil. For example, Argentina's National Advisory Commission on Agricultural Biotechnology has implemented a regulatory process where technology providers are able to submit data to demonstrate that no new genetic material is introduced into the animal's genome. If the submission is successful, the product will not be subject to regulations governing genetically modified products in Argentina. Brazil has recently instituted a similar process. While such a process may significantly expedite time to market and may reduce developmental costs, we recognize the importance of also working with key stakeholders and the public to create product awareness and build public acceptance prior to commercialization.

Regulation of self-limiting insect technologies

Oxitec has developed a GE self-limiting line of the mosquito *Aedes aegypti*, OX513A, as well as a new second generation mosquito, OX5034. Moreover, Oxitec has developed other self-limiting insects to suppress crop pests. While the GE mosquito

was historically subject to regulatory review by the FDA as a new animal drug, jurisdiction was shifted to the EPA in October 2017. Under the Federal Insecticide, Fungicide, and Rodenticide Act, or FIFRA, the EPA is charged with protecting human health and the environment by ensuring that registered pesticides do not cause unreasonable adverse effects to man or the environment. FIFRA's definition of "pesticide" includes "any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest". Prior to this shift, the FDA published in August 2016 a final EA and FONSI regarding impacts on human health, animal health and the environment of the OX513A GE mosquito based on review of information and evidence related to an investigational trial in Key Haven, Florida. Following the transfer of jurisdiction to the EPA, Oxitec submitted regulatory dossiers to the EPA for the release of the OX513A GE mosquito in Florida and other states. Oxitec is now seeking approval for trial releases of its OX5034 mosquito. Oxitec's OX513A and OX5034 GE mosquitos have also been approved by Brazil's National Biosafety Committee, or CTNBio, for community-wide releases. Additionally, open field trials of Oxitec's mosquitoes have been conducted in the Cayman Islands, Panama, and Malaysia under relevant permits or approvals. Further approvals will be required for commercial production and use.

Self-limiting GE insects used to control crop pests—instead of disease carrying vectors—are regulated by the USDA. Under the Plant Protection Act, the USDA's Animal and Plant Health Inspection Service, or APHIS, has broad authority to regulate plant pests to protect crops and other plants. Therefore, USDA regulates organisms and products that are known or suspected to be plant pests or that pose a plant pest risk, including those that have been genetically modified. While Oxitec's GE self-limiting insects are designed to suppress hard-to-control or resistant plant pests, they are still currently subject to the USDA's jurisdiction. When an applicant has developed sufficient data to demonstrate that the organism no longer poses a plant pest risk, the applicant can petition APHIS to "deregulate" the article, meaning the GE organism should no longer be considered a regulated article under APHIS regulations. In 2017, APHIS released a final EA and subsequent FONSI supporting a limited environmental release of Oxitec's GE diamondback moth. This conclusion was based on the finding that it would be unlikely for these insects to impact the physical, biological and human health environment. These self-limiting insects will also likely be subject to foreign agriculture GE regulations and authorizing bodies, such as CTNBio and the Ministry of Agriculture in Brazil as well as CONABIA in Argentina and the Office of the Gene Technology Regulator in Australia.

Regulation of agricultural technologies/plants and food products

The manufacturing, marketing and certain areas of research related to some of the potential food products developed by us and our subsidiaries and collaborators are subject to regulation by federal and state governmental authorities in the United States. As it relates to GE foods and/or plants, they are subject to regulation by the FDA, USDA, and EPA under the *Coordinated Framework for the Regulation of Biotechnology*. These technologies have been regulated under this framework for over two decades. Similar regulatory approval systems are in place globally as biotech crops have been planted in over 26 countries, including over 19 developing countries. Currently, our Arctic apple and Florian technologies are subject to these plant biotechnology regulations. As previously noted above for gene-edited animal technologies, global processes are evolving that we believe may streamline the review and assessment of these technologies. In a number of countries, including the United States, which has implemented an "Am I Regulated" process, specific gene-edited plant products will not be subject to GMO regulation if simple nucleotide changes were made and/or no new genetic material has been incorporated in the final product.

The Arctic apple, which is one of our commercial plant biotechnology products, has undergone significant regulatory review in recent years, and a few varieties have been successfully deregulated and authorized for sale in the United States. In February 2015, the USDA announced its decision to deregulate Okanagan's Golden Delicious apple variety and Granny Smith apple variety, or together the Arctic apples. In reaching its decision, the USDA conducted a final plant pest risk assessment concluding that Arctic apples are unlikely to pose a plant pest risk to agriculture and other plants in the United States. The USDA also completed an EA to comply with the NEPA and concluded that deregulation is not likely to have a significant impact on the human environment. Concurrent with the USDA, Okanagan also engaged in a voluntary food safety assessment consultation with the FDA regarding its Arctic apples. The FDA completed its assessment in March 2015. As part of bringing the assessment to closure, Okanagan was required to submit summaries of its safety and nutritional assessments for its Arctic apples. Based on the information provided by Okanagan and other information available to the agency, the FDA concluded the Arctic apple is not materially different in safety, nutrition, composition, or other relevant characteristics from food and feed from apples currently on the market, and the apples do not raise any issues that would require premarket review or approval by the FDA. In August 2016, the USDA announced its decision to extend a preliminary determination of nonregulated status to Okanagan's Arctic Fuji apple variety.

Comparable authorities to the federal and state governmental authorities in the United States are involved in the regulation of plant technology products in other countries, such as the European Food Safety Authority in Europe, CONABIA in Argentina, CNTBio in Brazil, and Health Canada in Canada. For example, in relation to Okanagan, Health Canada announced its decision in March 2015 that it has no objection to the food use of the Arctic apple in Canada. In reaching its decision, Health Canada conducted a comprehensive assessment of the Golden Delicious and Granny Smith varieties according to its *Guidelines for the*

Safety Assessment of Novel Foods. These guidelines are consistent with internationally accepted principles for establishing the safety of foods with novel traits adopted by the Codex Alimentarius Commission. Following this assessment, it was determined that the changes made to the Arctic apple did not pose a greater risk to human health than apples currently available on the Canadian market. In addition, Health Canada also concluded that the Arctic apple would have no impact on allergies and that there are no differences in the nutritional value of the Arctic apple compared to other traditional apple varieties available for consumption.

Regulation of microbes and microbial products

The use of GMMs, such as our yeast and methanotroph strains, is subject to laws and regulations in many countries. In the United States, the EPA regulates the commercial use of many GMMs as well as potential products produced from GMMs. Various states within the United States could choose to regulate products made with GMMs as well. While the strain of genetically-modified yeast that we use, S. cerevisiae, is eligible for exemption from EPA review because it is generally recognized as safe, we must satisfy certain criteria to achieve this exemption, including, but not limited to, use of compliant containment structures and safety procedures. We expect to encounter GMM regulations in most if not all of the countries in that we may seek to make our products; however, the scope and nature of these regulations will likely vary from country to country. If we cannot meet the applicable requirements in countries in which we intend to produce our products using GMMs, then our business will be adversely affected.

In addition to the use of the dried fermentation, biomass from the GMMs for animal feed is subject to approval as a new feed ingredient. In the United States, ingredients intended as components of animal feed must be either (i) described by an Association of American Feed Control Officials, or AAFCO, ingredient definition; (ii) generally recognized as safe, or GRAS, for the intended use; or (iii) approved food additives and listed in the Code of Federal Regulations, or CFR. The Federal Food, Drug and Cosmetic Act requires that any substance that is added to or is expected to become a component of animal food, either directly or indirectly, must be used in accordance with a food additive regulation unless it is GRAS for that intended use. The AAFCO Official Publication includes the list of approved food additives as well as the list of GRAS substances. In addition, many of the ingredients in the AAFCO Official Publication are not approved food additives and may not meet the criteria needed to be recognized as GRAS (21 CFR 570.30). Nevertheless, the FDA has accepted the listing of certain ingredients (e.g., those used as sources of nutrients, aroma, or taste) in the AAFCO Official Publication for their marketing in interstate commerce, provided there were no apparent safety concerns about the use or composition of the ingredient.

Regardless of the regulatory pathway, the following areas should be addressed: human food safety, target animal safety, environmental impact, utility (intended physical, nutritional or other technical effect), manufacturing chemistry, labeling, and proposed regulation. Based on preliminary evaluation, the feed derivative *M. capsulatus* biomass could potentially be commercialized following completion of the FDA's GRAS notification process. Under this process, the safety of *M. capsulatus* biomass is determined by a panel of experts, qualified by training and experience, to evaluate the feed ingredient, with a subsequent review and determination made by the FDA. If approved, the FDA then issues a "no objections" letter. However, if the 'killed' GM *M. capsulatus* is contained in the final feed product, additional data and information may be required to characterize the microbial ingredient, such as molecular characterization and potential pathogenicity. For use in Canada, the manufacture, sale and import of livestock feeds are regulated under the *Feeds Act* and *Regulations* administered by the CFIA. Under these regulations, all feeds must be safe to livestock, humans and the environment as determined by a premarket review.

Energy and chemical regulation

The environmental regulations discussed above also govern the development, manufacture and marketing of energy and chemical products. Chemical products produced by us and our collaborators may be subject to government regulations in our target markets. In the United States, the EPA administers the requirements of the TSCA, which regulates the commercial registration, distribution and use of many chemicals. Before an entity can manufacture or distribute significant volumes of a chemical, it needs to determine whether that chemical is listed in the TSCA inventory. If the substance is listed, then manufacture or distribution can commence immediately. If not, then in most cases a "Chemical Abstracts Service" number registration and pre-manufacture notice must be filed with the EPA, which has 90 days to review the filing. A similar requirement exists in Europe under the REACH regulation. Additional regulations may apply to specific subsets of chemicals such as, for example, fuel products that are subject to regulation by various government agencies including, in the United States, the EPA and the California Air Resources Board.

Research and development

As of December 31, 2018, we had 464 research and development employees. We incurred expenses of $404.6 million, $143.2 million and $112.1 million in 2018, 2017, and 2016, respectively, on research and development activities. We anticipate that

our research and development expenditures could increase as we investigate other applications for our synthetic biotechnologies and further develop our internally developed programs, including those we reacquired from former collaborators in 2018. Our primary domestic research and development operations are located in laboratory facilities in Germantown, Maryland; South San Francisco, California; Davis, California; and San Diego, California; and our primary international research and development operations are located in laboratory facilities in Budapest, Hungary; Ghent, Belgium; Campinas, Brazil; and Oxford, England.

Financial information

Collaboration revenues, product revenues, service revenues and other revenues and operating income for each of the last three fiscal years, along with assets as of December 31, 2018 and 2017, are set forth in the consolidated financial statements, which are included in Item 8 of this Annual Report. Financial information about geographic areas is set forth in "Notes to the Consolidated Financial Statements - Note 2" appearing elsewhere in this Annual Report.

Production

As of December 31, 2018, we had 232 production employees. Our primary domestic production facilities, including approximately 360 acres of land, are located in Sioux Center, Iowa. The land and facilities are primarily used for our embryo transfer and in vitro fertilization processes, as well as housing livestock used in such processes. We also lease or own regional production facilities and land in California, Maryland, Missouri, New York, Oklahoma, South Dakota, Texas, and Washington for these purposes. Additionally, we are scaling up commercial production of our non-browning apples in Washington and our AAS salmon in Canada, in anticipation of generating future revenues from each of these product lines.

Employees

As of December 31, 2018, we had 882 full-time and 97 part-time employees. We consider our employee relations to be good.

Corporate information

We are a Virginia corporation formed in 1998 and our principal executive offices are located at 20374 Seneca Meadows Parkway, Germantown, MD 20876, and our telephone number is (301) 556-9900.

Additional information

Our website is *www.dna.com*. The information on, or that can be accessed through, our website does not constitute part of, and is not deemed to be incorporated by reference into, this Annual Report. We post regulatory filings on this website as soon as reasonably practicable after they are electronically filed with or furnished to the SEC. These filings include annual reports on Form 10-K; quarterly reports on Form 10-Q; current reports on Form 8-K; Section 16 reports on Forms 3, 4, and 5; and any amendments to those reports filed with or furnished to the SEC. We also post our press releases on our website. Access to these filings or any of our press releases on our website is available free of charge. Copies are also available, without charge, from Intrexon Corporation Investor Relations, 20374 Seneca Meadows Parkway, Germantown, Maryland 20876. Reports filed with the SEC may be viewed at *www.sec.gov*.

In addition, our Corporate Governance Guidelines, Code of Business Conduct and Ethics, and charters for the Audit Committee, the Compensation Committee and the Nominating and Governance Committee are available free of charge to shareholders and the public through the "Corporate Governance" section of our website. Printed copies of the foregoing are available to any shareholder upon written request to our Communications Department at the address set forth on the cover of this Annual Report or may be requested through our website, *www.dna.com.*

Item 1A. Risk Factors

Investing in our common stock involves a high degree of risk. You should carefully consider the risks described below, together with the other information contained in this Annual Report, including our consolidated financial statements and the related notes appearing at the end of this Annual Report, before making your decision to invest in shares of our common stock. We cannot assure you that any of the events discussed in the risk factors below will not occur. These risks could have a material and adverse impact on our business, results of operations, financial condition or prospects. If that were to happen, the trading price of our common stock could decline, and you could lose all or part of your investment.

This Annual Report also contains forward-looking statements that involve risks and uncertainties. Our actual results could differ materially from those anticipated in these forward-looking statements as a result of certain factors, including the risks faced by us described below and elsewhere in this Annual Report. See "Special Note Regarding Forward-Looking Statements" for information relating to these forward-looking statements.

RISKS RELATED TO OUR FINANCIAL POSITION, INDEBTEDNESS, OPERATING RESULTS AND NEED FOR ADDITIONAL CAPITAL

We have a history of net losses, and we may not achieve or maintain profitability.

We have incurred net losses since our inception, including net losses attributable to Intrexon of $509.3 million, $117.0 million and $186.6 million in 2018, 2017 and 2016, respectively. As of December 31, 2018, we had an accumulated deficit of $1.3 billion. We may incur losses and negative cash flow from operating activities for the foreseeable future. To date, we have derived a significant portion of our revenues from ECCs and license agreements, but we expect these revenues will decrease considerably as a result of our evolving business model. We no longer expect to receive reimbursement of costs incurred by us for research and development services and will no longer recognize previously deferred revenues associated with the terminated collaborations. In addition, after our reacquisition of rights to fields previously licensed to collaborators, we no longer expect to receive from those collaborators reimbursement of costs incurred by us for research and development services. If our existing collaborators terminate their ECCs, license agreements or JVs with us or we are unable to commercialize products through our subsidiaries and JVs or enter into strategic transactions, our revenues could be adversely affected. In addition, certain of our collaborations and license agreements provide for milestone payments, future royalties and other forms of contingent consideration, the payment of which are uncertain as they are dependent on our collaborators' abilities and willingness to successfully develop and commercialize products. Moreover, many of the products being commercialized by us are in the early stages of development or preliminary stages of sales. We expect a significant period of time could pass before the achievement of contractual milestones and the realization of royalties on products commercialized under our collaborations or before commercialization of our various products and revenues is sufficient to achieve profitability. As a result, our expenses may exceed revenues for the foreseeable future, and we may not achieve profitability. If we fail to achieve profitability, or if the time required to achieve profitability is longer than we anticipate, we may not be able to continue our business. Even if we do achieve profitability, we may not be able to sustain or increase profitability on a quarterly or annual basis.

We will need substantial additional capital in the future in order to fund our business and have identified conditions that raise substantial doubt about our ability to continue as a going concern.

Our consolidated financial statements as of and for the year ended December 31, 2018 have been prepared on the basis that we will continue as a going concern, which contemplates the realization of assets and satisfaction of liabilities in the normal course of business. We have incurred significant losses since our inception and we expect that we will continue to incur losses as we aim to successfully execute our business plan. We are and will continue to be dependent on additional public or private financings, new collaborations or licensing arrangements with strategic partners, or additional equity and debt financing sources to fund continuing operations. Based on our balance of cash, cash equivalents and short-term investments of $222.5 million at December 31, 2018 and recurring losses since inception, there is substantial doubt about our ability to continue as a going concern within one year after the date that these financial statements are issued. We expect our future capital requirements will be substantial, particularly as we continue to develop our business and pursue our internal research and development programs and for capital investment needed to scale up our commercial operations. Our need for additional capital will depend on many factors, including:

- progress in our research and development programs, as well as the magnitude of these programs;
- the timing, receipt, and amount of any payments received in connection with strategic transactions;
- the timing, receipt, and amount of upfront, milestone, and other payments, if any, from present and future collaborators, if any;
- the timing, receipt, and amount of sales and royalties, if any, from our potential products;
- our ability to maintain or improve the volume and pricing of our current product and service offerings and to develop new offerings, including those that may incorporate new technologies;
- costs we might incur to reacquire previously licensed rights for our own development;

- the timing and capital requirements to scale up our various product and service offerings and customer acceptance thereof;
- our ability to maintain and establish additional collaborative arrangements and/or new strategic initiatives;
- the timing of regulatory approval of products of our collaborations and operations;
- the resources, time, and cost required for the preparation, filing, prosecution, maintenance, and enforcement of patent claims;
- investments we may make in current and future collaborators, including JVs;
- strategic mergers and acquisitions, including both the upfront acquisition cost as well as the cost to integrate, maintain, and expand the strategic target; and
- the costs associated with legal activities, including litigation, arising in the course of our business activities and our ability to prevail in any such legal disputes.

If future financings involve the issuance of equity securities, our existing shareholders would suffer further dilution. If we raise additional debt financing, we may be subject to restrictive covenants that limit our ability to conduct our business. We may not be able to raise sufficient additional funds on terms that are favorable to us, if at all. If we fail to raise sufficient funds and continue to incur losses, our ability to fund our operations, take advantage of strategic opportunities, develop products or technologies, or otherwise respond to competitive pressures could be significantly limited. If this happens, we may be forced to delay or terminate research or development programs or the commercialization of products resulting from our technologies, curtail or cease operations or obtain funds through strategic transactions, ECCs, JVs or other collaborative and licensing arrangements that may require us to relinquish commercial rights, or grant licenses on terms that are not favorable to us. If adequate funds are not available, we will not be able to successfully execute our business plan or continue our business.

Servicing our debt requires a significant amount of cash, and we may not have sufficient cash flows from our business to pay our substantial debt.

Our ability to make scheduled payments of the principal of, to pay interest on or to refinance our indebtedness, including the 3.50 percent convertible senior notes due 2023, or Convertible Notes, issued in July 2018, depends on our future performance, which is subject to economic, financial, competitive and other factors beyond our control. Our business may not continue to generate cash flows from operations in the future sufficient to service our debt and make necessary capital expenditures. If we are unable to generate such cash flows, we may be required to adopt one or more alternatives, such as selling assets, restructuring debt or obtaining additional equity capital on terms that may be onerous or highly dilutive. Our ability to refinance our indebtedness will depend on the capital markets and our financial condition at such time. We may not be able to engage in any of these activities or engage in these activities on desirable terms, which could result in a default on our debt obligations.

The Convertible Notes are our exclusive obligations and are not guaranteed by any of our operating subsidiaries. A substantial portion of our consolidated assets is held by our subsidiaries. Accordingly, our ability to service our debt, including the Convertible Notes, depends on the results of operations of our subsidiaries and upon the ability of such subsidiaries to provide us with cash, whether in the form of dividends, loans or otherwise, to pay amounts due on our obligations, including the Convertible Notes. Our subsidiaries are separate and distinct legal entities and have no obligation, contingent or otherwise, to make payments on the Convertible Notes or to make any funds available for that purpose. In addition, dividends, loans or other distributions to us from such subsidiaries may be subject to contractual and other restrictions and are subject to other business considerations.

Despite our current debt levels, we may still incur substantially more debt or take other actions that would intensify the risks discussed above.

Despite our current consolidated debt levels, we and our subsidiaries may incur substantial additional debt in the future, subject to the restrictions contained in our debt instruments, some of which may be secured debt. We are not restricted under the terms of the indenture governing the Convertible Notes from incurring additional debt, securing existing or future debt, recapitalizing our debt or taking a number of other actions that are not limited by the terms of the indenture governing the Convertible Notes that could have the effect of diminishing our ability to make payments on the Convertible Notes when due.

We may not have the ability to raise the funds necessary to settle conversions of the Convertible Notes in cash or to repurchase the Convertible Notes upon a fundamental change, and our future debt may contain limitations on our ability to pay cash upon conversion or repurchase of the Convertible Notes.

Holders of Convertible Notes have the right to require us to repurchase their Convertible Notes upon the occurrence of a fundamental change at a fundamental change repurchase price equal to 100 percent of the principal amount of the Convertible Notes to be repurchased, plus accrued and unpaid interest, if any. In addition, upon conversion of the Convertible Notes, unless we elect to deliver solely shares of our common stock to settle such conversion (other than paying cash in lieu of delivering any fractional share), we will be required to make cash payments in respect of the Convertible Notes being converted. However, we may not have enough available cash or be able to obtain financing at the time we are required to make repurchases of Convertible Notes surrendered therefor or Convertible Notes being converted. In addition, our ability to repurchase the Convertible Notes or to pay cash upon conversions of the Convertible Notes may be limited by law, by regulatory authority or by agreements governing our future indebtedness. Our failure to repurchase Convertible Notes at a time when the repurchase is required by the indenture or to pay any cash payable on future conversions of the Convertible Notes as required by the indenture would constitute a default under the indenture. A default under the indenture or the fundamental change itself could also lead to a default under agreements governing our future indebtedness. If the repayment of the related indebtedness were to be accelerated after any applicable notice or grace periods, we may not have sufficient funds to repay the indebtedness and repurchase the Convertible Notes or make cash payments upon conversions thereof.

The conditional conversion feature of the Convertible Notes, if triggered, may adversely affect our financial condition and operating results.

In the event the conditional conversion feature of the Convertible Notes is triggered, holders of Convertible Notes will be entitled to convert the Convertible Notes at any time during specified periods at their option. If one or more holders elect to convert their Convertible Notes, unless we elect to satisfy our conversion obligation by delivering solely shares of our common stock (other than paying cash in lieu of delivering any fractional share), we would be required to settle a portion or all of our conversion obligation through the payment of cash, which could adversely affect our liquidity. In addition, even if holders do not elect to convert their Convertible Notes, we could be required under applicable accounting rules to reclassify all or a portion of the outstanding principal of the Convertible Notes as a current rather than long-term liability, which would result in a material reduction of our net working capital.

The accounting for convertible debt securities that may be settled in cash, such as the Convertible Notes, could have a material effect on our reported financial results.

In May 2008, the Financial Accounting Standards Board, or FASB, issued FASB Staff Position No. APB 14-1, *Accounting for Convertible Debt Instruments That May Be Settled in Cash Upon Conversion (Including Partial Cash Settlement)*, which has subsequently been codified as Accounting Standards Codification, or ASC, Subtopic 470-20, *Debt with Conversion and Other Options*, or ASC 470-20. Under ASC 470-20, an entity must separately account for the liability and equity components of the convertible debt instruments (such as the Convertible Notes) that may be settled entirely or partially in cash upon conversion in a manner that reflects the issuer's economic interest cost. The effect of ASC 470-20 on the accounting for the Convertible Notes is that the equity component is required to be included in the additional paid-in capital section of shareholders' equity on our consolidated balance sheet, and the value of the equity component would be treated as original issue discount for purposes of accounting for the debt component of the Convertible Notes. As a result, we record a greater amount of noncash interest expense in current periods presented as a result of the amortization of the discounted carrying value of the Convertible Notes to their face amount over the term of the Convertible Notes. We report lower net income in our financial results because ASC 470-20 requires interest to include both the current period's amortization of the debt discount and the instrument's coupon interest, which could adversely affect our reported or future financial results, the trading price of our common stock and the trading price of the Convertible Notes.

In addition, under certain circumstances, convertible debt instruments (such as the Convertible Notes) that may be settled entirely or partly in cash are currently accounted for utilizing the treasury stock method, the effect of which is that the shares issuable upon conversion of the Convertible Notes are not included in the calculation of diluted earnings per share except to the extent that the conversion value of the Convertible Notes exceeds their principal amount. Under the treasury stock method, for diluted earnings per share purposes, the transaction is accounted for as if the number of shares of common stock that would be necessary to settle such excess, if we elected to settle such excess in shares, are issued. We cannot be sure that the accounting standards in the future will continue to permit the use of the treasury stock method. If we are unable to use the treasury stock method in accounting for the shares issuable upon conversion of the Convertible Notes, then our diluted earnings per share would be adversely affected.

Our quarterly and annual operating results may fluctuate in the future. As a result, we may fail to meet or exceed the expectations of research analysts or investors, which could cause our stock price to decline.

Our financial condition and operating results have varied significantly in the past and may continue to fluctuate from quarter to quarter and year to year in the future due to a variety of factors, many of which are beyond our control. Factors relating to our business that may contribute to these fluctuations include the following factors, as well as other factors described elsewhere in this Annual Report:

- our ability to achieve or maintain profitability;
- the feasibility of producing and commercializing products enabled by our technologies;
- our ability to enter into strategic transactions, collaborations, or JVs;
- our relationships, and the associated exclusivity terms, with collaborators and licensees in our target end markets;
- our ability to develop and maintain technologies that our collaborators and licensees continue to use and that new collaborators are seeking;
- obligations to provide resources to our collaborators or to the collaborations themselves pursuant to the terms of the relevant ECC, license agreement or JV agreement;
- our ability to manage our growth;
- the outcomes of research programs, clinical trials, or other product development and approval processes conducted by us and our collaborators and licensees;
- the ability of us and our collaborators and licensees to develop and successfully commercialize products enabled by our technologies;
- our ability to successfully scale up production of our commercial products and customer acceptance thereof;
- risks associated with the international aspects of our business;
- our ability to integrate any businesses or technologies we may acquire with our business;
- our ability to accurately report our financial results in a timely manner;
- our dependence on, and the need to attract and retain, key management and other personnel;
- our ability to obtain, protect and enforce our intellectual property rights;
- our ability to prevent the theft or misappropriation of our intellectual property, know-how or technologies;
- potential advantages that our competitors, the competitors of our collaborators, and potential competitors may have in securing funding or developing competing technologies or products;
- our ability to obtain additional capital that may be necessary to expand our business;
- our collaborators' ability to obtain additional capital that may be necessary to develop and commercialize products under our ECCs, license agreements and JVs;
- business interruptions such as power outages and other natural disasters;
- public concerns about the ethical, legal and social ramifications of GE products and processes;
- the impact of new accounting pronouncements on our current and future operating results;
- our ability to use our net operating loss carryforwards to offset future taxable income; and

- the results of our consolidated subsidiaries.

Due to the various factors mentioned above, and others, the results of any prior quarterly or annual periods should not be relied upon as indications of our future operating performance.

We have a limited operating history, which may make it difficult to evaluate our current business and predict our future performance.

Our limited operating history and the evolution of our business model may make it difficult to evaluate our current business and predict our future performance. Any assessments of our current business and predictions made about our future success or viability may not be as accurate as they could be if we had a longer operating history. We have encountered and will continue to encounter risks and difficulties frequently experienced by growing companies in rapidly changing industries. If we do not address these risks successfully, our business will be harmed.

We may pursue strategic acquisitions and investments that could have an adverse impact on our business if they are unsuccessful.

We have made acquisitions in the past and, if appropriate opportunities become available, we may acquire additional businesses, assets, technologies or products to enhance our business in the future. In connection with any future acquisitions, we could:

- issue additional equity securities, which would dilute our current shareholders;
- incur substantial debt to fund the acquisitions; or
- assume significant liabilities.

Although we conduct due diligence reviews of our acquisition targets, such processes may fail to reveal significant liabilities. Acquisitions involve numerous risks, including:

- problems integrating the purchased operations, facilities, technologies or products;
- unanticipated costs and other liabilities;
- diversion of management's attention from our core businesses;
- adverse effects on existing business relationships with current and/or prospective collaborators, customers and/or suppliers;
- risks associated with entering markets in which we have no or limited prior experience; and
- potential loss of key employees.

Acquisitions also may require us to record goodwill and non-amortizable intangible assets that will be subject to impairment testing on a regular basis and potential periodic impairment charges, incur amortization expenses related to certain intangible assets, and incur large and immediate write-offs and restructuring and other related expenses, all of which could harm our operating results and financial condition. In addition, we may acquire companies that have insufficient internal financial controls, which could impair our ability to integrate the acquired company and adversely impact our financial reporting. If we fail in our integration efforts with respect to any of our acquisitions and are unable to efficiently operate as a combined organization, our business and financial condition may be adversely affected.

We recorded a $60.5 million impairment charge in the year ended December 31, 2018. See "Notes to the Consolidated Financial Statements - Note 11" appearing elsewhere in this Annual Report for additional discussion.

We may encounter difficulties in connection with our acquisitions.

We cannot be certain that any acquisition will be successful or that we will realize the anticipated benefits of the acquisition. In particular, we may not be able to realize the strategic and operational benefits and objectives we had anticipated. In addition,

we may face increased competition in the markets for any acquired products. Any of the following factors may have a material adverse effect on our business, operating results and financial condition. These factors may include:

- the potential disruption of our ongoing business and diversion of management resources;
- unanticipated expenses related to the acquired operations;
- the impairment of relationships with the acquired customers;
- the impairment of relationships with key suppliers and their ability to meet our demand;
- potential unknown liabilities associated with the acquired business and technology;
- potential liabilities related to litigation involving the acquired companies;
- potential periodic impairment of goodwill and intangible assets acquired; and
- potential inability to retain, integrate and motivate key personnel.

We own equity interests in several of our collaborators and have exposure to the volatility and liquidity risks inherent in holding their equity.

We own equity interests in several of our collaborators. The process by which we obtain equity interests in our collaborators and the factors we consider in deciding whether to acquire, hold or dispose of these equity positions may differ significantly from those that an independent investor would consider when purchasing equity interests in the collaborator. One significant factor would include our own expectation as to the success of our efforts to assist the collaborator in developing products enabled by our technologies. Owning equity in our collaborators increases our exposure to the risks of our collaborators' businesses beyond the products of those collaborations. Our equity ownership in our collaborators exposes us to volatility and the potential for negative returns. We may have restrictions on resale and/or limited markets to sell our equity ownership. In many cases, our equity position is a minority position which exposes us to further risk as we are not able to exert control over the companies in which we hold securities.

In connection with future collaborations or JVs, we may, from time to time, receive from collaborators, both public and private, warrants, rights and/or options, all of which involve special risks. To the extent we receive warrants or options in connection with future collaborations or JVs, we would be exposed to risks involving pricing differences between the market value of underlying securities and our exercise price for the warrants or options, a possible lack of liquidity and the related inability to close a warrant or options position, all of which could ultimately have an adverse effect on our financial position.

We use estimates in determining the fair value of certain assets and liabilities. If our estimates prove to be incorrect, we may be required to write down the value of these assets or write up the value of these liabilities, which could adversely affect our financial position.

Our ability to measure and report our financial position and operating results is influenced by the need to estimate the impact or outcome of future events on the basis of information available at the time of the financial statements. An accounting estimate is considered critical if it requires that management make assumptions about matters that were highly uncertain at the time the accounting estimate was made. If actual results differ from management's judgments and assumptions, then they may have an adverse impact on our results of operations and cash flows.

Fair value is estimated based on a hierarchy that maximizes the use of observable inputs and minimizes the use of unobservable inputs. Observable inputs are inputs that reflect the assumptions that market participants would use in pricing the asset or liability developed based on market data obtained from sources independent of the reporting entity. Unobservable inputs are inputs that reflect the reporting entity's own assumptions about the assumptions market participants would use in pricing the asset or liability developed based on the best information available in the circumstances. The fair value hierarchy prioritizes the inputs to valuation techniques into three broad levels whereby the highest priority is given to Level 1 inputs and the lowest to Level 3 inputs.

Valuations are highly dependent upon the reasonableness of management's assumptions and the predictability of the relationships that drive the results of our valuation methodologies. Because of the inherent unpredictability in the future

performance of the investments requiring Level 3 valuations, we may be required to adjust the value of certain assets, which could adversely affect our financial position.

We rely on our subsidiaries, collaborators and other third parties to deliver timely and accurate information in order to accurately report our financial results in the time frame and manner required by law.

We need to receive timely, accurate and complete information from a number of third parties in order to accurately report our financial results on a timely basis. We rely on our subsidiaries and collaborators to provide us with complete and accurate information regarding revenues, expenses and payments owed to or by us on a timely basis. In addition, we intend to rely on current and future collaborators under our collaboration agreements and JVs to provide us with product sales and cost saving information in connection with royalties, if any, owed to us. If the information that we receive is not accurate, our consolidated financial statements may be materially incorrect and may require restatement, and we may not receive the full amount of consideration to which we are entitled under our collaboration agreements or JVs. Although we have audit rights with these parties, performing such an audit could be expensive and time consuming and may not be adequate to reveal any discrepancies in a time frame consistent with our reporting requirements. We own a significant equity position in several of our collaborators, including a majority position in one of our collaborators. In the future, we may need to consolidate the financial statements of one or more other collaborators into our consolidated financial statements. Although we have contractual rights to receive information and certifications allowing us to do this, such provisions may not ensure that we receive information that is accurate or timely. As a result, we may have difficulty completing accurate and timely financial disclosures, which could have an adverse effect on our business.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited.

As of December 31, 2018, we had net operating loss carryforwards of approximately $369.1 million for United States federal income tax purposes available to offset future taxable income, including $116.6 million generated after 2017, and United States federal and state research and development tax credits of $7.9 million prior to consideration of annual limitations that may be imposed under Section 382 of the Internal Revenue Code of 1986, as amended, or Section 382. Carryforwards generated prior to 2018 begin to expire in 2022. As a result of our past issuances of stock, as well as due to prior mergers and acquisitions, certain of Intrexon's net operating losses have been subject to limitations pursuant to Section 382. As of December 31, 2018, Intrexon has utilized all net operating losses subject to Section 382 limitations, other than those losses inherited via acquisitions. As of December 31, 2018, approximately $41.9 million of domestic net operating losses were acquired via acquisition and are limited based on the value of the target at the time of the transaction. Future changes in stock ownership may also trigger an ownership change and, consequently, a Section 382 limitation. As of December 31, 2018, our direct foreign subsidiaries had foreign loss carryforwards of approximately $159.8 million, most of which do not expire.

The Tax Cuts and Jobs Act of 2017, or Tax Act, introduced certain limitations on utilization of losses that are generated after 2017, generally limiting utilization of those losses to 80 percent of future annual taxable income. However, losses generated after 2017 will generally have an indefinite carryforward period.

We are exposed to exchange rate fluctuation.

We have international subsidiaries in a number of foreign countries, including Belgium, Brazil, Canada, Hungary, and the United Kingdom. As a consequence, we are exposed to risks associated with changes in foreign currency exchange rates. We present our consolidated financial statements in United States dollars. Our international subsidiaries have assets and liabilities denominated in currencies other than the United States dollar. Future expenses and revenues of our international subsidiaries are expected to be denominated in currencies other than in United States dollars. Therefore, movements in exchange rates to translate from foreign currencies may have an impact on our reported results of operations, financial position and cash flows.

RISKS RELATED TO OUR TECHNOLOGIES AND BUSINESS OPERATIONS

Ethical, legal and social concerns about synthetic biologically engineered products and processes could limit or prevent the use of products or processes using our technologies, limit consumer acceptance and limit our revenues.

Our technologies and the technologies of our JVs and collaborators involve the use of synthetic biologically engineered products or synthetic biological technologies. Public perception about the safety and environmental hazards of, and ethical concerns over, GE products and processes could influence public acceptance of our and our collaborators' technologies, products and processes.

The subject of GMOs has received negative publicity, which has aroused public debate. In addition, certain of the products of our operating subsidiaries have been the subject of negative publicity, including AAS, Arctic apples and GE mosquitoes. This adverse publicity has led to, and could continue to lead to, greater regulation and trade restrictions on imports of genetically altered products. Further, there is a risk that products produced using our technologies could cause adverse health effects or other adverse events, which could also lead to negative publicity.

There is also an active and vocal group of opponents to GMOs who wish to ban or restrict the technology and who, at a minimum, hope to sway consumer perceptions and acceptance of this technology. Their efforts include regulatory legal challenges and labeling campaigns for genetically modified products, as well as application of pressure to consumer retail outlets seeking a commitment not to carry genetically modified products. Further, these groups have a history of bringing legal action against companies attempting to bring new biotechnology products to market. For example, on March 30, 2016, a coalition of non-governmental organizations filed a complaint against the FDA, the United States Fish and Wildlife Service, and related individuals for their roles in the approval of AAS. We may be subject to future additional litigation brought by one or more of these organizations in their attempt to block the development or sale of our products. In addition, animal rights groups and various other organizations and individuals have attempted to stop genetic engineering activities by pressing for legislation and additional regulation in these areas. We may not be able to overcome the negative consumer perceptions and potential legal hurdles that these organizations seek to instill or assert against our products, and our business could be harmed.

If we and our collaborators are not able to overcome the ethical, legal and social concerns relating to synthetic biological engineering, products and processes using our technologies may not be accepted. These concerns could result in increased expenses, regulatory scrutiny, delays or other impediments to our programs or the public acceptance and commercialization of products and processes dependent on our technologies or inventions. The ability of us and our collaborators to develop and commercialize products, or processes using our technologies could be limited by public attitudes and governmental regulation.

Inadvertent releases or unintended consequences of releases of synthetic biology technologies by us or others could lead to adverse effects on our business and results of operations.

The synthetic biological technologies that we develop may have significantly enhanced characteristics compared to those found in naturally occurring organisms, enzymes or microbes. While we produce many of these synthetic biological technologies only for use in a controlled laboratory and industrial environment, the release of such synthetic biological technologies into uncontrolled environments could have unintended consequences. Any adverse effect resulting from such a release, by us or others, could have a material adverse effect on the public acceptance of our products and our business and financial condition. Such a release could result in enhanced regulatory activity and we could have exposure to liability for any resulting harm.

We may become subject to increasing regulation in the future.

We have a diverse portfolio of proprietary and complementary technologies in the areas of human health, animal health, public health and energy that are subject to significant and diverse regulations that govern research, operations and product approval. Regulatory compliance is critical to our freedom to operate, our management of potential liabilities and, ultimately, our freedom to sell our and our collaborators' products. While we and our subsidiaries maintain regulatory compliance practices, we rely on our collaborators' compliance with laws and regulations applicable to the products they produce. We do not independently monitor whether our collaborators comply with applicable laws and regulations. Failure to comply with applicable regulatory requirements may subject us to administrative and/or judicially imposed sanctions or monetary penalties as well as reputational and other harms. Moreover, obtaining and maintaining regulatory approval have been, and will likely continue to be, increasingly difficult, time consuming and costly. Legislative bodies or regulatory agencies could enact new laws or regulations, change existing laws or regulations, or change their interpretations of laws or regulations at any time, which could affect our ability to obtain or maintain approval of our products or product candidates. The rate and degree of change in existing laws and regulations and regulatory expectations have accelerated in established markets, and regulatory expectations continue to evolve in emerging markets. We are unable to predict whether and when such changes could occur or whether such changes will have a material adverse effect on our business.

We have limited experience bringing new products through development and successful commercialization. Even if our technologies enable new products, we or our collaborators may not be successful in commercializing the products that result from our technologies.

Even if our technologies enable new products, there is no guarantee that we or our collaborators will be successful in creating additional products enabled by our technologies. Furthermore, neither we nor our collaborators may be able to commercialize the resulting products or our collaborators may decide to use other methods competitive with our technologies that do not utilize synthetic biology. Several of our wholly and majority-owned subsidiaries have received regulatory approvals, including

AquaBounty and Okanagan. These approvals do not, however, guarantee our success in commercializing the products of these subsidiaries. If we are not successful in commercializing our products, our business could be harmed.

Changing labeling requirements may negatively impact consumer acceptance of the products of our operating subsidiaries.

Historically, we were not required to label AAS or our Arctic apples at the retail level as containing genetically modified ingredients. However, because several states either passed or considered new laws specifying varying requirements for labeling such products, the United States Congress passed the National BioEngineered Food Disclosure Law in July 2016 to establish a national mandatory standard for labeling for foods that are or may be bioengineered. As part of the new law, Congress directed the USDA to establish the disclosure standards. On December 20, 2018, the USDA released its National Bioengineered Food Disclosure Standard that defined bioengineered foods as "those that contain detectable genetic material that has been modified through certain lab techniques and cannot be created through conventional breeding or found in nature." The Agricultural Marketing Service of the USDA also developed the List of Bioengineered Foods identifying certain bioengineered crops or foods and for which regulated entities must maintain records. Both AAS and our Arctic apples are part of this list and we are currently in the process of assessing the impact of the new regulations on us and our subsidiaries. However, the mandatory labeling requirements could cause consumers to view the label as either a warning or as an indication that AAS is inferior to traditional Atlantic salmon or our Arctic apples are inferior to traditional apples. These perceptions could negatively impact consumer acceptance of the products of our operating subsidiaries and ultimately harm our business.

The FDA has only approved a few gene therapies and regulation of gene therapies is still nascent.

The FDA first approved a gene therapy for use in humans in 2017, and to date has only approved a limited number. Regulatory requirements governing gene and cell therapy products have changed frequently and may continue to change in the future. The field of gene therapies is still very early in development and remains predominantly experimental. Clinical trials with gene therapies have encountered a multitude of significant technical problems in the past, including unintended integration with host DNA leading to serious adverse events, poor levels of protein expression, transient protein expression, viral overload, immune reactions to either viral capsids utilized to deliver DNA, DNA itself, proteins expressed or cells transfected with DNA. There can be no assurance that our development efforts or those of our collaborators will be timely or successful, that we or they will receive the regulatory approvals necessary to initiate clinical trials, where applicable, or that we will ever be able to successfully commercialize a product enabled by our technologies. To the extent that we or our collaborators utilize viral constructs or other systems to deliver gene therapies and the same or similar delivery systems demonstrate unanticipated and/or unacceptable side effects in preclinical or clinical trials conducted by ourselves or others, we may be forced to, or elect to, discontinue development of such products.

If we lose key personnel, including key management personnel, or are unable to attract and retain additional personnel, it could delay our product development programs, harm our research and development efforts, and we may be unable to pursue collaborations or develop our own products.

Our business involves complex operations across a variety of markets and requires a management team and employee workforce that is knowledgeable in the many areas in which we operate. The loss of any key members of our management, including our Chief Executive Officer, Randal J. Kirk, or the failure to attract or retain other key employees who possess the requisite expertise for the conduct of our business, could prevent us from developing and commercializing our products for our target markets and entering into collaborations or licensing arrangements to execute on our business strategy. In addition, the loss of any key scientific staff, or the failure to attract or retain other key scientific employees, could prevent us from developing our technologies for our target markets or from further developing and commercializing our products and services offerings to execute on our business strategy. We may not be able to attract or retain qualified employees in the future due to the intense competition for qualified personnel among biotechnology, synthetic biology and other technology-based businesses, or due to the unavailability of personnel with the qualifications or experience necessary for our business. If we are not able to attract and retain the necessary personnel to accomplish our business objectives, we may experience staffing constraints that will adversely affect our ability to meet the demands of our collaborators and customers in a timely fashion or to support our internal research and development programs. In particular, our product and process development programs are dependent on our ability to attract and retain highly skilled scientists. Competition for experienced scientists and other technical personnel from numerous companies and academic and other research institutions may limit our ability to attract and retain such personnel on acceptable terms.

Our planned activities, including the further development and scale-up of operating subsidiaries, will require additional expertise in specific industries and areas applicable to the products and processes developed through our technologies or acquired through strategic or other transactions, especially in the end markets that we seek to penetrate. These activities will

require the addition of new personnel, and the development of additional expertise by existing personnel. The inability to attract personnel with appropriate skills or to develop the necessary expertise could impair our ability to grow our business.

We have limited financial and managerial resources, requiring us to prioritize our development efforts over other opportunities.

Because we have limited financial and managerial resources, we will be required to prioritize our application of resources to particular development efforts. Any resources we expend on one or more of these efforts could be at the expense of other potentially profitable opportunities. If we focus our efforts and resources on one or more of these opportunities or markets and they do not lead to commercially viable products, our revenues, financial condition and results of operations could be adversely affected.

We may encounter difficulties managing our growth, which could adversely affect our business.

Currently, we are working simultaneously on multiple projects targeting several industries. These diversified operations place increased demands on our limited resources and require us to substantially expand the capabilities of our administrative and operational resources and to attract, train, manage and retain qualified management, technicians, scientists and other personnel. As our operations expand domestically and internationally, we will need to continue to manage multiple locations and additional relationships with various customers, collaborators, suppliers and other third parties. Our ability to manage our operations, growth and various projects effectively will require us to make additional investments in our infrastructure to continue to improve our operational, financial and management controls and our reporting systems and procedures and to attract and retain sufficient numbers of talented employees, which we may be unable to do effectively. As a result, we may be unable to manage our expenses in the future, which may negatively impact our gross margins or operating margins in any particular quarter. In addition, we may not be able to successfully improve our management information and control systems, including our internal control over financial reporting, to a level necessary to manage our growth.

Competitors and potential competitors may develop products and technologies that make ours obsolete or garner greater market share than ours.

We do not believe that we have any direct competitors who provide comparable technologies of similar depth and breadth that enable to the same extent the commercialization of products developed using synthetic biology across a broad spectrum of biologically-based industries. However, there are companies that have competing technologies for individual pieces of our proprietary suite of complementary technologies. One portion of our proprietary technology related to DNA synthesis and assembly includes the ability to synthesize new DNA. We believe the following companies engage in the manufacture of DNA components: ATUM, Inc.; Blue Heron Biotech, LLC (a subsidiary of OriGene); Integrated DNA Technologies, Inc. (IDT); GenScript USA, Inc.; Life Technologies Corporation, now part of Thermo Fisher Scientific Inc.; and Twist BioScience Corporation.

The synthetic biology industry and each of the commercial sectors we have targeted are characterized by rapid technological change and extensive competition. Our future success will depend on our ability to maintain a competitive position with respect to technological advances. Academic institutions also are working in this field. Technological development by others may result in our technologies, as well as products developed by our collaborators using our technologies, becoming obsolete.

The rapidly evolving market for developing GE T-cells in particular, is characterized by intense competition and rapid innovation. Genetically engineering T-cells faces significant competition in the CAR technology space from multiple companies and their collaborators, such as Novartis/University of Pennsylvania, Bluebird Bio/Celgene/Juno Therapeutics, Gilead/Kite Pharma, Cellectis, Allogene Therapeutics, Adaptimmune/GSK, Autolus Therapeutics, and Bellicum Pharmaceuticals. We face competition from non-cell based treatments offered by other companies such as Amgen, AstraZeneca, Bristol-Myers Squibb, Incyte, Merck, and Roche.

Our ability to compete successfully will depend on our ability to develop proprietary technologies that can be used by our collaborators to produce products that reach the market in a timely manner and are technologically superior to and/or are less expensive than other products on the market. Certain of our competitors may benefit from local government subsidies and other incentives that are not available to us or our collaborators. As a result, our competitors may be able to develop competing and/or superior technologies and processes, and compete more aggressively and sustain that competition over a longer period of time than we or our collaborators can. As more companies develop new intellectual property in our markets, a competitor could acquire patent or other rights that may limit products using our technologies, which could lead to litigation.

We may be sued for product liability.

Each of our collaborations requires the collaborator to indemnify us for liability related to products produced pursuant to the ECC or JV and to obtain insurance coverage related to product liability in amounts considered standard for the industry. We believe that these industry-standard coverage amounts range from $10 million to $40 million in the aggregate. Even so, we may be named in product liability suits relating to products that are produced by our collaborators using our technologies. Moreover, as we develop more products through our own operations and JVs, our potential exposure to such claims will increase. These claims could be brought by various parties, including other companies who purchase products from us or our collaborators or by the end users of the products. We cannot guarantee that our collaborators will not breach the indemnity and insurance coverage provisions of the ECCs or JVs. Further, insurance coverage is expensive and may be difficult to obtain, and may not be available to us or to our collaborators in the future on acceptable terms, or at all. We cannot assure you that we or our collaborators will have adequate insurance coverage against potential claims. In addition, although we currently maintain product liability insurance for our technologies in amounts we believe to be commercially reasonable, if the coverage limits of these insurance policies are not adequate, a claim brought against us, whether covered by insurance or not, could have a material adverse effect on our business, results of operations, financial condition and cash flows. This insurance may not provide adequate coverage against potential losses, and if claims or losses exceed our liability insurance coverage, we may go out of business. If we cannot successfully defend ourselves against product liability claims, we may incur substantial liabilities or be required to limit commercialization of our product candidates. Regardless of the merits or eventual outcome, liability claims may result in:

- reduced resources of our management to pursue our business strategy;
- decreased demand for products enabled by our technologies;
- injury to our or our collaborators' reputations and significant negative media attention;
- withdrawal of clinical trial participants;
- initiation of investigations by regulators;
- product recalls, withdrawals or labeling, marketing or promotional restrictions;
- significant costs to defend resulting litigation;
- substantial monetary awards to trial participants or patients;
- loss of revenue; and
- the inability to commercialize any products using our technologies.

We depend on sophisticated information technology and infrastructure.

We rely on various information systems to manage our operations. These systems are complex and include software that is internally developed, software licensed from third parties and hardware purchased from third parties. These products may contain internal errors or defects, particularly when first introduced or when new versions or enhancements are released. Failure of these systems could have an adverse effect on our business, which in turn may materially adversely affect our operating results and financial condition.

If we experience a significant breach of data security or disruption in our information systems, our business could be adversely affected.

We rely on various information systems to manage our operations and to store information, including sensitive data such as confidential business information and personally identifiable information. These systems could be vulnerable to interruption or malfunction, including due to events beyond our control, and to unauthorized access, computer hackers, ransomware, viruses and other security problems. Failure of these systems or any significant breach of our data security could have an adverse effect on our business and may materially adversely affect our operating results and financial condition.

Data security breaches could result in loss or misuse of information, which could, in turn, result in potential regulatory actions or litigation, including material claims for damages, compelled compliance with breach notification laws, interruption to our

operations, damage to our reputation or could otherwise have a material adverse effect on our business, financial condition and operating results. Companies throughout our industry have been increasingly subject to a wide variety of security incidents, cyber-attacks and other attempts to gain unauthorized access to networks or sensitive information. While we have implemented and continue to implement cybersecurity safeguards and procedures, we may be unable to implement adequate protective measures. As cyber threats continue to evolve, we may be required to expend additional resources to enhance our cybersecurity measures or to investigate or remediate any vulnerabilities or breaches.

Although we maintain insurance to protect ourselves in the event of a breach or disruption of our information systems, we cannot ensure that the coverage is adequate to compensate for any damages that may be incurred.

We may incur significant costs complying with environmental, health and safety laws and regulations, and failure to comply with these laws and regulations could expose us to significant liabilities.

We use hazardous chemicals and radioactive and biological materials in our business and are subject to a variety of federal, state, local and international laws and regulations governing, among other matters, the use, generation, manufacture, transportation, storage, handling, disposal of, and human exposure to these materials both in the United States and overseas, including regulation by governmental regulatory agencies, such as the Occupational Safety and Health Administration and the EPA. We have incurred, and will continue to incur, capital and operating expenditures and other costs in the ordinary course of our business in complying with these laws and regulations.

We have international operations and assets and may have additional international operations and assets in the future. Our international operations and assets may be subject to various economic, social and governmental risks.

Our international operations and any future international operations may expose us to risks that could negatively impact our future results. Our operations may not develop in the same way or at the same rate as might be expected in a country with an economy similar to the United States. The additional risks that we may be exposed to in these cases include, but are not limited to:

- tariffs and trade barriers;
- currency fluctuations, which could decrease our revenues or increase our costs in United States dollars;
- regulations related to customs and import/export matters;
- tax issues, such as tax law changes and variations in tax laws;
- limited access to qualified staff;
- inadequate infrastructure;
- cultural and language differences;
- inadequate banking systems;
- different and/or more stringent environmental laws and regulations;
- restrictions on the repatriation of profits or payment of dividends;
- crime, strikes, riots, civil disturbances, terrorist attacks or wars;
- nationalization or expropriation of property;
- law enforcement authorities and courts that are weak or inexperienced in commercial matters; and
- deterioration of political relations among countries.

The agricultural products of several of our operating subsidiaries are subject to disease outbreaks that can increase the cost of production and/or reduce production harvests, and the loss of existing organisms and germplasm would result in the loss of commercial technology.

Several of the products of our operating subsidiaries, including Trans Ova, Exemplar, AquaBounty and Okanagan, are subject to periodic outbreaks of a variety of diseases. Although these companies take measures to protect their stock, there can be no assurance that a disease will not damage or destroy existing organisms or germplasm. The economic impact of disease to our subsidiaries' production systems can be significant, as farmers must incur the cost of preventive measures, such as vaccines and antibiotics, and then if infected, the cost of lost or reduced harvests.

Our plans to pursue development and commercialization of adoptive cellular therapies based on CAR T-cell therapies, or CARs, are new approaches to cancer treatment that present significant challenges in a competitive landscape and the success of our efforts depends in large part on our owned and licensed intellectual property, and our efforts may be affected by litigation and developments in intellectual property law outside of our control.

Through our wholly owned subsidiary, Precigen, we intend to employ technologies licensed from the University of Texas MD Anderson Cancer Center, together with our existing suite of proprietary technologies, through our existing license with ZIOPHARM and internal programs, to pursue the development and commercialization of adoptive cellular therapies based on CARs under control of RheoSwitch technology targeting a variety of cancer malignancies. Because this is a newer approach to cancer immunotherapy and cancer treatment generally, developing and commercializing product candidates subjects us and our licensee to a number of challenges, including:

- obtaining regulatory approval from the FDA and other regulatory authorities that have very limited experience with the commercial development of genetically modified T-cell therapies for cancer;
- developing and deploying consistent and reliable processes for engineering a patient's T-cells *ex vivo* and infusing the engineered T-cells back into the patient;
- possibly conditioning patients with chemotherapy in conjunction with delivering each of the potential products, which may increase the risk of adverse side effects of the potential products;
- educating medical personnel regarding the potential side effect profile of each of the potential products, such as the potential adverse side effects related to cytokine release;
- developing processes for the safe administration of these potential products, including long-term follow-up for all patients who receive the potential products;
- sourcing additional clinical and, if approved, commercial supplies for the materials used to manufacture and process the potential products;
- developing a manufacturing process and distribution network with a cost of goods that allows for an attractive return on investment;
- establishing sales and marketing capabilities after obtaining any regulatory approval required to gain market access and acceptance;
- developing therapies for types of cancers beyond those addressed by the current potential products;
- not infringing the intellectual property rights, in particular, the patent rights, of third parties, including competitors developing alternative CAR T-cell therapies; and
- avoiding any applicable regulatory barriers to market, such as data and marketing exclusivities held by third parties, including competitors with approved CAR T-cell therapies.

We cannot be sure that T-cell immunotherapy technologies developed by Precigen or our licensee will yield satisfactory products that are safe and effective, scalable, or profitable.

Because our gene therapy technology is novel, it is difficult to predict the time and cost of development and of subsequently obtaining regulatory approval.

There can be no assurance that we, including our subsidiaries and our collaborators, will not experience problems or delays in developing new product candidates and that such problems or delays will not cause unanticipated costs, or that any such development problems can be solved. We also may experience unanticipated problems or delays in expanding our manufacturing capacity, which may prevent the completion of clinical trials and the commercializing of products on a timely or profitable basis, if at all. For example, we, a collaborator or another group may uncover a previously unknown risk with any of our product candidates, and this may prolong the period of observation required for obtaining regulatory approval or may necessitate additional clinical testing.

In addition, the clinical trial requirements of the FDA, European Medicines Agency, or EMA, and other regulatory authorities and the criteria these regulators use when evaluating product candidates vary substantially according to the type, complexity, novelty and intended use and market of such product candidates. The regulatory approval process for novel product candidates such as ours can be more expensive and take longer than for other, better known or more extensively studied product candidates. Even if we and our collaborators are successful in developing product candidates, it is difficult to determine how long it will take or how much it will cost to obtain regulatory approvals in either the United States or the European Union or how long it will take to commercialize these product candidates.

Regulatory requirements governing gene and cell therapy products have changed frequently and may continue to change in the future. For example, the FDA has established the Office of Cellular, Tissue and Gene Therapies within the Center for Biologics Evaluation and Research, or CBER, to consolidate the review of gene therapy and related products and has established the Cellular, Tissue and Gene Therapies Advisory Committee to advise CBER in its marketing application review process. Gene therapy clinical trials conducted at institutions that receive funding for recombinant DNA research from NIH also potentially are subject to review by the NIH office of Biotechnology Activities' Recombinant DNA Advisory Committee, or RAC; however, NIH has announced that the RAC will only publicly review clinical trials if the trials cannot be evaluated by standard oversight bodies and pose unusual risks. Although the FDA decides whether individual gene therapy protocols may proceed, the RAC public review process, if undertaken, can delay the initiation of a clinical trial, even if the FDA has reviewed the trial design and details and approved its initiation. Conversely, the FDA can put a clinical trial or an IND on clinical hold even if the RAC has provided a favorable review or an exemption from in-depth, public review. In addition, adverse developments in clinical trials of gene therapy products conducted by others may cause the FDA or other oversight bodies to change the requirements for approval of any of our product candidates and those of our collaborators. Navigating these various requirements and frameworks may require significant time and money, and compliance with these requirements does not guarantee regulatory approval of any marketing applications.

There is a high failure rate for drugs and biologics proceeding through clinical trials, at all stages of development.

Results from preclinical studies or previous clinical trials are not necessarily predictive of future clinical trial results, and interim results of a clinical trial are not necessarily indicative of final results. Our product candidates and those of our collaborators may fail to show the desired results in clinical development despite demonstrating positive results in preclinical studies or having successfully advanced through initial clinical trials.

There is a high failure rate for drugs and biologics proceeding through clinical trials and may occur at any stage due to a multitude of factors both within and outside our control. Many companies in the pharmaceutical and biotechnology industries have suffered significant setbacks in late-stage clinical trials even after achieving promising results in preclinical testing and earlier-stage clinical trials. Data obtained from preclinical and clinical activities are subject to varying interpretations, which may delay, limit or prevent regulatory approval. In addition, we and our collaborators may experience regulatory delays or rejections as a result of many factors, including changes in regulatory policy during the period of product candidate development. Any such delays could materially and adversely affect our business, financial condition, results of operations and prospects. If clinical trials result in negative or inconclusive results, we or our collaborators may decide, or regulators may require us, to discontinue trials of the products or conduct additional clinical trials or preclinical studies.

Our and our collaborators' product candidates may cause undesirable side effects or have other properties that could delay or prevent their regulatory approval, limit the commercial potential or result in significant negative consequences following any potential marketing approval.

There have been several significant adverse side effects in gene therapy treatments in the past, including reported cases of leukemia and death seen in other trials using other vectors. While new recombinant vectors and other approaches have been developed to reduce these side effects, gene therapy and synthetic biology therapy in general is still a relatively new approach

to disease treatment and additional adverse side effects could develop. There also is the potential risk of delayed adverse events following exposure to these products due to persistent biologic activity of the genetic material or other components of products used to carry the genetic material.

Other possible adverse side effects that could occur with treatment with synthetic biology products include an immunologic reaction early after administration that, while not necessarily adverse to the patient's health, could substantially limit the effectiveness of the treatment. In previous clinical trials involving adeno-associated virus, vectors for gene therapy, some subjects experienced the development of a T-cell response, whereby after the vector is within the target cell, the cellular immune response system triggers the removal of transduced cells by activated T-cells. If similar effect occurs with our or our collaborators' products, we or our collaborators may decide or be required to halt or delay further clinical development of our product candidates.

Additionally, if any of our or our collaborators' product candidates receives marketing approval, the FDA could require us to adopt a REMS to ensure that the benefits outweigh its risks, which may include, among other things, a medication guide outlining the risks of the product for distribution to patients and a communication plan to health care practitioners. Such requirements could prevent us from achieving or maintaining market acceptance of our product candidates and could significantly harm our business, prospects, financial condition and results of operations.

We and our collaborators may find it difficult to enroll patients in clinical trials, which could delay or prevent us and our collaborators from proceeding with clinical trials.

Identifying and qualifying patients to participate in clinical trials of our and our collaborators' product candidates is critical to success. The timing of clinical trials depends on the ability to recruit patients to participate as well as completion of required follow-up periods. If patients are unwilling to participate in our or our collaborators' clinical studies for any number of reasons, such as because of negative publicity from adverse events related to the biotechnology or gene therapy fields, the timeline for recruiting patients, conducting clinical trials and obtaining regulatory approval may be delayed. These delays could result in increased costs, delays in advancing product candidates, or termination of the clinical trials altogether.

Even if we and our collaborators complete the necessary clinical trials, we cannot predict when, or if, we and our collaborators will obtain regulatory approval to commercialize a product candidate and the approval may be for a more narrow indication than we or our collaborators seek.

We and our collaborators cannot commercialize a product candidate until the appropriate regulatory authorities have reviewed and approved the product candidate. Even where product candidates meet their endpoints in clinical trials, the regulatory authorities may not complete their review processes in a timely manner, or may not grant regulatory approval. Additional delays may result if an FDA Advisory Committee or other regulatory authority recommends non-approval or restrictions on approval. In addition, we and our collaborators may experience delays or rejections based upon additional government regulation from future legislation or administrative action, or changes in regulatory authority policy during the period of product development, clinical trials and the review process.

Regulatory authorities also may approve a product candidate for more limited indications than requested or they may impose significant limitations in the form of narrow indications, warnings or a REMS. These regulatory authorities may require precautions or contra-indications with respect to conditions of use or they may grant approval subject to the performance of costly post-marketing clinical trials. In addition, regulatory authorities may not approve the labeling claims that are necessary or desirable for the successful commercialization of our product candidates. Any of the foregoing scenarios could materially harm the commercial prospects for our product candidates and materially and adversely affect our business, financial condition, results of operations and prospects.

Even if we or our collaborators obtain regulatory approval for a product candidate, the product will remain subject to regulatory oversight.

Even if we and our collaborators obtain regulatory approval for our product candidates, these candidates will be subject to ongoing regulatory requirements for manufacturing, labeling, packaging, storage, advertising, promotion, sampling, record-keeping and submission of safety and other post-market information. Regulatory approvals also may be subject to a REMS, limitations on the approved indicated uses for which the product may be marketed or to the conditions of approval, or contain requirements for potentially costly post-marketing testing, including Phase 4 clinical trials, and surveillance to monitor the quality, safety and efficacy of the product. For example, the holder of an approved BLA is obligated to monitor and report adverse events and any failure of a product to meet the specifications in the BLA. The FDA guidance advises that patients treated with some types of gene therapy undergo follow-up observations for potential adverse events for as long as 15 years.

The holder of an approved BLA also must submit new or supplemental applications and obtain FDA approval for certain changes to the approved product, product labeling or manufacturing process. Advertising and promotional materials must comply with FDA rules and are subject to FDA review, in addition to other potentially applicable federal and state laws.

In addition, product manufacturers and their facilities are subject to continual review and periodic inspections by the FDA and other regulatory authorities for compliance with cGMP requirements and adherence to commitments made in the United States or foreign marketing application. If we, our collaborators, or a regulatory authority discover previously unknown problems with a product, such as adverse events of unanticipated severity or frequency, or problems with the facility where the product is manufactured or disagrees with the promotion, marketing or labeling of that product, a regulatory authority may impose restrictions relative to that product, the manufacturing facility or us, including requiring recall or withdrawal of the product from the market or cessation of manufacturing.

If we fail to comply with applicable regulatory requirements following approval of any of our product candidates, a regulatory authority may take adverse actions, which include, among other things, a range of sanctions from issuing a warning letter to causing us to withdraw the product from the market.

In addition, the FDA's policies, and those of equivalent foreign regulatory agencies, may change and additional government regulations may be enacted that could prevent, limit or delay regulatory approval of our product candidates. We cannot predict the likelihood, nature or extent of government regulation that may arise from future legislation or administrative action, either in the United States or abroad. If we are slow or unable to adapt to changes in existing requirements or the adoption of new requirements or policies, or if we are not able to maintain regulatory compliance, we may lose any marketing approval that we may have obtained and we may not achieve or sustain profitability, which would materially and adversely affect our business, financial condition, results of operations and prospects.

Our reliance on third parties, such as contract manufacturing organizations and contract or clinical research organizations, may result in delays in completing, or a failure to complete, non-clinical testing or clinical trials if they fail to perform under our agreements with them. Such failures could adversely affect our financial results and our commercial prospects.

In the course of product development, we may engage contract or clinical manufacturing organizations to supply us with our product candidates or products to be used in non-clinical and clinical testing and contract research organizations to conduct and manage non-clinical and clinical studies. We are responsible for ensuring that each of our clinical trials is conducted in accordance with the general investigational plan and protocols for the trial. Moreover, the FDA requires us to comply with GCPs for conducting, recording, and reporting the results of clinical trials to assure that data and reported results are credible and accurate and that the rights, integrity and confidentiality of trial participants are protected. Our reliance on third parties that we do not control does not relieve us of these responsibilities and requirements. If these third parties do not successfully carry out their contractual duties or regulatory obligations or meet expected deadlines, if the quality or accuracy of the data they obtain is compromised due to the failure to adhere to our clinical protocols or regulatory requirements or for other reasons, our clinical trials may be extended, delayed, suspended or terminated, and we may not be able to obtain regulatory approval for our product candidates.

In addition, if our third-party contract manufacturers and suppliers do not supply us with our product candidates or products in a timely fashion and in compliance with applicable quality and regulatory requirements, including cGMPs, or otherwise fail or refuse to comply with their obligations to us under our supply and manufacturing arrangements, we may not have adequate remedies for any breach, and their failure to supply us could impair or preclude our ability to meet our supply needs for non-clinical and clinical studies, including those being conducted in collaboration with our partners. Such failures could delay our product development efforts, and our business, operating results and financial condition could be adversely affected.

RISKS RELATED TO MANUFACTURING HUMAN THERAPEUTICS

Synthetic biology therapies are novel, complex and difficult to manufacture. We or our collaborators could experience production problems that result in delays in product development or commercialization programs or otherwise adversely affect our business.

The manufacturing processes that we and our collaborators use to produce synthetic biology product candidates for human therapeutics are complex, novel and have not been validated for commercial use. Several factors could cause production interruptions, including equipment malfunctions, facility contamination, raw material shortages or contamination, natural disasters, disruption in utility services, human error, or disruptions in the operations of our suppliers.

Our and our collaborators' synthetic biology product candidates require processing steps that are more complex than those required for most chemical pharmaceuticals. Moreover, unlike chemical pharmaceuticals, the physical and chemical properties of a biologic often cannot be fully characterized. As a result, assays of the finished product may not be sufficient to ensure that the product will perform in the intended manner. Accordingly, it is necessary to employ multiple steps to control our manufacturing process to assure that the product candidate is made strictly and consistently in compliance with the process. Problems with the manufacturing process, even minor deviations from the normal process, could result in product defects or manufacturing failures that result in lot failures, product recalls, product liability claims or insufficient inventory. We or our collaborators may encounter problems achieving adequate quantities and quality of clinical-grade materials that meet FDA, EMA or other applicable standards or specifications with consistent and acceptable production yields and costs.

Any problems in our manufacturing process or facilities could make us a less attractive collaborator for potential partners, which could limit our access to additional attractive development programs.

Delays in obtaining regulatory approval of manufacturing processes and facilities or disruptions in manufacturing processes may delay or disrupt our commercialization efforts.

Before we or our collaborators can begin to commercially manufacture our product candidates for human therapeutics, we must obtain regulatory approval from the FDA for the applicable manufacturing process and facility. This likely will require the manufacturing facility to pass a pre-approval inspection by the FDA. A manufacturing authorization must also be obtained from the appropriate European Union regulatory authorities.

In order to obtain FDA approval, we will need to ensure that all of the processes, methods and equipment are compliant with cGMP and perform extensive audits of vendors, contract laboratories and suppliers. If any of our vendors, contract laboratories or suppliers is found to be out of compliance with cGMP, we may experience delays or disruptions in manufacturing while we work with these third parties to remedy the violation(s) or while we work to identify suitable replacement vendors. The cGMP requirements govern, among other things, quality control of the manufacturing process, raw materials, containers/closures, buildings and facilities, equipment, storage and shipment, labeling, laboratory activities, data integrity, documentation policies and procedures, and returns. In complying with cGMP, we will be obligated to expend time, money and effort in production, record keeping and quality control to assure that the product meets applicable specifications and other requirements. If we fail to comply with these requirements, we would be subject to possible regulatory action that could adversely affect our business, results of operations, financial condition and cash flows, including the inability to sell any products that we may develop.

Ethical, legal and social issues related to genetic testing may reduce demand for our product candidates, if approved.

We anticipate that prior to receiving certain cellular, gene, or other synthetic biology therapies, patients may be required to undergo genetic testing. Genetic testing has raised concerns regarding the appropriate utilization and the confidentiality of information provided by genetic testing. Genetic tests for assessing a person's likelihood of developing a chronic disease have focused public attention on the need to protect the privacy of genetic information. For example, concerns have been expressed that insurance carriers and employers may use these tests to discriminate on the basis of genetic information, resulting in barriers to the acceptance of genetic tests by consumers. This could lead to governmental authorities prohibiting genetic testing or calling for limits on or regulating the use of genetic testing, particularly for diseases for which there is no known cure. Any of these scenarios could decrease demand for our product candidates, if approved.

The commercial success of any of our and our collaborators' product candidates will depend upon the degree of market acceptance by physicians, patients, third-party payors and others in the medical community.

Ethical, social and legal concerns about cellular, gene or other synthetic biology therapies could result in additional regulations restricting or prohibiting our products. Even with the requisite approvals from the FDA in the United States, the EMA in the European Union, and other regulatory authorities internationally, the commercial success of product candidates will depend, in part, on the acceptance of physicians, patients and health care payors of synthetic biology therapy products in general, and our and our collaborators' product candidates in particular, as medically necessary, cost-effective and safe. Any product that we or our collaborators commercialize may not gain acceptance by physicians, patients, health care payors and others in the medical community. If these products do not achieve an adequate level of acceptance, we may or our collaborators may not generate significant product revenue to make the products profitable.

RISKS ASSOCIATED WITH OUR BUSINESS STRATEGY

The evolution of our business strategy may not be a successful strategy and may increase our capital requirements, increase our costs or otherwise harm our operating results and financial condition.

Our business strategy has evolved, and continues to evolve, toward relationships and structures that provide us with more control and ownership over the development process and commercialization path. This approach entails risks in implementation and operations and there is no guarantee that it will be successful. Furthermore, the changing focus of our business strategy may require additional capital beyond what we have historically used and what is available, and we may incur costs associated with the implementation and execution of our changing business strategy. In addition, as we perform our annual impairment tests, we will evaluate the impact of changes in our business strategy and, as a result, may incur impairment charges and write-offs and other related expenses, any of which, if material, could harm our operating results and financial condition.

If we fail to maintain and successfully manage our existing ECCs or JVs, we may not be able to develop and commercialize our technologies and achieve or sustain profitability.

We have entered into ECCs or JVs with strategic collaborators to develop products enabled by our technologies. There can be no guarantee that we can successfully manage these ECCs or JVs. We must use diligent efforts to carry out development activities under the ECCs. The exclusivity provisions of each ECC restrict our ability to commercialize our technologies in the designated field covered by the ECC. In most cases, the collaborator may terminate the ECC with us for any reason upon 90 days' notice. In all cases, the ECC may be terminated if we fail to exercise diligent efforts or breach, and fail to cure, other provisions of the ECC. In addition, since our efforts to date have focused on a small number of collaborators in certain targeted sectors, our business could be adversely affected if one or more of these collaborators terminate their ECCs or JVs, fail to use our technologies or fail to develop commercially viable products enabled by our technologies.

To the extent they continue to be part of our business, maintenance of ECCs and JVs also will subject us to other risks, including:

- we have relinquished important rights regarding the commercialization, marketing and distribution of products and we may disagree with our collaborators' plans in these areas;
- although we retain broad rights with respect to intellectual property developed under the ECCs, our collaborators have the right, under certain circumstances, to take control of the enforcement of such intellectual property;
- we may have lower revenues than if we were to develop, manufacture, market and distribute products enabled by our technologies ourselves;
- a collaborator could, without the use of our synthetic biology technologies, develop and market a competing product either independently or in collaboration with others, including our competitors;
- our collaborators could be undercapitalized or fail to secure sufficient resources to fund the development and/or commercialization of the products enabled by our technologies in accordance with the ECC;
- our collaborators could become unable or less willing to expend their resources on research and development or commercialization efforts with respect to our technologies due to general market conditions, their financial condition or other circumstances beyond our control;
- we may be unable to manage multiple simultaneous ECCs or JVs or fulfill our obligations with respect thereto;
- disagreements with a collaborator could develop and any conflict with a collaborator could reduce our ability to enter into future ECCs or JVs and negatively impact our relationships with one or more existing collaborators;
- our collaborators could terminate our ECC or JV with them, in which case, our collaborators may retain rights related to certain products, we may not be able to find another collaborator to develop different products in the field and we may not be able to develop different products in the field ourselves;
- our business could be negatively impacted if any of our collaborators undergo a change of control to a third party who is not willing to work with us on the same terms or commit the same resources as our current collaborator; and

- our collaborators may operate in countries where their operations could be adversely affected by changes in the local regulatory environment or by political unrest.

If any of these events occur, or if we fail to maintain our ECCs or JVs with our collaborators, we may not be able to commercialize our existing and potential technologies, grow our business or generate sufficient revenues to support our operations.

Certain of our collaborators, including some businesses over which we have significant influence, will need additional capital.

In order for certain of our collaborators to execute on their business plans, they will have future capital requirements. We may be asked to, or need to, invest additional funds in these collaborators so that they can execute on their business plans. If we fail to invest such additional funds, the collaborator may not have sufficient capital to continue operations.

We rely on our collaborators to develop, commercialize and market certain products, and they may not be successful.

We depend on our collaborators to commercialize certain products enabled by our technologies. If our collaborators are not able to successfully develop the products enabled by our technologies, none of these enabled products will become commercially available and we will receive no back-end payments under our ECCs or JVs. Because we do not currently and may never possess the resources necessary to independently develop and commercialize all of the potential products that may result from our technologies, our ability to succeed in certain markets depends on our ability to develop and commercialize potential products through an ECC or JV. Some of our existing collaborators do not themselves have the resources necessary to commercialize products, and they in turn will need to rely on additional sources of financing or third-party collaborations. In addition, pursuant to our current ECCs or JVs and similar ECCs or JVs that we may enter into in the future, we have limited or no control over the amount or timing of resources that any collaborator is able or willing to devote to developing products or collaborative efforts. Any of our collaborators may fail to perform its obligations under the ECC. Our collaborators may breach or terminate their ECCs or JVs with us or otherwise fail to conduct their collaborative activities successfully and in a timely manner. If any of these events were to occur, our revenues, financial condition and results of operations could be adversely affected.

The sales process for strategic transactions or JVs may be lengthy and unpredictable, and we may expend substantial funds and management effort with no assurance of successfully entering into such transactions to commercialize our technologies.

Historically, the sales process for our ECCs and JVs has at times been lengthy and unpredictable. Our evolving focus on consummating strategic transactions and JVs may be equally or more challenging to consummate. Our sales and licensing efforts may require the effective demonstration of the benefits, value, differentiation, validation of our products, technologies and services and significant education and training of multiple personnel and departments within the potential collaborator's organization. We may expend substantial funds and management effort with no assurance that we will execute a transaction or otherwise sell our products, technologies or services. In addition, this lengthy sales cycle makes it more difficult for us to accurately forecast revenue in future periods and may cause revenues and operating results to vary significantly in such periods.

Many of our JVs, subsidiaries, and collaborators have no experience producing products at the commercial scale needed for the development of their business, and they will not succeed if they cannot effectively commercialize their products.

To develop products with our technologies, we or our JVs, subsidiaries, and collaborators must demonstrate the ability to utilize our technologies to produce desired products at the commercial scale and on an economically viable basis or they must collaborate with others to do so. The products and processes developed using our technologies may not perform as expected when applied at commercial scale, or we or our collaborators may encounter operational challenges for which we and they are unable to devise a workable solution. For example, contamination in the production process could decrease process efficiency, create delays and increase our collaborators' costs. Moreover, under the terms of our ECCs or JVs, we limit the ability of our collaborators to partner their programs with third parties. We and our collaborators may not be able to scale up our production in a timely manner, if at all, even if our collaborators successfully complete product development in their laboratories and pilot and demonstration facilities. If this occurs, the ability to commercialize products and processes using our technologies will be adversely affected, and, with respect to any products that are brought to market, our JVs, subsidiaries, or collaborators may not be able to lower the cost of production, which would adversely affect our ability to increase the future profitability of our business.

Markets in which we, our JVs, and collaborators are developing products using our technologies are subject to extensive regulation, and we rely on our JVs and collaborators to comply with all applicable laws and regulations.

Our technologies are used in products that are subject to extensive regulation by governmental authorities. We depend on our JVs and collaborators to comply with these laws and regulations with respect to products they produce using our technologies, and we do not independently monitor whether our collaborators comply with applicable laws and regulations. If either we, our JVs or our collaborators fail to comply with applicable laws and regulations, we are subject to substantial financial and operating risks because, in addition to our own compliance, we also depend on our JVs and collaborators to produce the end products enabled by our technologies for sale and because, in many cases, we have, or in the future may have, a substantial equity interest in our JVs and collaborators. These regulatory risks are extensive and include the following:

- complying with these regulations, including seeking approvals, the uncertainty of the scope of future regulations, and the costs of continuing compliance with regulations, could affect our sales and profitability and that of our JVs and collaborators and materially impact our operating results;
- our business could be adversely affected if our processes and those used by our JVs and collaborators to manufacture their final products fail to be approved by the applicable regulatory authorities;
- where products are subject to regulatory approval, the regulatory approval process can be lengthy, costly, time consuming and inherently unpredictable, and if we and our JVs and collaborators are ultimately unable to obtain regulatory approval for products using our technologies, our business will be substantially harmed;
- even if we and our JVs and collaborators are able to commercialize products using our technologies, the product may become subject to post-approval regulatory requirements, unfavorable pricing regulations, third-party payor reimbursement practices or regulatory reform initiatives that could harm our business;
- we and our JVs and collaborators conduct on-going research and development that relies on evaluations in animals, which may become subject to bans or additional regulations;
- compliance with existing or future environmental laws and regulations could have a material adverse impact on the development and commercialization of products using our technologies; and
- to the extent products produced using our technologies are commercialized outside the United States, they will be subject to additional laws and regulations under the jurisdictions in which such products are commercialized.

The markets in which we and our collaborators are developing products using our technologies are highly competitive.

The markets in which we and our collaborators are developing products are, and will continue to be, highly competitive, and there can be no assurance that we or our collaborators will be able to compete effectively. There are numerous companies presently in these markets that are developing products that may compete with, and could adversely affect the prices for, any products developed by our collaborators using our technologies. Many of these competitors and potential competitors are well-established companies with significant resources and experience, along with well-developed distribution systems and networks for their products, valuable historical relationships with potential customers and extensive sales and marketing programs for their products. Some of these competitors may use these resources and their market influence to impede the development and/or acceptance of the products developed by our collaborators using our technologies.

To the extent that any of our collaborators' competitors are more successful with respect to any key competitive factor or our collaborators are forced to reduce, or are unable to raise, the price of any products enabled by our technologies in order to remain competitive, our operating results and financial condition could be materially adversely affected. Competitive pressure could arise from, among other things, safety and efficacy concerns, limited demand or a significant number of additional competitive products being introduced into a particular market, price reductions by competitors, the ability of competitors to capitalize on their economies of scale, the ability of competitors to produce or otherwise procure products similar or equivalent to those of our collaborators at lower costs and the ability of competitors to access more or newer technology than our collaborators can access (including our own).

Our right to terminate our ECCs is limited.

Generally, we do not have the right to terminate an ECC except in limited circumstances such as the collaborator's failure to exercise diligent efforts in performing its obligations under the ECC, including its development of products enabled by our

technologies, or its breach of a term of the ECC that remains uncured for a specified period of time. Moreover, each of our collaborators receives an exclusive license to use all of our technologies in a designated field, potentially in perpetuity. The collaborators we choose in particular fields may not be in the best position to maximize the value of our technologies in that field, if they are capable of commercializing any products at all. In addition, the scope of the field for a particular ECC may prove to be too broad and result in the failure to maximize the value of our technologies in that field.

A significant portion of our business is conducted by JVs that we cannot operate solely for our benefit.

In JVs, we share ownership and management of a company with one or more parties who may not have the same goals, strategies, priorities or resources as we do and may compete with us outside the JV. JVs are intended to be operated for the benefit of all JV partners, rather than for our exclusive benefit. Operating a business as a JV often requires additional organizational formalities as well as time-consuming procedures for sharing information and making decisions. In JVs we are required to foster our relationships with our JV partners as well as promote the overall success of the JV, and if a JV partner changes or relationships deteriorate, our success in the JV may be materially adversely affected. The benefits from a successful JV are shared among the JV partners, so we do not receive all the benefits from our successful JVs. Moreover, as a partial owner of a JV, we are exposed to potential risks and liabilities that we do not face when we enter into an ECC.

RISKS RELATED TO OUR INTELLECTUAL PROPERTY

Our ability to compete may decline if we do not adequately protect our proprietary technologies or if we lose some of our intellectual property rights through costly litigation or administrative proceedings.

Our success depends in part on our ability to obtain patents and maintain adequate protection of our intellectual property in the United States and abroad for our suite of technologies and resultant products and potential products. We have adopted a strategy of seeking patent protection in the United States and abroad with respect to certain of the technologies used in or relating to our products and processes. We have also in-licensed rights to additional patents and pending patent applications in the United States and abroad. We intend to continue to apply for patents relating to our technologies, methods and products as we deem appropriate.

We have strategic positioning with respect to our key technologies including patent portfolios directed to: our switch technology covering aspects of our gene switches, such as our RheoSwitch Therapeutic System, and gene modulation systems, vectors, cells and organisms containing these switches, and their use; our activator ligand technology covering aspects of our activator ligands and their use; and our cell identification and selection technology covering aspects of our cell identification and selection platform, including our cell purification, isolation, characterization and manipulation technologies. We have also filed counterpart patents and patent applications in other jurisdictions, including Australia, Argentina, Brazil, Canada, China, Europe, Hong Kong, India, Indonesia, Israel, Japan, Korea, Mexico, New Zealand, Philippines, Russia, Singapore, South Africa and Taiwan. In the future, we may file in these or additional jurisdictions as deemed appropriate for the protection of our technologies.

The enforceability of patents, as well as the actual patent term and expiration thereof, involves complex legal and factual questions and, therefore, the extent of enforceability cannot be guaranteed. Issued patents and patents issuing from pending applications may be challenged, invalidated or circumvented. Moreover, the United States Leahy-Smith America Invents Act, enacted in September 2011, brought significant changes to the United States patent system, which include a change to a "first to file" system from a "first to invent" system and changes to the procedures for challenging issued patents and disputing patent applications during the examination process, among other things. These changes could increase the costs and uncertainties surrounding the prosecution of our patent applications and the enforcement or defense of our patent rights. Additional uncertainty may result from legal precedent handed down by the United States Court of Appeals for the Federal Circuit and United States Supreme Court as they determine legal issues concerning the scope and construction of patent claims and inconsistent interpretation of patent laws by the lower courts. Accordingly, we cannot ensure that any of our pending patent applications will result in issued patents, or even if issued, predict the breadth of the claims upheld in our and other companies' patents. Given that the degree of future protection for our proprietary rights is uncertain, we cannot ensure that we were the first to invent the inventions covered by our pending patent applications; we were the first to file patent applications for these inventions; the patents we have obtained, particularly certain patents claiming nucleic acids, proteins, or methods, are valid and enforceable; and the proprietary technologies we develop will be patentable.

In addition, unauthorized parties may attempt to copy or otherwise obtain and use our products or technology. Monitoring unauthorized use of our intellectual property is difficult, and we cannot be certain that the steps we have taken will prevent unauthorized use of our technologies, particularly in certain foreign countries where the local laws may not protect our proprietary rights as fully as in the United States. Moreover, third parties could practice our inventions in territories where we

do not have patent protection. Such third parties may then try to import into the United States or other territories products, or information leading to potentially competing products, made using our inventions in countries where we do not have patent protection for those inventions. If competitors are able to use our technologies, our ability to compete effectively could be harmed. Moreover, others may independently develop and obtain patents for technologies that are similar to or superior to our technologies. If that happens, we may need to license these technologies, and we may not be able to obtain licenses on reasonable terms, if at all, which could harm our business.

We also rely on trade secrets to protect our technologies, especially in cases when we believe patent protection is not appropriate or obtainable. However, trade secrets are difficult to protect. While we require our employees, academic collaborators, collaborators, consultants and other contractors to enter into confidentiality agreements, we may not be able to adequately protect our trade secrets or other proprietary or licensed information. If we cannot maintain the confidentiality of our proprietary and licensed technologies and other confidential information, our ability and that of our licensor to receive patent protection and our ability to protect valuable information owned or licensed by us may be imperiled. Enforcing a claim that a third-party entity illegally obtained and is using any of our trade secrets is expensive and time consuming, and the outcome is unpredictable. Moreover, our competitors may independently develop equivalent knowledge, methods and know-how.

Litigation or other proceedings or third-party claims of intellectual property infringement could require us to spend significant time and money and could prevent us from commercializing our technologies or impact our stock price.

Our commercial success also depends in part on not infringing patents and proprietary rights of third parties and not breaching any licenses or other agreements that we have entered into with regard to our technologies, products and business. We cannot ensure that patents have not been issued to third parties that could block our or our collaborators' ability to obtain patents or to operate as we would like. There may be patents in some countries that, if valid, may block our ability to make, use or sell our products in those countries, or import our products into those countries, if we are unsuccessful in circumventing or acquiring the rights to these patents. There also may be claims in patent applications filed in some countries that, if granted and valid, also may block our ability to commercialize products or processes in these countries if we are unable to circumvent or license them.

The biotechnology industry is characterized by frequent and extensive litigation regarding patents and other intellectual property rights. Many companies have employed intellectual property litigation as a way to gain a competitive advantage. Our involvement in litigation, interferences, opposition proceedings or other intellectual property proceedings inside and outside of the United States, to defend our intellectual property rights or as a result of alleged infringement of the rights of others, may divert management's time from focusing on business operations and could cause us to spend significant amounts of money. Some of our competitors may have significantly greater resources and, therefore, they are likely to be better able to sustain the cost of complex patent or intellectual property litigation than we could. The uncertainties associated with litigation could have a material adverse effect on our ability to raise the funds necessary to continue our business or to enter into additional collaborations with others. Furthermore, any potential intellectual property litigation also could force us or our collaborators to do one or more of the following:

- stop selling, incorporating or using products that use the intellectual property at issue;
- obtain from the third party asserting its intellectual property rights a license to sell or use the relevant technology, which license may not be available on reasonable terms, if at all; or
- redesign those products or processes that use any allegedly infringing technology, or relocate the operations relating to the allegedly infringing technology to another jurisdiction, which may result in significant cost or delay to us, or that could be technically infeasible.

The patent landscape in the field of synthetic biology is particularly complex. We are aware of United States and foreign patents and pending patent applications of third parties that cover various aspects of synthetic biology including patents that some may view as covering aspects of our technologies. In addition, there may be patents and patent applications in the field of which we are not aware. In many cases, the technologies we develop are early-stage technologies, and we and our collaborators are just beginning the process of designing and developing products using these technologies. Although we will seek to avoid pursuing the development of products that may infringe any patent claims that we believe to be valid and enforceable, we and our collaborators may fail to do so. Moreover, given the breadth and number of claims in patents and pending patent applications in the field of synthetic biology and the complexities and uncertainties associated with them, third parties may allege that we or our collaborators are infringing upon patent claims even if we do not believe such claims to be valid and enforceable.

Except for claims we believe will not be material to our financial results, no third party has asserted a claim of infringement against us. Others may hold proprietary rights that could prevent products using our technologies from being marketed. Any patent-related legal action against persons who license our technologies, our collaborators or us claiming damages and seeking to enjoin commercial activities relating to products using our technologies or our processes could subject us to potential liability for damages and require our licensor or us to obtain a license to continue to manufacture or market such products or any future product candidates that use our technologies. We cannot predict whether we or our licensor would prevail in any such actions or that any license required under any of these patents would be made available on commercially acceptable terms, if at all. In addition, we cannot be sure that any such products or any future product candidates or processes could be redesigned to avoid infringement, if necessary. Accordingly, an adverse determination in a judicial or administrative proceeding, or the failure to obtain necessary licenses, could prevent our collaborators from developing and commercializing products using our technologies, which could harm our business, financial condition and operating results.

If any of our competitors have filed patent applications or obtained patents that claim inventions also claimed by us, we may have to participate in interference proceedings declared by the USPTO to determine priority of invention and, thus, the right to the patents for these inventions in the United States. These proceedings could result in substantial cost to us even if the outcome is favorable. Even if successful, an interference may result in loss of certain of our important claims.

Any litigation or proceedings could divert our management's time and efforts. Even unsuccessful claims could result in significant legal fees and other expenses, diversion of management's time, and disruption in our business. Uncertainties resulting from initiation and continuation of any patent or related litigation could harm our ability to compete.

Obtaining and maintaining our patent protection depends on compliance with various procedural, document submission, fee payment and other requirements imposed by governmental patent agencies, and our patent protection could be reduced or eliminated for non-compliance with these requirements.

The USPTO and various foreign governmental patent agencies require compliance with a number of procedural, documentary, fee payment and other provisions during the patent process. Given the size of our intellectual property portfolio, compliance with these provisions involves significant time and expense. There are situations in which noncompliance can result in abandonment or lapse of a patent or patent application, resulting in partial or complete loss of patent rights in the relevant jurisdiction. In such an event, competitors might be able to enter the market earlier than would otherwise have been the case.

If we do not obtain additional protection under the Hatch-Waxman Amendments, other United States legislation, and similar foreign legislation by extending the patent terms and obtaining regulatory exclusivity for our technologies, our business may be materially harmed.

Depending upon the timing, duration and specifics of FDA marketing approval of products using our technologies, one or more of the United States patents we own or license may be eligible for limited patent term restoration under the Hatch-Waxman Amendments. The Hatch-Waxman Amendments permit a patent restoration term of up to five years as compensation for patent term lost during product development and the FDA regulatory review process. However, we may not be granted an extension because of, for example, failing to apply within applicable deadlines, failing to apply prior to expiration of relevant patents or otherwise failing to satisfy applicable requirements. Moreover, the applicable time period or the scope of patent protection afforded could be less than we request. If we are unable to obtain patent term extension or restoration or the term of any such extension is less than we request, our competitors may obtain approval of competing products following our patent expiration, and our ability to generate revenues could be materially adversely affected.

Some of our products may not have patent protection and, as a result, potential competitors face fewer barriers in introducing competing products. We and our collaborators may rely on trade secrets and other unpatented proprietary information to protect our commercial position with respect to such products, which we may be unable to do. In some instances, we and our collaborators may also rely on regulatory exclusivity, including orphan drug exclusivity, to protect our products from competition. Some of our or our collaborators' products may be subject to the BPCIA, which may provide those products exclusivity that prevents approval of a biosimilar product that references the data in one of our BLAs in the United States for 12 years after approval. However, the BPCIA and other regulatory exclusivity frameworks may evolve over time based on statutory changes, FDA issuance of new regulations, and judicial decisions. In addition, the BPCIA exclusivity period does not prevent another company from independently developing a product that is highly similar to an approved product, generating all the data necessary for a full BLA and seeking approval. BPCIA exclusivity only assures that another company cannot rely on the innovator company's data and the FDA's prior approvals to support the biosimilar product's approval. As a result, it is possible that a potential competing drug product might obtain FDA approval before applicable exclusivity periods have expired.

Enforcing our intellectual property rights may be difficult and unpredictable.

If we were to initiate legal proceedings against a third party to enforce a patent claiming one of our technologies, the defendant could counterclaim that our patent is invalid and/or unenforceable or assert that the patent does not cover its manufacturing processes, manufacturing components or products. Proving patent infringement may be difficult, especially where it is possible to manufacture a product by multiple processes. Furthermore, in patent litigation in the United States, defendant counterclaims alleging both invalidity and unenforceability are commonplace. Although we believe that we have conducted our patent prosecution in accordance with the duty of candor and in good faith, the outcome following legal assertions of invalidity and unenforceability during patent litigation is unpredictable. With respect to the validity of our patent rights, we cannot be certain, for example, that there is no invalidating prior art, of which we and the patent examiner were unaware during prosecution. If a defendant were to prevail on a legal assertion of invalidity and/or unenforceability, we would not be able to exclude others from practicing the inventions claimed therein. Such a loss of patent protection could have a material adverse impact on our business. Even if our patent rights are found to be valid and enforceable, patent claims that survive litigation may not cover commercially valuable products or prevent competitors from importing or marketing products similar to our own, or using manufacturing processes or manufacturing components similar to those used to produce the products using our technologies.

Although we believe we have obtained assignments of patent rights from all inventors, if an inventor did not adequately assign their patent rights to us, a third party could obtain a license to the patent from such inventor. This could preclude us from enforcing the patent against such third party.

We may not be able to enforce our intellectual property rights throughout the world.

The laws of some foreign countries do not protect intellectual property rights to the same extent as the laws of the United States. Many companies have encountered significant problems in protecting and defending intellectual property rights in certain foreign jurisdictions. The legal systems of certain countries, particularly certain developing countries, do not favor the enforcement of patents and other intellectual property protection, particularly those relating to synthetic biology. This could make it difficult for us to stop the infringement of our patents or misappropriation of our other intellectual property rights. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial costs and divert our efforts and attention from other aspects of our business. Accordingly, our efforts to protect our intellectual property rights in such countries may be inadequate.

If our technologies or products using our technologies are stolen, misappropriated or reverse engineered, others could use the technologies to produce competing technologies or products.

Third parties, including our collaborators, contract manufacturers, contractors and others involved in our business, often have access to our technologies. If our technologies, or products using our technologies, were stolen, misappropriated or reverse engineered, they could be used by other parties that may be able to reproduce our technologies or products using our technologies, for their own commercial gain. If this were to occur, it would be difficult for us to challenge this type of use, especially in countries with limited intellectual property protection.

Confidentiality agreements with employees and others may not adequately prevent disclosures of trade secrets and other proprietary information.

We have taken measures to protect our trade secrets and proprietary information, but these measures may not be effective. We require our new employees and consultants to execute confidentiality agreements upon the commencement of an employment or consulting arrangement with us. These agreements generally require that all confidential information developed by the individual or made known to the individual by us during the course of the individual's relationship with us be kept confidential and not disclosed to third parties. These agreements also generally provide that inventions conceived by the individual in the course of rendering services to us shall be our exclusive property. Nevertheless, our proprietary information may be disclosed, third parties could reverse engineer our technologies or products using our technologies, and others may independently develop substantially equivalent proprietary information and techniques or otherwise gain access to our trade secrets. Costly and time-consuming litigation could be necessary to enforce and determine the scope of our proprietary rights, and failure to obtain or maintain trade secret protection could adversely affect our competitive business position.

RISKS RELATED TO OUR COMMON STOCK

We do not anticipate paying cash dividends, and accordingly, shareholders should rely on stock appreciation for return on their investment.

We have never declared or paid cash dividends on our capital stock. We do not anticipate paying cash dividends in the future and intend to retain all of our future earnings, if any, to finance the operations, development and growth of our business. As a result, appreciation of the price of our common stock, which may never occur, will provide a return to shareholders. Investors seeking cash dividends should not invest in our common stock. We have on two occasions distributed equity securities to our shareholders as a special stock dividend: 17,830,305 shares of ZIOPHARM common stock were distributed in June 2015 and 1,776,557 shares of AquaBounty common stock were distributed in January 2017. However, it is possible that we may never declare a special dividend again, and shareholders should not rely upon potential future special dividends as a source of return on their investment.

Our stock price is volatile and purchasers of our common stock could incur substantial losses.

Our stock price has been, and is likely to continue to be, volatile. The market price of our common stock could fluctuate significantly for many reasons, including in response to the risks described in this "Risk Factors" section, or for reasons unrelated to our operations, such as reports by media or industry analysts, investor perceptions or negative announcements by our collaborators regarding their own performance, as well as industry conditions and general financial, economic and political instability. From January 1, 2017 through February 15, 2019, our common stock has traded as high as $26.99 per share and as low as $6.21 per share. The stock market in general, as well as the market for biopharmaceutical companies in particular, has experienced extreme volatility that has often been unrelated to the operating performance of particular companies. The market price of our common stock may be influenced by many factors, including, among others:

- announcements of acquisitions, collaborations, financings or other transactions by us;
- public concern as to the safety of our products;
- termination or delay of a development program;
- the recruitment or departure of key personnel; and
- the other factors described in this "Risk Factors" section.

If securities or industry analysts do not publish research or reports, or publish inaccurate or unfavorable research or reports about our business, our share price and trading volume could decline.

The trading market for our shares of common stock depends, in part, on the research and reports that securities or industry analysts publish about us or our business. We do not have any control over these analysts. If securities or industry analysts do not continue to cover us, the trading price for our shares of common stock may be negatively impacted. If one or more of the analysts who covers us downgrades our shares of common stock, changes their opinion of our shares or publishes inaccurate or unfavorable research about our business, our share price would likely decline. If one or more of these analysts ceases coverage of us or fails to publish reports on us regularly, demand for our shares of common stock could decrease and we could lose visibility in the financial markets, which could cause our share price and trading volume to decline.

The issuance of our common stock pursuant to a share lending agreement, including sales of the shares that we lend, and other market activity related to the share lending agreement may lower the market price of our common stock.

In connection with our offering of the Convertible Notes in July 2018, we entered into a share lending agreement with J.P. Morgan Securities LLC (that we refer to when acting in this capacity as the "share borrower"), the underwriter for our offering, pursuant to which we agreed to lend up to 7,479,431 shares of our common stock to the share borrower.

We were informed by the share borrower that it or one of its affiliates intended to use the short position created by the share loan and the concurrent short sales of the borrowed shares to facilitate transactions by which investors in the Convertible Notes, or the Convertible Notes Investors, hedge their investments through short sales or privately negotiated derivatives transactions.

The existence of the share lending agreement in connection with the offering of the borrowed shares, the short sales of our common stock effected in connection with the sale of the Convertible Notes and the related derivatives transactions, or any unwind of such short sales or derivatives transactions, could cause the market price of our common stock to be lower over the term of the share

lending agreement than it would have been had we not entered into that agreement, due to the effect of the increase in the number of outstanding shares of our common stock or otherwise. For example, in connection with any cash settlement of any such derivative transaction, the share borrower or its affiliates may purchase shares of our common stock and the Convertible Notes Investors may sell shares of our common stock, which could temporarily increase, temporarily delay a decline in, or temporarily decrease, the market price of our common stock. The market price of our common stock could be further negatively affected by these or other short sales of our common stock, including other sales by the Convertible Notes Investors hedging their investment therein.

Adjustments by the Convertible Notes Investors of their hedging positions in our common stock and the expectation thereof may have a negative effect on the market price of our common stock.

The borrowed shares are used by the Convertible Notes Investors to establish hedged positions with respect to our common stock through short sale transactions or privately negotiated derivative transactions. The number of borrowed shares may be more or less than the number of shares that will be needed in such hedging transactions. Any buying or selling of shares of our common stock by those Convertible Notes Investors to adjust their hedging positions may affect the market price of our common stock.

In addition, the existence of the Convertible Notes may also encourage short selling by market participants because the conversion of the Convertible Notes could depress our common stock price. The price of our common stock could be affected by possible sales of our common stock by the Convertible Notes Investors who view the Convertible Notes as a more attractive means of equity participation in us and by hedging or arbitrage trading activity that we expect to occur involving our common stock. This hedging or arbitrage trading activity could, in turn, affect the market price of the Convertible Notes.

Changes in the accounting guidelines relating to the borrowed shares or our inability to classify the borrowed shares as equity could decrease our reported earnings per share and potentially our common stock price.

Because the borrowed shares (or identical shares) must be returned to us when the share lending agreement terminates pursuant to its terms (or earlier in certain circumstances), we believe that under generally accepted accounting principles in the United States, or U.S. GAAP, as presently in effect, assuming the borrowed shares issued pursuant to the share lending agreement are classified as equity under U.S. GAAP, the borrowed shares will not be considered outstanding for the purpose of computing and reporting our earnings per share. If accounting guidelines were to change in the future or we are unable to classify the borrowed shares issued pursuant to the share lending agreement as equity, we may be required to treat the borrowed shares as outstanding for purposes of computing earnings per share, our reported earnings per share would be reduced and our common stock price could decrease, possibly significantly.

If our executive officers and directors choose to act together, they may be able to significantly influence our management and operations, acting in their own best interests and not necessarily those of other shareholders.

As of December 31, 2018, our executive officers and directors owned approximately 45 percent of our voting common stock, including shares subject to outstanding options; restricted stock units, or RSUs; and warrants. As a result, these shareholders, acting together, would be able to significantly influence all matters requiring approval by our shareholders, including the election of directors and the approval of mergers or other business combination transactions, as well as our management and affairs. The interests of this group of shareholders may not always coincide with the interests of other shareholders, and they may act in a manner that advances their best interests and not necessarily those of other shareholders. This concentration of ownership control may:

- delay, defer or prevent a change in control;
- entrench our management and/or the board of directors; or
- impede a merger, consolidation, takeover or other business combination involving us that other shareholders may desire.

We have engaged in transactions with companies in which Randal J. Kirk, our Chief Executive Officer, and his affiliates have an interest.

We have engaged in a variety of transactions, including ECCs, with companies in which Mr. Kirk and affiliates of Mr. Kirk have a direct or indirect interest. See "Notes to the Consolidated Financial Statements - Notes 4, 5, 7, 14 and 17" appearing elsewhere in this Annual Report for a discussion of such transactions. Mr. Kirk serves as the Senior Managing Director and Chief Executive Officer of Third Security and owns 100 percent of the equity interests of Third Security. We believe that each

of these transactions was on terms no less favorable to us than terms we could have obtained from unaffiliated third parties, and each of these transactions was approved by at least a majority of the disinterested members of the audit committee of our board of directors. In addition, subsequent to our consummation of the ECCs with certain related parties, Mr. Kirk and his affiliates invested in these companies. Furthermore, as we execute on these ECCs or JVs going forward, a conflict may arise between our interests and those of Mr. Kirk and his affiliates.

As of December 31, 2018, Randal J. Kirk controlled approximately 42 percent of our common stock and is able to control or significantly influence corporate actions, which may result in Mr. Kirk taking actions contrary to the desires of our other shareholders.

We have historically been controlled, managed and principally funded by Randal J. Kirk, our Chairman and Chief Executive Officer, and affiliates of Mr. Kirk, including Third Security. As of December 31, 2018, Mr. Kirk and shareholders affiliated with him beneficially owned approximately 42 percent of our voting stock. Mr. Kirk is able to control or significantly influence all matters requiring approval by our shareholders, including the election of directors and the approval of mergers or other business combination transactions. The interests of Mr. Kirk may not always coincide with the interests of other shareholders, and he may take actions that advance his personal interests and are contrary to the desires of our other shareholders.

Our articles of incorporation authorize us to issue preferred stock with terms that are preferential to those of our common stock.

Our articles of incorporation authorize us to issue, without the approval of our shareholders, one or more classes or series of preferred stock having such designations, preferences, limitations and relative rights, including preferences over our common stock respecting dividends and distributions, as our board of directors may determine. For example, in connection with the formation of a Preferred Stock Equity Facility, which was subsequently terminated in June 2018, we filed an amendment to our articles of incorporation to set the designations of our Series A Preferred Stock, which, if and when issued, would have certain preferences over our common stock, including accrued dividends of 8 percent per annum and, subject to limited exceptions, seniority to our common stock with respect to the rights to the payment of dividends and on parity with our common stock with respect to the distribution of our assets in the event of a liquidation, dissolution, or winding up or change of control. In the future, we may enter into similar facilities or issue preferred stock that have greater rights, preferences and privileges than our common stock.

A significant portion of our total outstanding shares of common stock is restricted from immediate resale but may be sold into the market in the near future. This could cause the market price of our common stock to drop significantly, even if our business is doing well.

Sales of a substantial number of shares of our common stock in the public market could occur at any time. These sales, or the perception in the market that the holders of a large number of shares of common stock intend to sell shares, could reduce the market price of our common stock. If Mr. Kirk or any of his affiliates were to sell a substantial portion of the shares they hold, it could cause our stock price to decline.

In addition, as of December 31, 2018, there were 11,093,063 shares subject to outstanding options that will become eligible for sale in the public market to the extent permitted by any applicable vesting requirements, lock-up agreements and Rules 144 and 701 under the Securities Act of 1933, as amended. As of December 31, 2018, there were 970,341 RSUs outstanding. Shares issuable upon the exercise of such options and upon vesting of the RSUs can be freely sold in the public market upon issuance and once vested. Additionally, as of December 31, 2018, we had 5,086,700 of shares available for grant under the 2013 Omnibus Incentive Plan.

We are subject to anti-takeover provisions in our articles of incorporation and bylaws and under Virginia law that could delay or prevent an acquisition of our Company, even if the acquisition would be beneficial to our shareholders.

Certain provisions of Virginia law, the commonwealth in which we are incorporated, and our articles of incorporation and bylaws could hamper a third party's acquisition of us, or discourage a third party from attempting to acquire control of us. These provisions include:

- a provision allowing our board of directors to issue preferred stock with rights senior to those of the common stock without any vote or action by the holders of our common stock. The issuance of preferred stock could adversely affect the rights and powers, including voting rights, of the holders of common stock;

- establish advance notice requirements for nominations for election to the board of directors or for proposing matters that can be acted on at shareholder meetings;
- the inability of shareholders to convene a shareholders' meeting without the support of shareholders owning together 25 percent of our common stock;
- the application of Virginia law prohibiting us from entering into a business combination with the beneficial owner of 10 percent or more of our outstanding voting stock for a period of three years after the 10 percent or greater owner first reached that level of stock ownership, unless we meet certain criteria;
- allow the authorized number of our directors to be changed only by resolution of our board of directors;
- limit the manner in which shareholders can remove directors from the board;
- require that shareholder actions must be effected at a duly called shareholder meeting and prohibit actions by our shareholders by written consent; and
- limit who may call a special meeting of shareholders.

These provisions also could limit the price that certain investors might be willing to pay in the future for shares of our common stock. In addition, these provisions make it more difficult for our shareholders, should they choose to do so, to remove our board of directors or management.

If we fail to maintain an effective system of internal control over financial reporting, we may not be able to accurately report our financial results or prevent fraud. As a result, shareholders could lose confidence in our financial and other public reporting, which would harm our business and the trading price of our common stock.

Effective internal controls over financial reporting are necessary for us to provide reliable financial reports and, together with adequate disclosure controls and procedures, are designed to prevent fraud. Any failure to implement required new or improved controls, or difficulties encountered in their implementation, could cause us to fail to meet our reporting obligations. In addition, any testing by us conducted in connection with Section 404 of the Sarbanes-Oxley Act, or any subsequent testing by our independent registered public accounting firm, may reveal deficiencies in our internal controls over financial reporting that are deemed to be material weaknesses or that may require prospective or retroactive changes to our financial statements or identify other areas for further attention or improvement. Inferior internal controls could also cause investors to lose confidence in our reported financial information, which could have a negative effect on the trading price of our common stock.

We have previously reported material weaknesses in our internal control over financial reporting. As discussed in Part II, Item 9A, "Controls and Procedures", during the second quarter of 2018 we identified and disclosed a material weakness in our controls over the adoption of ASC 606, *Revenue from Contracts with Customers*, or ASC 606. Based upon the remediation actions described in such section, management has concluded that such material weakness has been remediated as of December 31, 2018. Although we believe we have taken appropriate actions to remediate the control deficiencies we have identified and to strengthen our internal control over financial reporting, we cannot assure you that we will not discover other material weaknesses in the future.

Item 1B. Unresolved Staff Comments

Not applicable.

Item 2. Properties

We establish the geographic locations of our research and development operations based on proximity to the relevant market expertise and access to available talent pools. The following table shows information about our primary lab operations as of December 31, 2018:

Location	Square Footage
Germantown, Maryland	56,258
South San Francisco, California	55,609
Davis, California	32,867
San Diego, California	23,409
Budapest, Hungary	18,367
Ghent, Belgium	14,198
Campinas, Brazil	12,530
Oxford, England	10,000

Our primary domestic production facilities are located in Sioux Center, Iowa, and include approximately 281,000 square feet of production and office facilities and approximately 360 acres of land. The land and production facilities are primarily used for embryo transfer and in vitro fertilization processes, as well as housing livestock used in such processes. We also lease or own regional production facilities and land in California, Maryland, Missouri, New York, Oklahoma, South Dakota, Texas, and Washington for these purposes. Additionally, we are scaling up commercial production of our non-browning apples in Washington and our AAS salmon in Canada in anticipation of generating future revenues from each of these product lines.

We lease an additional 36,000 square feet of administrative offices in South San Francisco, California; West Palm Beach, Florida; Germantown, Maryland; and Blacksburg, Virginia. The terms of our leases range from one to ten years. See also "Management's Discussion and Analysis of Financial Condition and Results of Operations — Contractual Obligations and Commitments" appearing elsewhere in this Annual Report.

Item 3. Legal Proceedings

In March 2012, Trans Ova was named as a defendant in a licensing and patent infringement suit brought by XY, LLC, or XY, alleging that certain of Trans Ova's activities breached a 2004 licensing agreement and infringed on patents that XY allegedly owned. Trans Ova filed a number of counterclaims in the case. In Colorado District Court, the matter proceeded to a jury trial in January 2016. The jury determined that XY and Trans Ova had each breached the licensing agreement and that Trans Ova had infringed XY's patents. In April 2016, the court issued its post-trial order, awarding $0.5 million in damages to Trans Ova and $6.1 million in damages to XY. The order also provided Trans Ova with a compulsory license to XY's technology, subject to an ongoing royalty obligation. Both parties appealed the district court's order, which appeal was decided in May 2018 by the Court of Appeals for the Federal Circuit. The Court denied Trans Ova's appeal of its claims for antitrust, breach of contract and patent invalidity (except as to one patent, for which the Court affirmed invalidity in a separate, same-day ruling in a third-party case). The Court considered the issue of willfulness to be moot since the district court did not award damages for the willfulness finding. Finally, the Court remanded the district court's calculation of the ongoing royalty and instructed the district court to re-calculate the ongoing royalty in light of post-verdict economic factors.

Since the inception of the 2004 agreement, Trans Ova has remitted payments to XY pursuant to the terms of that agreement, or pursuant to the terms of the April 2016 court order, and has recorded these payments in cost of services in the consolidated statements of operations for the respective periods. For the period from inception of the 2004 agreement through the court's April 2016 order, aggregate royalty and license payments were $3.2 million, of which $2.8 million had not yet been deposited by XY. In 2016, we recorded the expense of $4.2 million, representing the excess of the net damages awarded to XY, including prejudgment interest, over the liability previously recorded by Trans Ova for uncashed checks previously remitted to XY. In August 2016, Trans Ova deposited the net damages amount, including prejudgment interest, into the court's treasury, to be held until the appeals process is complete and final judgment amounts are determined. As of December 31, 2018, this amount is included in restricted cash on the accompanying consolidated balance sheet appearing elsewhere in this Annual Report.

In December 2016, Trans Ova elected to void the outstanding checks discussed above, and these amounts have been reclassified to other accrued liabilities on the accompanying consolidated balance sheets as of December 31, 2018 and 2017, appearing elsewhere in this Annual Report.

In December 2016, XY filed a complaint for patent infringement and trade secret misappropriation against Trans Ova in the District Court of Waco, Texas. Since the claims in this 2016 complaint directly relate to the 2012 licensing dispute and patent issues, Trans Ova filed and was granted a motion for change of venue to Colorado District Court. Trans Ova also filed a motion to dismiss, from which the Court dismissed ten of the twelve counts of the complaint. Presently, two counts for patent infringement remain pending. Trans Ova and we could elect to enter into a settlement agreement in order to avoid the further costs and uncertainties of litigation.

We may become subject to other claims, assessments and governmental investigations from time to time in the ordinary course of business. Such matters are subject to many uncertainties and outcomes are not predictable with assurance. We accrue liabilities for such matters when it is probable that future expenditures will be made and such expenditures can be reasonably estimated. We do not believe that any such matters, individually or in the aggregate, will have a material adverse effect on our business, financial condition, results of operations, or cash flows.

Item 4. Mine Safety Disclosures

Not applicable.

PART II

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities

Market Information and Holders of Record

Our common stock trades on the Nasdaq Global Select Market, or NASDAQ, under the symbol "XON".

As of February 15, 2019, we had 291 holders of record of our common stock. The actual number of shareholders is greater than this number of record holders and includes shareholders who are beneficial owners but whose shares are held in street name by brokers and other nominees. This number of holders of record also does not include shareholders whose shares may be held in trust by other entities.

Dividends

We have never declared or paid any cash dividends on our capital stock. We currently intend to retain earnings, if any, to finance the growth and development of our business and do not expect to pay any cash dividends on our common stock in the foreseeable future.

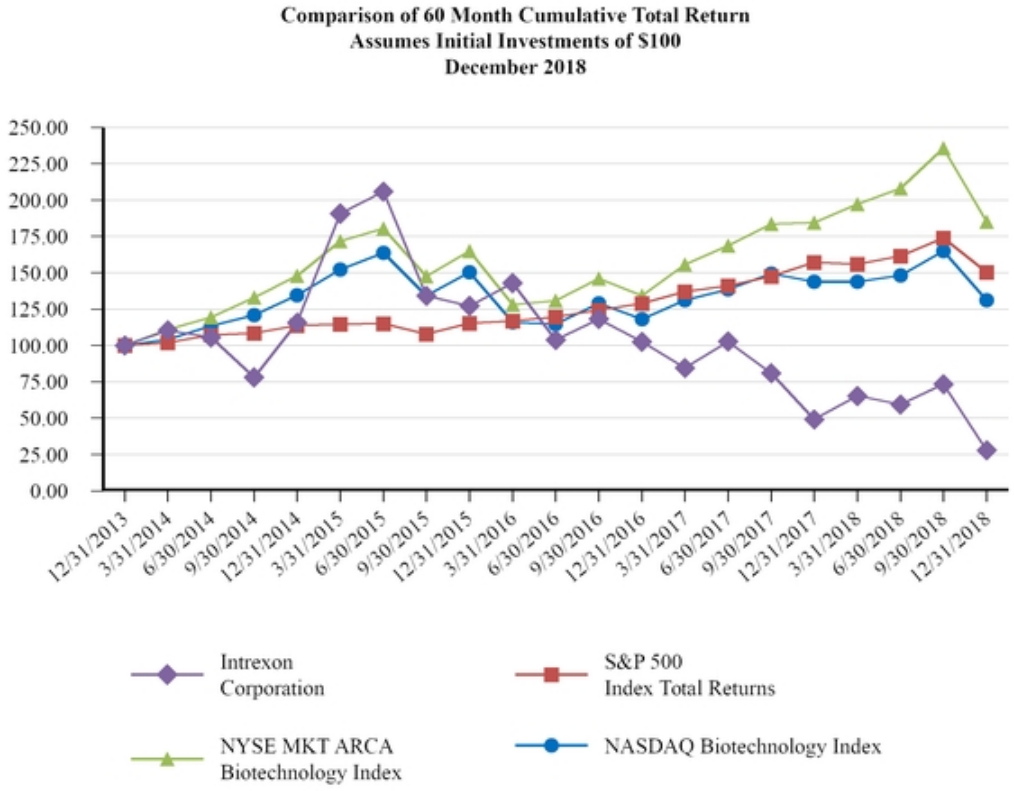
Securities Authorized for Issuance Under Equity Compensation Plans

Information about our equity compensation plans is incorporated herein by reference to Item 12 of Part III of this Annual Report.

Stock Performance Graph

This performance graph shall not be deemed "soliciting material" or to be "filed" with the SEC for purposes of Section 18 of the Securities Exchange Act of 1934, or otherwise subject to the liabilities under that Section, and shall not be deemed to be incorporated by reference into any filing of Intrexon Corporation under the Securities Act of 1933, as amended, or the Exchange Act.

The following graph shows a comparison from December 31, 2013 through December 31, 2018 of the cumulative total return for our common stock; the Standard & Poor's 500 Stock Index, or the S&P 500 Index; the NYSE MKT ARCA Biotechnology Index; and the NASDAQ Biotechnology Index. The graph assumes that $100 was invested at the market close on December 31, 2013 in the common stock of Intrexon Corporation, the S&P 500 Index, the NYSE MKT ARCA Biotechnology Index, and the NASDAQ Biotechnology Index, and data for the S&P 500 Index, the NYSE MKT ARCA Biotechnology Index, and the NASDAQ Biotechnology Index assumes reinvestments of dividends. The NASDAQ Biotechnology Index is now included in this comparison as a result of Intrexon's inclusion in the index beginning December 24, 2018. We have elected to replace the NYSE MKT ARCA Biotechnology Index with the NASDAQ Biotechnology Index because we believe that it is a more appropriate comparison. In this transition year, the stock performance graph below includes the comparative performance of the new index and the previously reported index. The stock price performance of the following graph is not necessarily indicative of future stock price performance.



Company / Index	Base Period 12/31/2013	3/31/2014	6/30/2014	9/30/2014	12/31/2014
Intrexon Corporation	**$ 100.00**	$ 110.46	$ 105.59	$ 78.07	$ 115.67
S&P 500 Index	**100.00**	101.81	107.14	108.34	113.69
NYSE MKT ARCA Biotechnology Index	**100.00**	111.02	119.23	132.91	147.91
NASDAQ Biotechnology Index	**100.00**	104.25	113.51	120.87	134.40

Company / Index	3/31/2015	6/30/2015	9/30/2015	12/31/2015	3/31/2016	6/30/2016	9/30/2016	12/31/2016
Intrexon Corporation	$ 190.63	$ 205.75	$ 134.07	$ 127.12	$ 142.88	$ 103.76	$ 118.14	$ 102.45
S&P 500 Index	114.77	115.09	107.68	115.26	116.82	119.68	124.29	129.05
NYSE MKT ARCA Biotechnology Index	171.66	180.28	147.67	164.76	127.90	130.85	145.91	134.07
NASDAQ Biotechnology Index	152.23	163.69	134.34	150.22	115.85	114.54	128.86	118.15

Company / Index	3/31/2017	6/30/2017	9/30/2017	12/31/2017	3/31/2018	6/30/2018	9/30/2018	12/31/2018
Intrexon Corporation	$ 84.42	$ 102.60	$ 80.97	$ 49.07	$ 65.29	$ 59.37	$ 73.34	$ 27.85
S&P 500 Index	136.88	141.11	147.44	157.24	156.04	161.40	173.85	150.34
NYSE MKT ARCA Biotechnology Index	155.55	168.50	183.62	184.59	197.02	208.05	235.73	185.08
NASDAQ Biotechnology Index	130.95	138.67	149.41	143.74	143.83	148.26	164.86	131.00

Recent Sales of Unregistered Securities and Use of Proceeds from Registered Securities

(a) Sales of Unregistered Securities

From January 1, 2018 through December 31, 2018, we issued 696,033 unregistered shares of our common stock as payment under the services agreement entered into and effective as of November 1, 2015, as amended, by and between us and Third Security as previously discussed in our Current Report on Form 8-K filed on January 2, 2018.

We issued the above referenced shares of common stock in reliance on exemptions from registration under Section 4(a)(2) of the Securities Act.

(b) Use of Proceeds

None.

(c) Issuer Purchases of Equity Securities

None.

Item 6. Selected Financial Data

The following tables set forth our selected consolidated financial data for the periods and as of the dates indicated. You should read the following selected consolidated financial data in conjunction with our audited consolidated financial statements and the related notes thereto included elsewhere in this Annual Report and the "Management's Discussion and Analysis of Financial Condition and Results of Operations" section of this Annual Report.

The selected consolidated financial data set forth below as of December 31, 2018 and 2017, and for the years ended December 31, 2018, 2017 and 2016, are derived from our audited consolidated financial statements included elsewhere in this Annual Report. The selected consolidated financial data set forth below as of December 31, 2016, 2015, and 2014, and for the years ended December 31, 2015 and 2014, are derived from our audited consolidated financial statements contained in reports previously filed with the SEC, not included herein. Our audited consolidated financial statements have been prepared in United States dollars in accordance with U.S. GAAP.

Our historical results for any prior period are not necessarily indicative of results to be expected in any future period.

	Year Ended December 31,				
	2018	2017 (5)	2016	2015 (6)	2014 (7)
	(In thousands, except share and per share amounts)				
Statements of Operations Data:					
Collaboration and licensing revenues	$ 76,869	$ 145,579	$ 109,871	$ 87,821	$ 45,212
Product revenues	28,528	33,589	36,958	41,879	11,481
Service revenues	52,419	50,611	43,049	42,923	14,761
Total revenues (1)	160,574	230,981	190,926	173,605	71,930
Total operating expenses	666,184	368,871	316,092	320,469	141,892
Operating loss	(505,610)	(137,890)	(125,166)	(146,864)	(69,962)
Net loss	(514,706)	(126,820)	(190,274)	(87,994)	(85,616)
Net loss attributable to noncontrolling interests	5,370	9,802	3,662	3,501	3,794
Net loss attributable to Intrexon	(509,336)	(117,018)	(186,612)	(84,493)	(81,822)
Net loss attributable to common shareholders	(509,336)	(117,018)	(186,612)	(84,493)	(81,822)
Net loss attributable to common shareholders per share, basic and diluted	$ (3.93)	$ (0.98)	$ (1.58)	$ (0.76)	$ (0.83)
Weighted average shares outstanding, basic and diluted	129,521,731	119,998,826	117,983,836	111,066,352	99,170,653

	December 31,				
	2018	2017 (5)	2016	2015 (6)	2014 (7)
	(In thousands)				
Balance Sheet Data:					
Cash and cash equivalents	$ 102,768	$ 68,111	$ 62,607	$ 135,782	$ 27,466
Short-term and long-term investments	119,688	6,273	180,595	207,975	115,608
Investments in preferred stock (2)	191	161,225	129,545	—	—
Total assets	716,177	846,851	949,068	982,046	576,272
Deferred revenue, current and non-current (1)	69,764	236,397	310,142	197,729	113,209
Long-term debt (3)	211,794	8,037	7,948	8,528	10,369
Other liabilities (4)	55,897	55,872	61,730	70,903	43,405
Total Intrexon shareholders' equity	362,855	533,631	560,237	694,078	384,761
Noncontrolling interests	15,867	12,914	9,011	10,808	24,528
Total equity	378,722	546,545	569,248	704,886	409,289

(1) Revenues and deferred revenue in 2018 are accounted for under ASC 606, and revenues and deferred revenue prior to 2018 are accounted for under ASC 605, *Revenue Recognition*, or ASC 605. We adopted ASC 606 on January 1, 2018 using the modified retrospective method, which applies the changes in accounting prospectively and does not restate prior periods.

(2) In conjunction with the ZIOPHARM License Agreement in 2018, all of our ZIOPHARM preferred shares were returned to ZIOPHARM.

(3) In 2018, we completed a registered underwritten public offering of $200,000 aggregate principal amount of Convertible Notes.

(4) Other liabilities include $8,801, $15,629, and $20,485 of deferred consideration as of December 31, 2016, 2015, and 2014, respectively.

(5) In 2017, we acquired GenVec, Inc., or GenVec, and began including the results of its operations effective on the acquisition date. In 2017, we also acquired the remaining 49 percent of outstanding equity of Biological & Popular Culture, Inc.

(6) In 2015, we acquired ActoGeniX NV, Okanagan, and Oxitec and began including the results of their operations effective on the respective acquisition dates.

(7) In 2014, we acquired Medistem, Inc. and Trans Ova and began including the results of their operations effective on the respective acquisition dates.

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations

The following discussion and analysis of financial condition and results of operations is provided to enhance the understanding of, and should be read in conjunction with, Part I, Item 1, "Business" and Item 8, "Financial Statements and Supplementary Data." For information on risks and uncertainties related to our business that may make past performance not indicative of future results, or cause actual results to differ materially from any forward-looking statements, see "Special Note Regarding Forward-Looking Statements," and Part I, Item 1A, "Risk Factors."

Financial overview

We have incurred significant losses since our inception. We anticipate that we may continue to incur significant losses for the foreseeable future, and we may never achieve or maintain profitability. Outside of collaboration and license fee payments and sales of products and services, which vary over time, we have not generated significant revenues, including revenues or royalties from product sales by us or our collaborators. Certain of our consolidated subsidiaries require regulatory approval and/or commercial scale-up before they may commence significant product sales and operating profits.

Sources of revenue

Historically, we have derived our collaboration and licensing revenues through agreements with counterparties for the development and commercialization of products enabled by our technologies. Generally, the terms of these collaborations provide that we receive some or all of the following: (i) technology access fees upon signing; (ii) reimbursements of costs incurred by us for our research and development and/or manufacturing efforts related to specific applications provided for in the collaboration; (iii) milestone payments upon the achievement of specified development, regulatory and commercial activities; and (iv) royalties on sales of products arising from the collaboration.

Our technology access fees and milestone payments may be in the form of cash or securities of the collaborator. Our collaborations contain multiple arrangements, and we typically defer revenues from the technology access fees and milestone payments received and recognize such revenues in the future over the anticipated performance period. We are also entitled to sublicensing revenues in those situations where our collaborators choose to license our technologies to other parties.

From time to time, we and certain collaborators may cancel the agreements or we may repurchase rights to the exclusive fields from collaborators, relieving us of any further performance obligations under the agreement. Upon such circumstances or when we determine no further performance obligations are required of us under an agreement, we may recognize any remaining deferred revenue as either collaboration revenue or as a reduction of in-process research and development expense, depending on the circumstances.

We generate product and service revenues primarily through sales of products or services that are created from technologies developed or owned by us. Our primary current offerings include sales of advanced reproductive technologies, including our bovine embryo transfer and in vitro fertilization processes and from genetic preservation and sexed semen processes and applications of such processes to other livestock, as well as sales of livestock and embryos produced using these processes and used in production. We recognize revenue when control of the promised product is transferred to the customer or when the promised service is completed.

In future periods, our revenues will depend in part on our ability to partner our more mature programs and capabilities, the number of collaborations to which we are party, the advancement and creation of our programs and programs within our collaborations and the extent to which we or our collaborators bring products enabled by our technologies to market. We expect our collaboration revenues will decrease considerably as a result of our reacquisition of rights to fields previously licensed to collaborators, after which we no longer expect to receive reimbursement of costs incurred by us for research and development services and will no longer recognize previously deferred revenues associated with the terminated collaboration. Our revenues will also depend upon our ability to maintain or improve the volume and pricing of our current product and service offerings and to develop and scale up production of new offerings from the various technologies of our subsidiaries. Our future revenues may also include additional revenue streams we may acquire through mergers and acquisitions. In light of our limited operating history and experience, there can be no assurance as to the timing, magnitude and predictability of revenues to which we might be entitled.

Cost of products and services

Cost of products and services includes primarily labor and related costs, drugs and supplies used primarily in the embryo transfer and in vitro fertilization processes, livestock and feed used in production, and facility charges, including rent and depreciation. Fluctuations in the price of livestock and feed have not had a significant impact on our operating margins and no derivative financial instruments are used to mitigate the price risk.

Research and development expenses

We recognize research and development expenses as they are incurred. Our research and development expenses consist primarily of:

- salaries and benefits, including stock-based compensation expense, for personnel in research and development functions;
- fees paid to consultants and contract research organizations who perform research on our behalf and under our direction;
- costs related to laboratory supplies used in our research and development efforts;

- costs related to certain in-licensed technology rights or reacquired in-process research and development;
- depreciation of leasehold improvements and laboratory equipment;
- amortization of patents and related technologies acquired in mergers and acquisitions; and
- rent and utility costs for our research and development facilities.

We have no individually significant research and development projects, and our research and development expenses primarily relate to either the costs incurred to expand or otherwise improve our multiple platform technologies, the costs incurred to develop a specific application of our technologies in support of current or prospective partners, or costs incurred to expand or otherwise improve our products and services. Research and development expenses, including costs for preclinical and clinical development, incurred for programs we support pursuant to an ECC agreement are typically reimbursed by the partner at cost, and all other research and development programs may be terminated or otherwise deferred at our discretion. The amount of our research and development expenses may be impacted by, among other things, the number of ECCs and the number and size of programs we may support on behalf of an ECC.

The table below summarizes our research and development expenses incurred to expand or otherwise improve our multiple platform technologies, the costs incurred to develop a specific application of our technologies in support of current or prospective partners, or costs incurred to expand or otherwise improve our products and services for the years ended December 31, 2018, 2017, and 2016. Other research and development expenses for these periods include indirect salaries and overhead expenses that are not allocated to either expanding or improving our multiple platform technologies, specific applications of our technologies in support of current or prospective partners, or expanding or improving our product and services offerings. Additionally, other research and development expenses for the year ended December 31, 2018 include $236.7 million of expense related to in-process research and development reacquired from several collaborators in 2018.

	Year Ended December 31,		
	2018	2017	2016
	(In thousands)		
Expansion or improvement of our platform technologies	$ 19,788	$ 14,515	$ 12,195
Specific applications of our technologies in support of current and prospective partners	74,169	77,001	62,960
Expansion or improvement of our product and service offerings	27,331	27,134	17,585
Other	283,298	24,557	19,395
Total research and development expenses	$ 404,586	$ 143,207	$ 112,135

Other than our expenses related to reacquired in-process research and development, we expect that our research and development expenses will increase as we develop our own proprietary programs and expand our offerings. We believe these increases will likely include increased costs related to the hiring of additional personnel in research and development functions, increased costs paid to consultants and contract research organizations, and increased costs related to laboratory supplies. Research and development expenses may also increase as a result of ongoing research and development operations that we might assume through mergers and acquisitions.

Selling, general and administrative expenses

Selling, general and administrative, or SG&A, expenses consist primarily of salaries and related costs, including stock-based compensation expense, for employees in executive, operational, finance, sales and marketing, information technology, legal and corporate communications functions. Other significant SG&A expenses include rent and utilities, insurance, accounting and legal services, and expenses associated with obtaining and maintaining our intellectual property.

SG&A expenses may increase in the future to support our expanding operations as we explore new partnering opportunities and continue to develop our proprietary programs. These increases would likely include costs related to the hiring of additional personnel and increased fees for business development functions, costs associated with defending us in litigation matters, the costs of outside consultants, and other professional services. SG&A expenses may also increase as a result of ongoing operations that we might assume through mergers and acquisitions.

Other income (expense), net

We hold equity securities and preferred stock received and/or purchased from certain collaborators. Other than investments accounted for using the equity method discussed below, we elected the fair value option to account for our equity securities and preferred stock held in these collaborators. These equity securities and preferred stock are recorded at fair value at each reporting date. Unrealized appreciation (depreciation) resulting from fair value adjustments are reported as other income (expense) in the consolidated statements of operations. As such, we bear the risk that fluctuations in the securities' share prices may significantly impact our results of operations.

Interest expense is expected to increase in future periods as we incur interest expense related to the Convertible Notes issued in July 2018.

Interest income consists of interest earned on our cash and cash equivalents and short-term and long-term investments. Dividend income consists of the monthly preferred stock dividends received from our investments in preferred stock. Dividend income is expected to decrease in future periods because we returned our ZIOPHARM preferred shares to ZIOPHARM in October 2018.

Equity in net income (loss) of affiliates

Equity in net income or loss of affiliates is our pro-rata share of our equity method investments' operating results, adjusted for accretion of basis difference. We account for investments in our JVs and start-up entities backed by Harvest Intrexon Enterprise Fund I, LP, or Harvest, using the equity method of accounting since we have the ability to exercise significant influence, but not control, over the operating activities of these entities.

Results of operations

Comparison of the year ended December 31, 2018 to the year ended December 31, 2017

The following table summarizes our results of operations for the years ended December 31, 2018 and 2017, together with the changes in those items in dollars and as a percentage:

	Year Ended December 31,		Dollar Change	Percent Change
	2018	2017		
	(In thousands)			
Revenues (1)				
Collaboration and licensing revenues (2)	$ 76,869	$ 145,579	$ (68,710)	(47.2)%
Product revenues	28,528	33,589	(5,061)	(15.1)%
Service revenues	52,419	50,611	1,808	3.6 %
Other revenues	2,758	1,202	1,556	129.5 %
Total revenues	160,574	230,981	(70,407)	(30.5)%
Operating expenses				
Cost of products	35,698	33,263	2,435	7.3 %
Cost of services	27,589	29,525	(1,936)	(6.6)%
Research and development	404,586	143,207	261,379	182.5 %
Selling, general and administrative	137,807	146,103	(8,296)	(5.7)%
Impairment loss	60,504	16,773	43,731	>200%
Total operating expenses	666,184	368,871	297,313	80.6 %
Operating loss	(505,610)	(137,890)	(367,720)	>200%
Total other income (expense), net	(19,016)	22,473	(41,489)	(184.6)%
Equity in loss of affiliates	(11,608)	(14,283)	2,675	(18.7)%
Loss before income taxes	(536,234)	(129,700)	(406,534)	>200%
Income tax benefit	21,528	2,880	18,648	>200%
Net loss	(514,706)	(126,820)	(387,886)	>200%
Net loss attributable to noncontrolling interests	5,370	9,802	(4,432)	(45.2)%
Net loss attributable to Intrexon	$ (509,336)	$ (117,018)	$ (392,318)	>200%

(1) Revenues in 2018 are accounted for under ASC 606 and revenues in 2017 are accounted for under ASC 605. We adopted ASC 606 on January 1, 2018 using the modified retrospective method, which applies the changes in accounting prospectively and does not restate prior periods.

(2) Including $60,238 and $130,670 from related parties for the years ended December 31, 2018 and 2017, respectively.

Collaboration and licensing revenues

The following table shows the collaboration and licensing revenue recognized for the years ended December 31, 2018 and 2017, together with the changes in those items.

	Year Ended December 31,		Dollar Change
	2018	2017	
	(In thousands)		
ZIOPHARM Oncology, Inc.	$ 16,298	$ 69,812	$ (53,514)
Ares Trading S.A.	11,175	10,738	437
Oragenics, Inc.	1,353	2,020	(667)
Intrexon T1D Partners, LLC	2,502	5,968	(3,466)
Intrexon Energy Partners, LLC	6,929	10,665	(3,736)
Intrexon Energy Partners II, LLC	2,998	3,672	(674)
Genopaver, LLC	3,710	6,690	(2,980)
Fibrocell Science, Inc.	1,394	7,344	(5,950)
Persea Bio, LLC	955	946	9
OvaXon, LLC	—	1,966	(1,966)
S & I Ophthalmic, LLC	—	755	(755)
Harvest start-up entities (1)	14,447	15,232	(785)
Other	15,108	9,771	5,337
Total	$ 76,869	$ 145,579	$ (68,710)

(1) For the years ended December 31, 2018 and 2017, revenue recognized from collaborations with Harvest start-up entities include Genten Therapeutics, Inc.; CRS Bio, Inc.; Exotech Bio, Inc.; AD Skincare, Inc.; and Thrive Agrobiotics, Inc. For the year ended December 31, 2017, revenues recognized from collaborations with Harvest start-up entities also include Relieve Genetics, Inc.

Collaboration and licensing revenues decreased $68.7 million, or 47 percent, from the year ended December 31, 2017 due to (i) the mutual termination in 2017 of our second ECC with ZIOPHARM for the treatment of graft-versus-host disease, (ii) a decrease in research and development services for certain of our ECCs as we redeployed certain resources towards supporting prospective new platforms and partnering opportunities and began to focus more on the further development of relationships and structures that provide us with more control and ownership over the development process and commercialization path, including programs where we reacquired the previously licensed technology rights in 2018, and (iii) a decrease in research and development services we perform for collaborators upon the transition of program execution to our collaborators.

Product revenues and gross margin

Product revenue decreased $5.1 million, or 15 percent, from the year ended December 31, 2017. The decrease in product revenues was primarily due to lower milk prices which in turn resulted in lower customer demand for live calves, cows previously used in production, and cloned products. Gross margin on products declined in the current period as a result of the lower product sales and increased operating costs associated with new product offerings and cloned products.

Service revenues and gross margin

Service revenue increased $1.8 million, or 4 percent, over the year ended December 31, 2017. The increase in service revenues and gross margin thereon relates to pricing changes and an increase in the number of embryos produced per bovine in vitro fertilization cycle performed due to improved production results.

Research and development expenses

Research and development expenses increased $261.4 million, or 183 percent, over the year ended December 31, 2017. Current period research and development expenses include $236.7 million of expenses related to in-process research and development reacquired from former collaborators.

Selling, general and administrative expenses

SG&A expenses decreased $8.3 million, or 6 percent, from the year ended December 31, 2017. Legal and professional fees decreased $7.5 million primarily due to (i) decreased legal fees associated with ongoing litigation and (ii) decreased fees incurred for regulatory and other consultants.

Impairment loss

Impairment loss for the year ended December 31, 2018 of $60.5 million arose from a charge taken due to a change in our business strategy for commercializing the Oxitec technology targeting the *Aedes Aegypti* mosquito. Impairment loss for the year ended December 31, 2017 of $16.8 million resulted from our annual test for goodwill and indefinite-lived intangible asset impairment in the fourth quarter. Based on the price per share received by AquaBounty in its then-recent underwritten public offering, we determined that it was more likely than not that the fair value of our AquaBounty reporting unit was less than the carrying value and recorded a $13.0 million impairment charge representing the estimated excess of carrying value over fair value of this reporting unit. Additionally, in the fourth quarter of 2017, we decided to forgo further development of certain of our in-process research and development assets and as a result recorded a $3.0 million impairment charge.

Total other income (expense), net

Total other income (expense), net, decreased $41.5 million, or 185 percent, from the year ended December 31, 2017. This decrease was primarily attributable to losses on our investment in ZIOPHARM preferred stock prior to returning this investment to ZIOPHARM in October 2018, as well as an increase in interest expense related to the Convertible Notes issued in July 2018.

Comparison of the year ended December 31, 2017 to the year ended December 31, 2016

The following table summarizes our results of operations for the years ended December 31, 2017 and 2016, together with the changes in those items in dollars and as a percentage:

	Year Ended December 31,		Dollar Change	Percent Change
	2017	2016		
	(In thousands)			
Revenues				
Collaboration and licensing revenues (1)	$ 145,579	$ 109,871	$ 35,708	32.5 %
Product revenues	33,589	36,958	(3,369)	(9.1)%
Service revenues	50,611	43,049	7,562	17.6 %
Other revenues	1,202	1,048	154	14.7 %
Total revenues	230,981	190,926	40,055	21.0 %
Operating expenses				
Cost of products	33,263	37,709	(4,446)	(11.8)%
Cost of services	29,525	23,930	5,595	23.4 %
Research and development	143,207	112,135	31,072	27.7 %
Selling, general and administrative	146,103	142,318	3,785	2.7 %
Impairment loss	16,773	—	16,773	N/A
Total operating expenses	368,871	316,092	52,779	16.7 %
Operating loss	(137,890)	(125,166)	(12,724)	10.2 %
Total other income (expense), net	22,473	(47,865)	70,338	147.0 %
Equity in loss of affiliates	(14,283)	(21,120)	6,837	(32.4)%
Loss before income taxes	(129,700)	(194,151)	64,451	(33.2)%
Income tax benefit	2,880	3,877	(997)	(25.7)%
Net loss	(126,820)	(190,274)	63,454	(33.3)%
Net loss attributable to noncontrolling interests	9,802	3,662	6,140	167.7 %
Net loss attributable to Intrexon	$ (117,018)	$ (186,612)	$ 69,594	(37.3)%

(1) Including $130,670 and $93,792 from related parties for the years ended December 31, 2017 and 2016, respectively.

Collaboration and licensing revenues

The following table shows the collaboration and licensing revenue recognized for the years ended December 31, 2017 and 2016, together with the changes in those items.

	Year Ended December 31,		Dollar Change
	2017	2016	
	(In thousands)		
ZIOPHARM Oncology, Inc.	$ 69,812	$ 33,836	$ 35,976
Ares Trading S.A.	10,738	10,192	546
Oragenics, Inc.	2,020	2,752	(732)
Intrexon T1D Partners, LLC	5,968	1,908	4,060
Intrexon Energy Partners, LLC	10,665	17,552	(6,887)
Intrexon Energy Partners II, LLC	3,672	3,169	503
Genopaver, LLC	6,690	6,117	573
Fibrocell Science, Inc.	7,344	5,942	1,402
Persea Bio, LLC	946	1,278	(332)
OvaXon, LLC	1,966	2,934	(968)
S & I Ophthalmic, LLC	755	6,141	(5,386)
Harvest start-up entities (1)	15,232	4,974	10,258
Other	9,771	13,076	(3,305)
Total	$ 145,579	$ 109,871	$ 35,708

(1) For the years ended December 31, 2017 and 2016, revenue recognized from collaborations with Harvest start-up entities include Genten Therapeutics, Inc.; CRS Bio, Inc.; Relieve Genetics, Inc.; Exotech Bio, Inc.; AD Skincare, Inc.; and Thrive Agrobiotics, Inc.

Collaboration and licensing revenues increased $35.7 million, or 33 percent, over the year ended December 31, 2016 due primarily to (i) the recognition of previously deferred revenue totaling $28.9 million related to our second ECC with ZIOPHARM for the treatment of graft-versus-host disease, which was mutually terminated in December 2017 and (ii) a full year of recognition of deferred revenue associated with the payment received in June 2016 from ZIOPHARM to amend our collaborations.

Product revenues and gross margin

Product revenue decreased $3.4 million, or 9 percent, from the year ended December 31, 2016. The decrease in product revenues was primarily due to lower milk prices which in turn resulted in lower customer demand for cows and live calves. Gross margin on products improved slightly in the current period primarily due to a decline in the average cost of cows.

Service revenues and gross margin

Service revenue increased $7.6 million, or 18 percent, over the year ended December 31, 2016. The increase in service revenues relates to an increase in the number of bovine in vitro fertilization cycles performed due to higher customer demand. Gross margin on services decreased slightly in the current period primarily due to an increase in royalties and commissions due to vendors.

Research and development expenses

Research and development expenses increased $31.1 million, or 28 percent, over the year ended December 31, 2016. The increase is due primarily to increases in (i) lab supplies and consulting expenses; (ii) salaries, benefits and other personnel costs for research and development employees; (iii) depreciation and amortization; and (iv) rent and utilities expenses. Lab supplies and consulting expenses increased $11.3 million due to (i) the progression of certain programs into the preclinical and clinical phases with certain of our collaborators and (ii) the expansion or improvement of certain of our platform technologies. Salaries,

benefits and other personnel costs increased $8.0 million due to an increase in research and development headcount necessary to invest in current or expanding platforms and to develop new prospective collaborations and other partnering opportunities. Depreciation and amortization increased $5.8 million primarily as a result of (i) the amortization of developed technology acquired from Oxitec, which began in November 2016 upon the completion of certain operational and regulatory events, and (ii) the amortization of developed technology acquired from GenVec in June 2017. Rent and utilities expenses increased $3.3 million due to the expansion of certain facilities to support our increased headcount.

Selling, general and administrative expenses

SG&A expenses increased $3.8 million, or 3 percent, over the year ended December 31, 2016. Salaries, benefits and other personnel costs increased $4.2 million primarily due to increased headcount to support our expanding operations. Legal and professional fees increased $4.2 million primarily due to (i) increased legal fees to defend ongoing litigation and to support our evolving corporate strategy and (ii) consulting fees related to potential business opportunities and public relations. These increases were partially offset by $4.3 million in litigation expenses recorded in 2016 arising from the entrance of a court order in our trial with XY.

Impairment loss

Impairment loss for the year ended December 31, 2017 of $16.8 million resulted from our annual test for goodwill and indefinite-lived intangible asset impairment in the fourth quarter. Based on the price per share received by AquaBounty in its recent underwritten public offering, we determined that it was more likely than not that the fair value of our AquaBounty reporting unit was less than the carrying value and recorded a $13.0 million impairment charge representing the estimated excess of carrying value over fair value of this reporting unit. Additionally, in the fourth quarter of 2017, we decided to forgo further development of certain of our in-process research and development assets and as a result recorded a $3.0 million impairment charge.

Total other income (expense), net

Total other income (expense), net, increased $70.3 million, or 147 percent, over the year ended December 31, 2016. This increase was primarily attributable to (i) the change in fair market value of our equity securities portfolio, investments in preferred stock, and other convertible instruments and (ii) a full year of dividend income from our investment in preferred stock of ZIOPHARM.

Equity in net loss of affiliates

Equity in net loss of affiliates for the years ended December 31, 2017 and 2016 includes our pro-rata share of the net losses of our investments we account for using the equity method of accounting. The $6.8 million, or 32 percent, decrease was primarily due to the temporary redeployment of certain resources away from JV programs towards supporting prospective new platforms and additional collaborations.

Liquidity and capital resources

Sources of liquidity

We have incurred losses from operations since our inception and as of December 31, 2018, we had an accumulated deficit of $1.3 billion. From our inception through December 31, 2018, we have funded our operations principally with proceeds received from private and public equity and debt offerings, cash received from our collaborators and through product and service sales made directly to customers. As of December 31, 2018, we had cash and cash equivalents of $102.8 million and short-term investments of $119.7 million. Cash in excess of immediate requirements is typically invested primarily in money market funds and United States government debt securities in order to maintain liquidity and preserve capital.

We currently generate cash receipts primarily from sales of products and services, reimbursement of research and development services performed by us and from strategic transactions involving our subsidiaries.

Cash flows

The following table sets forth the significant sources and uses of cash for the periods set forth below:

	Year Ended December 31,		
	2018	2017	2016
	(In thousands)		
Net cash provided by (used in):			
Operating activities	$ (124,240)	$ (103,720)	$ (48,988)
Investing activities	(151,213)	104,332	(28,392)
Financing activities	309,795	4,284	12,065
Effect of exchange rate changes on cash, cash equivalents, and restricted cash	295	1,055	(873)
Net increase (decrease) in cash, cash equivalents, and restricted cash	$ 34,637	$ 5,951	$ (66,188)

Cash flows from operating activities:

In 2018, our net loss was $514.7 million, which includes the following significant noncash expenses totaling $440.0 million: (i) $236.7 million of expense related to reacquired in-process research and development previously licensed to certain of our collaborators, (ii) $60.5 million of impairment loss, (iii) $36.3 million of stock-based compensation expense, (iv) $33.1 million of depreciation and amortization expense, (v) $30.2 million of net unrealized and realized losses on our equity securities and preferred stock, (vi) $20.9 million of loss on disposal of assets, (vii) $11.6 million of equity in net loss of affiliates, and (viii) $10.7 million of shares issued as payment for services. These expenses were partially offset by (i) $21.3 million of net changes in deferred income taxes and (ii) $14.8 million of noncash dividend income. Additionally, we had a $20.0 million net increase in our operating assets and liabilities primarily as a result of the recognition of previously deferred revenue.

In 2017, our net loss was $126.8 million, which includes the following significant noncash expenses totaling $114.9 million: (i) $41.6 million of stock-based compensation expense, (ii) $31.1 million of depreciation and amortization expense, (iii) $16.8 million of impairment losses, (iv) $14.3 million of equity in net loss of affiliates, and (v) $11.1 million of shares issued as payment for services. These expenses were partially offset by $16.8 million of noncash dividend income. Additionally, we had a $74.6 million net increase in our operating assets and liabilities.

In 2016, our net loss was $190.3 million, which includes the following significant noncash expenses totaling $157.6 million: (i) $58.9 million of net unrealized and realized losses on our equity securities and preferred stock, (ii) $42.2 million of stock-based compensation expense, (iii) $24.6 million of depreciation and amortization expense, (iv) $21.1 million of equity in net loss of affiliates, and (v) $10.8 million of shares issued as payment for services. These expenses were partially offset by $7.4 million of noncash dividend income. Additionally, we had a $17.7 million net increase in our operating assets and liabilities primarily as a result of the recognition of previously deferred revenue, partially offset by a $10.0 million technology access fee received in cash pursuant to a new collaboration.

Cash flows from investing activities:

During 2018, we used $112.7 million for purchases of short-term investments, net of maturities; $41.6 million for purchases of property, plant and equipment; and $16.6 million for investments in our JVs, and we received $15.5 million in an asset acquisition.

During 2017, we received proceeds of $174.5 million from the maturity of short-term investments, and we used $46.7 million for purchases of property, plant and equipment; $14.2 million for the purchase of a land-based aquaculture facility by AquaBounty; and $11.2 million for investments in our JVs.

During 2016, we used $31.6 million for purchases of property, plant and equipment; $11.5 million for investments in our JVs; $7.2 million to acquire the assets of Old EnviroFlight; $3.0 million for the issuances of notes receivable; and $2.3 million for purchases of equity securities and warrants of certain of our collaborators, and we received $26.7 million of proceeds from the maturity of short-term investments, net of purchases.

Cash flows from financing activities:

During 2018, we received $219.9 million net proceeds from the issuance of long-term debt and $88.0 million net proceeds from public financings.

During 2017, we received $13.7 million proceeds from a private placement of our common stock with an affiliate of Third Security and paid $8.7 million of deferred consideration to former shareholders of acquired businesses.

During 2016, we received $19.2 million from stock option exercises and paid $6.7 million of deferred consideration to former shareholders of an acquired business.

Future capital requirements

Our future capital requirements will depend on many factors, including:

- progress in our research and development programs, as well as the magnitude of these programs;
- the timing, receipt and amount of any payments received in connection with strategic transactions;
- the timing, receipt and amount of upfront, milestone and other payments, if any, from present and future collaborators, if any;
- the timing, receipt and amount of sales and royalties, if any, from our potential products;
- our ability to maintain or improve the volume and pricing of our current product and service offerings and to develop new offerings, including those that may incorporate new technologies;
- costs we might incur to reacquire previously licensed rights for our own development;
- the timing and capital requirements to scale up our various product and service offerings and customer acceptance thereof;
- our ability to maintain and establish additional collaborative arrangements and/or new strategic initiatives;
- the timing of regulatory approval of products of our collaborations and operations;
- the resources, time and cost required for the preparation, filing, prosecution, maintenance and enforcement of patent claims;
- investments we may make in current and future collaborators, including JVs;
- strategic mergers and acquisitions, including both the upfront acquisition cost as well as the cost to integrate, maintain, and expand the strategic target; and
- the costs associated with legal activities, including litigation, arising in the course of our business activities and our ability to prevail in any such legal disputes.

Until such time, if ever, as we can regularly generate positive operating cash flows, we may finance our cash needs through a combination of equity offerings, debt financings, government or other third-party funding, strategic alliances and licensing arrangements. To the extent that we raise additional capital through the sale of equity or convertible debt securities, the ownership interests of our common shareholders will be diluted, and the terms of these securities may include liquidation or other preferences that adversely affect the rights of our common shareholders. Debt financing, if available, may involve agreements that include covenants limiting or restricting our ability to take specific actions, such as incurring additional debt, making capital expenditures or declaring dividends. If we raise additional funds through strategic transactions, collaborations, or licensing arrangements with third parties, we may have to relinquish valuable rights to our technologies, future revenue streams, research programs or product candidates or to grant licenses on terms that may not be favorable to us.

Our consolidated financial statements as of and for the year ended December 31, 2018 have been prepared on the basis that we will continue as a going concern, which contemplates the realization of assets and satisfaction of liabilities in the normal course

of business. Based on our balance of cash, cash equivalents and short-term investments of $222.5 million at December 31, 2018 and recurring losses since inception, there is substantial doubt about our ability to continue as a going concern within one year after the date that our financial statements were issued. Our ability to continue as a going concern will depend on whether we are able to generate positive cash flows through equity or debt financings, strategic collaborations or equity investments in our subsidiaries or platforms, and the continuation of cash revenues from collaborators and customers of our products and services. The consolidated financial statements do not include any adjustments that might result from the outcome of this uncertainty, which could have a material adverse effect on our financial condition. In addition, if we are unable to continue as a going concern, we may be unable to meet our obligations under our existing debt facilities, which could result in an acceleration of our obligation to repay all amounts outstanding under those facilities, and we may be forced to liquidate our assets. In such a scenario, the values we receive for our assets in liquidation or dissolution could be significantly lower than the values reflected in our consolidated financial statements.

If we do not achieve our planned operating results, our ability to continue as a going concern would be jeopardized and we may need to take the following actions to support our liquidity needs in 2019:

- shift our internal investments from subsidiaries and platforms whose potential for value creation is longer-term to near-term opportunities;
- sell certain of our operating subsidiaries to third parties;
- reduce operating expenditures for third-party contractors, including consultants, professional advisors, and other vendors; and
- reduce or delay capital expenditures, including non-essential facility expansions, lab equipment, and information technology projects.

Implementing this plan could have a negative impact on our ability to continue our business as currently contemplated, including, without limitation, delays or failures in our ability to:

- maintain the diversity of our various portfolio offerings;
- develop and commercialize products within planned timelines or at planned scales; and
- invest in new research and development efforts.

Contractual obligations and commitments

The following table summarizes our significant contractual obligations and commitments as of December 31, 2018 and the effects such obligations are expected to have on our liquidity and cash flows in future periods:

	Total	Less Than 1 Year	1-3 Years	3-5 Years	More Than 5 Years
			(In thousands)		
Operating leases	$ 77,910	$ 9,182	$ 19,037	$ 15,534	$ 34,157
Purchase commitments	20,055	9,210	10,845	—	—
Convertible debt (1)	255,290	—	55,290	200,000	—
Cash interest payable on convertible debt	31,500	7,000	14,000	10,500	—
Long-term debt, excluding convertible debt	6,318	559	958	1,862	2,939
Contingent consideration	585	—	585	—	—
Total	$ 391,658	$ 25,951	$ 100,715	$ 227,896	$ 37,096

(1) The convertible debt may be converted to Intrexon common stock or to the common stock of one of our subsidiaries.

In addition to the obligations in the table above, as of December 31, 2018 we also have the following significant contractual obligations described below.

In conjunction with the formation of our JVs, we committed to making future capital contributions subject to certain conditions and limitations. As of December 31, 2018, our remaining capital contribution commitments to our JVs were $14.9 million. These future capital contributions are not included in the table above due to the uncertainty of the timing and amounts of such contributions.

We are party to in-licensed research and development agreements with various academic and commercial institutions where we could be required to make future payments for annual maintenance fees as well as for milestones and royalties we might receive upon commercial sales of products that incorporate their technologies. These agreements are generally subject to termination by us and therefore no amounts are included in the tables above. As of December 31, 2018, we also had research and development commitments with third parties totaling $11.9 million that had not yet been incurred.

In January 2009, AquaBounty was awarded a grant to provide funding of a research and development project from the Atlantic Canada Opportunities Agency, a Canadian government agency. Amounts claimed by AquaBounty must be repaid in the form of a 10 percent royalty on any products commercialized out of this research and development project until fully paid. Because the timing of commercialization is subject to additional regulatory considerations, the timing of repayment is uncertain. AquaBounty claimed all amounts available under the grant, resulting in total long-term debt of $2.1 million on our consolidated balance sheet as of December 31, 2018. This amount is not included in the table above due to the uncertainty of the timing of repayment.

Net operating losses

As of December 31, 2018, we had net operating loss carryforwards of approximately $369.1 million for United States federal income tax purposes available to offset future taxable income, including $116.6 million generated after 2017, and United States federal and state research and development tax credits of approximately $7.9 million, prior to consideration of annual limitations that may be imposed under Section 382. Carryforwards generated prior to 2018 begin to expire in 2022. Our direct foreign subsidiaries have foreign loss carryforwards of approximately $159.8 million, most of which do not expire. Excluding certain deferred tax liabilities totaling $7.2 million, our remaining net deferred tax assets, which primarily relate to these loss carryforwards, are offset by a valuation allowance due to our history of net losses.

As a result of our past issuances of stock, as well as due to prior mergers and acquisitions, certain of our net operating losses have been subject to limitations pursuant to Section 382. As of December 31, 2018, Intrexon has utilized all net operating losses subject to Section 382 limitations, other than those losses inherited via acquisitions. As of December 31, 2018, approximately $41.9 million of domestic net operating losses were inherited via acquisitions and are limited based on the value of the target at the time of the transaction. Future changes in stock ownership may also trigger an ownership change and, consequently, a Section 382 limitation.

We do not file a consolidated income tax return with AquaBounty. As of December 31, 2018, AquaBounty had loss carryforwards for federal and foreign income tax purposes of approximately $37.8 million, including $9.4 million generated after 2017, and $14.0 million, respectively, and foreign research tax credits of $2.6 million available to offset future taxable income, prior to consideration of annual limitations that may be imposed under Section 382 or analogous foreign provisions. Carryforwards generated prior to 2018 began to expire in 2018. As a result of our ownership in AquaBounty passing 50 percent in 2013, an annual Section 382 limitation of approximately $0.9 million per year will apply to losses and credits carried forward by AquaBounty from prior years, which are also subject to prior Section 382 limitations.

The Tax Act introduced certain limitations on utilization of net operating losses that are generated after 2017, generally limiting utilization of those losses to 80 percent of future annual taxable income. However, losses generated after 2017 will generally have an indefinite carryforward period.

Off-balance sheet arrangements

We did not have during the periods presented, and we do not currently have, any off-balance sheet arrangements, other than operating leases and purchase commitments as mentioned above, as defined under SEC rules. On January 1, 2019, we are adopting Accounting Standards Update 2016-02, *Leases (Topic 842)*, or ASU 2016-02. Upon adoption of ASU 2016-02, we expect to recognize right-of-use assets and lease liabilities for operating leases within a range of $42.0 million to $47.0 million.

Critical accounting policies and estimates

Our management's discussion and analysis of our financial condition and results of operations is based on our consolidated financial statements, which we have prepared in accordance with U.S. GAAP. The preparation of these consolidated financial

statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the financial statements, as well as the reported revenues and expenses during the reporting periods. We evaluate these estimates and judgments on an ongoing basis. We base our estimates on historical experience and on various other factors that we believe are reasonable under the circumstances, the results of which form the basis for making judgments about the carrying value of assets and liabilities that are not readily apparent from other sources. Our actual results may differ from these estimates under different assumptions or conditions.

While our significant accounting policies are more fully described in "Notes to the Consolidated Financial Statements - Note 2" appearing elsewhere in this Annual Report, we believe that the following accounting policies are the most critical for fully understanding and evaluating our financial condition and results of operations.

Revenue recognition (for the year ended December 31, 2018)

Effective January 1, 2018, we apply ASC 606. Under ASC 606, we recognize revenue when our customer obtains control of the promised goods or services, in an amount that reflects the consideration that we expect to receive in exchange for those goods or services. To determine revenue recognition for arrangements that are within the scope of ASC 606, we perform the following five steps: (i) identify the contract(s) with a customer, (ii) identify the promises and distinct performance obligations in the contract, (iii) determine the transaction price, (iv) allocate the transaction price to the performance obligations in the contract, and (v) recognize revenue when (or as) we satisfy the performance obligations.

Collaboration and licensing revenues

We generate collaboration and licensing revenues through the execution of agreements with collaborators, known as ECCs, and licensing agreements whereby the collaborators or the licensee obtain exclusive access to our proprietary technologies for use in the research, development and commercialization of products and/or treatments in a contractually specified field of use. Generally, the terms of these agreements provide that we receive some or all of the following: (i) upfront payments upon consummation of the agreement; (ii) reimbursements for costs incurred by us for research and development and/or manufacturing efforts related to specific applications provided for in the agreement; (iii) milestone payments upon the achievement of specified development, regulatory and commercial activities; and (iv) royalties on sales of products arising from the collaboration or licensing agreement. The agreement typically continues in perpetuity unless terminated and each of our collaborators retains a right to terminate the agreement upon providing us written notice a certain period of time prior to such termination, generally 90 days.

Our collaboration and licensing agreements typically contain multiple promises, including technology licenses, research and development services and in certain cases manufacturing services. We determine whether each of the promises is a distinct performance obligation. As the nature of the promises in our collaboration and licensing agreements are highly integrated and interrelated, we typically combine most of our promises into a single performance obligation. Because we are performing research and development services during early-stage development, the services are integral to the utilization of the technology license. Therefore, we have determined that the technology license and research and development services are typically inseparable from each other during the performance period of our collaboration and licensing agreements. Contingent manufacturing services that may be provided under certain of our agreements are considered to be a separate future contract and not part of the current collaboration or licensing agreement.

At contract inception, we determine the transaction price, including fixed consideration and any estimated amounts of variable consideration. The upfront payment received upon consummation of the agreement is fixed and nonrefundable. Variable consideration is subject to a constraint and amounts are included in the transaction price to the extent that it is probable that a significant reversal in the amount of cumulative revenue recognized will not occur when the uncertainty associated with the variable consideration is subsequently resolved. Variable consideration may include reimbursements for costs incurred by us for research and development efforts; milestone payments upon the achievement of certain development, regulatory and commercial activities; and royalties on sales of products arising from the collaboration or licensing agreement. We determine the initial transaction price and exclude variable consideration that is otherwise constrained pursuant to the guidance in ASC 606.

The transaction price is allocated to the performance obligations in the agreement based on the standalone selling price of each performance obligation. We typically group the promises in our collaboration and licensing agreements into one performance obligation so the entire transaction price relates to this single performance obligation. The technology license included in the single performance obligation is considered a functional license. However, it is typically combined into a single performance obligation as we provide interrelated research and development services along with other obligations over an estimated period of performance. We utilize judgment to determine the most appropriate method to measure our progress of performance under

the agreement, primarily based on inputs necessary to fulfill the performance obligation. We evaluate our measure of progress to recognize revenue each reporting period and, if necessary, adjust the measure of performance and related revenue recognition. Our measure of performance and revenue recognition involves significant judgment and assumptions, including, but not limited to, estimated costs and timelines to complete our performance obligations. We evaluate modifications and amendments to our contracts to determine whether any changes should be accounted for prospectively or on a cumulative catch-up basis.

Payments received for cost reimbursements for research and development efforts are recognized as revenue as the services are performed, in connection with the single performance obligation discussed above. The reimbursements relate specifically to our efforts to provide services and the reimbursements are consistent with what we would typically charge other collaborators for similar services.

We assess the uncertainty of when and if the milestone will be achieved to determine whether the milestone is included in the transaction price. We then assess whether the revenue is constrained based on whether it is probable that a significant reversal of revenue would not occur when the uncertainty is resolved.

Royalties, including sales-based milestones, received under the agreements will be recognized as revenue when sales have occurred because we apply the sales- or usage-based royalties recognition exception provided for under ASC 606. We determined the application of this exception is appropriate because at the time the royalties are generated, the technology license granted in the agreement is the predominant item to which the royalties relate.

As we receive upfront payments in our collaboration and licensing agreements, we evaluate whether any significant financing components exist in our collaboration and licensing agreements. Based on the nature of our collaboration and licensing agreements, there are no significant financing components as the purpose of the upfront payment is not to provide financing. The purpose is to provide the collaborator with assurance that we will complete our obligations under the contract or to secure the right to a specific product or service at the collaborator's discretion. In addition, the variable payments generally align with the timing of performance or the timing of the consideration varies on the basis of the occurrence or nonoccurrence of a future event that is not substantially within the control of the collaborator or us.

From time to time, we and certain collaborators may cancel our agreements, relieving us of any further performance obligations under the agreement. Upon such cancellation or when we have determined no further performance obligations are required of us under an agreement, we recognize any remaining deferred revenue.

We recognized $76.9 million of collaboration and licensing revenues in the year ended December 31, 2018. As of December 31, 2018, we have $63.3 million of deferred revenue related to our receipt of upfront and milestone payments.

Product and service revenues

We generate product and service revenues primarily through sales of products and services that are created from technologies developed or owned by us. Our current offerings include sales of advanced reproductive technologies, including our bovine embryo transfer and in vitro fertilization processes and from genetic preservation and sexed semen processes and applications of such processes to other livestock, as well as sales of livestock and embryos produced using these processes and used in production. As each promised product or service is distinct, we recognize the transaction price as revenue when control of the promised product is transferred to the customer or when the promised service is rendered. Payment terms are typically due within 30 days. We recognized $80.7 million of these product and service revenues for the year ended December 31, 2018.

Revenue recognition (for the years ended December 31, 2017 and 2016)

Collaboration and licensing revenues

We generate collaboration and licensing revenue through collaboration and licensing agreements whereby the collaborators or the licensees obtain exclusive access to our proprietary technologies for use in the research, development and commercialization of products and/or treatments in a contractually specified field of use. Generally, the terms of these agreements provide that we receive some or all of the following: (i) upfront payments upon consummation of the agreement; (ii) reimbursements for costs incurred by us for research and development and/or manufacturing efforts related to specific applications provided for in the agreement; (iii) milestone payments upon the achievement of specified development, regulatory and commercial activities; and (iv) royalties on sales of products arising from the collaboration or licensing agreement.

Our collaborations and licensing agreements typically contain multiple elements, or deliverables, including technology licenses, research and development services, and in certain cases manufacturing services. We identify the deliverables within the agreements and evaluate which deliverables represent separate units of accounting. Analyzing the agreements to identify deliverables requires the use of judgment. A deliverable is considered a separate unit of accounting when the deliverable has value to the collaborator or licensee on a standalone basis based on the consideration of the relevant facts and circumstances for each agreement.

Consideration received is allocated at the inception of the agreement to all identified units of accounting based on their relative selling price. When available, the relative selling price for each deliverable is determined using vendor specific objective evidence, or VSOE, of the selling price or third-party evidence of the selling price, if VSOE does not exist. If neither VSOE nor third-party evidence of the selling price exists, we use our best estimate of the selling price for the deliverable. The amount of allocable consideration is limited to amounts that are fixed or determinable. The consideration received is allocated among the separate units of accounting, and the applicable revenue recognition criteria are applied to each of the separate units. We recognize the revenue allocated to each unit of accounting as we deliver the related goods or services. If we determine that certain deliverables should be treated as a single unit of accounting, then the revenue is recognized using either a proportional performance or straight-line method, depending on whether we can reasonably estimate the level of effort required to complete our performance obligations under an arrangement and whether such performance obligations are provided on a best-efforts basis. As we cannot reasonably estimate our performance obligations related to our collaborators or licensees, we recognize revenue on a straight-line basis over the period we expect to complete our performance obligations, which is reevaluated each reporting period.

The terms of our agreements may provide for milestone payments upon achievement of certain defined events. We apply the Milestone Method for recognizing milestone payments. Under the Milestone Method, we recognize consideration that is contingent upon the achievement of a milestone in its entirety as revenue in the period in which the milestone is achieved only if the milestone is substantive in its entirety. A milestone is considered substantive when it meets all of the following criteria:

- The consideration is commensurate with either the entity's performance to achieve the milestone or the enhancement of the value of the delivered item or items as a result of a specific outcome resulting from the entity's performance to achieve the milestone;
- The consideration relates solely to past performance; and
- The consideration is reasonable relative to all of the deliverables and payment terms within the arrangement.

In the event that a milestone is not considered substantive, we recognize the milestone consideration as revenue using the same method applied to the upfront payments.

Research and development services are a deliverable satisfied by us in accordance with the terms of the collaboration and licensing agreements and we consider these services to be inseparable from the license to the core technology; therefore, reimbursements of services performed are recognized as revenue. Because reimbursement (i) is contingent upon performance of the services by us, (ii) does not include a profit component and (iii) does not relate to any future deliverable, the revenue is recognized during the period in which the related services are performed and collection of such amounts is reasonably assured. Payments received for manufacturing services will be recognized when the earnings process related to the manufactured materials has been completed. Royalties to be received under the agreements will be recognized as earned.

From time to time, we and certain collaborators may cancel the agreements, relieving us of any further performance obligations under the agreement. When no further performance obligations are required of us under an agreement, we recognize any remaining deferred revenue.

We recognized $145.6 million and $109.9 million of collaboration and licensing revenues in the years ended December 31, 2017 and 2016, respectively. As of December 31, 2017, we have $230.5 million of deferred revenue related to our receipt of upfront and milestone payments.

Product and service revenues

We generate product and service revenues primarily through sales of products or services that are created from technologies developed or owned by us. Our current offerings include sales of advanced reproductive technologies, including our bovine embryo transfer and in vitro fertilization processes and from genetic preservation and sexed semen processes and applications of such processes to other livestock, as well as sales of livestock and embryos produced using these processes and used in

production. Revenue is recognized when (i) persuasive evidence of an arrangement exists, (ii) services have been rendered or delivery has occurred such that risk of loss has passed to the customer, (iii) the price is fixed or determinable, and (iv) collection from the customer is reasonably assured. We recognized $82.3 million, and $77.9 million of these product and service revenues for the years ended December 31, 2017 and 2016, respectively.

Investments in preferred stock

We hold preferred stock in certain of our collaborators, some of which may be converted to common stock as described in "Notes to the Consolidated Financial Statements - Note 7" appearing elsewhere in this Annual Report. We elected the fair value option to account for our investments in preferred stock whereby the value of preferred stock is adjusted to fair value as of each reporting date and unrealized gains and losses are reported in the consolidated statements of operations. These investments are subject to fluctuation in the future due to, among other things, the likelihood and timing of conversion of certain of the preferred stock into common stock, the volatility of each collaborator's common stock, and changes in general economic and financial conditions of the collaborators. These Level 3 investments are classified as noncurrent in the consolidated balance sheet since we do not intend to sell the investment nor expect the investments that are convertible into common stock to be converted within one year. In conjunction with the ZIOPHARM License Agreement in October 2018, our ZIOPHARM preferred shares, valued at $158.3 million, were returned to ZIOPHARM. As of December 31, 2018 and 2017, our investments in preferred stock are valued at $0.2 million and $161.2 million, respectively.

We are entitled to monthly dividends and record dividend income. We recorded $14.8 million and $16.8 million of dividend income in 2018 and 2017, respectively, most of which was related to our investment in ZIOPHARM preferred stock.

Valuation allowance for net deferred tax assets

We record a valuation allowance to offset any net deferred tax assets if, based upon the available evidence, it is more likely than not that we will not recognize some or all of the deferred tax assets. We have had a history of net losses since inception, and as a result, we have established a 100 percent valuation allowance for our net domestic and certain foreign deferred tax assets. If circumstances change and we determine that we will able to realize some or all of these net deferred tax assets in the future, we will record an adjustment to the valuation allowance.

Additionally, enacted changes in domestic or foreign tax rates, such as those as part of the Tax Act, that require remeasurement of our deferred tax assets and liabilities, also require remeasurement of our valuation allowance.

Consolidation of variable interest entities

We identify entities that (i) that do not have sufficient equity investment at risk to permit the entity to finance its activities without additional subordinated financial support, or (ii) in which the equity investors lack an essential characteristic of a controlling financial interest as variable interest entities, or VIEs. We perform an initial and on-going evaluation of the entities with which we have variable interests to determine if any of these entities are VIEs. If an entity is identified as a VIE, we perform an assessment to determine whether we have both: (i) the power to direct activities that most significantly impact the VIE's economic performance, and (ii) have the obligation to absorb losses from or the right to receive benefits of the VIE that could potentially be significant to the VIE. If both of these criteria are satisfied, we are identified as the primary beneficiary of the VIE. As of December 31, 2018 and 2017, we determined that certain of our collaborators and JVs as well as Harvest were VIEs. We were not the primary beneficiary for these entities since we did not have the power to direct the activities that most significantly impact the economic performance of the VIEs. Our aggregate investment balance of these VIEs as of December 31, 2018 and 2017, was $21.2 million and $185.3 million, respectively, which represents our maximum risk of loss related to the identified VIEs.

Valuation of goodwill and long-lived assets

We evaluate long-lived assets to be held and used, which include property, plant and equipment and intangible assets subject to amortization, for impairment whenever events or changes in circumstances indicate that the carrying amount of the assets may not be recoverable. Conditions that would necessitate an impairment assessment include a significant decline in the observable market value of an asset, a significant change in the extent or manner an asset is used, or a significant adverse change that would indicate that the carrying amount of an asset or group of assets is not recoverable.

Goodwill is tested for impairment annually, or more frequently if events or circumstances between annual tests indicate that the assets may be impaired. Impairment losses on goodwill are recognized based solely on a comparison of their fair value to carrying value, without consideration of any recoverability test.

During the years ended December 31, 2018 and 2017, we recorded $60.5 million and $16.8 million, respectively, of impairment charges to write down the values of goodwill and intangible assets recorded in certain of our prior acquisitions. See additional discussion regarding this impairment in "Notes to the Consolidated Financial Statements - Note 11" appearing elsewhere in this Annual Report.

Recent accounting pronouncements

See "Notes to the Consolidated Financial Statements - Note 2" appearing elsewhere in this Annual Report for a description of recent accounting pronouncements applicable to our business, which is incorporated herein by reference.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk

The following sections provide quantitative information on our exposure to interest rate risk, stock price risk, and foreign currency exchange risk. We make use of sensitivity analyses that are inherently limited in estimating actual losses in fair value that can occur from changes in market conditions.

Interest rate risk

We had cash, cash equivalents and short-term investments of $222.5 million and $74.4 million as of December 31, 2018 and 2017, respectively. Our cash and cash equivalents and short-term investments consist of cash, money market funds, United States government debt securities, and certificates of deposit. The primary objectives of our investment activities are to preserve principal, maintain liquidity and maximize income without significantly increasing risk. Our investments consist of United States government debt securities and certificates of deposit, which may be subject to market risk due to changes in prevailing interest rates that may cause the fair values of our investments to fluctuate. We believe that a hypothetical 100 basis point increase in interest rates would not materially affect the fair value of our interest-sensitive financial instruments and any such losses would only be realized if we sold the investments prior to maturity.

Investments in publicly traded companies' common stock

As of December 31, 2018, we owned 8,239,199 shares or approximately 55 percent of the common stock of AquaBounty, which is traded on the NASDAQ Stock Market. The fair value of our investment in AquaBounty as of December 31, 2018 and 2017, based on AquaBounty's quoted closing price on the NASDAQ Stock Market, was $16.9 million and $18.2 million, respectively. The fair value of our investment in AquaBounty as of December 31, 2018 would be approximately $18.6 million and $13.5 million, respectively, based on a hypothetical 10 percent increase or 20 percent decrease in the share price of AquaBounty. The fair value of our investment in AquaBounty as of December 31, 2017 would be approximately $20.0 million and $14.6 million, respectively, based on a hypothetical 10 percent increase or 20 percent decrease in the share price of AquaBounty.

Foreign currency exchange risk

We have international subsidiaries in a number of countries, including Belgium, Brazil, Canada, Hungary, and the United Kingdom. These subsidiaries' assets, liabilities, and current revenues and expenses are denominated in their respective foreign currency. We do not hedge our foreign currency exchange rate risk. The effect of a hypothetical 10 percent change in foreign currency exchange rates applicable to our business would not have a material impact on our consolidated financial statements.

Item 8. Financial Statements and Supplementary Data

The information required by this Item 8 is contained on pages F-1 through F-60 of this Annual Report and is incorporated herein by reference.

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure

None.

Item 9A. Controls and Procedures

Evaluation of Disclosure Controls and Procedures

Management, with the participation of our chief executive officer and our chief financial officer, evaluated the effectiveness of our disclosure controls and procedures as of December 31, 2018. The term "disclosure controls and procedures," as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act means controls and other procedures of a company that are designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC's rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the company's management, including its principal executive and principal financial officers, as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on their evaluation of our disclosure controls and procedures as of December 31, 2018, our chief executive officer and chief financial officer have concluded that, as of such date, our disclosure controls and procedures were effective at the reasonable assurance level.

Management's Annual Report on Internal Control Over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting as such term is defined in Rules 13a-15(f) and Rule 15d-15(f) of the Exchange Act. Our internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. Our internal control over financial reporting includes those policies and procedures that:

(i) pertain to the maintenance of records that in reasonable detail accurately and fairly reflect the transactions and dispositions of our assets;

(ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of consolidated financial statements in accordance with generally accepted accounting principles, and that our receipts and expenditures are being made only in accordance with authorizations of our management and directors; and

(iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of our assets that could have a material effect on the consolidated financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions or that the degree of compliance with the policies or procedures may deteriorate.

Our management assessed the effectiveness of our internal control over financial reporting as of December 31, 2018. In making this assessment, our management used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in *Internal Control - Integrated Framework* (2013). Based on this evaluation, management concluded that our internal control over financial reporting was effective as of December 31, 2018.

PricewaterhouseCoopers LLP, an independent registered public accounting firm, has audited the effectiveness of our internal control over financial reporting as of December 31, 2018, as stated in their report, which is included in Part II Item 8 of this Annual Report.

Remediation of Material Weakness in Internal Control Over Financial Reporting

A material weakness if a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of the annual or interim financial statements will not be prevented or detected on a timely basis.

During the second quarter of 2018, we identified and disclosed a material weakness in our internal control over financial reporting relating to controls over the adoption of ASC 606. Specifically, we did not design controls which were sufficiently precise to identify and account for the impacts of adopting ASC 606 on our open ECCs, including gross versus net presentation for payments pursuant to one of our contracts, the guidance for contract modifications to a contract that had been modified prior to the adoption of ASC 606, and the measurement of progress for performance obligations satisfied over time. This

control deficiency resulted in the misstatement of accumulated deficit, deferred revenue, and collaboration and licensing revenues, and restatement of our consolidated financial statements for the quarter ended March 31, 2018. To remediate the material weakness described above, we (i) engaged third-party technical accounting advisors on complex matters that fell within the scope of ASC 606; (ii) designed and implemented a more precise review framework whereby our advisors provided, and we reviewed, a more detailed assessment of how ASC 606 applies to all key elements of our contracts with customers; (iii) designed and implemented controls, including a comprehensive review of such deliverables and conclusions by management via a sufficiently detailed analysis of the relevant contracts, amendments, accounting guidance and related interpretations; and (iv) designed and implemented controls related to the ongoing revenue recognition accounting for our ECCs.

During the fourth quarter of 2018, we completed the testing of the changes noted above. Based on the evidence obtained in validating the design and operating effectiveness of these controls, we concluded that these changes to our controls and procedures have remediated the material weakness in our internal control over financial reporting as of December 31, 2018.

Changes in Internal Control Over Financial Reporting

There have been no changes in our internal control over financial reporting during the quarter ended December 31, 2018 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

Item 9B. Other Information

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance

The information required by this item is hereby incorporated by reference to our Definitive Proxy Statement relating to our 2019 Annual Meeting of Shareholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

Our board of directors has adopted a Code of Business Conduct and Ethics applicable to all officers, directors and employees, which is available on our website (*investors.dna.com*) under "Corporate Governance." We will provide a copy of this document, without charge, upon request, by writing to us at Intrexon Corporation, 20374 Seneca Meadows Parkway, Germantown, Maryland 20876, Attention: Investor Relations. We intend to satisfy the disclosure requirement under Item 5.05 of Form 8-K regarding amendment to, or waiver from, a provision of our Code of Business Conduct and Ethics by posting such information on our website at the address and location specified above.

Item 11. Executive Compensation

The information required by this item is hereby incorporated by reference to our Definitive Proxy Statement relating to our 2019 Annual Meeting of Shareholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters

The information required by this item is hereby incorporated by reference to our Definitive Proxy Statement relating to our 2019 Annual Meeting of Shareholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

Item 13. Certain Relationships and Related Transactions, and Director Independence

The information required by this item is hereby incorporated by reference to our Definitive Proxy Statement relating to our 2019 Annual Meeting of Shareholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

Item 14. Principal Accounting Fees and Services

The information required by this item is hereby incorporated by reference to our Definitive Proxy Statement relating to our 2019 Annual Meeting of Shareholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

PART IV

Item 15. Exhibits, Financial Statement Schedules

(a) The following consolidated financial statements of Intrexon Corporation and its subsidiaries, and the independent registered public accounting firm reports thereon, are included in Part II, Item 8 of this Annual Report:

1. Financial Statements.

Consolidated Financial Statements of Intrexon Corporation and Subsidiaries

Report of Independent Registered Public Accounting Firm

Consolidated Balance Sheets as of December 31, 2018 and 2017

Consolidated Statements of Operations for the Years Ended December 31, 2018, 2017, and 2016

Consolidated Statements of Comprehensive Loss for the Years Ended December 31, 2018, 2017, and 2016

Consolidated Statements of Shareholders' and Total Equity for the Years Ended December 31, 2018, 2017 and 2016

Consolidated Statements of Cash Flows for the Years Ended December 31, 2018, 2017, and 2016

Notes to the Consolidated Financial Statements

2. Financial Statement Schedules.

All financial statement schedules have been omitted because either the required information is not applicable or the information required is included in the consolidated financial statements and notes thereto included in this Annual Report.

3. Exhibits.

The exhibits are listed in Item 15(b) below.

(b) Exhibits

The following exhibits are filed with this Annual Report or incorporated by reference:

Exhibit No.	Description
1.1*	Controlled Equity OfferingSM Sales Agreement between Intrexon and Cantor Fitzgerald & Co., dated November 11, 2015 (11)
2.1*	Agreement and Plan of Merger, dated as of January 24, 2017, by and among Intrexon, GenVec and Intrexon GV Holding, Inc. (18)
3.1*	Amended and Restated Articles of Incorporation (3)
3.1A*	Articles of Amendment to the Amended and Restated Articles of Incorporation (21)
3.2*	Amended and Restated Bylaws (12)
4.1*	Specimen certificate evidencing shares of common stock (2)
4.2*	Form of Second Amended and Restated Warrant to Purchase Shares of Common Stock (2)
4.3*	Eighth Amended and Restated Investors' Rights Agreement, dated March 1, 2013, by and among Intrexon and the holders of the Company's preferred stock and certain holders of Intrexon's common stock and Joinder thereto (1)

4.4*	Base Indenture, dated July 3, 2018, by and between Intrexon Corporation and The Bank of New York Mellon Trust Company, N.A. (26)
4.5*	First Supplemental Indenture (including the form of 3.50% convertible senior notes due 2023), dated July 3, 2018, by and between Intrexon Corporation and The Bank of New York Mellon Trust Company, N.A. (26)
10.1†*	Intrexon Corporation Amended and Restated 2008 Equity Incentive Plan (2)
10.2†*	Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, effective as of June 9, 2014 (7)
10.2A†*	Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, Form of Restricted Stock Agreement (7)
10.2B†*	Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, Form of Incentive Stock Option Agreement (7)
10.2C†*	Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, Form of Nonqualified Stock Option Agreement (7)
10.2D†*	Amendment to the Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, effective as of June 11, 2015 (9)
10.2E†*	Amendment to the Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, effective as of June 9, 2016 (13)
10.2F†*	Amendment to the Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, effective as of June 28, 2017 (19)
10.2G†*	Amendment to the Intrexon Corporation Amended and Restated 2013 Omnibus Incentive Plan, as amended, effective as of June 7, 2018 (25)
10.2H†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Restricted Stock Unit Agreement, by and between Intrexon and Randal J. Kirk, effective as of November 1, 2015 (10)
10.2I†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Restricted Stock Unit Agreement, by and between Intrexon and Randal J. Kirk, effective as of November 1, 2016 (15)
10.2J†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Restricted Stock Unit Agreement, by and between Intrexon and Randal J. Kirk, dated as of December 30, 2016 (16)
10.2K†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Restricted Stock Unit Agreement, by and between Intrexon and Randal J. Kirk, effective as of April 1, 2017 (17)
10.2L†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Restricted Stock Unit Agreement, by and between Intrexon Corporation and Randal J. Kirk, effective as of April 1, 2018 (24)
10.2M†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Form of Restricted Stock Unit Agreement for Officers (23)
10.2N†*	Intrexon Corporation 2013 Amended and Restated Omnibus Incentive Plan, as amended, Form of Restricted Stock Unit Agreement for Directors (23)
10.3*	Exclusive Channel Partner Agreement, dated as of January 6, 2011, between Intrexon and ZIOPHARM Oncology, Inc., as amended (1)
10.3A*	Second Amendment to Exclusive Channel Partner Agreement, dated March 27, 2015, between Intrexon and ZIOPHARM Oncology, Inc. (8)
10.3B*	Third Amendment to Exclusive Channel Partner Agreement by and between ZIOPHARM Oncology, Inc. and Intrexon Corporation dated as of June 29, 2016 (14)
10.3C*	Amendment to Exclusive Channel Collaboration Agreement by and between ZIOPHARM Oncology, Inc. and Intrexon Corporation dated as of June 29, 2016 (14)
10.4#*	Exclusive Channel Collaboration Agreement, dated as of February 14, 2013, between Intrexon and AquaBounty Technologies, Inc. (1)
10.5*	Relationship Agreement, dated as of December 5, 2012, between Intrexon and AquaBounty Technologies, Inc. (1)
10.6#*	Exclusive Channel Collaboration Agreement, dated as of March 29, 2013, between Intrexon and Genopaver, LLC (1)

10.7†*	Second Amended and Restated Employment Agreement, dated as of August 31, 2006, between Intrexon and Thomas D. Reed (2)
10.8#*	Exclusive Channel Collaboration Agreement, dated as of March 26, 2014, by and between Intrexon Corporation and Intrexon Energy Partners, LLC (4)
10.9#*	Amended and Restated Limited Liability Company Agreement of Intrexon Energy Partners, LLC, dated as of March 26, 2014, by and among Intrexon and the parties thereto (4)
10.10*	Letter Agreement by and between ZIOPHARM Oncology, Inc., Intrexon and The University of Texas System Board of Regents on behalf of The University of Texas MD Anderson Cancer Center, dated as of January 9, 2015 (5)
10.11*	Securities Issuance Agreement by and among Intrexon, The University of Texas System Board of Regents on behalf of The University of Texas MD Anderson Cancer Center dated as of January 13, 2015 (5)
10.12*	Securities Issuance Agreement by and among Intrexon, The University of Texas System Board of Regents on behalf of The University of Texas MD Anderson Cancer Center dated as of January 13, 2015 (5)
10.13*	Registration Rights Agreement by and among Intrexon, The University of Texas System Board of Regents on behalf of The University of Texas MD Anderson Cancer Center dated as of January 13, 2015 (5)
10.14#*	License Agreement by and among ZIOPHARM Oncology, Inc., Intrexon and The University of Texas System Board of Regents on behalf of The University of Texas MD Anderson Cancer Center, dated as of January 13, 2015 (6)
10.15#*	License Agreement, dated October 5, 2018, by and between Precigen, Inc. and ZIOPHARM Oncology, Inc. (27)
10.16#*	License and Collaboration Agreement, dated as of March 27, 2015, among Intrexon, ARES Trading S.A. and ZIOPHARM Oncology, Inc. (8)
10.17†*	Intrexon Corporation Annual Executive Incentive Plan, adopted as of April 29, 2015 (9)
10.18*	Services Agreement, by and between Intrexon Corporation and Third Security, LLC, effective as of November 1, 2015 (10)
10.18A*	First Amendment to Services Agreement, by and between Intrexon Corporation and Third Security, LLC, effective as of October 31, 2016 (15)
10.18B*	Second Amendment to Services Agreement, by and between Intrexon Corporation and Third Security, LLC, effective as of December 30, 2016 (16)
10.18C*	Third Amendment to Services Agreement, by and between Intrexon Corporation and Third Security, LLC, dated as of December 28, 2017 (22)
10.19*	Share Lending Agreement, dated June 28, 2018, by and between Intrexon Corporation, J.P. Morgan Securities LLC and JPMorgan Chase Bank, National Association, New York Branch (26)
10.20†*	Preferred Stock Equity Facility Agreement, dated October 16, 2017, by and between Kapital Joe, LLC and Intrexon Corporation (20)
10.21†*	Termination of Preferred Stock Equity Facility Agreement, dated June 28, 2018 (26)
10.22#**	Securities Purchase, Assignment and Assumption Agreement, dated December 19, 2018, by and between Intrexon Corporation, ARES TRADING S.A. and Precigen, Inc.
10.23#**	Convertible Note issued to ARES TRADING S.A., dated December 28, 2018
21.1	List of Subsidiaries of Intrexon Corporation
23.1	Consent of PricewaterhouseCoopers LLP
31.1	Certification of Randal J. Kirk, Chairman and Chief Executive Officer (Principal Executive Officer) of Intrexon Corporation, pursuant to Rules 13a-14(a) and 15d-14(a) promulgated under the Securities Exchange Act of 1934, as amended, as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002
31.2	Certification of Rick L. Sterling, Chief Financial Officer (Principal Financial Officer) of Intrexon Corporation, pursuant to Rules 13a-14(a) and 15d-14(a) promulgated under the Securities Exchange Act of 1934, as amended, as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002

32.1**	Certification of Randal J. Kirk, Chairman and Chief Executive Officer (Principal Executive Officer) of Intrexon Corporation, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
32.2**	Certification of Rick L. Sterling, Chief Financial Officer (Principal Financial Officer) of Intrexon Corporation, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
101**	Interactive Data File (Intrexon Corporation and Subsidiaries Consolidated Financial Statements for the years ended December 31, 2018, 2017 and 2016, formatted in XBRL (eXtensible Business Reporting Language)). Attached as Exhibit 101 are the following documents formatted in XBRL: (i) the Consolidated Balance Sheets as of December 31, 2018 and 2017, (ii) the Consolidated Statements of Operations for the years ended December 31, 2018, 2017 and 2016, (iii) the Consolidated Statements of Shareholders' and Total Equity for the years ended December 31, 2018, 2017 and 2016, (iv) the Consolidated Statements of Cash Flows for the years ended December 31, 2018, 2017 and 2016 and (v) the Notes to the Consolidated Financial Statements.

* Previously filed and incorporated by reference to the exhibit indicated in the following filings by Intrexon:

(1) Registration Statement on Form S-1, filed with the Securities and Exchange Commission on July 9, 2013.

(2) Amendment No. 1 to Registration Statement on Form S-1, filed with the Securities and Exchange Commission on July 29, 2013.

(3) Current Report on Form 8-K, filed with the Securities and Exchange Commission on August 15, 2013.

(4) Current Report on Form 8-K/A, filed with the Securities and Exchange Commission on April 4, 2014.

(5) Current Report on Form 8-K, filed with the Securities and Exchange Commission on January 14, 2015.

(6) Current Report on Form 8-K/A, filed with the Securities and Exchange Commission on January 28, 2015.

(7) Current Report on Form 8-K, filed with the Securities and Exchange Commission on June 13, 2014.

(8) Current Report on Form 8-K, filed with the Securities and Exchange Commission on April 2, 2015.

(9) Current Report on Form 8-K, filed with the Securities and Exchange Commission on June 17, 2015.

(10) Current Report on Form 8-K/A, filed with the Securities and Exchange Commission on November 3, 2015.

(11) Current Report on Form 8-K, filed with the Securities and Exchange Commission on November 12, 2015.

(12) Current Report on Form 8-K, filed with the Securities and Exchange Commission on March 14, 2016.

(13) Current Report on Form 8-K, filed with the Securities and Exchange Commission on June 13, 2016.

(14) Current Report on Form 8-K, filed with the Securities and Exchange Commission on June 30, 2016.

(15) Current Report on Form 8-K, filed with the Securities and Exchange Commission on November 3, 2016.

(16) Current Report on Form 8-K, filed with the Securities and Exchange Commission on December 30, 2016.

(17) Current Report on Form 8-K, filed with the Securities and Exchange Commission on March 31, 2017.

(18) Amendment No. 2 to the Registration Statement on Form S-4, filed with the Securities and Exchange Commission on May 11, 2017.

(19) Current Report on Form 8-K, filed with the Securities and Exchange Commission on June 30, 2017.

(20) Current Report on Form 8-K, filed with the Securities and Exchange Commission on October 16, 2017.

(21) Quarterly Report on Form 10-Q, filed with the Securities and Exchange Commission on November 9, 2017.

(22) Current Report on Form 8-K, filed with the Securities and Exchange Commission on January 2, 2018.

(23) Annual Report on Form 10-K, filed with the Securities and Exchange Commission on March 1, 2018.

(24) Current Report on Form 8-K, filed with the Securities and Exchange Commission on April 5, 2018.

(25) Current Report on Form 8-K, filed with the Securities and Exchange Commission on June 8, 2018.

(26) Current Report on Form 8-K, filed with the Securities and Exchange Commission on July 3, 2018.

(27) Quarterly Report on Form 10-Q, filed with the Securities and Exchange Commission on November 8, 2018.

** Furnished herewith

† Indicates management contract or compensatory plan.

Portions of the exhibit (indicated by asterisks) have been omitted pursuant to a confidential treatment order granted by the Securities and Exchange Commission.

(c) Financial Statement Schedules

The response to Item 15(a)2 is incorporated herein by reference.

Item 16. Form 10-K Summary

None.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, as amended, the Registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

Dated: March 1, 2019

INTREXON CORPORATION

By: /S/ RANDAL J. KIRK
Randal J. Kirk
Chief Executive Officer and Chairman of the Board of Directors

Pursuant to the requirements of the Securities Exchange Act of 1934, as amended, this report has been signed below by the following persons on behalf of the Registrant and in the capacities and on the dates indicated.

Signature	Title	Date
/S/ RANDAL J. KIRK Randal J. Kirk	Chief Executive Officer and Chairman of the Board of Directors (Principal Executive Officer)	3/1/2019
/S/ RICK L. STERLING Rick L. Sterling	Chief Financial Officer (Principal Accounting and Financial Officer)	3/1/2019
/S/ CESAR L. ALVAREZ Cesar L. Alvarez	Director	2/28/2019
/S/ STEVEN FRANK Steven Frank	Director	2/28/2019
/S/ VINITA D. GUPTA Vinita D. Gupta	Director	2/28/2019
/S/ FRED HASSAN Fred Hassan	Director	2/28/2019
/S/ JEFFREY B. KINDLER Jeffrey B. Kindler	Director	2/28/2019
/S/ DEAN J. MITCHELL Dean J. Mitchell	Director	2/28/2019
/S/ ROBERT B. SHAPIRO Robert B. Shapiro	Director	2/28/2019
/S/ JAMES S. TURLEY James S. Turley	Director	2/28/2019

Index to the Financial Statements and Schedules

Intrexon Corporation and Subsidiaries

Consolidated Financial Statements

December 31, 2018, 2017 and 2016

Report of Independent Registered Public Accounting Firm

To the Board of Directors and Shareholders of Intrexon Corporation

Opinions on the Financial Statements and Internal Control over Financial Reporting

We have audited the accompanying consolidated balance sheets of Intrexon Corporation and its subsidiaries (the "Company") as of December 31, 2018 and 2017, and the related consolidated statements of operations, of comprehensive loss, of shareholders' and total equity and of cash flows for each of the three years in the period ended December 31, 2018, including the related notes (collectively referred to as the "consolidated financial statements"). We also have audited the Company's internal control over financial reporting as of December 31, 2018, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

In our opinion, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of the Company as of December 31, 2018 and 2017, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2018 in conformity with accounting principles generally accepted in the United States of America. Also in our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2018, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by the COSO.

Substantial Doubt About the Company's Ability to Continue as a Going Concern

The accompanying consolidated financial statements have been prepared assuming that the Company will continue as a going concern. As discussed in Note 1 to the consolidated financial statements, the Company has suffered recurring losses, cash outflows from operations and has an accumulated deficit that raise substantial doubt about its ability to continue as a going concern. Management's plans in regard to these matters are also described in Note 1. The consolidated financial statements do not include any adjustments that might result from the outcome of this uncertainty.

Change in Accounting Principle

As discussed in Note 2 to the consolidated financial statements, the Company changed the manner in which it accounts for revenues from contracts with customers in 2018.

Basis for Opinions

The Company's management is responsible for these consolidated financial statements, for maintaining effective internal control over financial reporting, and for its assessment of the effectiveness of internal control over financial reporting, included in Management's Annual Report on Internal Control Over Financial Reporting appearing under Item 9A. Our responsibility is to express opinions on the Company's consolidated financial statements and on the Company's internal control over financial reporting based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audits to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud, and whether effective internal control over financial reporting was maintained in all material respects.

Our audits of the consolidated financial statements included performing procedures to assess the risks of material misstatement of the consolidated financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the consolidated financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the consolidated financial statements. Our audit of internal control over financial reporting included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, and testing and evaluating the design and operating effectiveness of internal control based on the assessed risk. Our audits also included performing such other procedures as we considered necessary in the circumstances. We believe that our audits provide a reasonable basis for our opinions.

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ PricewaterhouseCoopers LLP

Raleigh, North Carolina
March 1, 2019

We have served as the Company's auditor since 2006.

Intrexon Corporation and Subsidiaries
Consolidated Balance Sheets
December 31, 2018 and 2017

(Amounts in thousands, except share data)	2018	2017
Assets		
Current assets		
Cash and cash equivalents	$ 102,768	$ 68,111
Restricted cash	6,987	6,987
Short-term investments	119,688	6,273
Equity securities	384	5,285
Receivables		
Trade, net	21,195	19,775
Related parties, net	4,129	17,913
Other, net	2,754	2,153
Inventory	21,447	20,493
Prepaid expenses and other	6,131	7,057
Total current assets	285,483	154,047
Equity securities, noncurrent	1,798	9,815
Investments in preferred stock	191	161,225
Property, plant and equipment, net	128,874	112,674
Intangible assets, net	129,291	232,877
Goodwill	149,585	153,289
Investments in affiliates	18,859	18,870
Other assets	2,096	4,054
Total assets	$ 716,177	$ 846,851

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Balance Sheets
December 31, 2018 and 2017

(Amounts in thousands, except share data)	2018	2017
Liabilities and Total Equity		
Current liabilities		
Accounts payable	$ 13,420	$ 8,701
Accrued compensation and benefits	10,687	6,474
Other accrued liabilities	20,620	21,080
Deferred revenue, including $6,945 and $29,155 from related parties as of December 31, 2018 and 2017, respectively	15,554	42,870
Lines of credit	466	233
Current portion of long-term debt	559	502
Related party payables	256	313
Total current liabilities	61,562	80,173
Long-term debt, net of current portion, including $55,290 to related parties as of December 31, 2018	211,235	7,535
Deferred revenue, net of current portion, including $52,227 and $157,628 from related parties as of December 31, 2018 and 2017, respectively	54,210	193,527
Deferred tax liabilities, net	7,213	15,620
Other long-term liabilities	3,235	3,451
Total liabilities	337,455	300,306
Commitments and contingencies (Note 16)		
Total equity		
Common stock, no par value, 200,000,000 shares authorized as of December 31, 2018 and 2017; and 160,020,466 shares and 122,087,040 shares issued and outstanding as of December 31, 2018 and 2017, respectively	—	—
Additional paid-in capital	1,722,012	1,397,005
Accumulated deficit	(1,330,545)	(847,820)
Accumulated other comprehensive loss	(28,612)	(15,554)
Total Intrexon shareholders' equity	362,855	533,631
Noncontrolling interests	15,867	12,914
Total equity	378,722	546,545
Total liabilities and total equity	$ 716,177	$ 846,851

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Operations
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands, except share and per share data)	2018	2017	2016
Revenues			
Collaboration and licensing revenues, including $60,238, $130,670, and $93,792 from related parties in 2018, 2017, and 2016, respectively	$ 76,869	$ 145,579	$ 109,871
Product revenues	28,528	33,589	36,958
Service revenues	52,419	50,611	43,049
Other revenues	2,758	1,202	1,048
Total revenues	160,574	230,981	190,926
Operating Expenses			
Cost of products	35,698	33,263	37,709
Cost of services	27,589	29,525	23,930
Research and development	404,586	143,207	112,135
Selling, general and administrative	137,807	146,103	142,318
Impairment loss	60,504	16,773	—
Total operating expenses	666,184	368,871	316,092
Operating loss	(505,610)	(137,890)	(125,166)
Other Income (Expense), Net			
Unrealized and realized appreciation (depreciation) in fair value of equity securities and preferred stock	(30,200)	2,586	(58,894)
Interest expense	(8,530)	(611)	(861)
Interest and dividend income	19,084	19,485	10,190
Other income, net	630	1,013	1,700
Total other income (expense), net	(19,016)	22,473	(47,865)
Equity in net loss of affiliates	(11,608)	(14,283)	(21,120)
Loss before income taxes	(536,234)	(129,700)	(194,151)
Income tax benefit	21,528	2,880	3,877
Net loss	$ (514,706)	$ (126,820)	$ (190,274)
Net loss attributable to the noncontrolling interests	5,370	9,802	3,662
Net loss attributable to Intrexon	$ (509,336)	$ (117,018)	$ (186,612)
Net loss attributable to Intrexon per share, basic and diluted	$ (3.93)	$ (0.98)	$ (1.58)
Weighted average shares outstanding, basic and diluted	129,521,731	119,998,826	117,983,836

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Comprehensive Loss
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands)	2018	2017	2016
Net loss	$ (514,706)	$ (126,820)	$ (190,274)
Other comprehensive income (loss):			
Unrealized gain (loss) on investments	(59)	87	430
Gain (loss) on foreign currency translation adjustments	(13,073)	20,599	(23,901)
Comprehensive loss	(527,838)	(106,134)	(213,745)
Comprehensive loss attributable to the noncontrolling interests	5,548	9,764	3,683
Comprehensive loss attributable to Intrexon	$ (522,290)	$ (96,370)	$ (210,062)

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Shareholders' and Total Equity
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands, except share data)	Common Stock Shares	Common Stock Amount	Additional Paid-in Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Intrexon Shareholders' Equity	Noncontrolling Interests	Total Equity
Balances at December 31, 2015	116,658,886	$ —	$1,249,559	$ (12,752)	$ (542,729)	$ 694,078	$ 10,808	$ 704,886
Stock-based compensation expense	—	—	42,108	—	—	42,108	73	42,181
Exercises of stock options and warrants	1,400,146	—	19,165	—	—	19,165	—	19,165
Shares issued as payment for services	434,061	—	10,777	—	—	10,777	—	10,777
Shares issued in asset acquisition	136,340	—	4,401	—	—	4,401	—	4,401
Shares issued as payment for contingent consideration	59,337	—	1,583	—	—	1,583	—	1,583
Acquisition of noncontrolling interest	—	—	(1,813)	—	—	(1,813)	1,813	—
Net loss	—	—	—	—	(186,612)	(186,612)	(3,662)	(190,274)
Other comprehensive loss	—	—	—	(23,450)	—	(23,450)	(21)	(23,471)
Balances at December 31, 2016	118,688,770	$ —	$1,325,780	$ (36,202)	$ (729,341)	$ 560,237	$ 9,011	$ 569,248

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Shareholders' and Total Equity
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands, except share data)	Common Stock Shares	Common Stock Amount	Additional Paid-in Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Intrexon Shareholders' Equity	Noncontrolling Interests	Total Equity
Balances at December 31, 2016	118,688,770	$ —	$1,325,780	$ (36,202)	$ (729,341)	$ 560,237	$ 9,011	$ 569,248
Cumulative effect of adoption of ASU 2016-09	—	—	1,461	—	(1,461)	—	—	—
Stock-based compensation expense	—	—	41,525	—	—	41,525	51	41,576
Exercises of stock options and warrants	149,429	—	952	—	—	952	28	980
Shares issued as payment for services	654,456	—	11,118	—	—	11,118	—	11,118
Shares issued in private placement	1,207,980	—	13,686	—	—	13,686	—	13,686
Shares and warrants issued in business combination	684,240	—	16,997	—	—	16,997	—	16,997
Acquisitions of noncontrolling interests	221,743	—	5,082	—	—	5,082	(5,995)	(913)
Shares issued as payment of deferred consideration	480,422	—	—	—	—	—	—	—
Adjustments for noncontrolling interests	—	—	2,789	—	—	2,789	(2,802)	(13)
Noncash dividend	—	—	(22,385)	—	—	(22,385)	22,385	—
Net loss	—	—	—	—	(117,018)	(117,018)	(9,802)	(126,820)
Other comprehensive income	—	—	—	20,648	—	20,648	38	20,686
Balances at December 31, 2017	122,087,040	$ —	$1,397,005	$ (15,554)	$ (847,820)	$ 533,631	$ 12,914	$ 546,545

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Shareholders' and Total Equity
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands, except share data)	Common Stock Shares	Common Stock Amount	Additional Paid-in Capital	Accumulated Other Comprehensive Loss	Accumulated Deficit	Total Intrexon Shareholders' Equity	Noncontrolling Interests	Total Equity
Balances at December 31, 2017	122,087,040	$ —	$1,397,005	$ (15,554)	$ (847,820)	$ 533,631	$ 12,914	$ 546,545
Cumulative effect of adoption of ASC 606	—	—	—	(104)	26,611	26,507	—	26,507
Stock-based compensation expense	—	—	36,174	—	—	36,174	122	36,296
Shares issued upon vesting of restricted stock units and for exercises of stock options and warrants	70,159	—	297	—	—	297	2,039	2,336
Shares issued as payment for services	909,980	—	10,695	—	—	10,695	—	10,695
Shares and warrants issued in public offerings, net of issuance costs	6,900,000	—	82,374	—	—	82,374	5,616	87,990
Equity component of convertible debt, net of issuance costs and deferred taxes	—	—	36,868	—	—	36,868	—	36,868
Shares issued pursuant to share lending agreement	7,479,431	—	—	—	—	—	—	—
Shares issued for reacquired in-process research and development	22,573,856	—	159,323	—	—	159,323	—	159,323
Adjustments for noncontrolling interests	—	—	(724)	—	—	(724)	724	—
Net loss	—	—	—	—	(509,336)	(509,336)	(5,370)	(514,706)
Other comprehensive loss	—	—	—	(12,954)	—	(12,954)	(178)	(13,132)
Balances at December 31, 2018	160,020,466	$ —	$1,722,012	$ (28,612)	$(1,330,545)	$ 362,855	$ 15,867	$ 378,722

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Cash Flows
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands)	2018	2017	2016
Cash flows from operating activities			
Net loss	$ (514,706)	$ (126,820)	$ (190,274)
Adjustments to reconcile net loss to net cash used in operating activities:			
Depreciation and amortization	33,112	31,145	24,572
Loss on abandonment and disposal of assets, net	20,928	3,124	666
Impairment loss	60,504	16,773	—
Reacquisition of in-process research and development	236,748	—	—
Unrealized and realized (appreciation) depreciation on equity securities and preferred stock, net	30,200	(2,586)	58,894
Noncash dividend income	(14,841)	(16,756)	(7,421)
Amortization of premiums (discounts) on investments, net	(771)	411	1,070
Equity in net loss of affiliates	11,608	14,283	21,120
Stock-based compensation expense	36,296	41,576	42,202
Shares issued as payment for services	10,695	11,118	10,777
Provision for bad debts	1,779	1,217	1,963
Accretion of debt discount and amortization of deferred financing costs	4,378	—	—
Deferred income taxes	(21,278)	(2,528)	(3,467)
Other noncash items	1,093	(517)	1,662
Changes in operating assets and liabilities:			
Receivables:			
Trade	(2,698)	740	2,588
Related parties	11,003	631	6,804
Notes	—	—	(42)
Other	(542)	661	271
Inventory	(478)	663	3,807
Prepaid expenses and other	1,006	492	(932)
Other assets	652	(1,017)	2,189
Accounts payable	4,680	(3,402)	3,618
Accrued compensation and benefits	4,385	(1,466)	(12,402)
Other accrued liabilities	356	3,007	9,002
Deferred revenue	(38,578)	(75,337)	(25,481)
Deferred consideration	—	(313)	(630)
Related party payables	(52)	(147)	310
Other long-term liabilities	281	1,328	146
Net cash used in operating activities	(124,240)	(103,720)	(48,988)

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Cash Flows
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands)	2018	2017	2016
Cash flows from investing activities			
Purchases of investments	(178,681)	—	(75,246)
Maturities of investments	65,975	174,542	101,987
Purchases of equity securities, preferred stock, and warrants	—	(1,161)	(2,308)
Proceeds from sales of equity securities	217	235	280
Acquisitions of businesses, net of cash received	(920)	2,054	—
Investments in affiliates	(16,582)	(11,189)	(11,542)
Return of investment in affiliate	2,598	—	—
Cash received (paid) in asset acquisitions	15,500	(14,219)	(7,244)
Purchases of property, plant and equipment	(41,587)	(46,666)	(31,629)
Proceeds from sale of assets	2,267	1,636	274
Issuances of notes receivable	—	(2,400)	(2,964)
Proceeds from repayment of notes receivable	—	1,500	—
Net cash provided by (used in) investing activities	(151,213)	104,332	(28,392)
Cash flows from financing activities			
Proceeds from issuance of shares in a private placement	—	13,686	—
Proceeds from issuance of shares and warrants in public offerings, net of issuance costs	87,990	—	—
Acquisitions of noncontrolling interests	—	(913)	—
Advances from lines of credit	4,561	5,906	5,075
Repayments of advances from lines of credit	(4,328)	(6,493)	(4,816)
Proceeds from long-term debt, net of issuance costs	219,859	325	547
Payments of long-term debt	(623)	(519)	(1,201)
Payments of deferred consideration for acquisitions	—	(8,678)	(6,705)
Proceeds from stock option and warrant exercises	2,336	980	19,165
Payment of stock issuance costs	—	(10)	—
Net cash provided by financing activities	309,795	4,284	12,065
Effect of exchange rate changes on cash, cash equivalents, and restricted cash	295	1,055	(873)
Net increase (decrease) in cash, cash equivalents, and restricted cash	34,637	5,951	(66,188)
Cash, cash equivalents, and restricted cash			
Beginning of period	75,545	69,594	135,782
End of period	$ 110,182	$ 75,545	$ 69,594

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Consolidated Statements of Cash Flows
Years Ended December 31, 2018, 2017 and 2016

(Amounts in thousands)	2018	2017	2016
Supplemental disclosure of cash flow information			
Cash paid during the period for interest	$ 3,868	$ 617	$ 964
Cash paid during the period for income taxes	216	566	10
Significant noncash financing and investing activities			
Stock received as consideration for collaboration agreements	$ —	$ —	$ 18,766
Preferred stock received as consideration for collaboration amendments	—	—	120,000
Receivables converted to preferred stock	—	3,385	—
Stock and warrants issued in business combinations	—	16,997	—
Stock issued to acquire noncontrolling interests	—	5,082	—
Stock issued for reacquired in-process research and development	159,323	—	—
Stock issued in asset acquisition	—	—	4,401
Long-term debt issued to a related party in an asset acquisition	30,000	—	—
Contingent consideration assumed in asset acquisition	—	—	3,660
Stock issued as payment for contingent consideration	—	—	1,583
Noncash dividend to shareholders	—	22,385	—
Purchases of property and equipment included in accounts payable and other accrued liabilities	2,267	2,257	652
Purchases of equipment financed through debt	234	—	—
Receivable recorded in anticipation of dissolution of affiliate	—	2,598	—
Transfer of inventory to breeding stock	—	—	1,191

The following table provides a reconciliation of the cash, cash equivalents, and restricted cash balances as of December 31, 2018 and 2017 as shown above:

	2018	2017
Cash and cash equivalents	$ 102,768	$ 68,111
Restricted cash	6,987	6,987
Restricted cash included in other assets	427	447
Cash, cash equivalents, and restricted cash	$ 110,182	$ 75,545

The accompanying notes are an integral part of these consolidated financial statements.

Intrexon Corporation and Subsidiaries
Notes to the Consolidated Financial Statements
(Amounts in thousands, except share and per share data)

1. Organization and Basis of Presentation

Intrexon Corporation ("Intrexon"), a Virginia corporation, uses synthetic biology to focus on programming biological systems to alleviate disease, remediate environmental challenges, and provide sustainable food and industrial chemicals, which may be accomplished directly or through collaborations and joint ventures. Intrexon's primary domestic operations are in California, Florida, Maryland, and Virginia, and its primary international operations are in Hungary. There have been no commercialized products derived from Intrexon's collaborations to date.

Precigen, Inc. ("Precigen"), a dedicated discovery and clinical stage biopharmaceutical company advancing the next generation of gene and cellular therapies using precision technology to target urgent and intractable diseases in immuno-oncology, autoimmune disorders, and infectious diseases, is a wholly owned subsidiary of Intrexon with primary operations in Maryland.

ActoBio Therapeutics, Inc. ("ActoBio") is pioneering a new class of microbe-based biopharmaceuticals that enable expression and local delivery of disease-modifying therapeutics and is a wholly owned subsidiary of Intrexon with primary operations in Belgium.

Trans Ova Genetics, L.C. ("Trans Ova"), and Progentus, L.C. ("Progentus"), providers of advanced reproductive technologies, including services and products sold to cattle breeders and other producers, are wholly owned subsidiaries with primary operations in Iowa, Maryland, Missouri, New York, Oklahoma, and Texas. ViaGen, L.C. ("ViaGen"), a provider of genetic preservation and cloning technologies, is a wholly owned subsidiary of Trans Ova with primary operations in Iowa.

Oxitec Limited ("Oxitec"), a pioneering company in biological insect control solutions, is a wholly owned subsidiary of Intrexon with primary operations in England and Brazil.

Intrexon Produce Holdings, Inc. ("IPHI") is a wholly owned subsidiary of Intrexon. Okanagan Specialty Fruits, Inc. ("Okanagan"), a company that developed and received regulatory approval for the world's first non-browning apple without the use of any artificial additives, is a wholly owned subsidiary of IPHI with primary operations in Canada. Fruit Orchard Holdings, Inc. ("FOHI") is a wholly owned subsidiary of IPHI with primary operations in Washington.

Exemplar Genetics, LLC ("Exemplar") is a provider of genetically engineered swine for medical and genetic research and a wholly owned subsidiary with primary operations in Iowa.

As of December 31, 2018, Intrexon owned approximately 55% of AquaBounty Technologies, Inc. ("AquaBounty"), a company focused on improving productivity in commercial aquaculture, and whose common stock is listed on the NASDAQ Stock Market. See Note 14 for additional discussion.

Intrexon Corporation and its consolidated subsidiaries are hereinafter referred to as the "Company."

These consolidated financial statements are presented in United States dollars and are prepared under accounting principles generally accepted in the United States of America ("U.S. GAAP").

Liquidity and Going Concern

The Company has incurred operating losses since its inception and management expects operating losses and negative cash flows to continue for the foreseeable future and, as a result, the Company will require additional capital to fund its operations and execute its business plan. As of December 31, 2018, the Company had $222,456 in cash, cash equivalents and short-term investments which is not sufficient to fund the Company's planned operations through one year after the date the consolidated financial statements are issued and accordingly, there is substantial doubt about the Company's ability to continue as a going concern. The analysis used to determine the Company's ability to continue as a going concern does not include cash sources outside of the Company's direct control that management expects to be available within the next twelve months.

The Company may not be able to obtain sufficient additional funding through monetizing certain of its existing assets, entering into new license and collaboration agreements, issuing additional equity or debt instruments or any other means, and if it is able to do so, they may not be on satisfactory terms. The Company's ability to raise additional capital in the equity and debt markets, should the Company choose to do so, is dependent on a number of factors, including, but not limited to, the market demand for

the Company's common stock, which itself is subject to a number of business risks and uncertainties, as well as the uncertainty that the Company would be able to raise such additional capital at a price or on terms that are favorable to the Company. Should the Company not be able to secure additional funding though these means, the Company may have to engage in any or all of the following activities: (i) shift internal investments from subsidiaries and platforms whose potential for value creation is longer-term to near-term opportunities; (ii) sell certain of our operating subsidiaries to third parties; (iii) reduce operating expenditures for third-party contractors, including consultants, professional advisors and other vendors; and (iv) reduce or delay capital expenditures, including non-essential facility expansions, lab equipment, and information technology projects. These actions may have a material adverse impact on the Company's ability to achieve certain of its planned objectives. Even if the Company is able to source additional funding, it may be forced to significantly reduce its operations if its business prospects do not improve. If the Company is unable to source additional funding, it may be forced to shut down operations altogether. These consolidated financial statements have been prepared on a going concern basis and do not include any adjustments to the amounts and classification of assets and liabilities that may be necessary in the event the Company can no longer continue as a going concern.

2. Summary of Significant Accounting Policies

Principles of Consolidation

The accompanying consolidated financial statements reflect the operations of the Company and its subsidiaries. All intercompany accounts and transactions have been eliminated.

Revenue Recognition (For the Year Ended December 31, 2018)

Effective January 1, 2018, the Company applies Accounting Standards Codification ("ASC") Topic 606, *Revenue from Contracts with Customers* ("ASC 606"). Under ASC 606, the Company recognizes revenue when its customer obtains control of the promised goods or services, in an amount that reflects the consideration that the Company expects to receive in exchange for those goods or services. To determine revenue recognition for arrangements that are within the scope of ASC 606, the Company performs the following five steps: (i) identify the contract(s) with a customer, (ii) identify the promises and distinct performance obligations in the contract, (iii) determine the transaction price, (iv) allocate the transaction price to the performance obligations in the contract, and (v) recognize revenue when (or as) the Company satisfies the performance obligations.

Collaboration and licensing revenues

The Company generates collaboration and licensing revenues through the execution of agreements with collaborators (known as exclusive channel collaborations, "ECC" or "ECCs") and licensing agreements whereby the collaborators or the licensee obtain exclusive access to the Company's proprietary technologies for use in the research, development and commercialization of products and/or treatments in a contractually specified field of use. Generally, the terms of these agreements provide that the Company receives some or all of the following: (i) upfront payments upon consummation of the agreement; (ii) reimbursements for costs incurred by the Company for research and development and/or manufacturing efforts related to specific applications provided for in the agreement; (iii) milestone payments upon the achievement of specified development, regulatory and commercial activities; and (iv) royalties on sales of products arising from the collaboration or licensing agreement. The agreement typically continues in perpetuity unless terminated and each of the Company's collaborators retain a right to terminate the agreement upon providing the Company written notice a certain period of time prior to such termination, generally 90 days.

The Company's collaboration and licensing agreements typically contain multiple promises, including technology licenses, research and development services and in certain cases manufacturing services. The Company determines whether each of the promises is a distinct performance obligation. As the nature of the promises in the Company's collaboration and licensing agreements are highly integrated and interrelated, the Company typically combines most of its promises into a single performance obligation. Because the Company is performing research and development services during early-stage development, the services are integral to the utilization of the technology license. Therefore, the Company has determined that the technology license and research and development services are typically inseparable from each other during the performance period of its collaboration and licensing agreements. Contingent manufacturing services that may be provided under certain of the Company's agreements are considered to be a separate future contract and not part of the current collaboration or licensing agreement.

At contract inception, the Company determines the transaction price, including fixed consideration and any estimated amounts of variable consideration. The upfront payment received upon consummation of the agreement is fixed and nonrefundable.

Variable consideration is subject to a constraint and amounts are included in the transaction price to the extent that it is probable that a significant reversal in the amount of cumulative revenue recognized will not occur when the uncertainty associated with the variable consideration is subsequently resolved. Variable consideration may include reimbursements for costs incurred by the Company for research and development efforts; milestone payments upon the achievement of certain development, regulatory and commercial activities; and royalties on sales of products arising from the collaboration or licensing agreement. The Company determines the initial transaction price and excludes variable consideration that is otherwise constrained pursuant to the guidance in ASC 606.

The transaction price is allocated to the performance obligations in the agreement based on the standalone selling price of each performance obligation. The Company typically groups the promises in its collaboration and licensing agreements into one performance obligation so the entire transaction price relates to this single performance obligation. The technology license included in the single performance obligation is considered a functional license. However, it is typically combined into a single performance obligation as the Company provides interrelated research and development services along with other obligations over an estimated period of performance. The Company utilizes judgment to determine the most appropriate method to measure its progress of performance under the agreement, primarily based on inputs necessary to fulfill the performance obligation. The Company evaluates its measure of progress to recognize revenue each reporting period and, if necessary, adjusts the measure of performance and related revenue recognition. The Company's measure of performance and revenue recognition involves significant judgment and assumptions, including, but not limited to, estimated costs and timelines to complete its performance obligations. The Company evaluates modifications and amendments to its contracts to determine whether any changes should be accounted for prospectively or on a cumulative catch-up basis.

Payments received for cost reimbursements for research and development efforts are recognized as revenue as the services are performed, in connection with the single performance obligation discussed above. The reimbursements relate specifically to the Company's efforts to provide services and the reimbursements are consistent with what the Company would typically charge other collaborators for similar services.

The Company assesses the uncertainty of when and if the milestone will be achieved to determine whether the milestone is included in the transaction price. The Company then assesses whether the revenue is constrained based on whether it is probable that a significant reversal of revenue would not occur when the uncertainty is resolved.

Royalties, including sales-based milestones, received under the agreements will be recognized as revenue when sales have occurred because the Company applies the sales- or usage-based royalties recognition exception provided for under ASC 606. The Company determined the application of this exception is appropriate because at the time the royalties are generated, the technology license granted in the agreement is the predominant item to which the royalties relate.

As the Company receives upfront payments in its collaboration and licensing agreements, it evaluates whether any significant financing components exist in its collaboration and licensing agreements. Based on the nature of its collaboration and licensing agreements, there are no significant financing components as the purpose of the upfront payment is not to provide financing. The purpose is to provide the collaborator with assurance that the Company will complete its obligations under the contract or to secure the right to a specific product or service at the collaborator's discretion. In addition, the variable payments generally align with the timing of performance or the timing of the consideration varies on the basis of the occurrence or nonoccurrence of a future event that is not substantially within the control of the collaborator or the Company.

From time to time, the Company and certain collaborators may cancel their agreements, relieving the Company of any further performance obligations under the agreement. Upon such cancellation or when the Company has determined no further performance obligations are required of the Company under an agreement, the Company recognizes any remaining deferred revenue.

Product and service revenues

The Company generates product and service revenues primarily through sales of products and services that are created from technologies developed or owned by the Company. The Company's current offerings include sales of advanced reproductive technologies, including the Company's bovine embryo transfer and in vitro fertilization processes and from genetic preservation and sexed semen processes and applications of such processes to other livestock, as well as sales of livestock and embryos produced using these processes and used in production. As each promised product or service is distinct, the Company recognizes the transaction price as revenue when control of the promised product is transferred to the customer or when the promised service is rendered. Payment terms are typically due within 30 days.

Revenue Recognition (For the Years Ended December 31, 2017 and 2016)

Collaboration and licensing revenues

The Company generates collaboration and licensing revenue through collaboration and licensing agreements whereby the collaborators or the licensee obtain exclusive access to the Company's proprietary technologies for use in the research, development and commercialization of products and/or treatments in a contractually specified field of use. Generally, the terms of these agreements provide that the Company receives some or all of the following: (i) upfront payments upon consummation of the agreement, (ii) reimbursements for costs incurred by the Company for research and development and/or manufacturing efforts related to specific applications provided for in the agreement, (iii) milestone payments upon the achievement of specified development, regulatory and commercial activities, and (iv) royalties on sales of products arising from the collaboration or licensing agreement.

The Company's collaboration and licensing agreements typically contain multiple elements, or deliverables, including technology licenses, research and development services, and in certain cases manufacturing services. The Company identifies the deliverables within the agreements and evaluates which deliverables represent separate units of accounting. Analyzing the agreements to identify deliverables requires the use of judgment. A deliverable is considered a separate unit of accounting when the deliverable has value to the collaborator or licensee on a standalone basis based on the consideration of the relevant facts and circumstances for each agreement.

Consideration received is allocated at the inception of the agreement to all identified units of accounting based on their relative selling price. When available, the relative selling price for each deliverable is determined using vendor specific objective evidence ("VSOE") of the selling price or third-party evidence of the selling price, if VSOE does not exist. If neither VSOE nor third-party evidence of the selling price exists, the Company uses its best estimate of the selling price for the deliverable. The amount of allocable consideration is limited to amounts that are fixed or determinable. The consideration received is allocated among the separate units of accounting, and the applicable revenue recognition criteria are applied to each of the separate units. The Company recognizes the revenue allocated to each unit of accounting as the Company delivers the related goods or services. If the Company determines that certain deliverables should be treated as a single unit of accounting, then the revenue is recognized using either a proportional performance or straight-line method, depending on whether the Company can reasonably estimate the level of effort required to complete its performance obligations under an arrangement and whether such performance obligations are provided on a best-efforts basis. As the Company cannot reasonably estimate its performance obligations related to its collaborators or licensees, the Company recognizes revenue on a straight-line basis over the period it expects to complete its performance obligations, which is reevaluated each reporting period.

The terms of the Company's agreements may provide for milestone payments upon achievement of certain defined events. The Company applies the Milestone Method for recognizing milestone payments. Under the Milestone Method, the Company recognizes consideration that is contingent upon the achievement of a milestone in its entirety as revenue in the period in which the milestone is achieved only if the milestone is substantive in its entirety. A milestone is considered substantive when it meets all of the following criteria:

(1) The consideration is commensurate with either the entity's performance to achieve the milestone or the enhancement of the value of the delivered item or items as a result of a specific outcome resulting from the entity's performance to achieve the milestone;

(2) The consideration relates solely to past performance; and

(3) The consideration is reasonable relative to all of the deliverables and payment terms within the arrangement.

In the event that a milestone is not considered substantive, the Company recognizes the milestone consideration as revenue using the same method applied to upfront payments.

Research and development services are a deliverable satisfied by the Company in accordance with the terms of the collaboration and licensing agreements and the Company considers these services to be inseparable from the license to the core technology; therefore, reimbursements of services performed are recognized as revenue. Because reimbursement (i) is contingent upon performance of the services by the Company, (ii) does not include a profit component, and (iii) does not relate to any future deliverable, the revenue is recognized during the period in which the related services are performed and collection of such amounts is reasonably assured. Payments received for manufacturing services will be recognized when the earnings process related to the manufactured materials has been completed. Royalties to be received under the agreements will be recognized as earned.

From time to time, the Company and certain collaborators may cancel their agreements, relieving the Company of any further performance obligations under the agreement. When no further performance obligations are required of the Company under an agreement, the Company recognizes any remaining deferred revenue.

Product and service revenues

The Company generates product and service revenues primarily through sales of products and services that are created from technologies developed or owned by the Company. The Company's current offerings include sales of advanced reproductive technologies, including the Company's bovine embryo transfer and in vitro fertilization processes and from genetic preservation and sexed semen processes and applications of such processes to other livestock, as well as sales of livestock and embryos produced using these processes and used in production. Revenue is recognized when (i) persuasive evidence of an arrangement exists, (ii) services have been rendered or delivery has occurred such that risk of loss has passed to the customer, (iii) the price is fixed or determinable, and (iv) collection from the customer is reasonably assured.

Research and Development

The Company considers that regulatory requirements inherent in the research and development of new products preclude it from capitalizing such costs. Research and development expenses include salaries and related costs of research and development personnel, including stock-based compensation expense, costs to acquire or reacquire technology rights, consultants, facilities, materials and supplies associated with research and development projects as well as various laboratory studies. Costs incurred in conjunction with collaboration and licensing arrangements are included in research and development. Indirect research and development costs include depreciation, amortization and other indirect overhead expenses.

The Company has research and development arrangements with third parties that include upfront and milestone payments. As of December 31, 2018 and 2017, the Company had research and development commitments with third parties that had not yet been incurred totaling $11,853 and $10,682, respectively. The commitments are generally cancellable by the Company at any time upon written notice.

Cash and Cash Equivalents

All highly liquid investments with an original maturity of three months or less at the date of purchase are considered to be cash equivalents. Cash balances at a limited number of banks may periodically exceed insurable amounts. The Company believes that it mitigates its risk by investing in or through major financial institutions. Recoverability of investments is dependent upon the performance of the issuer. As of December 31, 2018 and 2017, the Company had cash equivalent investments in highly liquid money market accounts at major financial institutions of $40,155 and $43,012, respectively.

Restricted Cash

Restricted cash represents funds deposited with the United States Treasury, as required by a court decision resulting from litigation against Trans Ova (Note 16).

Short-term and Long-term Investments

As of December 31, 2018, short-term investments include United States government debt securities and certificates of deposit. The Company determines the appropriate classification as short-term or long-term at the time of purchase based on original maturities and management's reasonable expectation of sales and redemption. The Company reevaluates such classification at each balance sheet date. The Company's written investment policy requires investments to be explicitly rated by two of Standard & Poor's, Moody's or Fitch and to have a minimum rating of A1, P1 or F-1, respectively, from those agencies. In addition, the investment policy limits the amount of credit exposure to any one issuer.

Equity Securities

The Company holds equity securities received and/or purchased from certain collaborators. Other than investments accounted for using the equity method, the Company elected the fair value option to account for its equity securities held in these collaborators. These equity securities are recorded at fair value at each reporting date and are subject to market price volatility. Unrealized gains and losses resulting from fair value adjustments are reported in the consolidated statements of operations. The fair value of these equity securities is subject to fluctuation in the future due to the volatility of the stock market, changes in general economic conditions and changes in the financial conditions of these collaborators. Equity securities that the Company does not intend to sell within one year are classified as noncurrent in the consolidated balance sheet.

The Company records the fair value of securities received on the date the collaboration is consummated or the milestone is achieved using the closing, quoted price of the collaborator's security on that date, assuming the transfer of consideration is considered perfunctory. If the transfer of the consideration is not considered perfunctory, the Company considers the specific facts and circumstances to determine the appropriate date on which to evaluate fair value. The Company also evaluates whether any discounts for trading restrictions or other basis for lack of marketability should be applied to the fair value of the securities at inception of the collaboration. In the event the Company concludes that a discount should be applied, the fair value of the securities is adjusted at inception of the collaboration and re-evaluated at each reporting period thereafter.

Investments in Preferred Stock

The Company holds preferred stock in certain of its collaborators, most of which may be converted to common stock as described in Note 7. The Company elected the fair value option to account for its investments in preferred stock whereby the value of preferred stock is adjusted to fair value as of each reporting date and unrealized gains and losses are reported in the consolidated statements of operations. These investments are subject to fluctuation in the future due to, among other things, the likelihood and timing of conversion of certain of the preferred stock into common stock, the volatility of each collaborator's common stock, and changes in general economic and financial conditions of the collaborators. The investments are classified as noncurrent in the consolidated balance sheet since the Company does not intend to sell the investments nor expect the investments that are convertible into common stock to be converted within one year.

The Company is entitled to monthly dividends and records dividend income as described in Note 7.

Fair Value of Financial Instruments

Fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. As such, fair value is a market-based measurement that should be determined based on assumptions that market participants would use in pricing an asset and liability. As a basis for considering such assumptions, the Company uses a three-tier fair value hierarchy that prioritizes the inputs used in its fair value measurements. The hierarchy gives the highest priority to unadjusted quoted prices in active markets for identical assets or liabilities (Level 1 measurements) and the lowest priority to unobservable inputs (Level 3 measurements). The three levels of the fair value hierarchy are as follows:

Level 1:	Quoted prices in active markets for identical assets and liabilities;
Level 2:	Other than quoted prices included in Level 1 inputs that are observable for the asset or liability, either directly or indirectly; and
Level 3:	Unobservable inputs for the asset or liability used to measure fair value to the extent that observable inputs are not available.

Concentrations of Risk

Due to the Company's mix of fixed and variable rate securities holdings, the Company's investment portfolio is susceptible to changes in interest rates. As of December 31, 2018, gross unrealized losses on the Company's short-term investments were not material. From time to time, the Company may liquidate some or all of its investments to fund operational needs or other activities, such as capital expenditures or business acquisitions, or distribute its equity securities to shareholders as a stock dividend. Depending on which investments the Company liquidates to fund these activities, the Company could recognize a portion, or all, of the gross unrealized losses.

Financial instruments that potentially subject the Company to concentrations of credit risk consist primarily of trade and related party receivables. The Company controls credit risk through credit approvals, credit limits and monitoring procedures. The Company performs ongoing credit evaluations of its customers but generally does not require collateral to support accounts receivable.

Equity Method Investments

The Company accounts for its investments in each of its joint ventures and for its investments in start-up entities backed by the Harvest Intrexon Enterprise Fund I, LP ("Harvest"), a related party, (Note 17) using the equity method of accounting based upon relative ownership interest. The Company's investments in these entities are included in investments in affiliates in the

accompanying consolidated balance sheets. See additional discussion related to certain of the Harvest start-up entities in Note 3.

The Company accounts for its investment in Oragenics, Inc. ("Oragenics"), one of its collaborators and a related party, using the fair value option. Oragenics was considered an equity method investment until September 30, 2018, by which point the Company's ownership level had significantly decreased. See Note 7 for additional discussion regarding Oragenics. The Company's ownership of Oragenics was 29.4% as of December 31, 2017, and the fair value of the Company's investment was $3,085 as of that date, which is included as equity securities, noncurrent, in the accompanying consolidated balance sheet. Unrealized depreciation in the fair value of these securities was $4,159 and $10,523 for the years ended December 31, 2017 and 2016, respectively.

Summarized financial data as of December 31, 2018 and 2017, and for the years ended December 31, 2018, 2017, and 2016, for the Company's equity method investments are shown in the following tables.

	December 31,	
	2018	2017
Current assets	$ 17,485	$ 61,086
Noncurrent assets	31,274	13,598
Total assets	48,759	74,684
Current liabilities	4,226	6,213
Net assets	$ 44,533	$ 68,471

	Year Ended December 31,		
	2018	2017	2016
Revenues	$ 557	$ 254	$ 417
Operating expenses	36,990	41,904	62,373
Operating loss	(36,433)	(41,650)	(61,956)
Other, net	44	(8)	1,535
Net loss	$ (36,389)	$ (41,658)	$ (60,421)

Variable Interest Entities

The Company identifies entities that (i) do not have sufficient equity investment at risk to permit the entity to finance its activities without additional subordinated financial support or (ii) in which the equity investors lack an essential characteristic of a controlling financial interest as variable interest entities ("VIE" or "VIEs"). The Company performs an initial and on-going evaluation of the entities with which the Company has variable interests to determine if any of these entities are VIEs. If an entity is identified as a VIE, the Company performs an assessment to determine whether the Company has both (i) the power to direct activities that most significantly impact the VIE's economic performance and (ii) have the obligation to absorb losses from or the right to receive benefits of the VIE that could potentially be significant to the VIE. If both of these criteria are satisfied, the Company is identified as the primary beneficiary of the VIE.

As of December 31, 2018 and 2017, the Company determined that certain of its collaborators and joint ventures as well as Harvest were VIEs. The Company was not the primary beneficiary for these entities since it did not have the power to direct the activities that most significantly impact the economic performance of the VIEs. The Company's aggregate investment balances of these VIEs as of December 31, 2018 and 2017, were $21,219 and $185,261, respectively, which represents the Company's maximum risk of loss related to the identified VIEs.

Trade Receivables

Trade receivables consist of credit extended to the Company's customers in the normal course of business and are reported net of an allowance for doubtful accounts. The Company reviews its customer accounts on a periodic basis and records bad debt expense for specific amounts the Company evaluates as uncollectible. Past due status is determined based upon contractual terms. Amounts are written off at the point when collection attempts have been exhausted. Management estimates uncollectible amounts considering such factors as current economic conditions and historic and anticipated customer performance. This estimate can fluctuate due to changes in economic, industry or specific customer conditions that may require adjustment to the

allowance recorded by the Company. Management has included amounts believed to be uncollectible in the allowance for doubtful accounts.

The following table shows the activity in the allowance for doubtful receivable accounts for the years ended December 31, 2018, 2017, and 2016:

	2018	2017	2016
Beginning balance	$ 4,631	$ 3,703	$ 2,081
Charged to operating expenses	1,779	1,217	1,963
Write offs of accounts receivable, net of recoveries	(1,267)	(289)	(341)
Ending balance	$ 5,143	$ 4,631	$ 3,703

Inventory

The Company's inventory primarily includes adult female cows that are used in certain production processes and are recorded at acquisition cost using the first-in, first-out method or net realizable value, whichever is lower. Work-in-process inventory includes allocations of production costs and facility costs for products currently in production and is recorded at the lower of cost or net realizable value. Significant declines in the price of cows could result in unfavorable adjustments to inventory balances.

Property, Plant and Equipment

Property, plant and equipment are stated at cost, less accumulated depreciation and amortization. Major additions or betterments are capitalized and repairs and maintenance are generally expensed as incurred. Depreciation and amortization is calculated using the straight-line method over the estimated useful lives of the assets. The estimated useful lives of these assets are as follows:

	Years
Land improvements	4–20
Buildings and building improvements	3–25
Furniture and fixtures	1–10
Equipment	1–10
Breeding stock	1–4
Computer hardware and software	1–7

Leasehold improvements are amortized over the shorter of the useful life of the asset or the applicable lease term, generally one to twenty years.

Goodwill

Goodwill represents the future economic benefits arising from other assets acquired in a business combination that are not individually identified and separately recognized. Goodwill is reviewed for impairment at least annually. The Company performs a qualitative assessment to determine whether it is more-likely-than-not that the fair value of a reporting unit is less than its carrying amount prior to performing the goodwill impairment test. If this is the case, the goodwill impairment test is required. If it is more-likely-than-not that the fair value of a reporting unit is greater than the carrying amount, the goodwill impairment test is not required.

If the goodwill impairment test is required, first, the fair value of the reporting unit is compared with its carrying amount (including goodwill). If the fair value of the reporting unit is less than its carrying amount, an indication of goodwill impairment exists for the reporting unit and the entity must record the impairment charge for the excess carrying amount, which is limited to the amount of goodwill allocated to the reporting unit. If the fair value of the reporting unit exceeds its carrying amount, no goodwill impairment charge is necessary.

The Company performs its annual impairment review of goodwill in the fourth quarter, or sooner if a triggering event occurs prior to the annual impairment review. In the fourth quarter of 2018, the Company concluded that Precigen and ActoBio are

now separate reporting units. Accordingly, the Company performed a relative fair value allocation of certain of its goodwill, as well as an impairment review of the reallocated goodwill. See Note 11 for additional discussion regarding the results of this review for the year ended December 31, 2017, which resulted in a goodwill impairment charge.

Intangible Assets

Intangible assets subject to amortization consist of patents, developed technologies and know-how; customer relationships; and trademarks acquired as a result of mergers and acquisitions. These intangible assets are subject to amortization, were recorded at fair value at the date of acquisition and are stated net of accumulated amortization. Indefinite-lived intangible assets consist of in-process research and development technologies acquired in mergers or acquisitions and were recorded at fair value at the dates of the respective acquisitions.

The Company amortizes long-lived intangible assets to reflect the pattern in which the economic benefits of the intangible asset are expected to be realized. The intangible assets are amortized over their estimated useful lives, ranging from three to twenty-one years for the patents, developed technologies and know-how; customer relationships; and trademarks.

Impairment of Long-Lived Assets

Long-lived assets to be held and used, including property, plant and equipment and intangible assets subject to amortization, are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of the assets may not be recoverable. Conditions that would necessitate an impairment assessment include a significant decline in the observable market value of an asset, a significant change in the extent or manner in which an asset is used, or a significant adverse change that would indicate that the carrying amount of an asset or group of assets is not recoverable.

Indefinite-lived intangible assets, including in-process research and development, are tested for impairment annually, or more frequently if events or circumstances between annual tests indicate that the asset may be impaired. Impairment losses on indefinite-lived intangible assets are recognized based solely on a comparison of their fair value to carrying value, without consideration of any recoverability test. The Company monitors the progression of its in-process research and development, as the likelihood of success is contingent upon commercial development or regulatory approval.

See Note 11 for additional discussion of impairment of long-lived assets for the years ended December 31, 2018 and 2017.

Convertible Notes

The Company allocated the proceeds received in July 2018 from the issuance of Intrexon's 3.50% convertible senior notes due 2023 (the "Convertible Notes") between long-term debt (liability component) and additional paid-in capital (equity component) within the consolidated balance sheet. The original value assigned to long-term debt is the estimated fair value as of the issuance date of a similar debt instrument without a conversion option. The original value assigned to additional paid-in capital represents the value of the conversion option and is calculated by deducting the fair value of the long-term debt from the principal amount of the Convertible Notes and is not remeasured as long as it continues to meet the requirements for equity classification. The original value of the conversion option will accrete to the carrying value of the long-term debt and result in additional noncash interest expense over the expected life of the Convertible Notes using the effective interest method.

Debt issuance costs related to the Convertible Notes are also allocated between long-term debt and additional paid-in capital based on the original value assigned to each. Debt issuance costs allocated to long-term debt reduced the original carrying value and will accrete to the carrying value of the long-term debt and result in additional noncash interest expense over the expected life of the Convertible Notes using the effective interest method. Debt issuance costs allocated to additional paid-in capital are recorded as reduction of the original value assigned to the conversion option.

See Note 12 for the further discussion of the Convertible Notes.

Foreign Currency Translation

The assets and liabilities of foreign subsidiaries, where the local currency is the functional currency, are translated from their respective functional currencies into United States dollars at the exchange rates in effect at the balance sheet date, with resulting foreign currency translation adjustments recorded in the consolidated statement of comprehensive loss. Revenue and expense amounts are translated at average rates during the period.

Income Taxes

Income taxes are accounted for under the asset and liability method. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to both differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases as well as operating loss and tax credit carryforwards. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rates is recognized in income in the period that includes the enactment date of the change. Valuation allowances are established when necessary to reduce deferred tax assets to the amount expected to be realized.

The Company identifies any uncertain income tax positions and recognizes the effect of income tax positions only if those positions are more likely than not of being sustained. Recognized income tax positions are measured at the largest amount that is greater than 50% likely of being realized. Changes in recognition or measurement are reflected in the period in which the change in judgment occurs. The Company records interest, if any, related to unrecognized tax benefits as a component of interest expense. Penalties, if any, are recorded in selling, general and administrative expenses.

On December 22, 2017, the Tax Cuts and Jobs Act of 2017 (the "Tax Act") was signed into law and significantly revised United States corporate income tax law by, among other things, reducing the corporate income tax rate to 21% effective January 1, 2018, eliminating the corporate alternative minimum tax and implementing a modified territorial tax system that includes a one-time transition tax on deemed repatriated earnings from foreign subsidiaries. The United States Securities and Exchange Commission ("SEC") Staff issued Staff Accounting Bulletin No. 118 ("SAB 118") to address the application of U.S. GAAP in situations when a registrant does not have the necessary information available, prepared, or analyzed, including computations, in reasonable detail to complete the accounting for certain income tax effects of the Tax Act. The Company recognized provisional tax impacts related to revaluation of most of the Company's domestic deferred tax assets, the impact of revaluation of those deferred tax assets on the Company's valuation allowance and elimination of the corporate alternative minimum tax, and included those amounts in the consolidated financial statements for the year ended December 31, 2017. The Company completed its accounting for the Tax Act in the fourth quarter of 2018, and there were no significant adjustments to the previously recorded provisional amounts.

In addition, the Tax Act implemented a new minimum tax on global intangible low-taxed income ("GILTI"). A company can elect an accounting policy to account for GILTI in either of the following ways:

- As a period charge in the future period in which the tax arises; or
- As part of deferred taxes related to the investment or subsidiary.

The Company elected to account for GILTI as a period charge in the period in which the tax arises. There was no impact to the accompanying consolidated financial statements as of and for the year ended December 31, 2018.

See Note 13 for additional discussion of the Tax Act.

Share-Based Payments

Intrexon uses the Black-Scholes option pricing model to estimate the grant-date fair value of all stock options. The Black-Scholes option pricing model requires the use of assumptions for estimated expected volatility, estimated expected term of stock options, risk-free rate, estimated expected dividend yield, and the fair value of the underlying common stock at the date of grant. Since Intrexon does not have sufficient history to estimate the expected volatility of its common stock price, expected volatility is based on a blended approach that utilizes the volatility of Intrexon's common stock and the volatility of peer public entities that are similar in size and industry. Intrexon estimates the expected term of all options based on previous history of exercises. The risk-free rate is based on the United States Treasury yield curve in effect at the time of grant for the expected term of the option. The expected dividend yield is 0% as Intrexon does not expect to declare cash dividends in the near future. The fair value of the underlying common stock is determined based on the quoted market price on the Nasdaq Global Select Market ("NASDAQ"). Forfeitures are recorded when incurred. The assumptions used in the Black-Scholes option pricing model for the years ended December 31, 2018, 2017 and 2016 are set forth in the table below:

	2018	2017	2016
Valuation assumptions			
Expected dividend yield	0%	0%	0%
Expected volatility	55%—59%	57%—60%	59%—60%
Expected term (years)	6.25	6.25	6.25
Risk-free interest rate	2.33%—3.06%	1.89%—2.27%	1.23%—2.17%

Grant date fair value for the Company's restricted stock units ("RSUs") is based on the fair value of the underlying common stock as determined based on the quoted market price on the NASDAQ on the date of grant.

Net Loss per Share

Basic net loss per share is calculated by dividing net loss attributable to common shareholders by the weighted average shares outstanding during the period, without consideration of common stock equivalents. Diluted net loss per share is calculated by adjusting weighted average shares outstanding for the dilutive effect of common stock equivalents outstanding for the period, using the treasury-stock method. For purposes of the diluted net loss per share calculation, shares to be issued pursuant to convertible debt, stock options, RSUs, and warrants are considered to be common stock equivalents but are excluded from the calculation of diluted net loss per share because their effect would be anti-dilutive and, therefore, basic and diluted net loss per share were the same for all periods presented.

Segment Information

While the Company generates revenues from multiple sources, including collaboration agreements, licensing, and products and services primarily associated with bovine reproduction, management is organized around a singular research and development focus to further the development of the Company's underlying synthetic biology technologies. Accordingly, the Company has determined that it operates in one segment. As of December 31, 2018 and 2017, the Company had $16,839 and $21,837, respectively, of long-lived assets in foreign countries. The Company recognized revenues derived in foreign countries totaling $11,945, $17,605, and $11,969 for the years ended December 31, 2018, 2017 and 2016, respectively.

Use of Estimates

The preparation of financial statements in conformity with U.S. GAAP requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, the disclosure of contingent assets and liabilities at the date of the financial statements, and the reported amounts of revenues and expenses during the reporting periods. Actual results could differ from those estimates.

Recently Adopted Accounting Pronouncements

The Company adopted ASC 606 for open contracts on January 1, 2018 using the modified retrospective approach. As a result of the adoption of ASC 606, including guidance on contract modifications, the Company recognized a cumulative catch-up adjustment to decrease deferred revenue in the net amount of $26,507 and accumulated deficit in the net amount of $26,611 and to increase accumulated other comprehensive loss in the net amount of $104.

In accordance with ASC 606, the disclosure of the impacted line items upon adoption of ASC 606 on the Company's consolidated statement of operations for the year ended December 31, 2018 and consolidated balance sheet as of December 31, 2018 was as follows:

	Year Ended December 31, 2018		
	As Reported	Balances Without Adoption of ASC 606	Effect of Change
Consolidated Statement of Operations			
Collaboration and licensing revenues	$ 76,869	$ 78,441	$ (1,572)
Net loss	(514,706)	(513,134)	(1,572)
Net loss attributable to Intrexon	(509,336)	(507,764)	(1,572)

	December 31, 2018		
	As Reported	Balances Without Adoption of ASC 606	Effect of Change
Consolidated Balance Sheet			
Liabilities			
Deferred revenue, current	$ 15,554	$ 18,934	$ (3,380)
Deferred revenue, net of current portion	54,210	48,082	6,128
Total equity			
Accumulated deficit	(1,330,545)	(1,355,583)	25,038
Accumulated other comprehensive loss	(28,612)	(28,598)	(14)

In February 2018, the Financial Accounting Standards Board ("FASB") issued Accounting Standards Update ("ASU") 2018-02, *Income Statement-Reporting Comprehensive Income (Topic 220): Reclassification of Certain Tax Effects from Accumulated Other Comprehensive Income* ("ASU 2018-02"). The provisions of ASU 2018-02 allow a reclassification from accumulated other comprehensive income to retained earnings for stranded tax effects resulting from the Tax Act. The amendments in ASU 2018-02 may be applied either in the period of adoption or retrospectively to each period (or periods) in which the effect of the change in the United States federal corporate income tax rate in the Tax Act is recognized. The Company adopted this provision in 2018, and there was no material impact to the accompanying financial statements.

In May 2017, the FASB issued ASU 2017-09, *Compensation-Stock Compensation (Topic 718) – Scope of Modification Accounting* ("ASU 2017-09"). The provisions of ASU 2017-09 provide guidance about which changes to the terms or conditions of a share-based payment award require an entity to apply modification accounting in ASC Topic 718 ("ASC 718"). An entity should account for the effects of a modification unless (a) the fair value of the modified award is the same as the fair value of the original award, (b) the vesting conditions of the modified award are the same as the vesting conditions of the original award and (c) the classification of the modified award as an equity instrument or a liability instrument is the same as the classification of the original award immediately before the original award is modified. The Company adopted this standard effective January 1, 2018, and will apply this guidance to future modifications.

In November 2016, the FASB issued ASU 2016-18, *Statement of Cash Flows (Topic 230) - Restricted Cash (A Consensus of the FASB Emerging Issues Task Force)* ("ASU 2016-18"). The provisions of ASU 2016-18 require amounts generally described as restricted cash and restricted cash equivalents to be included with cash and cash equivalents when reconciling the total beginning and ending balances for the periods presented on the statement of cash flows. The Company adopted this standard effective January 1, 2018. In accordance with the provisions of ASU 2016-18, net cash used in operating activities decreased by $6,987 and the "Cash, cash equivalents, and restricted cash" ending period balance increased by $6,987 for the year ended December 31, 2016 in the accompanying consolidated statement of cash flows. The beginning and ending period balances increased by $6,987 and $7,434, respectively; net cash used in operating activities decreased by $419; and the effect of exchange rate changes on cash, cash equivalents, and restricted cash increased by $28 in the accompanying consolidated statement of cash flows for the year ended December 31, 2017 from what was previously reported in the Company's Annual Report for the period ended December 31, 2017.

In October 2016, the FASB issued ASU 2016-16, *Income Taxes (Topic 740) - Intra-Entity Transfers of Assets Other Than Inventory* ("ASU 2016-16"). The provisions of ASU 2016-16 remove the prohibition in ASC Topic 740 against the immediate recognition of the current and deferred income tax effects of intra-entity transfers of assets other than inventory. The Company adopted this standard effective January 1, 2018, and the implementation of this standard did not have a material impact on the Company's consolidated financial statements.

In August 2016, the FASB issued ASU 2016-15, *Statement of Cash Flows (Topic 230) - Classification of Certain Cash Receipts and Cash Payments* ("ASU 2016-15"). The provisions of ASU 2016-15 address eight specific cash flow issues and how those certain cash receipts and cash payments are presented and classified in the statement of cash flows under ASC Topic 230 and other Topics. The Company adopted this standard effective January 1, 2018, and the implementation of this standard did not have a material impact on the Company's consolidated financial statements.

In January 2016, the FASB issued ASU 2016-01, *Financial Instruments - Overall (Subtopic 825-10) - Recognition and Measurement of Financial Assets and Financial Liabilities* ("ASU 2016-01"). The provisions of ASU 2016-01 make targeted improvements to enhance the reporting model for financial instruments to provide users of financial statements with more decision-useful information, including certain aspects of recognition, measurement, presentation, and disclosure of financial instruments. In February 2018, the FASB issued ASU 2018-03, *Technical Corrections and Improvements to Financial Instruments-Overall (Subtopic 825-10): Recognition and Measurement of Financial Assets and Financial Liabilities*, to clarify certain aspects of the guidance issued in ASU 2016-01. The Company adopted this standard effective January 1, 2018, and the implementation of this standard did not have a material impact on the Company's consolidated financial statements.

Recently Issued Accounting Pronouncements

In February 2016, the FASB issued ASU 2016-02, *Leases (Topic 842)* ("ASU 2016-02"). The provisions of ASU 2016-02 set out the principles for the recognition, measurement, presentation and disclosure of leases for both parties to a contract (i.e. lessees and lessors). The new standard requires lessees to apply a dual approach, classifying leases as either finance or operating leases based on the principle of whether or not the lease is effectively a financed purchase by the lessee. This classification will determine whether lease expense is recognized based on an effective interest method or on a straight-line basis over the term of the lease, respectively. A lessee is also required to record a right-of-use ("ROU") asset and a lease liability for all leases with a term of greater than 12 months regardless of their classification. Leases with a term of 12 months or less will be accounted for in a similar manner as under existing guidance for operating leases today. ASU 2016-02 supersedes the previous lease standard, ASC Topic 840 ("ASC 840"), *Leases*. In July 2018, the FASB issued ASU 2018-10, *Codification Improvements to Topic 842 (Leases)*, and ASU 2018-11, *Leases (Topic 842), Targeted Improvements* ("ASU 2018-11"), which provide (i) narrow amendments to clarify how to apply certain aspects of the new lease standard, (ii) entities with an additional transition method to adopt the new standard, and (ii) lessors with a practical expedient for separating components of a contract. ASU 2018-11 specifically permits an entity to elect an additional transition method to the existing modified retrospective transition requirements. Under the new transition method, an entity could adopt the provisions of ASU No. 2016-02 by recognizing a cumulative-effect adjustment to the opening balance of retained earnings in the period of adoption without adjustment to the financial statements for periods prior to adoption. Consequently, an entity's reporting for the comparative periods presented in the financial statements in which it adopts the new leases standard will continue to be in accordance with the previous lease guidance in ASC 840. ASU No. 2018-11 also allows a practical expedient that permits lessors to not separate non-lease components from the associated lease component if certain conditions are present. All of these ASUs related to ASC Topic 842 are effective for annual periods and interim periods within those annual periods beginning after December 15, 2018, and is effective for the Company for the year ending December 31, 2019. The Company is adopting ASU 2016-02 using the modified retrospective method, upon its effective date of January 1, 2019. The Company is electing the package of practical expedients permitted under the transition guidance within the new standard, which among other things, allows the Company to carryforward the historical lease classification for all leases in effect at adoption. The Company will make an accounting policy election to keep leases with an initial term of 12 months or less off of the consolidated balance sheet and will recognize those lease payments in the consolidated statements of operations on a straight-line basis over the lease term. Upon adoption of ASU 2016-02, the Company expects to recognize ROU assets and lease liabilities for operating leases within a range of $42,000 to $47,000.

In October 2018, the FASB issued ASU 2018-18, *Collaborative Arrangements (Topic 808): Clarifying the Interaction between Topic 808 and Topic 606* ("ASU 2018-18"). The provisions of ASU 2018-18 clarify when certain transactions between collaborative arrangement participants should be accounted for under ASC 606 and incorporates unit-of-account guidance consistent with ASC 606 to aid in this determination. The guidance is effective for annual periods and interim periods within those annual periods beginning after December 15, 2019, with early adoption permitted, and is effective for the Company for the year ending December 31, 2020. The Company is currently evaluating the impact that the implementation of this standard will have on the Company's consolidated financial statements.

In October 2018, the FASB issued ASU 2018-17, *Consolidation (Topic 810): Targeted Improvements to Related Party Guidance for Variable Interest Entities* ("ASU 2018-17"). The provisions of ASU 2018-17 modify the guidance under ASC Topic 810 related to the evaluation of indirect interests held through related parties under common control when determining whether fees paid to decision makers and service providers are variable interests. Indirect interests held through related parties that are under common control are no longer considered to be the equivalent of direct interests in their entirety and instead should be considered on a proportional basis. This guidance more closely aligns with accounting of how indirect interests held through related parties under common control are considered for determining whether a reporting entity must consolidate a VIE. The guidance is effective for annual periods and interim periods within those annual periods beginning after December 15, 2019, with early adoption permitted, and is effective for the Company for the year ending December 31, 2020. The Company is currently evaluating the impact that the implementation of this standard will have on the Company's consolidated financial statements.

In August 2018, the FASB issued ASU 2018-15, *Intangibles-Goodwill and Other-Internal-Use Software (Subtopic 350-40): Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract* ("ASU 2018-15"). The provisions of ASU 2018-15 clarify the accounting for implementation costs of a hosting arrangement that is a service contract. The new standard requires an entity (customer) in a hosting arrangement that is a service contract to follow existing internal-use software guidance to determine which implementation costs to capitalize as an asset related to the service contract and which costs to expense. Capitalized implementation costs of a hosting arrangement that is a service contract should be amortized over the term of the hosting arrangement, which might extend beyond the noncancelable period if there are options to extend or terminate. ASU 2018-15 also specifies the financial statement presentation of capitalized implementation costs and related amortization, in addition to required disclosures for material capitalized implementation costs related to hosting arrangements that are service contracts. The guidance is effective for annual periods and interim periods within those annual periods beginning after December 15, 2019, with early adoption permitted, and is effective for the Company for the year ending December 31, 2020. The Company is currently evaluating the impact that the implementation of this standard will have on the Company's consolidated financial statements.

In August 2018, the FASB issued ASU 2018-13, *Fair Value Measurements (Topic 820): Disclosure Framework-Changes to the Disclosure Requirements for Fair Value Measurements* ("ASU 2018-13"). The provisions of ASU 2018-13 modify the disclosures related to recurring and nonrecurring fair value measurements. Disclosures related to the transfer of assets between Level 1 and Level 2 hierarchies have been eliminated and various additional disclosures related to Level 3 fair value measurements have been added, modified or removed. The guidance is effective for annual periods and interim periods within those annual periods beginning after December 15, 2019, but entities are permitted to early adopt either the entire standard or only the provisions that eliminate or modify the requirements. This standard is effective for the Company for the year ending December 31, 2020. The Company is currently evaluating the impact that the implementation of this standard will have on the Company's consolidated financial statements.

In June 2018, the FASB issued ASU 2018-07, *Compensation-Stock Compensation (Topic 718): Improvements to Nonemployee Share-Based Payment Accounting* ("ASU 2018-07"). The provisions of ASU 2018-07 expand the scope of ASC 718 to include share-based payment transactions for acquiring goods and services from nonemployees. The guidance is effective for annual periods and interim periods within those annual periods beginning after December 15, 2018, with early adoption permitted no earlier than an entity's adoption date of ASC 606, and is effective for the Company for the year ending December 31, 2019. The Company is currently evaluating the impact that the implementation of this standard will have on the Company's consolidated financial statements.

In June 2016, the FASB issued ASU 2016-13, *Financial Instruments-Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments* ("ASU 2016-13"). The provisions of ASU 2016-13 modify the impairment model to utilize an expected loss methodology in place of the currently used incurred loss methodology, and requires a consideration of a broader range of reasonable and supportable information to inform credit loss estimates. The guidance is effective for annual periods and interim periods within those annual periods beginning after December 15, 2019, with early adoption permitted, and is effective for the Company for the year ending December 31, 2020. The Company is currently evaluating the impact that the implementation of this standard will have on the Company's consolidated financial statements.

Reclassifications

Certain insignificant reclassifications have been made to the prior year consolidated financial statements to conform to the current year presentation.

3. Mergers and Acquisitions

Asset Acquisition of Certain Harvest Entities

In September 2018, the Company, through its wholly owned subsidiary ActoBio, issued $30,000 of convertible promissory notes to Harvest, a related party, to acquire Harvest's ownership in CRS Bio, Inc. ("CRS Bio"); Genten Therapeutics, Inc. ("Genten Therapeutics"); and Relieve Genetics, Inc. ("Relieve Genetics") (collectively the "Harvest entities") (Note 17). The Company also received $15,500 cash in the transaction from the acquisition of the Harvest entities. Prior to the transaction, the Company held a noncontrolling interest in the Harvest entities, with a combined carrying value for all entities of $4,303, and accounted for its ownership using the equity method of accounting. Following the transaction, the Company owns 100% of the equity interests of the Harvest entities including the rights that had been previously licensed to the Harvest entities by the Company. The Harvest entities did not meet the definition of a business and accordingly, the transaction was accounted for as an asset acquisition.

By reacquiring the rights previously licensed to the Harvest entities, the Company is relieved from its obligations under the original ECCs and therefore wrote off deferred revenue of $10,078 as part of the transaction. The remaining value acquired of $8,721 was considered in-process research and development related to the reacquired rights under the ECCs and expensed immediately.

See Note 12 for additional discussion of the convertible promissory notes.

GenVec Acquisition

In June 2017, pursuant to an Agreement and Plan of Merger (the "GenVec Merger Agreement"), the Company acquired 100% of the outstanding shares of GenVec, Inc. ("GenVec"), a clinical-stage company and pioneer in the development of AdenoVerse gene delivery technology. Pursuant to the GenVec Merger Agreement, the former shareholders of GenVec received an aggregate of 684,240 shares of the Company's common stock and have the right to receive contingent consideration equal to 50% of any milestone or royalty payments received under one of GenVec's collaboration agreements, provided such payments are received within three years after the closing of the transaction. The Company also assumed warrants held by certain former shareholders of GenVec. The results of GenVec's operations subsequent to the acquisition date have been included in the consolidated financial statements.

The fair value of the total consideration transferred was $17,582. The acquisition date fair value of each class of consideration transferred is presented below:

Common shares	$	15,616
Warrants		1,381
Contingent consideration		585
	$	17,582

The fair value of the shares of the Company's common stock issued was based on the quoted closing price of the Company's common stock immediately prior to the closing of the acquisition. The fair value of the warrants assumed was estimated using the Black-Scholes option-pricing model. The fair value of the contingent consideration was determined using a probability weighted discounted cash flows model and is considered a freestanding financial instrument and recorded at fair value each reporting period. The estimated fair value of assets acquired and liabilities assumed at the acquisition date is shown below:

Cash and cash equivalents	$	2,054
Short-term investments		542
Trade receivables		75
Other receivables		97
Prepaid expenses and other		227
Property and equipment		250
Intangible assets		14,000
Other noncurrent assets		58
Total assets acquired		17,303
Accounts payable		2,158
Accrued compensation and benefits		1,226
Other accrued expenses		856
Other long-term liabilities		92
Deferred tax liabilities		239
Total liabilities assumed		4,571
Net assets acquired		12,732
Goodwill		4,850
Total consideration	$	17,582

The acquired intangible assets include developed technology, the fair value of which was determined using the multi-period excess earning method, which is a variation of the income approach that converts future cash flows to single discounted present value amounts. The intangible assets are being amortized over a useful life of eleven years. Goodwill, which is not deductible for tax purposes, represents the assembled workforce and the anticipated buyer-specific synergies arising from the combination of the Company's and GenVec's technology.

Acquisition-related costs totaling $507 and $12 are included in selling, general and administrative expenses in the accompanying consolidated statements of operations for the years ended December 31, 2017 and 2016, respectively.

Unaudited Condensed Pro Forma Financial Information

GenVec's results of operations subsequent to the acquisition are included in the consolidated statements of operations. The following unaudited condensed pro forma financial information for the years ended December 31, 2017 and 2016, is presented as if the acquisition had been consummated on January 1, 2016:

	Year Ended December 31,	
	2017	2016
	Pro Forma	
Revenues	$ 231,213	$ 191,437
Loss before income taxes	(136,966)	(201,210)
Net loss	(134,275)	(197,144)
Net loss attributable to the noncontrolling interests	9,802	3,662
Net loss attributable to Intrexon	(124,473)	(193,482)

4. Investments in Joint Ventures

Intrexon Energy Partners

In March 2014, the Company and certain investors (the "IEP Investors"), including an affiliate of Third Security, LLC ("Third Security"), a related party, entered into a Limited Liability Company Agreement that governs the affairs and conduct of business of Intrexon Energy Partners, LLC ("Intrexon Energy Partners"), a joint venture formed to optimize and scale-up the Company's methane bioconversion platform ("MBP") technology for the production of certain fuels and lubricants. The Company also entered into an ECC with Intrexon Energy Partners providing exclusive rights to the Company's technology for the use in bioconversion, as a result of which the Company received a technology access fee of $25,000 while retaining a 50% membership interest in Intrexon Energy Partners. The IEP Investors made initial capital contributions, totaling $25,000 in the aggregate, in exchange for pro rata membership interests in Intrexon Energy Partners totaling 50%. In addition, Intrexon has committed to make capital contributions of up to $25,000, and the IEP Investors, as a group and pro rata in accordance with their respective membership interests in Intrexon Energy Partners, have committed to make additional capital contributions of up to $25,000, at the request of Intrexon Energy Partners' board of managers (the "Intrexon Energy Partners Board") and subject to certain limitations. As of December 31, 2018, the Company's remaining commitment was $4,938. Intrexon Energy Partners is governed by the Intrexon Energy Partners Board, which has five members. Two members of the Intrexon Energy Partners Board are designated by the Company and three members are designated by a majority of the IEP Investors. The Company and the IEP Investors have the right, but not the obligation, to make additional capital contributions above the initial limits when and if solicited by the Intrexon Energy Partners Board.

The Company's investment in Intrexon Energy Partners was $(656) and $(444) as of December 31, 2018 and 2017, respectively, and is included in other accrued liabilities in the accompanying consolidated balance sheets.

Intrexon Energy Partners II

In December 2015, the Company and certain investors (the "IEPII Investors"), including Harvest, entered into a Limited Liability Company Agreement that governs the affairs and conduct of business of Intrexon Energy Partners II, LLC ("Intrexon Energy Partners II"), a joint venture formed to utilize the Company's MBP technology for the production of 1,4-butanediol, an industrial chemical used to manufacture spandex, polyurethane, plastics, and polyester. The Company also entered into an ECC with Intrexon Energy Partners II that provides exclusive rights to the Company's technology for use in the field, as a result of which the Company received a technology access fee of $18,000 while retaining a 50% membership interest in Intrexon Energy Partners II. The IEPII Investors made initial capital contributions, totaling $18,000 in the aggregate, in exchange for pro rata membership interests in Intrexon Energy Partners II totaling 50%. In December 2015, the owners of Intrexon Energy Partners II made a capital contribution of $4,000, half of which was paid by the Company. Intrexon has committed to make additional capital contributions of up to $10,000, and the IEPII Investors, as a group and pro rata in accordance with their respective membership interests in Intrexon Energy Partners II, have committed to make additional capital contributions of up to $10,000, at the request of Intrexon Energy Partners II's board of managers (the "Intrexon Energy Partners II Board") and subject to certain limitations. Intrexon Energy Partners II is governed by the Intrexon Energy Partners II Board, which has five members. One member of the Intrexon Energy Partners II Board is designated by the Company and four members are designated by a majority of the IEPII Investors. The Company and the IEPII Investors have the right, but not the obligation, to make additional capital contributions above the initial limits when and if solicited by the Intrexon Energy Partners II Board.

The Company's investment in Intrexon Energy Partners II was $(50) and $572 as of December 31, 2018 and 2017, respectively, and is included in other accrued liabilities and investments in affiliates, respectively, in the accompanying consolidated balance sheets.

EnviroFlight

In February 2016, the Company entered into a series of transactions involving EnviroFlight, LLC ("Old EnviroFlight"), Darling Ingredients Inc. ("Darling") and a newly formed venture between the Company and Darling ("New EnviroFlight"). The Company determined that the series of integrated transactions to acquire substantially all of the assets of Old EnviroFlight for cash, common stock, and contingent consideration should be accounted for as a single transaction, which constituted a business, and considered New EnviroFlight to be the accounting acquirer. Consideration paid to Old EnviroFlight was $4,244 in cash, 136,340 shares of the Company's common stock valued at $4,401 and contingent consideration estimated at $3,660. Contemporaneously, all the assets acquired from Old EnviroFlight, with the exception of certain developed technology, and $3,000 of cash were contributed to New EnviroFlight in exchange for a non-controlling, 50% membership interest in New EnviroFlight. The Company's contributions to New EnviroFlight included an exclusive license to the developed technology that was retained by the Company. Darling received the remaining 50% membership interest in New EnviroFlight as consideration for terminating rights previously held in the developed technology with Old EnviroFlight. New EnviroFlight was formed to

generate high-nutrition, low environmental impact animal and fish feed, as well as fertilizer products, from black soldier fly larvae. Through December 31, 2018, both the Company and Darling have made subsequent capital contributions of $17,000. All of the employees of Old EnviroFlight became employees of New EnviroFlight.

The Company determined that its investment in New EnviroFlight should be accounted for using the equity method of accounting. The Company recorded an estimated fair value of $5,425 for its investment in New EnviroFlight and $9,880 for the retained developed technology intangible asset. The developed technology is being amortized over a period of twenty-one years. The contingent consideration liability payable to the members of Old EnviroFlight is considered a freestanding financial instrument and is recorded at fair value each reporting period. New EnviroFlight met a regulatory milestone, as defined in the asset purchase agreement, and the members of Old EnviroFlight received a portion of the contingent consideration consisting of 59,337 shares of the Company's common stock valued at $1,583 in October 2016. The members of Old EnviroFlight had a right to receive up to $4,000 of additional shares of the Company's common stock if certain commercial milestones were met prior to February 2019. No liability was recorded as of December 31, 2018 (Note 8), and these commercial milestones were not met prior to February 2019.

The Company's investment in New EnviroFlight was $16,720 and $7,092 as of December 31, 2018 and 2017, respectively, and is included in investments in affiliates in the accompanying consolidated balance sheets.

Intrexon T1D Partners

In March 2016, the Company and certain investors (the "T1D Investors"), including affiliates of Third Security, entered into a Limited Liability Company Agreement that governs the affairs and conduct of business of Intrexon T1D Partners, LLC ("Intrexon T1D Partners"), a joint venture formed to utilize the Company's proprietary ActoBiotics platform to develop and commercialize products to treat type 1 diabetes. The Company also entered into an ECC with Intrexon T1D Partners that provides the exclusive rights to the Company's technology for use in the field, as a result of which the Company received a technology access fee of $10,000 while retaining a 50% membership interest in Intrexon T1D Partners. The T1D Investors made initial capital contributions, totaling $10,000 in the aggregate, in exchange for pro rata membership interests in Intrexon T1D Partners totaling 50%. Intrexon committed to make capital contributions of up to $5,000, and the T1D Investors, as a group and pro rata in accordance with their respective membership interests in Intrexon T1D Partners, committed to make additional capital contributions of up to $5,000, at the request of Intrexon T1D Partners' board of managers, which consisted of two members appointed by the Company and three members appointed by a majority of the T1D Investors. The Company satisfied its commitment in 2018.

In November 2018, the Company, together with its wholly owned subsidiary ActoBio, issued 1,933,737 shares of Intrexon common stock valued at $18,970 to the T1D Investors to acquire their ownership interest in Intrexon T1D Partners. Following the transaction, the Company owns 100% of the membership interests in Intrexon T1D Partners, including the rights that had been previously licensed to Intrexon T1D Partners by the Company in the ECC. Intrexon T1D Partners did not meet the definition of a business, and accordingly, the transaction was accounted for as an asset acquisition. By reacquiring the rights previously licensed to Intrexon T1D Partners, the Company was relieved from its obligations under the original ECC and therefore wrote off $8,517 of deferred revenue as part of the transaction. The remaining value of $10,453 was considered in-process research and development related to the reacquired rights under the ECC and expensed immediately.

Other Joint Ventures

In December 2013, the Company and OvaScience, Inc. ("OvaScience") formed a joint venture, OvaXon, LLC ("OvaXon"). Additionally, the Company entered into separate ECC agreements with OvaXon and OvaScience. In March 2018, the Company and OvaScience agreed to terminate the ECC agreement with OvaScience. The Company and Millendo Therapeutics, Inc., a company that subsequently acquired OvaScience, are in discussions regarding the future of the OvaXon joint venture and the related ECC agreement.

In September 2013, the Company and Sun Pharmaceutical Industries, Inc. ("Sun Pharmaceutical Industries") formed a joint venture, S & I Ophthalmic, LLC ("S & I Ophthalmic"), which entered into an ECC agreement with the Company. In December 2017, both the Company and Sun Pharmaceutical Industries agreed to dissolve S & I Ophthalmic and terminate the related ECC agreement. In January 2018, the Company received $2,598 upon the dissolution of S & I Ophthalmic, which represented the Company's portion of S & I Ophthalmic's remaining cash after all liabilities were settled.

5. Collaboration and Licensing Revenue

The Company's collaborations and licensing agreements provide for multiple promises to be satisfied by the Company and typically include a license to the Company's technology platforms, participation in collaboration committees, and performance of certain research and development services. Based on the nature of the promises in the Company's collaboration and licensing agreements, the Company typically combines most of its promises into a single performance obligation because the promises are highly interrelated and not individually distinct. At contract inception, the transaction price is typically the upfront payment received and is allocated to the single performance obligation. The Company has determined the transaction price should be recognized as revenue based on its measure of progress under the agreement primarily based on inputs necessary to fulfill the performance obligation.

See Note 2 for additional discussion of the Company's revenue recognition policy related to collaboration and licensing payments.

The Company determines whether collaborations and licensing agreements are individually significant for disclosure based on a number of factors, including total revenue recorded by the Company pursuant to collaboration and licensing agreements, collaborators or licensees with either majority-owned subsidiaries or equity method investments, or other qualitative factors. Collaboration and licensing revenues generated from consolidated subsidiaries are eliminated in consolidation. Amounts for periods subsequent to January 1, 2018 reflect revenue recognition under ASC 606.

The following tables summarize the amounts recorded as revenue in the consolidated statements of operations for each significant counterparty to a collaboration or licensing agreement for the years ended December 31, 2018, 2017 and 2016.

	Year Ended December 31,		
	2018	2017	2016
ZIOPHARM Oncology, Inc.	$ 16,298	$ 69,812	$ 33,836
Ares Trading S.A.	11,175	10,738	10,192
Oragenics, Inc.	1,353	2,020	2,752
Intrexon T1D Partners, LLC	2,502	5,968	1,908
Intrexon Energy Partners, LLC	6,929	10,665	17,552
Intrexon Energy Partners II, LLC	2,998	3,672	3,169
Genopaver, LLC	3,710	6,690	6,117
Fibrocell Science, Inc.	1,394	7,344	5,942
Persea Bio, LLC	955	946	1,278
OvaXon, LLC	—	1,966	2,934
S & I Ophthalmic, LLC	—	755	6,141
Harvest start-up entities (1)	14,447	15,232	4,974
Other	15,108	9,771	13,076
Total	$ 76,869	$ 145,579	$ 109,871

(1) For the years ended December 31, 2018, 2017, and 2016, revenue recognized from collaborations with Harvest start-up entities include Genten Therapeutics, Inc.; CRS Bio, Inc.; Exotech Bio, Inc.; AD Skincare, Inc.; and Thrive Agrobiotics, Inc. For the years ended December 31, 2017 and 2016, revenue recognized from collaborations with Harvest start-up entities also include Relieve Genetics, Inc.

The following is a summary of the terms of the Company's significant collaborations and licensing agreements.

ZIOPHARM Collaborations

In January 2011, the Company entered into an ECC with ZIOPHARM Oncology, Inc. ("ZIOPHARM"), a related party at the time. Pursuant to the ECC, ZIOPHARM received a license to the Company's technology platform within the field of oncology as defined more specifically in the agreement. Upon execution of the ECC, the Company received 3,636,926 shares of ZIOPHARM's common stock valued at $17,457 as upfront consideration. In addition to the promises discussed above, the Company transferred two clinical product candidates to ZIOPHARM for which $1,115 of the upfront consideration was allocated and recognized as collaboration revenue in 2011. The remaining $16,342 of upfront consideration was allocated to a

single performance obligation as discussed above. The Company was entitled to additional shares of common stock at the date of the dosing of the first patient in a Phase II clinical trial of a product candidate created, produced or developed by ZIOPHARM using the Company's technology ("ZIOPHARM Milestone"). In October 2012, the ZIOPHARM Milestone was achieved and the Company received 3,636,926 shares of ZIOPHARM's common stock valued at $18,330 as milestone consideration. Upon adoption of ASC 606, the Company recorded a cumulative catch-up adjustment of $873 related to milestone consideration. The Company allocated the ZIOPHARM Milestone to the two performance obligations and recognized those in a manner similar to the discussion above. The Company received reimbursement payments for research and development services provided and manufacturing services for Company materials provided to ZIOPHARM during the ECC. In March 2015, in conjunction with the worldwide License and Collaboration Agreement ("Merck Agreement") with Ares Trading S.A. ("Ares Trading"), a wholly owned subsidiary of Merck KGaA, and ZIOPHARM discussed below, the Company and ZIOPHARM amended their existing ECC. The amendment modified the scope of the ECC in connection with the Merck Agreement and provided that the Company would pay to ZIOPHARM 50% of all payments received for upfront fees, milestones and royalties under the Merck Agreement. See discussion of the Merck Agreement below.

In September 2015, the Company entered into its second ECC with ZIOPHARM ("ZIOPHARM ECC 2"). Pursuant to the ECC, ZIOPHARM received a license to the Company's technology platform to develop and commercialize novel biotherapeutics for the treatment of patients with graft-versus-host disease, or GvHD. Upon execution of ZIOPHARM ECC 2, the Company received a technology access fee of $10,000. The Company received reimbursement payments for research and development services provided pursuant to the agreement during the ECC and manufacturing services for Company materials provided to ZIOPHARM during the ECC. In December 2017, the Company and ZIOPHARM mutually agreed to terminate ZIOPHARM ECC2 and accordingly, the Company recognized the remaining balance of the deferred revenue associated with ZIOPHARM ECC2 totaling $28,943.

In June 2016, the Company amended each of its two existing collaboration agreements with ZIOPHARM and as a result the rate of the royalty that the Company is entitled to receive on certain products commercialized pursuant to the agreements was reduced from 50% to 20%. As consideration for execution of the amendments, ZIOPHARM issued the Company 100,000 shares of ZIOPHARM's Series 1 Preferred Stock valued at $120,000. The Company allocated the consideration received to each ECC based on the cumulative value of upfront and milestone payments previously received pursuant to that ECC. Upon adoption of ASC 606, the Company recognized a cumulative catch-up adjustment of $32,422 as a result of the contract modification requiring a cumulative catch-up under ASC 606 versus prospective recognition under previous revenue recognition accounting standards. See Note 7 for additional discussion of the terms of the preferred stock and the accounting treatment.

In October 2018, the Company, through its wholly owned subsidiary Precigen, entered into a license agreement (the "ZIOPHARM License Agreement") with ZIOPHARM, which terminated and replaced the terms of the original ZIOPHARM ECC, including the amendments thereto. Pursuant to the terms of the ZIOPHARM License Agreement, the Company granted ZIOPHARM an exclusive, worldwide, royalty-bearing, sub-licensable license to research, develop and commercialize (i) products utilizing the Company's RheoSwitch gene switch ("RTS") to express IL-12 (the "IL-12 Products") for the treatment of cancer, (ii) chimeric antigen receptor ("CAR") products directed to (a) CD19 for the treatment of cancer (the "CD19 Products"), and (b) a second target, subject to the rights of the Company to pursue such target under the Merck Agreement, and (iii) T-cell receptor ("TCR") products (the "TCR Products") designed for neoantigens for the treatment of cancer or the treatment and prevention of human papilloma virus ("HPV") to the extent that the primary reason for such treatment or prevention is to prevent cancer, which is referred to as the HPV Field. The Company has also granted ZIOPHARM an exclusive, worldwide, royalty-bearing, sub-licensable license for certain patents relating to the Company's *Sleeping Beauty* technology to research, develop and commercialize TCR Products for both neoantigens and shared antigens for the treatment of cancer and in the HPV Field. ZIOPHARM will be solely responsible for all aspects of the research, development and commercialization of the exclusively licensed products for the treatment of cancer. ZIOPHARM is required to use commercially reasonable efforts to develop and commercialize IL-12 Products and CD19 Products, and after a two-year period, the TCR Products. The Company also granted ZIOPHARM an exclusive, worldwide, royalty-bearing, sub-licensable license to research, develop and commercialize products utilizing an additional construct that expresses RTS IL-12 (the "Gorilla IL-12 Products") for the treatment of cancer and in the HPV Field. ZIOPHARM is responsible for all development costs associated with each of the licensed products, other than Gorilla IL-12 Products. ZIOPHARM and the Company will share the development costs and operating profits for Gorilla IL-12 Products, with ZIOPHARM responsible for 80% of the development costs and receiving 80% of the operating profits, as defined in the ZIOPHARM License Agreement, and the Company responsible for the remaining 20% of the development costs and receiving 20% of the operating profits, except that ZIOPHARM will bear all development costs and the Company will share equally in operating profits for Gorilla IL-12 Products in the HPV Field (the "Gorilla Program").

In consideration of the licenses and other rights granted by the Company, ZIOPHARM will pay the Company an annual license fee of $100 and agreed to reimburse the Company $1,000, payable in four quarterly installments, with respect to historical Gorilla IL-12 Products (the "historical Gorilla reimbursements"). ZIOPHARM will make milestone payments, payable upon the initiation of later stage clinical trials and upon the approval of exclusively licensed products in various jurisdictions, totaling up to an additional $52,500 for each of four exclusively licensed products, up to an aggregate of $210,000. In addition, ZIOPHARM will pay the Company tiered royalties ranging from low-single digits to high-single digits on the net sales derived from the sales of any approved IL-12 Products and CAR products. ZIOPHARM will also pay the Company royalties ranging from low-single digits to mid-single digits on the net sales derived from the sales of any approved TCR Products, up to maximum royalty amount of $100,000 in the aggregate. ZIOPHARM will also pay the Company 20% of any sublicensing income received by ZIOPHARM relating to the licensed products.

The Company reacquired rights to research, develop and commercialize CAR products for all other targets. In addition, the Company may research, develop and commercialize products for the treatment of cancer, outside of the products exclusively licensed to ZIOPHARM. The Company will pay ZIOPHARM royalties ranging from low-single digits to mid-single digits on the net sales derived from the sale of the Company's CAR products, up to $50,000. The Company will also be entitled to receive from ZIOPHARM reimbursement of costs incurred to transition the necessary knowledge and materials for ZIOPHARM programs for a period of up to one year from the effective date (the "Transition Services").

As between the parties, the Company agreed to perform all of the obligations of ZIOPHARM under the Merck Agreement, other than an obligation of exclusivity thereunder and ZIOPHARM will remain responsible for all payments owed under the Merck Agreement with respect to CD19 and the other target under the Merck Agreement as a result of ZIOPHARM's, its affiliates' or its sublicensees' exploitation of CAR products. Further, the Company is entitled to receive all rights and financial considerations with respect to all other CAR products, subject to the CAR royalties due to ZIOPHARM for such products. The ZIOPHARM License Agreement will terminate on a product-by-product and/or country-by-country basis upon the expiration of the later to occur of (i) the expiration of the last to expire patent claim for a licensed product, or (ii) 12 years after the first commercial sale of a licensed product in such country. In addition, ZIOPHARM may terminate the ZIOPHARM License Agreement on a country-by-country or program-by-program basis following written notice to the Company, and either party may terminate the ZIOPHARM License Agreement following notice of a material breach.

Pursuant to the ZIOPHARM License Agreement, the 2016 Securities Issuance Agreement between the Company and ZIOPHARM was terminated as of the effective date of the ZIOPHARM License Agreement, all of the benefits, rights, obligations and liabilities thereunder immediately ceased and terminated and the Company returned to ZIOPHARM all of the preferred stock owned by the Company as of the Effective Date, which was valued at $158,376. See Note 7 for additional discussion of the preferred stock.

Prior to the execution of the ZIOPHARM License Agreement, the Company had $51,084 of deferred revenue remaining from the original ECC, which was related to the Company's obligations to perform under that agreement. Replacement of the original ECC with the ZIOPHARM License Agreement is a contract modification under ASC 606 that represents the termination of the original agreement and the creation of a new agreement as the remaining rights, obligations, and services to be exchanged, which are limited to the Transition Services, are distinct from those under the ECC. Therefore, the Company reviewed the various forms of consideration in the ZIOPHARM License Agreement to determine the transaction price. As the Company's obligations under the ZIOPHARM License Agreement are only related to the Transition Services and no other obligations under the ECC remain, a portion of the previously deferred revenue from the ECC should be relieved, which the Company determined to be $49,329, and the remaining $1,755 was included in the transaction price. The initial annual license payment of $100 was also included in the transaction price. The remaining annual license payments and potential milestone payments were constrained at the modification date and will only be recognized when the payments become probable of being received. Royalty payments from sales of ZIOPHARM products developed pursuant to the ZIOPHARM License Agreement will be recognized when the sales occur. The Company will recognize payments from Transition Services as those services are performed and will recognize the transaction price of $1,855 as it performs the Transition Services required under the ZIOPHARM License Agreement.

The Company also reviewed the consideration paid and potential consideration to be paid to ZIOPHARM as part of the ZIOPHARM License Agreement, which includes the $158,376 of ZIOPHARM preferred stock returned by the Company and potential royalty payments to ZIOPHARM from sales of the Company's CAR products. The Company determined the exchange of its investment in ZIOPHARM preferred stock for certain CAR rights previously licensed under the ECC (i.e., in-process research and development) and the relief of performance obligations to ZIOPHARM under the ECC constituted an exchange for distinct goods and services. Therefore, the Company wrote off the $49,329 of relieved deferred revenue and recorded an expense of $109,047 for the reacquired in-process research and development. Potential royalty payments to ZIOPHARM will be expensed as incurred as they relate to distinct goods or services.

The Company determined that the Gorilla Program represents a separate collaboration agreement under the scope of ASC 808, *Collaborative Arrangements*, ("ASC 808") and will not be included in the accounting for the ZIOPHARM License Agreement under ASC 606. The Company recognized $500 of the historical Gorilla reimbursements on the contract modification date and will recognize the remaining amounts when receipt is probable. The development costs and operating profits from the Gorilla Program will be recognized in accordance with ASC 808.

Merck Licensing Agreement

In March 2015, the Company signed the Merck Agreement with Ares Trading and ZIOPHARM through which the parties established a collaboration for the research and development and commercialization of certain products for the prophylactic, therapeutic, palliative or diagnostic use for cancer in humans. Pursuant to the Merck Agreement, the Company received a technology access fee of $115,000 as upfront consideration, of which $57,500 was paid to ZIOPHARM in accordance with the terms of the agreement. Upon the selection of the first two targets by Ares Trading, the Company received $10,000 in equal quarterly installments over two years.

In December 2018, the Company entered into a Securities Purchase, Assignment and Assumption Agreement (the "Merck Purchase Agreement") with Ares Trading pursuant to which the Company reacquired Ares Trading's development and commercialization rights under the Merck Agreement. As consideration for the reacquisition of the Merck Agreement, the Company issued Ares Trading 20,640,119 shares of Intrexon common stock valued at $140,353 and agreed to pay Ares Trading a royalty of 10% of the net sales derived from two CAR products specified in the Merck Purchase Agreement. By reacquiring the rights previously licensed to Ares Trading, the Company is relieved of its obligations under the Merck Agreement and therefore wrote off deferred revenue of $31,826. The remaining value acquired of $108,527 was considered in-process research and development related to the reacquired rights under the Merck Agreement and expensed immediately. The potential future royalty payments to Ares Trading do not represent consideration paid to a customer and will be recorded when the payments are probable. See Note 12 for additional discussion of this transaction.

Oragenics Collaborations

In June 2012, the Company entered into an ECC with Oragenics, a publicly traded company focused on becoming the world leader in novel antibiotics against infectious diseases and a related party. Pursuant to the ECC, at the transaction effective date, Oragenics received a license to the Company's technology platform within the field of lantibiotics for the treatment of infectious diseases in humans and companion animals as defined more specifically in the agreement. Upon execution of the ECC, the Company received a technology access fee of 439,243 shares of Oragenics' common stock valued at $6,588 as upfront consideration. In November 2017, the Company amended the ECC agreement with Oragenics, and as a result, the Company is entitled to up to $35,000 of potential one-time payments for certain regulatory milestones. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during the ECC and manufacturing services for Company materials provided to Oragenics during the ECC. Oragenics will pay the Company 25% of the quarterly profits derived from the sale of products developed from the ECC, as defined in the agreement.

Oragenics is responsible for funding the further development of lantibiotics toward the goal of commercialization, conducting preclinical and clinical development of product candidates, as well as for other aspects of commercialization or manufacturing of the product candidates. The term of the ECC commenced in June 2012 and continues until terminated pursuant to the ECC agreement. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Oragenics upon 90 days written notice to the Company.

In June 2015, the Company entered into a separate ECC with Oragenics ("Oragenics ECC 2"). Pursuant to Oragenics ECC 2, at the transaction effective date, Oragenics received a license to the Company's technology platform within the field of biotherapeutics for use in certain treatments of oral mucositis and other diseases and conditions of the oral cavity, throat, and esophagus. Upon execution of Oragenics ECC 2, the Company received a technology access fee of a $5,000 convertible promissory note maturing on or before December 31, 2015 as upfront consideration. Prior to the maturity date, Oragenics had the right to convert the promissory note into shares of Oragenics' common stock, subject to its shareholders' approval. In December 2015, Oragenics converted the promissory note into 338,100 shares of Oragenics' common stock. Following an amendment in November 2017, the Company is entitled to up to $37,500 of potential one-time payments for development and commercial milestones under Oragenics ECC 2. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during Oragenics ECC 2 and manufacturing services for Company materials provided to Oragenics during Oragenics ECC 2. Oragenics will pay the Company royalties as a percentage in the low-teens of net sales derived from the sale of products developed from Oragenics ECC 2, as defined in the agreement.

Oragenics is responsible for funding the further development of Oragenics ECC 2 products towards the goal of commercialization, conducting preclinical and clinical development of product candidates, as well as for other aspects of commercialization or manufacturing of the product candidates. The term of the ECC commenced in June 2015 and may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Oragenics upon 90 days written notice to the Company.

Intrexon T1D Partners Collaboration

In March 2016, the Company entered into an ECC with Intrexon T1D Partners, a joint venture between the Company and certain investors and a related party. Pursuant to the ECC, Intrexon T1D Partners received an exclusive license to the Company's technology platform to develop and commercialize products to treat type 1 diabetes. Upon execution of the ECC, the Company received a technology access fee of $10,000. The Company received reimbursement of research and development services provided pursuant to the ECC agreement. In November 2018, the Company completed an asset acquisition with the T1D Investors, resulting in the Company owning 100% of the membership interest of Intrexon T1D Partners including all rights under the ECC (Note 4).

Genten Therapeutics Collaboration

In September 2016, the Company entered into an ECC with Genten Therapeutics, an affiliate of Harvest and a related party. Genten Therapeutics was formed for the purpose of entering into the ECC and developing and commercializing products using the Company's technology for expression of gluten peptides, alone or in combination with immunomodulatory cytokines, to reestablish immune tolerance for patients with celiac disease. Upon execution of the ECC, the Company received a technology access fee in the form of a $1,500 cash payment and equity in Genten Therapeutics valued at $3,000 as upfront consideration. The Company received reimbursement payments for research and development services provided pursuant to the ECC. In September 2018, the Company completed an asset acquisition with Harvest, resulting in the Company owning 100% of the equity interests of Genten Therapeutics including all rights under the ECC (Note 3).

CRS Bio Collaboration

In September 2016, the Company entered into an ECC with CRS Bio, an affiliate of Harvest and a related party. CRS Bio was formed for the purpose of entering into the ECC and developing and commercializing products through targeted delivery of antibodies for treatment of chronic rhinosinusitis with and without nasal polyps, by utilizing the Company's technology to block inflammatory mediators in the nasal passage, leading to improved breathing and, importantly, patients' quality of life. Upon execution of the ECC, the Company received a technology access fee in the form of equity in CRS Bio valued at $2,100. The Company received reimbursement payments for research and development services provided pursuant to the ECC. In September 2018, the Company completed an asset acquisition with Harvest, resulting in the Company owning 100% of the equity interests of CRS Bio including all rights under the ECC (Note 3).

Relieve Genetics Collaboration

In March 2016, the Company entered into an ECC with Relieve Genetics, an affiliate of Harvest and a related party. Relieve Genetics was formed for the purpose of entering into the ECC and developing and commercializing products using a viral vector expressing interleukin-10 for the treatment of chronic neuropathic pain resultant from cancer in humans. Upon execution of the ECC, the Company received a technology access fee in the form of equity in Relieve Genetics valued at $4,333 as upfront consideration. The Company received reimbursement payments for research and development services provided pursuant to the ECC. In September 2018, the Company completed an asset acquisition with Harvest, resulting in the Company owning 100% of the equity interests of Relieve Genetics including all rights under the ECC (Note 3).

Intrexon Energy Partners Collaboration

In March 2014, the Company entered into an ECC with Intrexon Energy Partners, a joint venture between the Company and certain investors and a related party. The ECC grants Intrexon Energy Partners an exclusive license to the Company's technology platform to optimize and scale-up the Company's methane bioconversion platform for the production of certain fuels and lubricants. Upon execution of the ECC, the Company received a technology access fee of $25,000 as upfront consideration. The Company receives reimbursement payments for research and development services as provided for in the ECC agreement. The term of the ECC commenced in March 2014 and continues until March 2034 unless terminated prior to that date by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Intrexon Energy Partners upon 90 days written notice to the Company.

Intrexon Energy Partners II Collaboration

In December 2015, the Company entered into an ECC with Intrexon Energy Partners II, a joint venture between the Company and certain investors and a related party. Pursuant to the ECC, Intrexon Energy Partners II received an exclusive license to the Company's technology platform to optimize and scale-up the Company's methane bioconversion platform for the production of 1,4-butanediol (BDO), a key chemical intermediate that is used to manufacture spandex, polyurethane, plastics, and polyester. Upon execution of the ECC, the Company received a technology access fee of $18,000 and is entitled to reimbursement of research and development services as provided for in the ECC agreement. The term of the ECC commenced in December 2015 and continues until December 2035; termination prior to that date may be initiated (i) by either party in the event of certain material breaches defined in the agreement or (ii) may be terminated voluntarily by Intrexon Energy Partners II upon 90 days written notice to the Company.

Exotech Bio Collaboration

In March 2016, the Company entered into an ECC with Exotech Bio, Inc. ("Exotech Bio"), an affiliate of Harvest and a related party. Exotech Bio was formed for the purpose of entering into the ECC and developing and commercializing products using exosomes carrying a RNA payload designed to kill, suppress, or render immune-visible a cancer cell. Upon execution of the ECC, the Company received a technology access fee in the form of equity in Exotech Bio valued at $5,000 as upfront consideration. In June 2018, the Company and Exotech Bio amended the ECC, which resulted in the expansion of the defined field of use and the Company's ownership in Exotech Bio increasing to 49%. The amendment also eliminated potential future milestone payments and royalties for which the Company was previously entitled. The Company receives reimbursement payments for research and development services provided pursuant to the ECC. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Exotech Bio upon 90 days written notice to the Company.

AD Skincare Collaboration

In June 2016, the Company entered into an ECC with AD Skincare, Inc. ("AD Skincare"), an affiliate of Harvest and a related party. AD Skincare was formed for the purpose of entering into the ECC and developing an advanced topical delivery system to improve the efficacy of biologically active ingredients aimed at improving signs of aging human skin. Upon execution of the ECC, the Company received a technology access fee in the form of equity in AD Skincare valued at $4,333 as upfront consideration. The Company is also entitled to up to $2,000 of potential payments for substantive and non-substantive development milestones for each product developed under the ECC, as well as up to $17,000 in one-time commercial milestones. The Company receives reimbursement payments for research and development services provided pursuant to the ECC. AD Skincare will pay the Company royalties as a percentage in the low double-digits on the quarterly net sales of products developed under the ECC, as defined in the agreement. AD Skincare is responsible for the development and commercialization of the product candidates. The term of the ECC commenced in June 2016 and continues until terminated pursuant to the ECC agreement. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by AD Skincare upon 90 days written notice to the Company.

Genopaver Collaboration

In March 2013, the Company entered into an ECC with Genopaver, LLC ("Genopaver"), an affiliate of Third Security and a related party. Genopaver was formed for the purpose of entering into the ECC and developing and commercializing products in the field of the fermentative production of alkaloids through genetically modified cell-lines and substrate feeds for use as active pharmaceutical ingredients or as commercially sold intermediates in the manufacture of active pharmaceutical ingredients. Upon execution of the ECC, the Company received a technology access fee of $3,000 as upfront consideration. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during the ECC. Genopaver will pay the Company royalties as a percentage in the lower-double digits on the quarterly gross profits of product sales from products developed under the ECC, as defined in the agreement. Genopaver is responsible for the development and commercialization of the product candidates. The term of the ECC commenced in March 2013 and continues until terminated pursuant to the ECC agreement. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Genopaver upon 90 days written notice to the Company.

Fibrocell Science Collaborations

In October 2012, the Company entered into an ECC ("Fibrocell ECC 1") with Fibrocell Science, Inc. ("Fibrocell"), a publicly traded cell and gene therapy company focused on diseases affecting the skin and connective tissue and a related party. Pursuant to Fibrocell ECC 1, at the transaction effective date, Fibrocell received a license to the Company's technology platform to

develop and commercialize genetically modified and non-genetically modified autologous fibroblasts and autologous dermal cells in the United States of America. Upon execution of Fibrocell ECC 1, the Company received a technology access fee of 87,835 shares of Fibrocell's common stock valued at $7,576 as upfront consideration. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during Fibrocell ECC 1 and manufacturing services for Company materials provided to Fibrocell during Fibrocell ECC 1. On a quarterly basis, Fibrocell will pay the Company royalties of 7% of net sales up to $25,000 and 14% of net sales above $25,000 on each product developed from Fibrocell ECC 1, as defined in the agreement. If Fibrocell uses the Company's technology platform to improve the production of a current or new Fibrocell product not developed from Fibrocell ECC 1, Fibrocell will pay the Company quarterly royalties equal to 33% of the cost of goods sold savings generated by the improvement, as defined in the agreement.

Fibrocell is responsible for conducting preclinical and clinical development of product candidates associated with Fibrocell ECC 1, as well as for other aspects of commercialization and manufacturing of the product candidates. The term of the ECC commenced in October 2012 and continues until terminated pursuant to the ECC agreement. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Fibrocell upon 90 days written notice to the Company.

In June 2013, the Company and Fibrocell entered into an amendment to the Fibrocell ECC 1. The amendment expanded the field of use defined in the ECC agreement. Under the terms of the amendment to the Fibrocell ECC 1, the Company received 82,919 shares of Fibrocell's common stock valued at $7,612 as a supplemental technology access fee.

In December 2015, the Company entered into a second ECC with Fibrocell ("Fibrocell ECC 2"). Pursuant to the ECC, at the transaction effective date, Fibrocell received a license to the Company's technology platform to develop and commercialize genetically-modified fibroblasts to treat chronic inflammatory and degenerative diseases of the joint, including arthritis and related conditions. Upon execution of the ECC, the Company received a technology access fee of $10,000. The Company is also entitled to (i) up to $30,000 of potential one-time payments for certain development and regulatory milestones for the first product developed under Fibrocell ECC 2, (ii) up to $30,000 of potential payments for certain regulatory milestones for each additional product developed under Fibrocell ECC 2, and (iii) up to $22,500 of potential payments for certain sales milestones for each product developed under Fibrocell ECC 2. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during the ECC and manufacturing services for Company materials provided to Fibrocell during the ECC. Fibrocell will pay the Company royalties as a percentage in the low double-digits of net sales derived from the sale of products developed from Fibrocell ECC 2, as defined in the agreement.

Fibrocell is responsible for conducting preclinical and clinical development of product candidates associated with Fibrocell ECC 2, as well as for other aspects of commercialization and manufacturing of the product candidates. The term of the ECC commenced in December 2015 and continues until terminated pursuant to the ECC agreement. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Fibrocell upon 90 days written notice to the Company.

All Fibrocell share data noted above reflect a 1-for-5 reverse stock split of Fibrocell's common stock effective May 25, 2018.

Thrive Agrobiotics Collaboration

In September 2015, the Company entered into an ECC with Thrive Agrobiotics, Inc. ("Thrive Agrobiotics"), an affiliate of Harvest and a related party. Thrive Agrobiotics was formed for the purpose of entering into the ECC and developing and commercializing products to improve the overall growth and feed efficiency in piglets. Upon execution of the ECC, the Company received a technology access fee in the form of equity in Thrive Agrobiotics valued at $1,667 as upfront consideration. The Company is also entitled to up to $5,500 of potential payments for development and commercial milestones for each product developed under the ECC. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during the ECC. Thrive Agrobiotics will pay the Company royalties as a percentage in the lower-double digits on the quarterly gross profits of product sales from products developed under the ECC, as defined in the agreement. Thrive Agrobiotics is responsible for the development and commercialization of the product candidates. The term of the ECC commenced in September 2015 and continues until terminated pursuant to the ECC agreement. The ECC may be terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Thrive Agrobiotics upon 90 days written notice to the Company.

Persea Bio Collaboration

In December 2014, the Company entered into an ECC with Persea Bio, LLC ("Persea Bio"), an affiliate of Third Security and a related party. Persea Bio was formed for the purpose of entering into the ECC and developing and commercializing a food

program, as defined in the agreement. Upon effectiveness of the ECC, the Company received a technology access fee of $5,000 as upfront consideration. The Company receives reimbursement payments for research and development services provided pursuant to the agreement during the ECC. Persea Bio will pay the Company royalties as a percentage in the lower-double digits on the quarterly gross profits of product sales from products derived from the ECC, as defined in the agreement. Persea Bio is responsible for the development and commercialization of the product candidates. The term of the ECC commenced in December 2014 and continues until terminated by either party in the event of certain material breaches defined in the agreement and may be terminated voluntarily by Persea Bio upon 90 days written notice to the Company.

AquaBounty Collaboration

In February 2013, the Company entered into an ECC with AquaBounty, a majority-owned consolidated subsidiary. The Company receives reimbursement payments for research and development services as provided for in the ECC agreement. In the event of product sales from a product developed from the ECC, the Company will receive 16.66% of quarterly gross profits for each product, as defined in the agreement. All revenues and expenses related to this ECC are eliminated in consolidation.

Deferred Revenue

Deferred revenue primarily consists of consideration received for the Company's collaborations and licensing agreements and prepayments for product and service revenues. Deferred revenue consists of the following:

	December 31,	
	2018	**2017**
Collaboration and licensing agreements	$ 63,284	$ 231,583
Prepaid product and service revenues	2,933	4,681
Other	3,547	133
Total	$ 69,764	$ 236,397
Current portion of deferred revenue	$ 15,554	$ 42,870
Long-term portion of deferred revenue	54,210	193,527
Total	$ 69,764	$ 236,397

The following table summarizes the remaining balance of deferred revenue associated with upfront and milestone payments for each significant counterparty to a collaboration or licensing agreement as of December 31, 2018 and 2017, including the estimated remaining performance period as of December 31, 2018. See discussion above for significant changes to our ECCs in 2018, including ZIOPHARM and Ares Trading.

	Average Remaining Performance Period (Years)	December 31, 2018	December 31, 2017
ZIOPHARM Oncology, Inc.	0.8	$ 1,214	$ 90,496
Ares Trading S.A.	0.0	—	40,789
Oragenics, Inc.	5.4	5,810	6,719
Intrexon T1D Partners, LLC	0.0	—	8,435
Intrexon Energy Partners, LLC	5.3	10,267	15,625
Intrexon Energy Partners II, LLC	5.9	14,060	13,833
Genopaver, LLC	5.3	1,175	1,704
Fibrocell Science, Inc.	5.9	17,519	16,607
Persea Bio, LLC	6.0	2,697	3,500
Harvest start-up entities (1)	6.2	7,644	18,400
Other	2.3	2,898	14,423
Total		$ 63,284	$ 230,531

(1) As of December 31, 2018 and December 31, 2017, the balance of deferred revenue for collaborations with Harvest start-up entities includes Exotech Bio, Inc.; AD Skincare, Inc.; and Thrive Agrobiotics, Inc. As of December 31, 2017, the balance of deferred revenue for collaborations with Harvest start-up entities also includes: Genten Therapeutics, Inc.; CRS Bio, Inc.; and Relieve Genetics, Inc. See Note 3 for further discussion of the asset acquisition of certain Harvest entities.

6. Short-term Investments

The Company's investments are classified as available-for-sale. The following table summarizes the amortized cost, gross unrealized gains and losses, and fair value of available-for-sale investments as of December 31, 2018:

	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Aggregate Fair Value
United States government debt securities	$ 119,401	$ —	$ (61)	$ 119,340
Certificates of deposit	348	—	—	348
Total	$ 119,749	$ —	$ (61)	$ 119,688

The following table summarizes the amortized cost, gross unrealized gains and losses, and fair value of available-for-sale investments as of December 31, 2017:

	Amortized Cost	Gross Unrealized Gains	Gross Unrealized Losses	Aggregate Fair Value
United States government debt securities	$ 6,000	$ —	$ (2)	$ 5,998
Certificates of deposit	275	—	—	275
Total	$ 6,275	$ —	$ (2)	$ 6,273

For more information on the Company's method for determining the fair value of its assets, see Note 2 – "Fair Value of Financial Instruments".

As of December 31, 2018, all of the available-for-sale investments were due within one year based on their contractual maturities.

Changes in market interest rates and bond yields cause certain investments to fall below their cost basis, resulting in unrealized losses on investments. The unrealized losses of the Company's investments were primarily a result of unfavorable changes in interest rates subsequent to the initial purchase of these investments and were not significant as of December 31, 2018.

As of December 31, 2018 and 2017, the Company did not consider any of its investments to be other-than-temporarily impaired. When evaluating its investments for other-than-temporary impairment, the Company reviews factors such as the length of time and extent to which fair value has been below its cost basis, the financial condition of the issuer, the Company's ability and intent to hold the security and whether it is more likely than not that it will be required to sell the investment before recovery of its cost basis.

7. Investments in Preferred Stock

Investment in ZIOPHARM Preferred Stock

In June 2016, the Company received 100,000 shares of Series 1 Preferred Stock (the "Preferred Shares") of ZIOPHARM with a per share stated value of $1,200, as consideration for amending their two previously existing ECC agreements (Note 5). The Company received a monthly dividend, paid in additional Preferred Shares, equal to $12.00 per Preferred Share held per month divided by the stated value of the Preferred Shares. In conjunction with the ZIOPHARM License Agreement in October 2018 (Note 5), the Company returned to ZIOPHARM all of the Preferred Shares owned or accrued by the Company as of the effective date of the agreement.

The investment in ZIOPHARM preferred stock was categorized as Level 3 as there were significant unobservable inputs and the Preferred Shares were not traded on a public exchange. The fair value of the investment in ZIOPHARM preferred stock was estimated using a probability-weighted expected return ("PWERM") model. The key inputs used in the PWERM model were (i) estimating the future returns for conversion of the Preferred Shares for both product approval and a change in control of ZIOPHARM (the "conversion events") using market data of the change in value for guideline companies as a result of these conversion events; (ii) estimating the expected date and likelihood of each conversion event; and (iii) discounting these estimated future returns using a discount rate for the Preferred Shares considering industry debt issuances originated by public funds and venture capital rates of return. The fair value of the Company's investment in ZIOPHARM preferred stock, including additional Preferred Shares received as dividends, was $160,832 as of December 31, 2017. During the years ended December 31, 2018, 2017 and 2016, the Company received and accrued an additional 11,415, 13,460, and 6,184 Preferred Shares, respectively, and recognized $14,793, $16,717, and $7,421 of dividend income in the accompanying consolidated statements of operations, respectively.

Investment in Fibrocell Preferred Stock

In March 2017, Fibrocell sold Series A Convertible Preferred Stock (the "Convertible Preferred Shares") convertible into shares of Fibrocell common stock and warrants to purchase shares of Fibrocell common stock to certain institutional and accredited investors, including the Company and affiliates of Third Security. The Company paid $1,161 in exchange for 1,161 Convertible Preferred Shares and warrants to acquire 99,769 shares of Fibrocell common stock, reflective of the 1-for-5 reverse stock split of Fibrocell's common stock effective May 25, 2018. The Convertible Preferred Shares are convertible at any time at the election of the Company and accrue dividends at 4% per annum, compounded quarterly, increasing the stated value of the shares. The investment in Fibrocell preferred stock is categorized as Level 3 as there are significant unobservable inputs and the Convertible Preferred Shares are not traded on a public exchange. The fair value of the investment in Fibrocell preferred stock is estimated using a conversion plus dividend approach utilizing the trading value of the underlying common stock and an estimated premium for the preferred stock dividend and other preferences. Market price volatility of Fibrocell's common stock and a significant change in the estimated preferred stock premium could result in a significant impact to the fair value of the investment in Fibrocell preferred stock. As of December 31, 2018 and 2017, the fair value of the Company's investment in Fibrocell preferred stock totaled $191 and $393, respectively. See Note 17 for additional discussion of the warrants.

Investment in Oragenics Preferred Stock

In November 2017, concurrent with Oragenics closing a preferred stock private placement, the Company exchanged a promissory note, including accrued interest, purchased from Oragenics in May 2017 and receivables due from Oragenics totaling $3,385 for Oragenics Series C preferred stock ("Series C Preferred Stock"). The Series C Preferred Stock is non-voting and non-convertible and is redeemable in whole or part at any time by Oragenics in cash. The Series C Preferred Stock accrues

an annual 12% dividend payable in additional Series C Preferred Stock through May 10, 2019, and after such date, the annual dividend increases to 20%. Additionally, the Company and Oragenics amended certain future payment terms under its ECCs (Note 5). As of December 31, 2018 and 2017, based on the most recent financial information available on Oragenics, the Company concluded that there was no value to its investment in Oragenics preferred stock.

Changes in the Fair Value of Investments in Preferred Stock

The following table summarizes the changes in the Level 3 investments in preferred stock during the years ended December 31, 2018 and 2017.

	2018	2017
Beginning balance	$ 161,225	$ 129,545
Purchase of preferred stock	—	766
Conversion of receivables to preferred stock	—	3,385
Dividend income from investments in preferred stock	14,841	16,756
Net unrealized appreciation (depreciation) in the fair value of the investments in preferred stock	(17,499)	10,773
Return of preferred stock	(158,376)	—
Ending balance	$ 191	$ 161,225

8. Fair Value Measurements

The carrying amount of cash and cash equivalents, restricted cash, receivables, prepaid expenses and other current assets, accounts payable, accrued compensation and benefits, other accrued liabilities, and related party payables approximate fair value due to the short maturity of these instruments.

Assets

The following table presents the placement in the fair value hierarchy of financial assets that are measured at fair value on a recurring basis, including the items for which the fair value option has been elected, as of December 31, 2018:

	Quoted Prices in Active Markets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)	December 31, 2018
Assets				
United States government debt securities	$ —	$ 119,340	$ —	$ 119,340
Equity securities	1,626	556	—	2,182
Preferred stock	—	—	191	191
Other	—	468	—	468
Total	$ 1,626	$ 120,364	$ 191	$ 122,181

The following table presents the placement in the fair value hierarchy of financial assets that are measured at fair value on a recurring basis, including the items for which the fair value option has been elected, as of December 31, 2017:

	Quoted Prices in Active Markets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)	December 31, 2017
Assets				
United States government debt securities	$ —	$ 5,998	$ —	$ 5,998
Equity securities	10,537	4,563	—	15,100
Preferred stock	—	—	161,225	161,225
Other	—	850	—	850
Total	$ 10,537	$ 11,411	$ 161,225	$ 183,173

The method used to estimate the fair value of the Level 1 assets in the tables above is based on observable market data as these equity securities are publicly-traded. The method used to estimate the fair value of the Level 2 short-term investments in the tables above is based on professional pricing sources for identical or comparable instruments, rather than direct observations of quoted prices in active markets. The method used to estimate the fair value of the Level 2 equity securities in the tables above is based on the quoted market price of the publicly-traded security, adjusted for a discount for lack of marketability. The methods used to estimate the fair value of the Level 3 assets are discussed in Note 7.

There were no transfers between levels of the fair value hierarchy during the year ended December 31, 2018.

Liabilities

The carrying values of the Company's long-term debt, excluding the Convertible Notes as discussed below, approximates fair value due to the length of time to maturity and/or the existence of interest rates that approximate prevailing market rates.

The calculated fair value of the Convertible Notes (Note 12) is approximately $141,000 as of December 31, 2018 and is based on the most recent third party trade of the instrument as of the balance sheet date. The fair value of the Convertible Notes are classified as Level 2 within the fair value hierarchy as there is not an active market for the Convertible Notes, however, third party trades of the instrument are considered observable inputs. The Convertible Notes are reflected at amortized cost on the accompanying consolidated balance sheet, which was $148,101 as of December 31, 2018.

The Company's contingent consideration liabilities (Notes 3 and 4) are measured on a recurring basis and were $585 as of December 31, 2018 and 2017. These fair value measurements were based on significant inputs not observable in the market and thus represented a Level 3 measurement. A significant change in unobservable inputs could result in a significant impact on the fair value of the Company's contingent consideration liabilities. The contingent consideration liabilities are remeasured to fair value at each reporting date until the contingencies are resolved, and those changes in fair value are recognized in earnings. The changes in the fair value of the Level 3 liabilities during the years ended December 31, 2018 and 2017 were as follows:

	2018	2017
Beginning balance	$ 585	$ 2,081
Acquisition date fair value of contingent consideration liability	—	585
Change in fair value of contingent consideration recognized in selling, general and administrative expenses	—	(2,081)
Ending balance	$ 585	$ 585

9. Inventory

Inventory consists of the following:

	December 31,	
	2018	2017
Supplies, embryos and other production materials	$ 4,729	$ 2,673
Work in process	4,391	4,767
Livestock	10,167	11,040
Feed	2,160	2,013
Total inventory	$ 21,447	$ 20,493

10. Property, Plant and Equipment, Net

Property, plant and equipment consist of the following:

	December 31,	
	2018	2017
Land and land improvements	$ 12,490	$ 11,767
Buildings and building improvements	20,371	18,183
Furniture and fixtures	1,891	2,515
Equipment	74,555	65,863
Leasehold improvements	28,289	25,277
Breeding stock	4,582	3,832
Computer hardware and software	11,697	10,128
Trees	11,910	6,642
Construction and other assets in progress	18,880	14,113
	184,665	158,320
Less: Accumulated depreciation and amortization	(55,791)	(45,646)
Property, plant and equipment, net	$ 128,874	$ 112,674

During the year ended December 31, 2018, the Company recorded a $5,057 loss on disposal of certain leasehold improvements, equipment, and other fixed assets in conjunction with the closing of one of its research and development facilities in Brazil. Additionally, included in the table above is $14,219 of land, buildings, and equipment related to a 2017 asset acquisition of a land-based aquaculture facility to be used in the production of AquAdvantage salmon in Indiana.

Depreciation expense was $14,328, $11,951 and $9,387 for the years ended December 31, 2018, 2017 and 2016, respectively.

11. Goodwill and Intangible Assets, Net

The changes in the carrying amount of goodwill for the years ended December 31, 2018 and 2017, are as follows:

	2018	2017
Beginning balance	$ 153,289	$ 157,175
Acquisitions	—	4,850
Impairment	—	(13,823)
Foreign currency translation adjustments	(3,704)	5,087
Ending balance	$ 149,585	$ 153,289

For the year ended December 31, 2017, the Company recorded a goodwill impairment charge since, based on the price per share received by AquaBounty in its recent underwritten public offering (Note 14), it was more-likely-than-not that the fair value of the AquaBounty reporting unit was less than its carrying amount. As a result, the Company compared the carrying

amount of the AquaBounty reporting unit to the fair value and determined the carrying amount exceeded the fair value resulting in a $13,001 goodwill impairment charge for the excess carrying value. The Company did not recognize any goodwill impairment charges during the years ended December 31, 2018 or 2016. The Company had $13,823 of accumulated impairment losses as of December 31, 2018.

Intangible assets consist of the following as of December 31, 2018:

	Weighted Average Useful Life (Years)	Gross Carrying Amount	Accumulated Amortization	Net
Patents, developed technologies and know-how	15.5	$ 152,482	$ (35,133)	$ 117,349
Customer relationships	6.5	10,700	(7,565)	3,135
Trademarks	9.3	6,800	(3,341)	3,459
In-process research and development		5,348	—	5,348
Total		$ 175,330	$ (46,039)	$ 129,291

Intangible assets consist of the following as of December 31, 2017:

	Gross Carrying Amount	Accumulated Amortization	Net
Patents, developed technologies and know-how	$ 263,615	$ (44,954)	$ 218,661
Customer relationships	10,700	(6,383)	4,317
Trademarks	6,800	(2,567)	4,233
In-process research and development	5,666	—	5,666
Total	$ 286,781	$ (53,904)	$ 232,877

The balance of in-process research and development includes certain in-process research and development technology acquired in the Company's acquisition of Oxitec in September 2015, and amortization will begin once certain regulatory approvals have been obtained for the in-process programs. In the fourth quarter of 2018, the Company recorded an impairment charge of $60,504 due to a change in the Company's business strategy for commercializing the Oxitec developed technology targeting the *Aedes Aegypti* mosquito, resulting in a lack of projected future cash flows to support the carrying value of the asset. In 2017, the Company recorded an impairment charge of $2,950 as part of its annual impairment assessment of indefinite-lived intangible assets due to the lack of projected future cash flows to support certain in-process research and development.

Additionally, in the fourth quarter of 2018, the Company recorded a $16,027 loss related to the abandonment of certain developed technologies that the Company ceased using in the fourth quarter of 2018. The Company does not expect to use these technologies as a defensive asset or market them for sale in the future. Because these technologies were used in combination with other technologies, the identifiable cash flows did not result in an impairment; however, because the Company made a decision to abandon the assets, it recorded the charge to research and development expense.

Amortization expense was $18,784, $19,194 and $15,185 for the years ended December 31, 2018, 2017 and 2016, respectively. Estimated aggregate amortization expense for definite lived intangible assets is expected to be as follows:

2019	$ 11,966
2020	11,863
2021	11,675
2022	10,676
2023	9,798
Thereafter	67,965
Total	$ 123,943

12. Lines of Credit and Long-Term Debt

Lines of Credit

Trans Ova has a $5,000 revolving line of credit with First National Bank of Omaha that matures on May 1, 2019. The line of credit bears interest at the greater of 2.95% above the London Interbank Offered Rate or 3.00%, and the actual rate was 5.30% as of December 31, 2018. As of December 31, 2018, there was no outstanding balance. The amount available under the line of credit is based on eligible accounts receivable and inventory up to the maximum principal amount. The line of credit is collateralized by certain of Trans Ova's assets and contains certain restricted covenants that include maintaining minimum tangible net worth and working capital and maximum allowable annual capital expenditures. Trans Ova was in compliance with these covenants as of December 31, 2018.

Exemplar has a $700 revolving line of credit with American State Bank that matures on October 30, 2019. The line of credit bears interest at 5.75% per annum. As of December 31, 2018, there was an outstanding balance of $466.

Long-Term Debt

Long-term debt consists of the following:

	December 31,	
	2018	**2017**
Convertible debt	$ 203,391	$ —
Notes payable	4,551	5,010
Royalty-based financing	2,085	2,132
Other	1,767	895
Long-term debt	211,794	8,037
Less current portion	559	502
Long-term debt, less current portion	$ 211,235	$ 7,535

Convertible Debt

Intrexon Convertible Notes

In July 2018, Intrexon completed a registered underwritten public offering of $200,000 aggregate principal amount of Convertible Notes and issued the Convertible Notes under an indenture (the "Base Indenture") between Intrexon and The Bank of New York Mellon Trust Company, N.A., as trustee, as supplemented by the First Supplemental Indenture (together with the Base Indenture, the "Indenture"). Intrexon received net proceeds of $193,958 after deducting underwriting discounts and offering expenses of $6,042.

The Convertible Notes are senior unsecured obligations of Intrexon and bear interest at a rate of 3.50% per year, payable semiannually in arrears on January 1 and July 1 of each year beginning on January 1, 2019. The Convertible Notes mature on July 1, 2023, unless earlier repurchased or converted. The Convertible Notes are convertible into cash, shares of Intrexon's common stock or a combination of cash and shares, at Intrexon's election. The initial conversion rate of the Convertible Notes is 58.6622 shares of Intrexon common stock per $1,000 principal amount of Convertible Notes (equivalent to an initial conversion price of approximately $17.05 per share of common stock). The conversion rate is subject to adjustment upon the occurrence of certain events, but will not be adjusted for any accrued and unpaid interest. In addition, following certain corporate events that occur prior to the maturity date as defined in the Indenture, Intrexon will increase the conversion rate for a holder who elects to convert its Convertible Notes in connection with such a corporate event in certain circumstances. Prior to April 1, 2023, the holders may convert the Convertible Notes at their option only upon the satisfaction of the following circumstances:

- During any calendar quarter commencing after the calendar quarter ending on September 30, 2018, if the last reported sales price of Intrexon's common stock for at least 20 trading days (whether or not consecutive) during the last 30 consecutive trading days of the immediately preceding calendar quarter is greater than or equal to 130% of the conversion price on each applicable trading day;

- During the five business day period after any five consecutive trading day period in which the trading price, as defined in the Indenture, for the Convertible Notes is less than 98% of the product of the last reported sales price of Intrexon's common stock and the conversion rate for the Convertible Notes on each such trading day; or

- Upon the occurrence of specified corporate events as defined in the Indenture.

None of the above events allowing for conversion prior to April 1, 2023 occurred during the year ended December 31, 2018. On or after April 1, 2023 until June 30, 2023, holders may convert their Convertible Notes at any time. Intrexon may not redeem the Notes prior to the maturity date.

If Intrexon undergoes a fundamental change, as defined in the Indenture, holders of the Convertible Notes may require Intrexon to repurchase for cash all or any portion of their Convertible Notes at a fundamental change repurchase price equal to 100% of the principal amount of the Convertible Notes to be repurchased, plus accrued and unpaid interest to, but excluding, the fundamental change repurchase date. The Indenture contains customary events of default, as defined in the agreement, and, if any of the events occur, could require repayment of a portion or all of the Convertible Notes, including accrued and unpaid interest. Additionally, the Indenture provides that Intrexon shall not consolidate with or merge with or into, or sell, convey, transfer or lease all or substantially all of its properties and assets to, another entity, unless (i) the surviving entity is organized under the laws of the United States and such entity expressly assumes all of Intrexon's obligations under the Convertible Notes and the Indenture; and (ii) immediately after such transaction, no default or event of default has occurred and is continuing under the Indenture.

The net proceeds received from the issuance of the Convertible Notes were initially allocated between long-term debt, the liability component, at $143,723 and additional paid-in capital, the equity component, at $50,235. Additional paid-in capital was further reduced by $13,367 of deferred taxes resulting from the difference between the carrying amount and the tax basis of the Convertible Notes that is created by the equity component, which also resulted in deferred tax benefit recognized from the reversal of valuation allowances on current year domestic operating losses in the same amount (Note 13). As of December 31, 2018, the outstanding principal balance on the Convertible Notes was $200,000 and the carrying value of long-term debt was $148,101. The effective interest rate on the Convertible Notes, including amortization of the long-term debt discount and debt issuance costs, is 11.02%. As of December 31, 2018, the unamortized long-term debt discount and debt issuance costs totaled $51,899.

Total interest expense related to the Convertible Notes was $7,840 for the year ended December 31, 2018, which consists of $3,462 cash interest expense paid in December and $4,378 of noncash interest expense.

ActoBio Convertible Notes

In September 2018, ActoBio issued $30,000 of convertible promissory notes (the "ActoBio Notes") to a related party in conjunction with an asset acquisition with Harvest (Note 3). The ActoBio Notes have a maturity date of September 6, 2020, accrue interest at 3.0% compounded annually, are convertible into shares of ActoBio common stock at any time by the holder, and are automatically convertible in shares of ActoBio common stock upon the closing of certain financing events as defined in the ActoBio Notes. If the ActoBio Notes have not been converted to ActoBio common stock by the maturity date, ActoBio can pay the principal and accrued interest in cash or with shares of Intrexon common stock at its election. There are no embedded features that are required to be separated from the debt host and accounted for separately, so the ActoBio Notes were recorded at $30,000. Interest expense for the year ended December 31, 2018 was $290. As of December 31, 2018, the carrying value of the ActoBio Notes, including accrued interest, was $30,290.

Intrexon and Precigen Convertible Note

In December 2018, in conjunction with the Merck Purchase Agreement (Note 5), Intrexon and Precigen jointly and severally issued a $25,000 convertible note (the "Merck Note") to Ares Trading in exchange for cash. The Merck Note has a maturity date of June 28, 2021 and will be converted to Intrexon common stock on the first trading day following maturity if not otherwise converted prior to that date. Prior to maturity, Ares Trading may convert the Merck Note, at their election, into (i) Intrexon common stock at any time, (ii) Intrexon common stock upon the Company's closing of qualified financing as defined in the agreement, (iii) Precigen equity upon Precigen closing a qualified financing as defined in the agreement, and (iv) Precigen common stock upon the closing of a qualified initial public offering ("IPO") of Precigen common stock. In the event of a conversion upon a qualified IPO, the conversion price will be 90% of the IPO price. In the event Ares Trading elects to convert the Merck Note into Precigen equity, the Merck Note accrues interest at a rate of 5% per year ("PIK interest") and will be converted with the outstanding principal. The Company determined that the potential PIK interest and IPO conversion

discount represented embedded derivatives requiring bifurcation from the debt host but had no significant value as of December 31, 2018.

Notes Payable

Trans Ova has a note payable to American State Bank that matures in April 2033 and has an outstanding principal balance of $4,482 as of December 31, 2018. Trans Ova pays monthly installments of $39, which includes interest at 3.95%. The note payable is collateralized by certain of Trans Ova's real estate and non-real estate assets.

Royalty-based Financing

AquaBounty has a royalty-based financing grant from the Atlantic Canada Opportunities Agency, a Canadian government agency, to provide funding of a research and development project. The total amount available under the award was $2,107, which AquaBounty claimed over a five year period. All amounts claimed by AquaBounty must be repaid in the form of a 10% royalty on any products commercialized out of this research and development project until fully paid. Because the timing of commercialization is subject to additional regulatory considerations, the timing of repayment is uncertain. As of the date of the acquisition by Intrexon in March 2013, AquaBounty had claimed $1,952 of the available funds and this amount was recorded at its acquisition date fair value of $1,107. The Company accretes the difference of $845 between the face value of amounts drawn and the acquisition date fair value over the expected period of repayment. Subsequent to the acquisition date, AquaBounty claimed the remaining balance available under the grant, resulting in total long term debt of $2,085 as of December 31, 2018.

Future Maturities

Future maturities of long-term debt are as follows:

2019	$ 559
2020	30,843
2021	25,405
2022	420
2023	201,442
Thereafter	2,939
Total	$ 261,608

The AquaBounty royalty-based financing grant is not included in the table above due to the uncertainty of the timing of repayment.

13. Income Taxes

The components of loss before income taxes are presented below:

	Year Ended December 31,		
	2018	**2017**	**2016**
Domestic	$ (443,337)	$ (71,343)	$ (157,067)
Foreign	(92,897)	(58,357)	(37,084)
Loss before income taxes	$ (536,234)	$ (129,700)	$ (194,151)

The components of income tax expense (benefit) are presented below:

	Year Ended December 31,		
	2018	2017	2016
United States federal income taxes:			
Current	$ (31)	$ 27	$ (17)
Deferred	(11,855)	(523)	1,396
Foreign income taxes:			
Current	(332)	(379)	(393)
Deferred	(5,068)	(2,269)	(5,177)
State income taxes:			
Current	113	—	—
Deferred	(4,355)	264	314
Income tax benefit	$ (21,528)	$ (2,880)	$ (3,877)

Income tax benefit for the years ended December 31, 2018, 2017 and 2016 differed from amounts computed by applying the applicable United States federal corporate income tax rate of 21% for 2018, and 34% for years prior to 2018, to loss before income taxes as a result of the following:

	2018	2017	2016
Computed statutory income tax benefit	$ (112,609)	$ (44,098)	$ (66,011)
State and provincial income tax benefit, net of federal income taxes	(24,724)	(3,294)	(7,905)
Nondeductible stock based compensation	1,834	4,147	3,321
Nondeductible officer compensation	294	476	—
Gain on dividend distribution of AquaBounty common stock	—	3,965	—
Impairment of goodwill	—	4,700	—
Research and development tax incentives	(1,088)	(1,166)	(6,350)
Acquisition and internal restructuring transaction costs	52	354	571
Provisional impact of the Tax Act	—	85,288	—
Enacted changes in foreign tax rates and foreign tax reforms	—	2,138	—
Reacquired in-process research and development	2,696	—	—
Change in deferred state tax rate	8,666	—	—
United States-foreign rate differential	3,017	5,410	3,463
Other, net	(486)	(64)	1,485
	(122,348)	57,856	(71,426)
Change in valuation allowance for deferred tax assets	100,820	(60,736)	67,549
Total income tax benefit	$ (21,528)	$ (2,880)	$ (3,877)

The tax effects of temporary differences that comprise the deferred tax assets and liabilities as of December 31, 2018 and 2017, are as follows:

	2018	2017
Deferred tax assets		
Allowance for doubtful accounts	$ 1,490	$ 1,300
Inventory	614	489
Equity securities and investments in affiliates	30,241	17,510
Intangible assets	71,205	—
Accrued liabilities	4,412	3,131
Stock-based compensation	29,297	26,936
Deferred revenue	16,297	61,785
Research and development tax credits	11,597	11,385
Net operating and capital loss carryforwards	148,411	111,453
Total deferred tax assets	313,564	233,989
Less: Valuation allowance	308,113	215,582
Net deferred tax assets	5,451	18,407
Deferred tax liabilities		
Property, plant and equipment	528	237
Intangible assets	—	33,790
Long-term debt	12,136	—
Total deferred tax liabilities	12,664	34,027
Net deferred tax liabilities	$ (7,213)	$ (15,620)

Activity within the valuation allowance for deferred tax assets during the years ended December 31, 2018, 2017 and 2016 was as follows:

	2018	2017	2016
Valuation allowance at beginning of year	$ 215,582	$ 256,165	$ 190,174
Increase (decrease) in valuation allowance as a result of			
Mergers and acquisitions, net	418	—	(1,416)
Current year operations	122,853	26,619	67,549
Adoption of ASC 606	(7,477)	—	—
Adoption of ASU 2016-09	—	17,843	—
Provisional impact of the Tax Act	—	(87,473)	—
Equity component of long-term debt	(13,367)	—	—
Change in deferred state tax rate	(8,666)	—	—
Changes in foreign tax rates and foreign tax reforms	—	1,327	—
Foreign currency translation adjustment	(1,230)	1,101	(142)
Valuation allowance at end of year	$ 308,113	$ 215,582	$ 256,165

In assessing the realizability of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent upon the generation of future taxable income during the periods in which those temporary differences become deductible. Management considers the scheduled reversal of deferred tax liabilities, projected future taxable income and tax planning strategies in making this assessment. Due to the Company and its subsidiaries' histories of net losses incurred from inception, any corresponding net domestic and certain foreign deferred tax assets have been fully reserved as the Company and its subsidiaries cannot sufficiently be assured that these deferred tax assets will be realized. The components of the deferred tax assets and liabilities as of the date of the mergers and acquisitions by the Company prior to consideration of the valuation allowance are substantially similar to the components of deferred tax assets presented herein.

The Company's past issuances of stock and mergers and acquisitions have resulted in ownership changes as defined in Section 382 of the Internal Revenue Code of 1986, as amended ("Section 382"). As a result, utilization of portions of the net operating losses may be subject to annual limitations, however as of December 31, 2018, all such limited losses applicable to Intrexon, other than losses inherited via acquisition, have been fully utilized. As of December 31, 2018, approximately $41,909 of the Company's domestic net operating losses were inherited via acquisition, including $13,376 acquired via the acquisition of GenVec, and are limited based on the value of the target at the time of the transaction.

As of December 31, 2018, the Company has loss carryforwards for United States federal income tax purposes of approximately $369,102 available to offset future taxable income, including $116,600 generated after 2017, and federal and state research and development tax credits of $7,881, prior to consideration of annual limitations that may be imposed under Section 382. Carryforwards generated prior to 2018 will begin to expire in 2022. The Company's direct foreign subsidiaries have foreign loss carryforwards of approximately $159,811, most of which do not expire.

The Company does not record deferred taxes on the undistributed earnings of its direct foreign subsidiaries because it does not expect the temporary differences related to those unremitted earnings to reverse in the foreseeable future. As of December 31, 2018, the Company's direct foreign subsidiaries had accumulated deficits of approximately $150,409. Future distributions of accumulated earnings of the Company's direct foreign subsidiaries may be subject to United States income and foreign withholding taxes.

The Company does not file a consolidated income tax return with AquaBounty. As of December 31, 2018, AquaBounty has loss carryforwards for federal and foreign income tax purposes of approximately $37,807, including $9,370 generated after 2017, and $14,007, respectively, and foreign tax credits of approximately $2,628 available to offset future taxable income, prior to consideration of annual limitations that may be imposed under Section 382 or analogous foreign provisions. Carryforwards generated prior to 2018 began to expire in 2018. As a result of the Company's ownership in AquaBounty passing 50% in 2013, an annual Section 382 of approximately $900 per year will apply to domestic losses and credits carried forward by AquaBounty from prior years, which are also subject to prior Section 382 limitations.

In the year ended December 31, 2017, the Company recorded a net provisional income tax benefit of $2,185 upon enactment of the Tax Act, which is comprised of several items. Amounts related to the remeasurement of most of the Company's domestic deferred tax assets as a result of the United States corporate rate change to 21% as part of the Tax Act are $87,473, which was fully offset by a reduction in the Company's valuation allowance. The Company's net United States deferred tax liability that is not offset by a valuation allowance was similarly written down, and the Company recorded a provisional deferred tax benefit of $1,730. The Company also recorded a provisional current tax benefit of $455 related to the expected refundability of accumulated corporate alternative minimum tax credits. The Company provisionally estimated its transition tax exposure to be zero, as any accumulated earnings in foreign subsidiaries are offset by accumulated deficits in other foreign subsidiaries. The Company completed its accounting for the Tax Act in the fourth quarter of 2018, and there were no significant adjustments to the previously recorded provisional amounts.

Additionally, in December 2017, Belgium enacted significant tax reform measures, the most significant of which to the Company is the limitation on the utilization of accumulated losses in years after 2017. After that date, loss carryforwards can only be used to offset 70% of taxable income that exceeds a certain threshold. As a result, the Company recorded adjustments to its net deferred tax assets and valuation allowances. These adjustments resulted in a net deferred tax liability of $2,307, which was recorded as a component of deferred tax expense for the year ended December 31, 2017.

The Company and its subsidiaries do not have material unrecognized tax benefits as of December 31, 2018. The Company does not anticipate significant changes in the amount of unrecognized tax benefits in the next 12 months. The Company's tax returns for years 2004 and forward are subject to examination by federal or state tax authorities due to the carryforward of unutilized net operating losses and research and development tax credits.

14. Shareholders' Equity

Issuances of Intrexon Common Stock

In January 2018, Intrexon closed a public offering of 6,900,000 shares of its common stock, including 1,000,000 shares of common stock purchased by affiliates of Third Security. The net proceeds of the offering were $82,374, after deducting underwriting discounts of $3,688 and offering expenses of $188, all of which were capitalized.

In December 2017, the Company entered into a securities purchase agreement with an affiliate of Third Security for the private placement of 1,207,980 shares of the Company's common stock for gross proceeds of $13,686.

Share Lending Agreement

Concurrently with the offering of the Convertible Notes (Note 12), Intrexon entered into a share lending agreement (the "Share Lending Agreement") with J.P. Morgan Securities LLC (the "Share Borrower") pursuant to which Intrexon loaned and delivered 7,479,431 shares of its common stock (the "Borrowed Shares") to the Share Borrower. The Share Lending Agreement will terminate, and the Borrowed Shares will be returned to Intrexon within five business days of such termination, upon (i) termination by the Share Borrower or (ii) the earliest to occur of (a) October 1, 2023 and (b) the date, if any, on which the Share Lending Agreement is either mutually terminated or terminated by one party upon a default by the other party. The Borrowed Shares were offered and sold to the public at a price of $13.37 per share under a registered offering (the "Borrowed Shares Offering"). Intrexon did not receive any proceeds from the sale of the Borrowed Shares to the public. The Share Borrower or its affiliates received all the proceeds from the sale of the Borrowed Shares to the public. Affiliates of Third Security purchased all of the shares of common stock in the Borrowed Shares Offering.

The Share Lending Agreement was entered into at fair value and met the requirements for equity classification. Therefore, the value is netted against the issuance of the Borrowed Shares in additional paid-in capital. Additionally, the Borrowed Shares are not included in the denominator for loss per share attributable to Intrexon shareholders unless the Share Borrower defaults on the Share Lending Agreement.

Issuances of AquaBounty Common Stock

In January 2018, AquaBounty completed an underwritten public offering that resulted in net proceeds of $10,616 after deducting discounts, fees and expenses. As part of this offering, Intrexon purchased $5,000 of additional AquaBounty common stock. In October 2018, certain investors exercised warrants acquired from the January 2018 offering, resulting in additional net proceeds of $4,316, including $3,077 from Intrexon.

In January 2017, in conjunction with the listing by AquaBounty of their common stock on the NASDAQ Stock Market, Intrexon purchased $25,000 of additional AquaBounty common stock and subsequently distributed shares of AquaBounty common stock as a dividend to Intrexon shareholders.

Dividends to Shareholders

In January 2017, the Company distributed to its shareholders 1,776,557 shares of AquaBounty common stock valued at $22,385. The distribution constituted a dividend to shareholders of record as of January 9, 2017. In connection with the distribution and pursuant to the terms of the Company's equity incentive plans, the conversion terms of all outstanding options for shares of the Company's common stock as of January 9, 2017 were adjusted to reflect the value of the distribution with respect to shares of the Company's common stock by decreasing the exercise prices and increasing the number outstanding options. This adjustment resulted in 46,766 additional outstanding options at a weighted average exercise price of $31.11.

Components of Accumulated Other Comprehensive Loss

The components of accumulated other comprehensive loss are as follows:

	December 31,	
	2018	**2017**
Unrealized loss on investments	$ (61)	$ (2)
Loss on foreign currency translation adjustments	(28,551)	(15,552)
Total accumulated other comprehensive loss	$ (28,612)	$ (15,554)

15. Share-Based Payments

The Company records the fair value of stock options and RSUs issued to employees and nonemployees as of the grant date as stock-based compensation expense. Stock-based compensation expense for employees and nonemployees is recognized over the requisite service period, which is typically the vesting period. Stock-based compensation costs included in the consolidated statements of operations are presented below:

	Year Ended December 31,		
	2018	2017	2016
Cost of products	$ 78	$ 116	$ 81
Cost of services	237	322	274
Research and development	9,676	9,336	9,251
Selling, general and administrative	26,305	31,802	32,596
Total	$ 36,296	$ 41,576	$ 42,202

Intrexon Stock Option Plans

In April 2008, Intrexon adopted the 2008 Equity Incentive Plan (the "2008 Plan") for employees and nonemployees pursuant to which Intrexon's board of directors granted share based awards, including stock options, to officers, key employees and nonemployees. Upon the effectiveness of the 2013 Omnibus Incentive Plan (the "2013 Plan"), no new awards may be granted under the 2008 Plan. As of December 31, 2018, there were 410,909 stock options outstanding under the 2008 Plan.

Intrexon adopted the 2013 Plan for employees and nonemployees pursuant to which Intrexon's board of directors may grant share-based awards, including stock options, and shares of common stock, to employees, officers, consultants, advisors, and nonemployee directors. The 2013 Plan became effective in August 2013, and as of December 31, 2018, there were 20,000,000 shares authorized for issuance under the 2013 Plan, of which 10,682,154 stock options and 970,341 RSUs were outstanding and 5,086,700 shares were available for grant.

Stock options may be granted with an exercise price equal to or greater than the stock's fair market value at the date of grant. Stock options may be granted with an exercise price less than the stock's fair market value at the date of grant if the stock options are replacement options in accordance with certain United States Treasury regulations. Virtually all stock options have ten-year terms and vest four years from the date of grant.

Stock option activity was as follows:

	Number of Shares	Weighted Average Exercise Price	Weighted Average Remaining Contractual Term (Years)
Balances at December 31, 2015	11,043,528	$ 32.66	8.49
Granted	4,644,860	29.39	
Exercised	(1,210,840)	(15.83)	
Forfeited	(2,760,809)	(40.34)	
Expired	(76,356)	(37.81)	
Balances at December 31, 2016	11,640,383	31.25	8.21
Granted	3,920,950	21.47	
Adjustment due to dividend (Note 14)	46,766	31.11	
Exercised	(149,429)	(6.37)	
Forfeited	(3,797,105)	(28.37)	
Expired	(278,818)	(33.18)	
Balances at December 31, 2017	11,382,747	28.99	7.32
Granted	1,470,339	14.26	
Exercised	(45,159)	(6.59)	
Forfeited	(929,596)	(21.48)	
Expired	(785,268)	(26.25)	
Balances at December 31, 2018	11,093,063	27.95	6.81
Exercisable at December 31, 2018	7,002,519	30.37	5.97

Total unrecognized compensation costs related to unvested awards as of December 31, 2018 were $37,353, and are expected to be recognized over a weighted-average period of approximately two years.

The weighted average grant date fair value of options granted during 2018, 2017 and 2016 was $7.94, $12.19 and $16.28, respectively. The aggregate intrinsic value of options exercised during 2018, 2017 and 2016 was $356, $2,429 and $22,704, respectively. The aggregate intrinsic value of options is calculated as the difference between the exercise price of the underlying options and the fair value of Intrexon's common stock for those shares where the exercise price was lower than the fair value of Intrexon's common stock on the date of exercise.

The following table summarizes additional information about stock options outstanding as of December 31, 2018:

	Options Outstanding				Options Exercisable			
Range of Exercise Prices	Number of Options	Weighted Average Exercise Price	Weighted Average Remaining Life (Years)	Aggregate Intrinsic Value	Number of Options	Weighted Average Exercise Price	Weighted Average Remaining Life (Years)	Aggregate Intrinsic Value
$ 3.17 — $ 19.52	1,973,818	$ 13.70	7.54	$ 169	833,007	$ 12.80	4.85	$ 169
$19.85 — $ 20.94	1,914,763	20.93	7.99	—	500,263	20.92	7.67	—
$21.00 — $ 27.08	2,057,126	23.29	7.26	—	1,248,370	23.01	6.69	—
$27.10 — $ 29.56	2,666,109	29.19	5.28	—	2,593,151	29.20	5.23	—
$29.58 — $ 65.08	2,481,247	47.24	6.59	—	1,827,728	47.65	6.54	—
	11,093,063	$ 27.95	6.81	$ 169	7,002,519	$ 30.37	5.97	$ 169

The following table summarizes additional information about stock options outstanding as of December 31, 2017:

	Options Outstanding				Options Exercisable			
Range of Exercise Prices	Number of Options	Weighted Average Exercise Price	Weighted Average Remaining Life (Years)	Aggregate Intrinsic Value	Number of Options	Weighted Average Exercise Price	Weighted Average Remaining Life (Years)	Aggregate Intrinsic Value
$ 2.64 — $ 9.30	453,371	$ 7.06	3.94	$ 2,020	453,371	$ 7.06	3.94	$ 2,020
$12.50 — $ 21.38	3,158,121	20.58	8.74	—	456,942	19.52	7.13	—
$21.43 — $ 28.81	3,399,721	25.55	6.91	—	1,804,401	25.86	5.69	—
$28.88 — $ 40.99	2,751,716	32.07	6.70	—	1,732,250	31.51	6.32	—
$41.41 — $ 65.08	1,619,818	53.52	7.42	—	859,733	53.07	7.38	—
	11,382,747	$ 28.99	7.32	$ 2,020	5,306,697	$ 29.96	6.14	$ 2,020

RSU activity was a follows:

	Number of Restricted Stock Units	Weighted Average Grant Date Fair Value	Weighted Average Remaining Contractual Term (Years)
Balances at December 31, 2017	—	$ —	0.00
Granted	1,069,126	13.84	
Vested	(25,000)	(15.82)	
Forfeited	(73,785)	(13.47)	
Balances at December 31, 2018	970,341	13.82	1.43

Total unrecognized compensation costs related to unvested RSU awards as of December 31, 2018 were $9,641, and are expected to be recognized over a weighted-average period of approximately three years.

Intrexon currently uses authorized and unissued shares to satisfy share award exercises.

The Company's Chief Executive Officer ("CEO") receives a base salary of $200 per month payable in fully vested shares of Intrexon common stock with such shares subject to a three-year lock-up on resale. The monthly number of shares of common stock is calculated based on the closing price on the last trading day of each month and the shares are issued pursuant to the terms of a Restricted Stock Unit Agreement ("RSU Agreement") between Intrexon and the CEO pursuant to the terms of the 2013 Plan. The RSU Agreement expires March 31, 2019 and is subject to renewal annually by the compensation committee of the board of directors of the Company. The fair value of the shares issued as compensation for services is included in selling, general, and administrative expenses in the Company's consolidated statements of operations and totaled $1,956, $1,908, and $1,861 for the years ended December 31, 2018, 2017 and 2016, respectively.

AquaBounty Stock Option Plans

In March 2016, AquaBounty's board of directors adopted the AquaBounty 2016 Equity Incentive Plan ("AquaBounty 2016 Plan") to replace the AquaBounty 2006 Equity Incentive Plan ("AquaBounty 2006 Plan"). The AquaBounty 2016 Plan provides for the issuance of incentive stock options, non-qualified stock options and awards of restricted and direct stock purchases to directors, officers, employees, and consultants of AquaBounty. The AquaBounty 2016 Plan was approved by AquaBounty's shareholders at its annual meeting in April 2016. Upon the effectiveness of the AquaBounty 2016 Plan, no new awards may be granted under the AquaBounty 2006 Plan.

As of December 31, 2018, there were 339,964 options outstanding under both AquaBounty plans, of which 303,986 were exercisable, at a weighted average exercise price of $7.09 per share. As of December 31, 2017, there were 227,203 options outstanding under these plans, of which 192,748 were exercisable, at a weighted average exercise price of $9.39 per share.

16. Commitments and Contingencies

Operating Leases

The Company leases certain facilities and equipment under noncancelable operating leases. The equipment leases are renewable at the option of the Company. As of December 31, 2018, future minimum lease payments under operating leases having initial or remaining noncancelable lease terms in excess of one year are as follows:

2019	$	9,182
2020		9,910
2021		9,127
2022		8,305
2023		7,229
Thereafter		34,157
Total	$	77,910

Rent expense, including other facility expenses, was $13,076, $11,064 and $8,593 in 2018, 2017 and 2016, respectively.

Purchase Commitments

As of December 31, 2018, the Company had outstanding contractual purchase commitments of $20,055, which primarily relate to amounts that will be paid in 2019 and 2020 upon delivery of commercial non-browning apple trees.

Contingencies

In March 2012, Trans Ova was named as a defendant in a licensing and patent infringement suit brought by XY, LLC ("XY") alleging that certain of Trans Ova's activities breached a 2004 licensing agreement and infringed on patents that XY allegedly owned. Trans Ova filed a number of counterclaims in the case. In Colorado District Court, the matter proceeded to a jury trial in January 2016. The jury determined that XY and Trans Ova had each breached the licensing agreement and that Trans Ova had infringed XY's patents. In April 2016, the court issued its post-trial order, awarding $528 in damages to Trans Ova and $6,066 in damages to XY. The order also provided Trans Ova with a compulsory license to XY's technology, subject to an ongoing royalty obligation. Both parties appealed the district court's order, which appeal was decided in May 2018 by the Court of Appeals for the Federal Circuit. The Court denied Trans Ova's appeal of its claims for antitrust, breach of contract and patent

invalidity (except as to one patent, for which the Court affirmed invalidity in a separate, same-day ruling in a third-party case). The Court considered the issue of willfulness to be moot since the district court did not award damages for the willfulness finding. Finally, the Court remanded the district court's calculation of the ongoing royalty and instructed the district court to re-calculate the ongoing royalty in light of post-verdict economic factors.

Since the inception of the 2004 agreement, Trans Ova has remitted payments to XY pursuant to the terms of that agreement, or pursuant to the terms of the April 2016 court order, and has recorded these payments in cost of services in the consolidated statements of operations for the respective periods. For the period from inception of the 2004 agreement through the court's April 2016 order, aggregate royalty and license payments were $3,170, of which $2,759 had not yet been deposited by XY. In the year ended December 31, 2016, the Company recorded expense of $4,228, which is included in selling, general and administrative expenses on the accompanying consolidated statement of operations, representing the excess of the net damages awarded to XY, including prejudgment interest, over the liability previously recorded by Trans Ova for uncashed checks previously remitted to XY. In August 2016, Trans Ova deposited the net damages amount, including prejudgment interest, into the court's treasury, to be held until the appeals process is complete and final judgment amounts are determined. As of December 31, 2018, this amount is included in restricted cash on the accompanying consolidated balance sheet. In December 2016, Trans Ova elected to void the outstanding checks discussed above, and these amounts have been reclassified to other accrued liabilities on the accompanying consolidated balance sheets as of December 31, 2018 and 2017.

In December 2016, XY filed a complaint for patent infringement and trade secret misappropriation against Trans Ova in the District Court of Waco, Texas. Since the claims in this 2016 complaint directly relate to the 2012 licensing dispute and patent issues, Trans Ova filed and was granted a motion for change of venue to Colorado District Court. Trans Ova also filed a motion to dismiss, from which the Court dismissed ten of the twelve counts of the complaint. Presently, two counts for patent infringement remain pending. Trans Ova and the Company could elect to enter into a settlement agreement in order to avoid the further costs and uncertainties of litigation.

The Company may become subject to other claims, assessments and governmental investigations from time to time in the ordinary course of business. Such matters are subject to many uncertainties and outcomes are not predictable with assurance. The Company accrues liabilities for such matters when it is probable that future expenditures will be made and such expenditures can be reasonably estimated. As of December 31, 2018 and 2017, the Company does not believe that any such matters, individually or in the aggregate, will have a material adverse effect on the Company's business, financial condition, results of operations, or cash flows.

17. Related Party Transactions

Third Security and Affiliates

The Company's CEO and Chairman of the board of directors is also the Senior Managing Director and CEO of Third Security and owns 100% of the equity interests of Third Security. In November 2015, the independent members of Intrexon's board of directors, with the recommendation of the audit committee of the board of directors, approved the execution of a Services Agreement ("Services Agreement") with Third Security pursuant to which Third Security provides the Company with certain professional, legal, financial, administrative, and other support services necessary to support the Company and its CEO. As consideration for providing these services, Third Security is entitled to a fee of $800 per month to be paid in the form of fully-vested shares of the Company's common stock. The number of shares of common stock is calculated based on the closing price of the Company's common stock on the 15th day of each month. The payments made by the Company under the Services Agreement constitute, in the aggregate, an award under the 2013 Plan and are subject to the terms of the 2013 Plan (Note 15). The Services Agreement had a term of one year, can be terminated by the Company at any time, and may be extended only by agreement of the parties, including approval of a majority of the independent members of Intrexon's board of directors. The independent members of Intrexon's board of directors, with the recommendation of the audit committee of the board of directors, subsequently approved extensions of the Services Agreement through January 1, 2019. For the years ended December 31, 2018, 2017 and 2016, the Company issued 696,033 shares, 500,650 shares, and 337,163 shares, respectively, with values of $8,324, $8,704, and $8,571, respectively, to Third Security as payment for services pursuant to the Services Agreement. In addition to the foregoing Services Agreement, the Company reimburses Third Security for certain out-of-pocket expenses incurred on the Company's behalf, and the total expenses incurred by the Company under this arrangement was $47, $409, and $309 for the years ended December 31, 2018, 2017 and 2016, respectively.

See also Note 15 regarding compensation arrangements between the Company and its CEO.

In October 2017, the Company entered into a Preferred Stock Equity Facility ("Preferred Stock Equity Facility") with an affiliate of Third Security ("Third Security Affiliate"). Under the Preferred Stock Equity Facility, the Company could, from

time to time at its sole and exclusive option, issue and sell to the Third Security Affiliate, up to $100,000 of newly issued Series A Redeemable Preferred Stock ("Series A Preferred Stock"). In conjunction with the Company's July 2018 registered underwritten public offering of Convertible Notes (Note 12), the Preferred Stock Equity Facility was terminated. No shares of Series A Preferred Stock had been issued under the Preferred Stock Equity Facility.

The Company also subleases certain administrative offices to Third Security. The significant terms of the lease mirror the terms of the Company's lease with the landlord, and the Company recorded sublease income of $89, $43, and $43 for the years ended December 31, 2018, 2017 and 2016, respectively.

Transactions with ECC Parties

In addition to entities controlled by Third Security, any entity in which the Company holds equity securities, including securities received as upfront or milestone consideration, and that also are party to a collaboration with the Company are considered to be related parties.

During 2018, the Company mutually terminated each of its ECC agreements with Histogenics Corporation ("Histogenics"), OvaScience, and Synthetic Biologics, Inc. ("Synthetic Biologics"). Upon termination of these ECCs, the Company recognized the remaining deferred revenue totaling $11,877.

In December 2017, the Company purchased certain property and equipment comprising the pilot plant production facility for its energy programs for $2,812 from Intrexon Energy Partners. The Company intends to use the pilot plant to support the collaborations with Intrexon Energy Partners and Intrexon Energy Partners II and its own research programs.

The Company holds a promissory note convertible into shares of Fibrocell common stock ("convertible note") and warrants to purchase shares of Fibrocell common stock. As of December 31, 2018 and 2017, the value of the convertible note and warrants totaled $120 and $575, respectively, and is included in other assets on the accompanying consolidated balance sheets.

In June 2016, the Company purchased 226,142 shares of Oragenics common stock at $5.20 per share.

In December 2016, the Company sold all of its investment in AmpliPhi Biosciences Corporation common stock, resulting in a realized loss of $4,098, which is included in unrealized and realized depreciation in fair value of equity securities on the consolidated statement of operations for the year ended December 31, 2016.

Other Related Parties

In June 2015, the Company entered into an agreement with Harvest, an investment fund sponsored by Harvest Capital Strategies, LLC, and a related party based on ownership in the fund by affiliates of Third Security. Harvest was established to invest in life science research and development start-up opportunities that the Company offered to Harvest with exclusive rights of first-look and first negotiation. Based on this agreement, Harvest established six new collaboration entities, each of which entered into an ECC with the Company in a designated field. The terms of such ECCs were negotiated between the Company and Harvest. As consideration for providing exclusive rights of first-look and first negotiation for start-up opportunities, the Company received a portion of the management fee collected by the fund sponsor of Harvest. These fees are included in other income in the accompanying consolidated statements of operations and totaled $1,839 and $2,483 for the years ended December 31, 2017 and 2016, respectively. In September 2017, the commitment period for Harvest was terminated and, as a result, the agreement with Harvest terminated. The termination of the agreement had no effect on the existing collaborations with Harvest-controlled entities. See Note 3 for further discussion of the asset acquisition of certain Harvest entities.

18. Net Loss per Share

The following table presents the computation of basic and diluted net loss per share:

	2018	2017	2016
Historical net loss per share:			
Numerator:			
Net loss attributable to Intrexon	$ (509,336)	$ (117,018)	$ (186,612)
Denominator:			
Weighted average shares outstanding, basic and diluted	129,521,731	119,998,826	117,983,836
Net loss attributable to Intrexon per share, basic and diluted	$ (3.93)	$ (0.98)	$ (1.58)

The following potentially dilutive securities as of December 31, 2018, 2017, and 2016, have been excluded from the above computations of diluted weighted average shares outstanding for the years then ended as they would have been anti-dilutive:

	December 31,		
	2018	2017	2016
Convertible debt	18,955,668	—	—
Options	11,093,063	11,382,747	11,640,383
Restricted stock units	970,341	—	—
Warrants	133,264	133,264	—
Total	31,152,336	11,516,011	11,640,383

19. Quarterly Financial Information (Unaudited)

The following information has been derived from unaudited consolidated statements that, in the opinion of management, include all recurring adjustments necessary for a fair statement of such information.

	Three Months Ended			
	March 31, 2018	June 30, 2018	September 30, 2018	December 31, 2018 (1)
Total revenues	$ 39,666	$ 45,275	$ 32,448	$ 43,185
Operating loss	(52,522)	(49,735)	(66,471)	(336,882)
Net loss	(47,409)	(66,829)	(58,746)	(341,722)
Net loss attributable to Intrexon	(46,165)	(65,382)	(57,324)	(340,465)
Net loss attributable to Intrexon per share, basic and diluted	$ (0.36)	$ (0.51)	$ (0.44)	$ (2.59)

(1) During the fourth quarter of 2018, the Company reacquired certain in-process research and development from ZIOPHARM, Ares Trading, and Intrexon T1D Partners, all of which were immediately expensed (Notes 4 and 5). The Company also recorded an intangible asset impairment charge and a loss on abandonment of certain of its intangible assets (Note 11). The Company also recognized the remaining balance of deferred revenue associated with Histogenics and Synthetic Biologics upon the mutual termination of the ECCs with these entities (Note 17).

	Three Months Ended			
	March 31, 2017	June 30, 2017	September 30, 2017	December 31, 2017 (1)
Total revenues	$ 53,504	$ 54,433	$ 46,016	$ 77,028
Operating loss	(31,381)	(35,270)	(44,747)	(26,492)
Net loss	(32,377)	(19,662)	(40,836)	(33,945)
Net loss attributable to Intrexon	(31,399)	(18,664)	(39,689)	(27,266)
Net loss attributable to Intrexon per share, basic and diluted	$ (0.26)	$ (0.16)	$ (0.33)	$ (0.23)

(1) During the fourth quarter of 2017, the Company recognized the remaining balance of deferred revenue associated with ZIOPHARM ECC2 upon the parties' mutual agreement to terminate (Note 5). The Company also recorded goodwill impairment charges primarily related to the AquaBounty reporting unit and an impairment charge related to certain of its in-process research and development assets (Note 11).

20. Defined Contribution Plans

The Company sponsors defined contribution plans covering employees who meet certain eligibility requirements. The Company makes contributions to the plans in accordance with terms specified in the plan agreement. The Company's contributions to the plans were $2,493, $2,367 and $1,857 in 2018, 2017 and 2016, respectively.

Confidential

Exhibit 10.22

SECURITIES PURCHASE, ASSIGNMENT AND ASSUMPTION AGREEMENT

DATED AS OF DECEMBER 19, 2018

BY AND AMONG

INTREXON CORPORATION,

ARES TRADING S.A.

AND

PRECIGEN, INC.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SECURITIES PURCHASE, ASSIGNMENT AND ASSUMPTION AGREEMENT

This Securities Purchase, Assignment and Assumption Agreement (this "**Agreement**") is dated as of December 19, 2018 (the "**Agreement Date**") by and among Intrexon Corporation, a corporation organized and existing under the laws of Virginia, having its principal place of business at 20374 Seneca Meadows Parkway, Germantown, MD 20876, USA ("**Intrexon**"), ARES TRADING S.A., a corporation organized and existing under the laws of Switzerland, having offices at Zone Industrielle de L'Ouriettaz, 117 Aubonne, Switzerland ("**ARES TRADING**"), Precigen, Inc., a Delaware corporation, having its principal place of business at 20358 Seneca Meadows Parkway, Germantown, MD 20876 ("**Precigen**" and, together with Intrexon, the "**Intrexon Parties**"). ARES TRADING, Intrexon and Precigen and may be referred to herein as a "**Party**" or, collectively, as "**Parties**."

RECITALS:

WHEREAS, Precigen (as assignee) and ARES TRADING are parties to that certain License and Collaboration Agreement dated as of March 27, 2015 by and among Precigen (as assignee of Intrexon's prior rights and obligations), ARES TRADING and ZIOPHARM Oncology, Inc. attached hereto as Exhibit A (the "**Collaboration Agreement**");

WHEREAS, ARES TRADING wishes to transfer and assign to Intrexon, and Intrexon wishes to accept and assume, ARES TRADING's rights and obligations under the Collaboration Agreement; and

WHEREAS, subject to the terms and conditions set forth in this Agreement, the Intrexon Parties wish to issue and sell to ARES TRADING, and ARES TRADING wishes to purchase from the Intrexon Parties, a convertible promissory note in the principal amount of $25,000,000.

NOW, THEREFORE, in consideration of the various promises and undertakings set forth herein, and for other valuable consideration, the receipt and adequacy of which are hereby acknowledged, the Parties, intending to be legally bound, agree as follows:

Article 1
DEFINITIONS

Capitalized terms used in this Agreement shall have the meanings given them in the Transaction Agreements, including the following meanings:

"**Affiliate**" means, with respect to a specified Person, any other Person that directly, or indirectly through one or more intermediaries, controls, or is controlled by, or is under common control with, the specified Person. A corporation or other entity will be regarded as under the control of another corporation or entity if the latter corporation or entity owns directly or indirectly controls more than fifty percent (50%) of the voting stock or other ownership interest of the former corporation or other entity, or if the latter corporation or entity possesses, directly

or indirectly, the power to direct or cause the direction of the management and policies of the former corporation or other entity or the power to elect or appoint fifty percent (50%) or more of the members of the governing body of the former corporation or entity.

"**Agreement**" has the meaning set forth in the Preamble.

"**Agreement Date**" has the meaning set forth in the Preamble.

"**ARES Indemnified Persons**" has the meaning set forth in Section 4.4.

"**ARES Indemnitees**" has the meaning set forth in Section 8.1.

"**ARES Nominee**" has the meaning set forth in Section 4.6.1.

"**ARES TRADING**" has the meaning set forth in the Preamble.

"**CAR**" or "**Chimeric Antigen Receptor**" has the meaning set forth in Annex 1.

"**CAR-T**" has the meaning set forth in Annex 1.

"**CAR-T Product**" has the meaning set forth in Annex 1.

"**Change of Control**" shall mean each of the following events with respect to an entity: (1) a merger or consolidation in which a) the relevant entity is a constituent party or b) a subsidiary of the relevant entity is a constituent party and the relevant entity issues shares of its capital stock pursuant to such merger or consolidation, except any such merger or consolidation involving the relevant entity or a subsidiary in which the shares of capital stock of the relevant entity outstanding immediately prior to such merger or consolidation continue to represent, or are converted into or exchanged for shares of capital stock that represent, immediately following such merger or consolidation, at least a majority, by voting power, of the capital stock of (x) the surviving or resulting entity; or (y) if the surviving or resulting entity is a wholly owned subsidiary of another entity immediately following such merger or consolidation, the parent entity of such surviving or resulting entity; or (2) the sale, lease, transfer, exclusive license or other disposition, in a single transaction or series of related transactions, by the relevant entity or any subsidiary of the relevant entity, of all or a material amount of the assets of the relevant entity and its subsidiaries taken as a whole; or the sale or disposition (whether by merger, consolidation or otherwise, and whether in a single transaction or a series of related transactions) of one or more subsidiaries of the relevant entity if a material amount of the assets of the relevant entity and its subsidiaries taken as a whole are held by such subsidiary or subsidiaries, except where such sale, lease, transfer, exclusive license or other disposition is to a wholly owned subsidiary of the relevant entity.

"**Claims**" means all Third Party demands, claims, actions, proceedings and liability (whether criminal or civil, in contract, tort or otherwise) for losses, damages, reasonable legal costs and other reasonable expenses of any nature.

"**Closing**" has the meaning set forth in Section 2.2.

"**Closing Date**" has the meaning set forth in Section 2.2.

"**Collaboration Agreement**" has the meaning set forth in the Recitals.

"**Collaboration Agreement Party**" has the meaning set forth in Section 6.5.

"**Commercialization**" means all activities directed to using, making or having made, manufacturing, marketing, holding or keeping (whether for disposal or otherwise) or otherwise disposing of, distributing, offering for sale or selling a Specified CAR-T Product (as well as importing and exporting activities in connection therewith), all activities directed to obtaining Pricing Approvals, and all activities directed to Phase 4 Studies; provided, that in no event shall Commercialization activities include Development or Development activities. "**Commercialize**" shall mean to perform the act of Commercialization.

"**Commercially Reasonable Efforts**" means where applied to the Development, manufacture or Commercialization of a product or carrying out specific tasks and obligations of a Party, the use of reasonable, diligent, good faith efforts and resources, as normally used by such Party for a product at a similar stage in its development or product life and is of similar market potential, taking into account, without limitation, commercial, legal and regulatory factors, target product profiles, product labeling, past performance, the regulatory environment and competitive market conditions, safety and efficacy of the product, the strength of its proprietary position and such other factors as such Party may reasonably consider, all based on conditions then prevailing. For clarity, Commercially Reasonable Efforts does not mean that a Party guarantees that it will actually accomplish the applicable task or objective.

"**Confidential Information**" means, with respect to a Party, all proprietary know-how, unpublished patent applications and other information and data of a financial, commercial, business, operational or technical nature that is: (a) disclosed by or on behalf of such Party or any of its Affiliates or otherwise made available to the other Party or any of its Affiliates, whether made available orally, in writing or in electronic form; or (b) learned by the other Party in the course of the activities under this Agreement, in each case including information comprising or relating to concepts, discoveries, inventions, data, designs or formulae in relation to this Agreement.

"**Designated Director Nominee**" has the meaning set forth in Section 4.6.1.

"**Develop**" or "**Development**" means all non-clinical, preclinical and post-IND filing development activities for any Specified CAR-T Product, including all clinical testing and studies

of any Specified CAR-T Product, toxicology studies, distribution of Specified CAR-T Product for use in clinical trials (including placebos and comparators), statistical analyses, and the preparation, filing and prosecution of any Marketing Authorization Application for any Specified CAR-T Product, as well as all regulatory affairs related to any of the foregoing.

"**Director Designation Notice**" has the meaning set forth in Section 4.6.1.

"**Disclosing Party**" has the meaning set forth in Section 10.1.1.

"**DPA**" means the Defense Production Act of 1950, as amended, 50 U.S.C. § 4565, and associated regulations at 31 C.F.R. Parts 800 and 801.

"**Earned Royalty**" has the meaning set forth in Annex I.

"**EMA**" means the European Medicines Agency or any successor entity thereto.

"**Exchange Act**" means the Securities Exchange Act of 1934, as amended, and the rules and regulations promulgated thereunder.

"**Equity Securities**" means any capital stock or other equity interest or any securities convertible into or exchangeable for capital stock or other equity interests or securities, or any other rights (preemptive or otherwise), warrants, options, calls or contracts of any character to acquire any of the foregoing capital stock, equity interests or securities from the issuer or holder thereof.

"**FDA**" means the United States Food and Drug Administration or any successor entity thereto.

"**FINRA**" has the meaning set forth in Section 4.4.

"**Form S-1"**, "**Form S-3**", "**Form S-4**" or "**Form S-8**" means a Registration Statement on Form S-1, a Registration Statement on Form S-3, a Registration Statement on Form S-4, or a Registration Statement on Form S-8, as appropriate, under the Securities Act, or any successor forms thereto.

"**GAAP**" means generally accepted accounting principles in the United States applied on a consistent basis.

"**Governmental Authority**" means any federal, national, state, provincial or local government, or political subdivision thereof, or any multinational organization or any authority, agency or commission entitled to exercise any administrative, executive, judicial, legislative, police, regulatory or taxing authority or power, or any court or tribunal (or any department, bureau or division thereof, or any governmental arbitrator or arbitral body).

"**Holder**" means a holder of Registrable Securities who is a Party to this Agreement. A person is deemed to be a holder of Registrable Securities whenever such person beneficially owns Registrable Securities.

"**HSR Act**" has the meaning set forth in Section 6.7.2.

"**IND**" means any investigational new drug application, clinical trial application, clinical trial exemption or similar or equivalent application or submission for approval to conduct human clinical investigations filed with or submitted to a Governmental Authority in conformance with the requirements of such Governmental Authority.

"**Indemnified Party**" has the meaning set forth in Section 8.3.

"**Indemnifying Party**" has the meaning set forth in Section 8.3.

"**Indication**" means a generally acknowledged disease or condition, a significant manifestation of a disease or condition, or symptoms associated with a disease or condition or a risk for a disease or condition. For the avoidance of doubt, all variants of a single disease or condition (e.g., variants of colon cancer or variants of prostate cancer), whether classified by severity or otherwise, shall be treated as the same Indication for purposes of this Agreement. Additionally, different uses for the same disease state shall be considered the same Indication (e.g., first-line treatment, treatment of metastatic disease and maintenance treatment).

"**Initial Press Release**" has the meaning set forth in Section 5.3.

"**Intrexon**" has the meaning set forth in the Preamble.

"**Intrexon Common Stock**" has the meaning set forth in Section 3.1.

"**Intrexon Indemnitees**" has the meaning set forth in Section 8.2.

"**Intrexon Parties**" has the meaning set forth in the Preamble.

"**Intrexon Shares**" has the meaning set forth in Section 3.1.

"**Law**" means any federal, state, local, foreign or multinational law, statute, standard, ordinance, code, rule, regulation, resolution or promulgation, or any order by any Governmental Authority, or any license, franchise, permit or similar right granted under any of the foregoing, or any similar provision having the force or effect of law.

"**Lock-up Period**" has the meaning set forth in Section 4.7.

"**Loss**" means any costs, disbursements, obligations, taxes, liabilities, losses, claims, damages (including incidental or consequential, loss of future revenue or income or loss of business reputation or opportunity, diminution of value or settlement of any kind or nature),

deficiencies, demands, judgments, interests, fines, penalties, suits, actions, causes of action, assessments, awards and expenses (including reasonable legal, accounting and other professional fees and expenses, including reasonable costs of investigation and amounts paid in settlement, and costs and expenses incurred in enforcing a right of indemnification or contribution hereunder), whether or not involving a third party, that are actually imposed on or otherwise actually incurred or suffered by the specified Person.

"**MAA**" or "**Marketing Authorization Application**" means an application to the appropriate Governmental Authority for approval to market a Specified CAR-T Product (but excluding Pricing Approval) in any particular jurisdiction and all amendments and supplements thereto.

"**Material Adverse Effect**" has the meaning set forth in the Note.

"**Nasdaq Stock Market**" has the meaning set forth in the Note.

"**National Securities Exchange**" means a securities exchange that has registered with the SEC under Section 6 of the Exchange Act.

"**Note**" means the promissory note issued to ARES TRADING pursuant to Section 2, in the form attached hereto as Exhibit D.

"**Note Consideration**" means Twenty-Five Million Dollars ($25,000,000).

"**Obligations**" has the meaning set forth in Section 11.7.

"**Offering Indemnified Party**" has the meaning set forth in Section 4.4.6.

"**Offering Indemnifying Party**" has the meaning set forth in Section 4.4.6.

"**Party**" or "**Parties**" has the meaning set forth in the Preamble.

"**Person**" means an association, a corporation, an individual, a partnership, a limited liability company, a limited partnership, limited liability partnership, a trust or any other entity or organization or a Governmental Authority.

"**Phase 4 Study**" means any study or data collection effort in respect to any Specified CAR-T Product for a particular Indication that is initiated after receipt of Regulatory Approval for such Specified CAR-T Product for such Indication.

"**Potential Claims**" has the meaning set forth in Section 6.6.1.

"**Precigen**" has the meaning set forth in the Preamble.

"**Precigen Board**" has the meaning set forth in Section 4.6.1.

"**Precigen Common Stock**" means the common stock of Precigen, Inc., $0.00001 par value per share.

"**Precigen Financing**" has the meaning set forth in the Note.

"**Precigen Shares**" means any Precigen Equity Securities issued pursuant to the Note.

"**Pre-Closing Period**" has the meaning set forth in Section 6.5.

"**Pricing Approvals**" means such mandatory governmental approvals, agreements, determinations or decisions establishing prices for the Specified CAR-T Products that can be charged and/or reimbursed in regulatory jurisdictions where the applicable Governmental Authorities approve or determine the price and/or reimbursement of pharmaceutical products.

"**Public Offering Date**" means the effectiveness of a Qualified IPO.

"**Qualified Company Financing**" has the meaning set forth in the Note.

"**Qualified IPO**" has the meaning set forth in the Note.

"**Receiving Party**" has the meaning set forth in Section 10.1.1.

"**Register**" means the filing and effectiveness of a registration of securities under the Securities Act.

"**Registered**" means a registration of securities under the Securities Act which has been filed and is effective.

"**Registrable Securities**" means Intrexon Shares owned by ARES TRADING as of the Closing Date immediately after giving effect to the Transactions and Shares of Intrexon Common Stock or Precigen Common Stock subsequently acquired by ARES TRADING or issuable to ARES TRADING upon conversion of the Note; provided, however, that any such Shares will cease to be Registrable Securities when (i) a Securities Act registration statement covering such Registrable Securities has been declared effective and such Registrable Securities have been disposed of pursuant to such effective registration statement, (ii) such Registrable Securities are distributed to the public pursuant to Rule 144 under the Securities Act, as such rule may be amended from time to time, or any other similar regulation hereafter adopted by the Commission ("**Rule 144**"), or (iii) after such time as the Registrable Securities become eligible for resale without volume or manner-of-sale restrictions and without current public information requirements pursuant to Rule 144 and the issuer thereof has caused its transfer agent to remove any legends notated on the Registrable Securities pursuant to Section 5.1; provided further, however, that if such securities become ineligible for resale pursuant to Rule 144 under the foregoing circumstances due to ARES TRADING being deemed an Affiliate of an Intrexon

Party, such securities shall again become Registrable Securities until such time as they thereafter cease to be Registrable Securities pursuant to any of the foregoing clauses (i), (ii) or (iii).

"**Registration Statement**" means each of the following: a Registration Statement contemplated by Section 4.4 of this Agreement, including, in each case, the prospectus, amendments and supplements to each such registration or prospectus, including pre- and post-effective amendments, all exhibits thereto, and all material incorporated by reference or deemed to be incorporated by reference in such registration statement.

"**Regulatory Approval**" or **"Regulatory Approvals"** means all approvals, including Pricing Approvals, necessary for the commercial sale of a Specified CAR-T Product in a given country or regulatory jurisdiction.

"**Released Claims**" has the meaning set forth in Section 6.6.1.

"**Releasees**" has the meaning set forth in Section 6.6.

"**Representative**" means, with respect to a specified Person, such Person's Subsidiaries, directors, officers, Affiliates, partners, employees, agents, advisers or representatives, including, without limitation, attorneys, accountants, consultants, bankers, financial advisers and any representatives of such advisers.

"**SEC**" has the meaning set forth in Section 6.2.5.

"**SEC Documents**" has the meaning set forth in Section 6.2.5.

"**Securities Act**" means the Securities Act of 1933, as amended, and the rules and regulations promulgated thereunder.

"**Selling Holder**" means, with respect to any registration statement, any Holder whose Registrable Securities are included therein.

"**Seller Indemnified Persons**" has the meaning set forth in Section 4.4.6.

"**Shares**" means shares of Intrexon Common Stock or Precigen Common Stock, any interests therein and any Equity Securities issued or issuable with respect to such shares of Intrexon Common Stock or Precigen Common Stock by way of stock dividends or stock splits or in connection with a combination of shares, recapitalization, merger, consolidation, or other reorganization or otherwise.

"Specified CAR-T Products" has the meaning set forth in Annex 1.

"**Sublicensing Royalty**" has the meaning set forth in Annex 1.

"**Subsidiary**" means, with respect to any Person, any other Person in which such Person has a direct or indirect equity or ownership interest in excess of 50%.

"**T-Cell**" has the meaning set forth in Annex 1.

"**Tax**" means all taxes, duties, fees, premiums, assessments, imposts, levies, rates, withholdings, dues, government contributions and other charges of any kind whatsoever, whether direct or indirect, together with all interest, penalties, fines, additions to tax or other additional amounts, imposed by any Governmental Authority.

"**Tax Return**" means any return, declaration, report, form, claim for refund, statement, information return or statement or other document required to be filed with respect to Taxes including any schedule or attachment thereto, and including any amendment thereof or supplement thereto.

"**Third Party**" means any Person other than Intrexon, ARES TRADING or Precigen.

"**Trading Day**" means any day on which the Nasdaq Stock Market is open for customary trading.

"**Transaction Agreements**" means this Agreement, including all Exhibits and Annexes hereto, the Deed of Assignment, the Note and the other agreements, certificates and instruments executed or to be executed by a Party pursuant hereto or thereto in connection with the Closing.

"**United States**" or "**US**" means the United States of America, its territories and possessions.

"**USD**" or "**$**" means the lawful currency of the United States of America.

Article 2
ASSIGNMENT AND ASSUMPTION

2.1 Assignment and Assumption of Collaboration Agreement. At the Closing ARES TRADING and Intrexon will execute and deliver the Deed of Assignment in substantially the form attached hereto as Exhibit B. ARES TRADING will assign and transfer to Intrexon all of its right, title and interest in, and future obligations and future liabilities, to and under the Collaboration Agreement and Intrexon will accept such assignment and transfer, assume all of ARES TRADING's duties and future obligations and liabilities under the Collaboration Agreement and agree to pay, perform and discharge, as and when due, all of the future obligations and liabilities of ARES TRADING under the Collaboration Agreement. Intrexon and Precigen accept and agree to such assignment and assumption and agree that, upon the effectiveness of such assignment, transfer and assumption, (i) ARES TRADING shall be fully and forever irrevocably released from any and all duties or future obligations and liabilities (whether known or unknown) under the Collaboration Agreement, including, without limitation, under Sections 2.3(b) and 2.5 and Articles 4, 5, 6 and 7

of the Collaboration Agreement; (ii) all obligations of ARES TRADING under the Collaboration Agreement are terminated and deemed satisfied; and (iii) all duties or future obligations and liabilities of ARES TRADING under the Collaboration Agreement arising from the Closing Date shall be met, discharged and performed by Intrexon. All licenses granted or to be granted by ARES TRADING under the Collaboration Agreement (including, without limitation, under Section 2.3 thereof) are terminated and of no further force or effect. The Parties agree and acknowledge that there is and was no Joint IP (as defined in the Collaboration Agreement) or Terminated Product or Terminated Products (as defined in the Collaboration Agreement). The Parties further agree and acknowledge that, by reason of this Agreement, effective on the Closing Date, ARES TRADING shall no longer be deemed to be a party to the Collaboration Agreement. No Intrexon Party has or shall have any authority to impose any future obligation or liability on ARES TRADING or any of its Affiliates arising under or relating to the future performance of the Collaboration Agreement or to cause ARES TRADING or any of its Affiliates to incur any such future obligation or liability.

2.2 Closing. The closing of the transactions contemplated by this Agreement (the "**Closing**") shall take place remotely via teleconference, at 10:00 a.m. New York time, on December 28, 2018, after satisfaction or waiver of all of the conditions to Closing set forth in Article 7 hereof, or at such other time, place or date as the Parties mutually agree. The date upon which the Closing actually occurs is referred to herein as the "**Closing Date**." The Closing shall become effective as of 11:59 p.m. New York time on the Closing Date.

Article 3
FINANCIAL PROVISIONS

3.1 Sale and Issuance of Intrexon Shares. As consideration for the rights granted by ARES TRADING under Section 2.1 to Intrexon, on the Closing Date, Intrexon shall issue and sell to ARES TRADING that number of shares (the "**Intrexon Shares**") of common stock of Intrexon, no par value per share (the "Intrexon Common Stock"), which have a value equal to One Hundred Fifty Million Dollars ($150,000,000) calculated based on the volume weighted-average price of Intrexon Common Stock on the Nasdaq Stock Market for the consecutive ten (10) trading day period ending on the trading day prior to the Closing Date as reported by Bloomberg, L.P. in respect of the period from the scheduled open of trading until the scheduled close of trading of the primary trading sessions on each such trading day.

3.2 Purchase and Sale of Note.

3.2.1 In exchange for the Note Consideration paid by ARES TRADING, on the Closing Date, the Intrexon Parties shall issue and sell to ARES TRADING the Note. The Note shall be in the form and contain terms as set forth on Exhibit D.

3.2.2 At the Closing, ARES TRADING shall pay to Intrexon the Note Consideration by wire transfer of immediately available funds.

3.3 Specified CAR-T Products Royalties. Commencing upon the Closing Date, in accordance with the terms and conditions set forth in Annex 1 to this Agreement, Precigen shall pay to ARES TRADING the Earned Royalties and Sublicensing Royalties in respect of the Specified CAR-T Products.

Article 4
OTHER AGREEMENTS OF THE PARTIES

4.1 Use of Note Proceeds. The Note Consideration shall be used by the Intrexon Parties solely for activities of the Intrexon Parties directly related to the advancement of Precigen therapeutic programs.

4.2 Development and Commercialization of Specified CAR-T Products. The Intrexon Parties, jointly and severally, hereby covenant and agree that, as of and from the Closing Date, Precigen shall use Commercially Reasonable Efforts to (a) Develop, including seeking applicable Regulatory Approvals, the Specified CAR-T Products and (b) Commercialize any Specified CAR-T Products for which it has obtained Regulatory Approval.

4.3 Shares to Be Issued. Any Equity Securities of Intrexon or Precigen issued to ARES TRADING or any of its Affiliates pursuant to any of the Transaction Agreements shall be newly issued Equity Securities of Intrexon or Precigen, as applicable, and shall not include any treasury shares or treasury stock.

4.4 Registration Rights. The Registrable Securities shall have the benefit of the provisions set forth in this Section 4.4.

4.4.1 Registration of Intrexon Shares. No later than **[*****]** prior to the end of the Lock-up Period, Intrexon shall prepare and file with the SEC a Registration Statement covering the resale of the Registrable Securities as would permit the sale and distribution of all the Registrable Securities consisting of Intrexon Shares from time to time pursuant to Rule 415 in the manner reasonably requested by ARES TRADING. In the event any Intrexon Shares shall again become Registrable Securities pursuant to the final proviso to the definition of Registrable Securities, Intrexon, as reasonably requested by ARES TRADING, shall prepare and file with the SEC as promptly as practicable another Registration Statement covering the resale of such Registrable Securities as would permit the sale and distribution of all such Registrable Securities consisting of Intrexon Shares from time to time pursuant to Rule 415 in the manner reasonably requested by ARES TRADING. Any such Registration Statement prepared and filed pursuant to this Section 4.4.1 shall be on Form S-3 (except if Intrexon is not then eligible to Register for resale the Registrable Securities on Form S-3, in which case such registration shall be on Form S-1 or another appropriate form in accordance with the Securities Act and the rules promulgated thereunder and Intrexon shall undertake to Register such Registrable Securities on Form S-3 as soon as practicable following the availability of such form, provided that Intrexon shall use commercially reasonable efforts to maintain the effectiveness of the Registration Statement then in effect until such time as a

Registration Statement on Form S-3 covering such Registrable Securities has been declared effective by the SEC). Intrexon shall (a) if such Registration Statement is not automatically effective upon filing, use commercially reasonable efforts to cause the Registration Statement filed by it to be declared effective under the Securities Act as promptly as practicable after the filing thereof but in any event on or prior to the end of the Lock-up Period, and (b) use commercially reasonable efforts to keep such Registration Statement continuously effective under the Securities Act until such date as all Registrable Securities covered by such Registration Statement have ceased to be Registrable Securities.

4.4.2 Registration of Intrexon Common Stock. In the event that ARES TRADING converts the Note into Intrexon Common Stock, then as promptly as practicable after the Conversion Date (as such term is defined in the Note), but in any event no later than **[*****]** prior to the end of the applicable Lock-up Period, Intrexon shall prepare and file with the SEC a Registration Statement covering the resale of such Registrable Securities as would permit the sale and distribution of all such Registrable Securities from time to time pursuant to Rule 415 in the manner reasonably requested by ARES TRADING. In the event any such Intrexon Common Stock shall again become Registrable Securities pursuant to the final proviso to the definition of Registrable Securities, Intrexon, as reasonably requested by ARES TRADING, shall prepare and file with the SEC as promptly as practicable another Registration Statement covering the resale of such Registrable Securities as would permit the sale and distribution of all such Registrable Securities from time to time pursuant to Rule 415 in the manner reasonably requested by ARES TRADING. Any such Registration Statement prepared and filed pursuant to this Section 4.4.2 shall be on Form S-3 (except if Intrexon is not then eligible to Register for resale the Registrable Securities on Form S-3, in which case such registration shall be on Form S-1 or another appropriate form in accordance with the Securities Act and the rules promulgated thereunder and Intrexon shall undertake to Register such Registrable Securities on Form S-3 as soon as practicable following the availability of such form, provided that Intrexon shall use commercially reasonable efforts to maintain the effectiveness of the Registration Statement then in effect until such time as a Registration Statement on Form S-3 covering such Registrable Securities has been declared effective by the SEC). Intrexon shall (a) if such Registration Statement is not automatically effective upon filing, use commercially reasonable efforts to cause the Registration Statement filed by it to be declared effective under the Securities Act as promptly as practicable after the filing thereof, and (b) use commercially reasonable efforts to keep such Registration Statement continuously effective under the Securities Act until such date as all Registrable Securities covered by such Registration Statement have ceased to be Registrable Securities.

4.4.3 Registration of Precigen Shares. In the event that ARES TRADING converts the Note into Precigen Common Stock in connection with a Qualified IPO, then promptly as practicable after the end of the Lock-Up Period, but in any event no later than **[*****]** prior to the end of the Lock-up Period, Precigen shall prepare and file with the SEC a Registration Statement covering the resale of the Registrable Securities consisting of Precigen Common Stock as would permit the sale and distribution of all such Registrable Securities consisting of Precigen Common

Stock from time to time pursuant to Rule 415 in the manner reasonably requested by ARES TRADING. In the event any Precigen Common Stock shall again become Registrable Securities pursuant to the final proviso to the definition of Registrable Securities, Precigen, as reasonably requested by ARES TRADING, shall prepare and file with the SEC as promptly as practicable another Registration Statement covering the resale of such Registrable Securities as would permit the sale and distribution of all the Registrable Securities consisting of Precigen Common Stock from time to time pursuant to Rule 415 in the manner reasonably requested by ARES TRADING. Any such Registration Statement prepared and filed pursuant to this Section 4.4.3 shall be on Form S-3 (except if Precigen is not then eligible to Register for resale the Registrable Securities on Form S-3, in which case such registration shall be on Form S-1 or another appropriate form in accordance with the Securities Act and the rules promulgated thereunder and Precigen shall undertake to Register such Registrable Securities on Form S-3 as soon as practicable following the availability of such form, provided that Precigen shall use commercially reasonable efforts to maintain the effectiveness of the Registration Statement then in effect until such time as a Registration Statement on Form S-3 covering such Registrable Securities has been declared effective by the SEC). Precigen shall (a) if such Registration Statement is not automatically effective upon filing, use commercially reasonable efforts to cause the Registration Statement filed by it to be declared effective under the Securities Act as promptly as practicable after the filing thereof and (b) use commercially reasonable efforts to keep such Registration Statement continuously effective under the Securities Act until such date as all Registrable Securities covered by such Registration Statement have ceased to be Registrable Securities.

4.4.4 Registration in a Precigen Financing. In the event that ARES TRADING converts the Note into Equity Securities of Precigen other than Precigen Common Stock in connection with a Precigen Financing, ARES TRADING shall be entitled to the customary registration rights related to the underlying Precigen Common Stock that are granted to the investors in the Precigen Financing **[*****]**.

4.4.5 Other Provisions Applicable to Registration. In connection with any registration of Registrable Securities pursuant to this Section 4.4, Intrexon or Precigen, as applicable, shall:

(a) use commercially reasonable efforts to ensure that (i) any Registration Statement filed pursuant to this Section 4.4 (a) complies in all material respects with the Securities Act and the rules and regulations thereunder, and (b) does not, when it becomes effective, contain an untrue statement of a material fact or omit to state a material fact required to be stated therein or necessary to make the statements therein not misleading, and (ii) any prospectus forming part of any such Registration Statement and any supplement to such prospectus does not include any untrue statement of a material fact or omit to state a material fact necessary in order to make the statements therein, in the light of the circumstances under which they are made, not misleading;

(b) furnish ARES TRADING with a copy of the Registration Statement and all amendments thereto and supply ARES TRADING with copies of any prospectus included therein (including a preliminary prospectus and all amendments and supplements thereto), in each case including all exhibits, and such other documents as may be reasonably requested, in such quantities as may be reasonably necessary for the purposes of the proposed sale or distribution covered by such registration. Intrexon or Precigen, as applicable, hereby consents to the use in accordance with all applicable law of each such Registration Statement (or amendment or post-effective amendment thereto) and each such prospectus (or preliminary prospectus or supplement thereto) by ARES TRADING and the underwriters, if any, in connection with the offering and sale of the securities covered by such registration statement or prospectus;

(c) (i) use commercially reasonable efforts to register or qualify the securities covered by such Registration Statement for sale under the securities laws of such states, if any, as is reasonably requested to permit the distribution of such securities and use commercially reasonable efforts to keep each such registration or qualification effective during the period such registration statement is required to be kept effective and to do such other acts or things reasonably necessary to enable the disposition in such jurisdictions of the securities covered by the applicable registration statement in accordance with applicable "blue sky" securities laws of such jurisdictions; provided, however, that the Issuer will not be required in connection therewith or as a condition thereof to qualify as a foreign corporation or to execute a general consent to service of process in any jurisdiction or become subject to taxation in any jurisdiction, and (ii) cooperate and assist in any filings required to be made with the Financial Industry Regulatory Authority, Inc. ("**FINRA**");

(d) cause the transfer agent and registrar of such issuer's common stock to release, effective upon the effectiveness of such registration and receipt of a certification by ARES TRADING that the Registrable Securities sold by ARES TRADING are sold pursuant to the Registration Statement and in compliance with applicable prospectus delivery requirements, any stop transfer orders and other transfer restrictions relating to the securities upon the sale by ARES TRADING pursuant to such registration;

(e) notify ARES TRADING promptly (and in any event within three (3) Trading Days):

(i) when the prospectus or any prospectus supplement or post-effective amendment has been filed, and with respect to the Registration Statement or any post-effective amendment, when the same has become effective;

(ii) of any request by the SEC or any other federal or state Governmental Authority for any amendments or supplements to the Registration Statement or the prospectus;

(iii) of the issuance by the SEC of any stop order suspending the effectiveness of the Registration Statement or the initiation of any proceedings for that purpose;

(iv) of the receipt of any notification with respect to the suspension of the qualification of the Registrable Securities for sale in any jurisdiction or the initiation of any proceeding for such purpose;

(v) of the happening of any event which makes any statement made in the Registration Statement, the prospectus or any document incorporated or deemed to be incorporated therein by reference untrue or which requires changes in the Registration Statement, the prospectus, or any document incorporated therein by reference in order to make the statements therein not misleading; and

(vi) of such issuer's determination that a post-effective amendment to the Registration Statement would be required;

(f) use commercially reasonable efforts to prevent the issuance of any order suspending the effectiveness of the Registration Statement or any order preventing or suspending the use of a prospectus or suspending the qualification of any of the Registrable Securities included therein for sale in any jurisdiction (subject to the proviso at the end of Section 4.4.5(c)(i)), and, in the event of the issuance of any stop order suspending the effectiveness of the Registration Statement, or of any order suspending or preventing the use of any related prospectus or suspending the qualification of any Registrable Securities included in such registration statement for sale in any jurisdiction (subject to the proviso at the end of Section 4.4(c)(i)), use its commercially reasonable efforts to promptly obtain the withdrawal of any such order;

(g) [RESERVED]

(h) as promptly as reasonably practicable, if required, based on the advice of such issuer's counsel, or upon the occurrence of any event contemplated by Section 4.4.5(e)(ii), prepare and file a supplement or post-effective amendment to the registration statement, the related prospectus or any document incorporated therein by reference or file any other required document so that, as thereafter delivered to the purchasers of the securities, the prospectus will not contain an untrue statement of a material fact or omit to state any material fact necessary to make the statements therein not misleading; and

(i) use its commercially reasonable efforts to (A) cause all securities covered by the Registration Statement to be listed on each securities exchange on which identical securities issued by such issuer are then listed if requested by ARES TRADING, (B) provide and cause to be maintained a transfer agent and registrar for all securities covered

by such Registration Statement, and (C) use its commercially reasonable efforts to provide a CUSIP number for the securities by the effective date of the registration statement.

4.4.6 Indemnification and Contribution.

(a) Intrexon or Precigen, as applicable, agrees to indemnify to the fullest extent permitted by law and hold harmless ARES TRADING, each of its Affiliates and each of its and their directors, officers, agents, Representatives, equity owners and employees, each Person who controls ARES TRADING within the meaning of Section 15 of the Securities Act or Section 20 of the Exchange Act and the directors, officers, Representatives, agents or employees of each such controlling person (each or all of the foregoing, as the context requires, the "**ARES Indemnified Persons**") against any and all Losses to which any such Ares Indemnified Persons may become subject under the Securities Act or any other statute or common law or otherwise, insofar as any such Losses will arise out of, be caused by or will be based upon (i) any untrue statement or alleged untrue statement of a material fact contained in the Registration Statement relating to the sale of the Registrable Securities covered thereby, or the omission or alleged omission to state therein a material fact required to be stated therein or necessary to make the statements therein not misleading, or (ii) any untrue statement or alleged untrue statement of a material fact contained in any preliminary prospectus (as amended or supplemented if such issuer will have filed with the SEC any amendment thereof or supplement thereof), if used prior to the effective date of such Registration Statement, or contained in the prospectus (as amended or supplemented if such issuer will have filed with the SEC any amendment thereof or supplement thereof, including the information deemed part of such Registration Statement pursuant to Rule 430A promulgated under the Securities Act), if used within the period during which such issuer will be required to keep the registration statement to which such prospectus relates current pursuant to the terms of this Agreement, or the omission or alleged omission to state therein (if so used) a material fact necessary in order to make the statements therein, in light of the circumstances under which they were made, not misleading; provided, however, that the foregoing indemnification agreement will not apply to such Losses which arise from the sale of Registrable Securities to any Person if such Losses arise out of, were caused by or based upon any such untrue statement or alleged untrue statement, or any such omission or alleged omission, (i) if such statement or omission was made in reliance upon and in conformity with information furnished in writing to the Issuer by ARES TRADING specifically for use in connection with the preparation of the Registration Statement or any preliminary prospectus or prospectus contained in the Registration Statement or any such amendment thereof or supplement thereto; (ii) if such untrue statement or omission was made in any preliminary prospectus to the extent that (a) the prospectus corrected such untrue statement or such omission and (b) the underwriter or ARES TRADING was legally required to and failed to send, deliver or make available a copy of the prospectus with or prior to the delivery of written confirmation of the sale by such underwriter or ARES TRADING to the Person asserting the claim from which such Losses arise; or (iii) if any

such Losses arise out of, are caused by or are based upon an untrue statement or omission in the prospectus, to the extent that (x) such untrue statement or omission is corrected in an amendment or supplement to the prospectus and (y) having previously been furnished by or on behalf of such issuer with copies of the prospectus as so amended or supplemented, such underwriter or ARES TRADING was legally required to and thereafter fails to deliver such prospectus as so amended or supplemented as required by applicable law, prior to or concurrently with the sale of Registrable Securities to the Person asserting the claim from which such Losses arise and such issuer timely made the prospectus available to such underwriter or ARES TRADING in accordance with this Agreement. This indemnity will be in addition to any other indemnification arrangements to which such Issuer may otherwise be a party.

(b) ARES TRADING agrees to indemnify to the fullest extent permitted by law and hold Intrexon or Precigen, as applicable, its directors, officers, agents, Representatives and employees, each Person who controls such issuer within the meaning of Section 15 of the Securities Act or Section 20 of the Exchange Act and the directors, officers, agents, Representatives or employees of such controlling persons (each or all of the foregoing, as the context requires, the "**Seller Indemnified Persons**") harmless against any and all Losses to which any such Seller Indemnified Person may become subject under the Securities Act or any other statute or common law or otherwise, insofar as any such Losses arise out of, were caused by or based upon any untrue statement of a material fact contained in any Registration Statement, prospectus or form of prospectus, or arising out of, caused by or based upon any omission of a material fact required to be stated therein or necessary to make the statements therein (in the case of the preliminary prospectus and the prospectus, in each case, including amendments or supplements, in light of the circumstances in which they were made) not misleading, to the extent, but only to the extent, that such untrue statement or omission is contained in any information furnished in writing by such Selling Holder to the Issuer expressly for use in such Registration Statement or prospectus; provided, however, that in no event will the liability of ARES TRADING hereunder be greater in amount than the dollar amount of the proceeds (net of the payment of underwriting discounts and commissions paid, payable or incurred by ARES TRADING) received by the Selling Holder upon the sale of the Registrable Securities giving rise to such indemnification obligation. The Intrexon Parties and ARES TRADING will be entitled to receive indemnities from underwriters, selling brokers, dealer managers and similar securities industry professionals participating in the distribution to the same extent as provided above with respect to information so furnished in writing by such Persons expressly for use in any prospectus or Registration Statement.

(c) Any Person entitled to indemnity or contribution under this Section 4.4.6 (an "**Offering Indemnified Party**") will give prompt written notice to the party from which such indemnity is sought (the "**Offering Indemnifying Party**") of any claim or of the commencement of any proceeding with respect to which such Offering

Indemnified Party seeks indemnification or contribution pursuant hereto; provided, however, that the failure so to notify the Offering Indemnifying Party will not relieve the Offering Indemnifying Party from any obligation or liability, except to the extent that the Offering Indemnifying Party has been prejudiced materially by such failure. The Offering Indemnifying Party will have the right to assume the defense of any such claim or proceeding at the Offering Indemnifying Party's expense, with counsel reasonably satisfactory to such Offering Indemnified Party, exercisable by giving written notice to an Offering Indemnified Party promptly after the receipt of written notice from such Offering Indemnified Party of such claim or proceeding; provided, however, that under such circumstances an Offering Indemnified Party will have the right to employ separate counsel in any such claim or proceeding and to participate in the defense thereof, at the expense of such Offering Indemnified Party, unless: (i) the Offering Indemnifying Party agrees to pay such fees and expenses; or (ii) the Offering Indemnifying Party fails promptly to assume the defense of such claim or proceeding; or (iii) the Offering Indemnified Party will have been advised by counsel that (A) there may be one or more material defenses available to such Offering Indemnified Party that are different from or additional to those available to the Offering Indemnifying Party or its Affiliates, or (B) a conflict of interest likely exists if such counsel represents such Offering Indemnified Party and such Offering Indemnifying Party or its Affiliate. If such Offering Indemnified Party notifies the Offering Indemnifying Party in writing that it elects to employ separate counsel at the expense of the Offering Indemnifying Party as specified above, the Offering Indemnifying Party will not have the right to assume the defense thereof, it being understood, however, that the Offering Indemnifying Party will not, in connection with any one such claim or proceeding, or separate but substantially similar or related claims or proceedings arising out of the same general allegations or circumstances, be liable for the fees and expenses of more than one separate firm of attorneys (together with appropriate local counsel which such counsel will be designated by the Offering Indemnified Party and be reasonably acceptable to the Offering Indemnifying Party) at any time for such Offering Indemnified Party, or for fees and expenses that are not reasonable. Whether or not such defense is assumed by the Offering Indemnifying Party, no Offering Indemnifying Party will be subject to any liability for any settlement made without its consent (which consent will not be unreasonably withheld). The Offering Indemnifying Party will not consent to entry of any judgment or settle or compromise any pending or threatened claim, action or proceeding, unless it contains as an unconditional term thereof the giving by the claimant or plaintiff to the Offering Indemnified Party of a release, in form and substance satisfactory to the Offering Indemnified Party, from all liability in respect of such claim or litigation for which such Offering Indemnified Party would be entitled to indemnification hereunder. The Offering Indemnifying Party's liability to any Offering Indemnified Party hereunder will not be extinguished solely because any other Offering Indemnified Party is not entitled to indemnity hereunder.

(d) If the indemnification provided for in this Section 4.4.6 is unavailable to an Offering Indemnified Party in respect of any Losses or is insufficient to hold such

Offering Indemnified Party harmless, then, except to the extent that contribution is not permitted under the Securities Act, each applicable Offering Indemnifying Party will contribute to the amount paid or payable by such Offering Indemnified Party as a result of such Losses, in such proportion as is appropriate to reflect the relative fault of the Offering Indemnifying Party, on the one hand, and such Offering Indemnified Party, on the other hand, in connection with the actions, statements or omissions that resulted in such Losses as well as any other relevant equitable considerations appropriate under the circumstances. The relative fault of such Offering Indemnifying Party, on the one hand, and such Offering Indemnified Party, on the other hand, will be determined by reference to, among other things, whether any action in question, including any untrue statement of a material fact or omission to state a material fact, has been taken or made by, or relates to information supplied by, such Offering Indemnifying Party or Offering Indemnified Party, and the parties' relative intent, knowledge, access to information concerning the matter with respect to which the claim was asserted and opportunity to correct or prevent such action, statement or omission. The amount paid or payable by a party as a result of any Losses will be deemed to include any legal or other fees or expenses reasonably incurred by such party in connection with any investigation or proceeding. The parties hereto agree that it would not be just and equitable if contribution pursuant to this Section 4.4.6 were determined by pro rata allocation or by any other method of allocation that does not take into account the equitable considerations referred to in this clause (d). Notwithstanding the provisions of this Section 4.4.6, ARES TRADING shall not be required to contribute any amount in excess of the amount by which the proceeds (net of the payment of underwriting discounts and commissions paid, payable or incurred by ARES TRADING) received by such Selling Holder from the sale of Registrable Securities exceeds the amount of any damages that ARES TRADING has otherwise been required to pay or contribute by reason of such untrue or alleged untrue statement or omission. No person guilty of fraudulent misrepresentation (within the meaning of Section 11 of the Securities Act) will be entitled to contribution from any Person who was not guilty of such fraudulent misrepresentation.

(e) The indemnity and contribution agreements contained in this Section 4.4.6 are in addition to any liability that the Indemnifying Parties may have to the Indemnified Parties.

4.5 Shareholder Rights Plans; Anti-Takeover Measures. No claim shall be made or enforced by either of the Intrexon Parties or any of their Affiliates, or with the consent of either of the Intrexon Parties, any other person, that ARES TRADING or any of its Affiliates is an "acquiring person" or "interested shareholder" under any control share acquisition, business combination, affiliated transactions, poison pill (including any distribution under a rights agreement) or similar anti-takeover plan or arrangement in effect with respect or applicable to either of the Intrexon Parties, including, without limitation, under Section 203 of the General Corporation Law of the State of Delaware or the provisions of the Virginia Stock Corporation Act, or that ARES TRADING or any of its Affiliates could be deemed to trigger the provisions of any such plan or arrangement, in either

case applying or purporting to apply to this Agreement or any of the transactions contemplated by this Agreement, solely by virtue of receiving Intrexon Common Stock or Precigen Equity Securities under the Transaction Agreements and assuming that neither ARES TRADING nor any of its Affiliates have acquired Intrexon Common Stock or Precigen Equity Securities outside of the Transaction Agreements or the transactions envisioned therein. The Intrexon Parties and their respective boards of directors have taken or will take prior to the issuance of any Intrexon Shares or any Equity Securities of Intrexon or Precigen upon conversion of the Note all necessary action, if any, in order to render inapplicable any control share acquisition, business combination, poison pill (including any distribution under a rights agreement) or other similar anti-takeover provision under such Party's articles or certificate of incorporation, as the case may be, or the laws of the state of its incorporation, which is or could become applicable to ARES TRADING or any of its Affiliates solely as a result of the issuance of the Intrexon Shares and any Equity Securities issued upon conversion of the Note.

4.6 Precigen Board Designation Right.

4.6.1 Commencing at any time that ARES TRADING or its Affiliates collectively beneficially own greater than **[*****]** of the then outstanding Shares of voting stock of Precigen (the **"Board Right Vesting Date"**) and at any time thereafter that ARES TRADING or its Affiliates collectively beneficially own **[*****]** of the Precigen Shares (as adjusted for any stock splits, stock dividends, recapitalizations or similar transaction) that ARES TRADING or its Affiliates owned on the Board Right Vesting Date, ARES TRADING shall have the right, by delivery of written notice to Precigen (a "**Director Designation Notice**"), to designate for nomination for election to the Precigen board of directors (the "**Precigen Board**") one (1) individual (an "**ARES Nominee**"), which individual shall not be an officer, director or employee of or consultant to ARES TRADING or any of its Affiliates or have any other pecuniary or personal relationship with ARES TRADING or any of its Affiliates which would render such ARES Nominee not independent of ARES TRADING, as such term is commonly applied and understood, and shall have the standard, customary, reasonable and appropriate qualifications to serve as a director of Precigen which Precigen applies to outside directors, in the reasonable determination of the Precigen Board.

4.6.2 As soon as reasonably practicable following receipt of the initial Director Designation Notice, Precigen agrees to nominate and elect such Designated Director Nominee to fill any vacancy on the Precigen Board and if necessary, to expand the size of the Precigen Board to create such vacancy. Thereafter, at each annual meeting of Precigen stockholders at which members of the Precigen Board are to be elected, or whenever action is to be taken by written consent for such purposes, Precigen agrees to nominate and recommend for election one (1) Designated Director Nominee designated by ARES TRADING. Each Intrexon Party agrees to vote, or cause to be voted, all Precigen Voting Securities that such Intrexon Party owns, or over which such Intrexon Party has direct or indirect voting or other control, from time to time and at all times, in whatever manner as shall be necessary to elect the ARES Nominee to the Precigen Board. **"Precigen Voting Securities"** means all securities of Precigen, holders of which are entitled to vote

for members of the Precigen Board, including without limitation, all Precigen Shares, by whatever name called, now owned or subsequently acquired by such Intrexon Party, however acquired, whether through stock splits, stock dividends, reclassifications, recapitalizations, similar events or otherwise.

4.6.3 In the event any Designated Director Nominee designated by ARES TRADING is unable to serve as a nominee for election as a director or to serve as a director, for any reason, ARES TRADING shall have the right to submit to Precigen for nomination the name of a replacement for such Designating Party's Designee and who shall serve as the nominee for election as director or serve as director. Should the ARES Nominee resign, be removed or die, a replacement ARES Nominee shall be selected in the manner set forth in Sections 4.6.1 and 4.6.2.

4.7 Lock-Up. At all times during the period commencing on the date of issuance of the Intrexon Shares or any Shares of Intrexon Common Stock or Precigen Equity Securities issued to ARES TRADING upon conversion of the Note and ending on the date that is one hundred eighty (180) days thereafter (a "**Lock-up Period**"), ARES TRADING shall not, and shall cause its Affiliates not to, without the prior written consent of the issuer thereof, offer, pledge, sell, contract to sell, or otherwise transfer or dispose of any Intrexon Shares issued to ARES TRADING on the Closing Date pursuant to this Agreement or any Shares of Intrexon Common Stock or Precigen Equity Securities issued to ARES TRADING upon conversion of the Note; provided, however, that this Section 4.7 shall not (i) apply to any transfer of Intrexon Shares or Precigen Shares by ARES TRADING to any of its Affiliates during the Lock-up Period, provided that as a condition of such transfer, such Affiliate agrees to be bound by the provisions of this Section 4.7 to the same extent as ARES TRADING; or (ii) prohibit or otherwise restrict the ability of ARES TRADING or its Affiliates to enter into a swap, hedge, or other arrangement that transfers to another, in whole or in part, the economic consequences of ownership of any Intrexon Shares or Precigen Shares; or (iii) impair any right of ARES TRADING to request or require any registration pursuant to Section 4.4 of this Agreement so long as ARES TRADING does not sell the Registrable Securities subject to such registration during the relevant Lock-Up Period. In the event Intrexon or Precigen consummates a Qualified Company Financing, a Precigen Financing or a Qualified IPO, any Lock-up Period in effect restricting transfers of Equity Securities of the same type and class as those offered and sold to Third Party investors in such Qualified Company Financing, Precigen Financing or Qualified IPO shall be extended to terminate on the date Randal J. Kirk is not subject to a materially similar lock-up obligation in respect of such type and class of securities, up to a maximum period of 18 consecutive months from the date of issuance of such Registrable Securities to ARES TRADING, including any days remaining in such pending Lock-up Period. Notwithstanding any other provision of this Section 4.7, this Section 4.7 shall not prohibit or restrict any disposition of Intrexon Equity Securities by ARES TRADING into (a) a tender offer or a merger or binding share exchange effected by a Third Party that if completed in accordance with its terms would result in a Change of Control or (b) an issuer tender offer by Intrexon or Precigen, as applicable. All restrictions pursuant to this Section 4.7 shall terminate upon (a) a Change of Control of the issuer of the securities subject to

such restrictions, (b) a liquidation or dissolution of subject issuer; and (c) the date on which the subject class of securities ceases to be Registered pursuant to Section 12 of the Exchange Act.

4.8 Limitations on Intrexon Shares. In no event shall the number of shares of Intrexon Common Stock issuable under the terms of the Transaction Agreements be greater than 27,800,000 or such greater amount as constitutes 19.99% of the outstanding shares of Intrexon Common Stock as of the date of this Agreement (the "**Nasdaq Share Limit**"). In furtherance of the foregoing, if (i) as of immediately prior to the completion of the Closing Date the number of Intrexon Shares that would be issuable pursuant to the formula set forth in Section 3.1 is greater than the Nasdaq Share Limit, then the number of Intrexon Shares issuable pursuant to this Agreement shall be reduced to a number equivalent to the Nasdaq Share Limit until such time as Intrexon obtains the consent set forth in the third sentence of this Section 4.8 or (ii) at any time upon conversion of the Note into Intrexon Common Stock the aggregate number of shares of Intrexon Common Stock issuable pursuant to the Transaction Agreements would exceed the Nasdaq Share Limit, then the number of shares of Intrexon Common Stock issuable pursuant to the Note shall be reduced to a number such that the aggregate number of shares of Intrexon Common Stock issued pursuant to the Transaction Agreements does not exceed the Nasdaq Share Limit until such time as Intrexon obtains the consent set forth in the third sentence of this Section 4.8. Promptly upon determination (which, in any event, shall be no more than **[*****]** after such determination) that the number of shares of Intrexon Common Stock that would be issuable on the Closing Date or upon conversion of the Note the aggregate number of shares of Intrexon Common Stock issuable pursuant to the Transaction Agreements would exceed the Nasdaq Share Limit, Intrexon shall take all action necessary to obtain the shareholder approval required pursuant to Rule 5635 of the Nasdaq Stock Market. If Intrexon cannot obtain the consent described in the foregoing sentence, despite taking all actions necessary to obtain such consent, it shall promptly pay ARES TRADING, by wire transfer of immediately available funds to an account designated by ARES TRADING, an amount equal to the Nasdaq Share Limit Shortfall. **"Nasdaq Share Limit Shortfall"** means USD equal to (i) with respect to Intrexon Shares, the value the Intrexon Shares which would have been issuable pursuant to this Agreement but for the provisions of the first sentence of this Section 4.8, with such value determined pursuant to the formula set forth in Section 3.1; and (ii) with respect to shares of Intrexon Common Stock issuable upon conversion of the Note, the product of the number of shares of Intrexon Common Stock which would have been issuable upon conversion of the Note but for the provisions of the first sentence of this Section 4.8, multiplied by the Conversion Price (as defined in the Note).

4.9 Commercially Reasonable Efforts to Amend Collaboration Agreement. The Inrexon Parties will use commercially reasonable efforts to amend or amend and restate the Collaboration Agreement prior to the **[*****]** anniversary of the Closing Date to reflect the removal of ARES TRADING as a party. Notwithstanding the foregoing, but subject to the other terms of the Transaction Agreements, the Intrexon Parties' duty under the foregoing sentence shall not require any such Party to expend cash (other than reasonable attorneys' fees and transaction expenses), to undertake litigation or to relinquish or divest any material benefit, right or property.

Article 5
LEGENDS; PUBLIC ANNOUNCEMENTS

5.1 Legends. ARES TRADING understands that the Intrexon Shares and any Intrexon Equity Securities or Precigen Equity Securities issuable upon the conversion of the Note, to the extent such Shares are issued to ARES TRADING in a transaction not involving a public offering, may be notated with one or all of the following legends:

(a) "THE SHARES REPRESENTED HEREBY HAVE NOT BEEN REGISTERED UNDER THE SECURITIES ACT OF 1933, AND HAVE BEEN ACQUIRED FOR INVESTMENT AND NOT WITH A VIEW TO, OR IN CONNECTION WITH, THE SALE OR DISTRIBUTION THEREOF. NO SUCH TRANSFER MAY BE EFFECTED WITHOUT AN EFFECTIVE REGISTRATION STATEMENT RELATED THERETO OR AN OPINION OF COUNSEL IN A FORM REASONABLY SATISFACTORY TO INTREXON THAT SUCH REGISTRATION IS NOT REQUIRED UNDER THE SECURITIES ACT OF 1933."; or

(b) any legend required by the securities Laws of any state to the extent such Laws are applicable to the Shares represented by the certificate, instrument, or book entry so legended.

5.2 Legend Removal. Intrexon and Precigen agree that at such time as any legend set forth in Section 5.1 is no longer required in respect of any Shares issued to ARES TRADING pursuant to the Agreement, the Issuer of such Shares bearing such legend will, no later than three (3) Trading Days following receipt by such Issuer of (a) a written request by ARES TRADING to such Issuer or such Issuer's transfer agent to have such legend removed and (b) such customary representations, notices and other documentation as is reasonably requested by such Issuer or its transfer agent (including an opinion of securities counsel to ARES TRADING, reasonably satisfactory to Intrexon and its transfer agent), deliver or cause to be delivered to ARES TRADING a certificate representing such Shares that is free from such legend, or, in the event that such Shares are uncertificated, remove any such legend in the Issuer's stock records. Neither Intrexon nor Precigen may make any notation on its records or give instructions to its transfer agent that enlarge the restrictions on transfer contained in this Agreement.

5.3 Public Announcements. Following execution and delivery of this Agreement by all Parties hereto, each of ARES TRADING and the Intrexon Parties shall be entitled to issue a press release, subject in each case to the prior review and approval of the other Parties (each, an "**Initial Press Release**"). Further, each of ARES TRADING and the Intrexon Parties shall be entitled to issue a press release consistent with their respective Initial Press Release following the Closing. Thereafter, the Intrexon Parties and ARES TRADING shall consult with each other before they or any of their respective Affiliates issue any other press release with respect to this Agreement or the transactions contemplated hereby and neither the Intrexon Parties nor ARES TRADING, nor any of their respective Affiliates, shall issue any such press release or make any such public statement

with respect thereto without the prior consent of the other party, which consent shall not be unreasonably withheld, delayed or conditioned; provided, however, that any party hereto may, without the prior consent of the other parties, issue such press release or make such public statement as may upon the advice of counsel be required by Law or by the rules of the Nasdaq Stock Market, any other National Securities Exchange, the Frankfurt Stock Exchange or any other stock exchange on which such Party's securities are listed or any automated quotation system on which such securities are quoted, provided that, to the extent time permits and to the extent legally permissible, any party issuing such a release or making such public statement has used all commercially reasonable efforts to consult with the other parties prior thereto.

Article 6
REPRESENTATIONS, WARRANTIES AND COVENANTS

6.1 Mutual Representations and Warranties. Each Party represents and warrants to the other Parties that, as of the date hereof and the Closing Date:

6.1.1 such Party is duly organized and validly existing under the Laws of the jurisdiction of its incorporation or organization;

6.1.2 such Party has taken all action necessary to authorize the execution and delivery of the Transaction Agreements to which they are party and (subject to satisfaction of Section 7.1.6 hereof) the performance of its obligations under such Transaction Agreements, including, with respect to Intrexon (as to which ARES TRADING makes no representation or warranty), the issuance, sale and delivery of the Intrexon Shares and, with respect to each of the Intrexon Parties (as to which ARES TRADING makes no representation or warranty), the issuance, sale and delivery of the Note and the issuance and delivery of the Equity Securities issuable upon conversion of the Note, have been, or will be on or prior to their issuance, duly authorized by all necessary corporate action on the part of such Party, and all such Shares have been duly reserved for issuance.

6.1.3 the Transaction Agreements are a legal and valid obligation of such Party, binding upon such Party and enforceable against such Party in accordance with the terms of such Transaction Agreements, except as enforcement may be limited by applicable bankruptcy, fraudulent conveyance, insolvency, reorganization, moratorium and other Laws relating to or affecting creditors' rights generally and by general equitable principles;

6.1.4 such Party has all right, power and authority to enter into the Transaction Agreements to which they will be a party, to (subject to satisfaction of Section 7.1.6 hereof) perform its obligations under such Transaction Agreements, including, with respect to Intrexon, the issuance, sale and delivery of the Intrexon Shares and, with respect to each of the Intrexon Parties, the issuance, sale and delivery of the Note and the issuance and delivery of the Equity Securities issuable upon conversion of the Note;

6.1.5 the execution, delivery and performance by such Party of the Transaction Agreements to which it is a party and the consummation by such Party of the transactions contemplated hereby or thereby (including, without limitation, with respect to each of the Intrexon Parties, the issuance of the Shares) do not and will not (i) conflict with or violate any provisions of such Party's certificate of incorporation or bylaws, (ii) conflict with, or constitute a default (or an event that with notice or lapse of time or both would result in a default) under, result in the creation of any lien upon any of the properties or assets of such Party or give to others any rights of termination, amendment, acceleration or cancellation (with or without notice, lapse of time or both) of, any material contract, or (iii) conflict with or result in a violation of any law, rule, regulation, order, judgment, injunction, decree or other restriction of any court or Governmental Authority to which such Party is subject (including federal and state securities laws and regulations and the rules and regulations, assuming the correctness of the representations and warranties made by such Party herein, of any self-regulatory organization to which such Party or its securities are subject), or by which any property or asset of such Party is bound or affected, except in the case of clauses (ii) and (iii) such as would not, individually or in the aggregate, have or reasonably be expected to result in a Material Adverse Effect, and in the case of clause (iii) with respect to any filings under the HSR Act (including how the transactions described herein would fare under review pursuant to the HSR Act) or under the DPA; and

6.1.6 except as set forth on Schedule 6.1.6 and in Section 6.2.2 (as to which ARES TRADING makes no representation or warranty) and in Section 6.3.9 (as to which the Intrexon Parties make no representation or warranty), and except with respect to (i) any filings required, and waiting period expirations or terminations under, the HSR Act or (ii) any filing required under the DPA, the execution, delivery or performance by it of the Transaction Agreements does not require any consent, order, approval or authorization of, notification or submission to, filing with, license or permit from, or exemption or waiver by, any Governmental Authority or any other person, except for such consents, approvals and filings which the failure of such Party, to make or obtain would not, individually or in the aggregate, constitute a Material Adverse Effect.

6.2 Representation and Warranties of Intrexon Parties. Intrexon and (other than with respect to Section 6.2.3, 6.2.6 and Sections 6.2.8-6.2.12) Precigen represent and warrant to ARES TRADING that, as of the date hereof and the Closing Date:

6.2.1 the Intrexon Shares, when issued, sold and delivered in accordance with the terms and for the consideration set forth in the Transaction Agreements, and the Intrexon Equity Securities and the Precigen Equity Securities issuable upon conversion of the Note, when issued, sold and delivered upon such conversion, will be duly and validly issued, fully paid and nonassessable, and free of restrictions on transfer other than restrictions created under applicable state and federal securities laws and liens or encumbrances created by or imposed by ARES TRADING. Assuming the accuracy of the representations and warranties of ARES TRADING contained in Section 6.3, (a) subject to the consents, approvals and filings described in Section 6.1.5, the Shares will be issued in compliance with all applicable federal and state securities laws and (b)

no registration of the Intrexon Shares under the Securities Act and any applicable state securities law is required for the offer and sale of the Intrexon Shares to ARES TRADING in the manner contemplated by the Transaction Agreements;

6.2.2 [RESERVED]

6.2.3 the authorized capital stock of Intrexon consists of (i) 200,000,000 shares of Intrexon Common Stock of which as of November 30, 2018, (x) 139,253,265 shares were issued and outstanding, (y) 11,109,696 shares are issuable upon the exercise of stock options outstanding, 970,341 shares are issuable pursuant to outstanding restricted stock unit awards, 5,197,149 shares are available for future issuance under Intrexon's stock incentive plan, and 133,264 shares are issuable upon the exercise of warrants outstanding, and (ii) 25,000,000 shares of Series A Preferred Stock, no par value, of which as of November 30, 2018, no shares were issued and outstanding;

6.2.4 Intrexon has Registered the Intrexon Common Stock pursuant to Section 12(b) of the Exchange Act. The Intrexon Common Stock is currently listed on Nasdaq Stock Market. Intrexon has not taken any action designed to, or which is likely to have the effect of, terminating the registration of the Intrexon Common Stock under the Exchange Act or delisting the Intrexon Common Stock from the Nasdaq Stock Market. Intrexon has not received any notification that, and has no knowledge that, the SEC or the Nasdaq Stock Market is contemplating terminating such listing or registration;

6.2.5 Intrexon has filed or furnished all forms, documents and reports required to be filed or furnished by it with the Securities and Exchange Commission (the "**SEC**") on a timely basis since January 1, 2018 (together with any documents so filed or furnished during such period on a voluntary basis, in each case as may have been amended, the "**SEC Documents**"). When so filed or furnished, each of the SEC Documents complied as to form in all material respects with the applicable requirements of the Securities Act, the Exchange Act and the Sarbanes-Oxley Act, except as set forth on Schedule 6.2.5. As of the date filed or furnished with the SEC, none of the SEC Documents contained any untrue statement of a material fact or omitted to state any material fact required to be stated therein or necessary to make the statements therein, in the light of the circumstances under which they were made, not misleading. There are no outstanding or unresolved comments received from the SEC with respect to any of the SEC Documents. Intrexon has never been an issuer subject to Rule 144(i) under the Securities Act. Each of the material contracts to which Intrexon is a party or to which the property or assets of Intrexon are subject has been filed as an exhibit to the SEC Documents;

6.2.6 the consolidated financial statements (including all related notes and schedules) of Intrexon included in the SEC Documents, fairly present in all material respects the consolidated financial position of Intrexon and its consolidated subsidiaries, as at the respective dates thereof, and the consolidated results of their operations, their consolidated cash flows and changes in stockholders' equity for the respective periods then ended and were prepared in all material respects in conformity with GAAP (except, in the case of the unaudited financial statements,

as permitted by the SEC) applied on a consistent basis during the periods referred to therein (except as may be indicated therein or in the notes thereto). Since January 1, 2018, subject to any applicable grace periods, Intrexon has been and is in compliance in all material respects with the applicable provisions of the Sarbanes-Oxley Act and the applicable rules and regulations of the Nasdaq Stock Market, except as set forth on Schedule 6.2.5;

6.2.7 except as specifically disclosed in SEC Documents filed prior to the date hereof, (i) there have been no events, occurrences or developments that have had or would reasonably be expected to have, either individually or in the aggregate, a Material Adverse Effect, (ii) Intrexon has not incurred any material liabilities other than (A) trade payables and accrued expenses incurred in the ordinary course of business consistent with past practice and (B) liabilities not required to be reflected in Intrexon's financial statements pursuant to GAAP or disclosed in filings made with the SEC, (iii) Intrexon has not altered materially its method of accounting or the manner in which it keeps its accounting books and records, (iv) Intrexon has not declared or made any dividend or distribution of cash, shares of capital stock or other property to its stockholders or purchased, redeemed or made any agreements to purchase or redeem any shares of its capital stock and (v) Intrexon has not issued any equity securities to any officer, director or Affiliate, except Intrexon Common Stock issued pursuant to existing Intrexon equity incentive plans or executive and director compensation arrangements disclosed in the SEC Documents;

6.2.8 Intrexon is not, and immediately after receipt of payment for the Intrexon Shares, will not be or be an "investment company" within the meaning of the Investment Company Act of 1940, as amended. Intrexon shall conduct its business in a manner so that it will not become subject to the Investment Company Act of 1940, as amended;

6.2.9 no Person has any right to cause Intrexon to effect the registration under the Securities Act of any securities of Intrexon other than those securities which are currently Registered on an effective registration statement on file with the SEC;

6.2.10 Intrexon has not, in the twelve (12) months, received written notice from the New York Stock Exchange of the Nasdaq Stock Market, as applicable, to the effect that Intrexon is not in compliance with the listing or maintenance requirements of such securities exchange. The Company is in compliance with all listing and maintenance requirements of the Nasdaq Stock Market on the date hereof;

6.2.11 Intrexon and the Intrexon Board of Directors have taken all necessary action, if any, in order to render inapplicable any control share acquisition, affiliated transactions, business combination, poison pill (including any distribution under a rights agreement) or other similar anti-takeover provision under the Company's charter documents or the laws of the State of Virginia that is or would reasonably be expected to become applicable to ARES TRADING or any of its Affiliates as a result of ARES TRADING or its Affiliates and Intrexon fulfilling their obligations or exercising their rights under the Transaction Agreements, including, without limitation, Intrexon's issuance of the Intrexon Shares and other Equity Securities issuable upon conversion of the Note and ARES

TRADING's ownership of the Intrexon Shares and any other Equity Securities issuable to ARES TRADING upon conversion of the Note; and

6.2.12 assuming the accuracy of ARES TRADING's representations and warranties set forth in Section 6.3, none of Intrexon, the Intrexon Parties nor any of their Affiliates or any person acting on its behalf has, directly or indirectly, at any time within the past six (6) months, made any offers or sales of any Equity Securities or solicited any offers to buy any Equity Securities under circumstances that would (i) eliminate the availability of the exemption from registration under Regulation D under the Securities Act in connection with the offer and sale by Intrexon or Precigen of the Intrexon Shares or Precigen Shares as contemplated hereby, or (ii) cause the offering of the Intrexon Shares pursuant to the Transaction Agreements to be integrated with prior offerings by Intrexon for purposes of any applicable law, regulation or stockholder approval provisions, including, without limitation, under the rules and regulations of the Nasdaq Stock Market.

6.3 Representation and Warranties of ARES TRADING. ARES TRADING hereby represents and warrants to the Intrexon Parties that, as of the date hereof and the Closing Date:

6.3.1 ARES TRADING is acquiring the Intrexon Shares and the Note and will acquire any Equity Securities issuable upon conversion of the Note for its own account, for investment and not with a view to, or for sale in connection with, the distribution thereof within the meaning of the Securities Act;

6.3.2 ARES TRADING is, and expects to be at the time of acquiring any Equity Securities issuable upon conversion of the Note, an "accredited investor," as that term is as defined in Rule 501(a) of Regulation D under the Securities Act and has sufficient knowledge and experience in financial and business matters to be capable of evaluating the merits and risks of its investment in the Intrexon Shares and the Note (including any Equity Securities issuable upon conversion thereunder) and is capable of bearing the economic risks of such investment;

6.3.3 ARES TRADING and its advisers have been (i) furnished with all materials relating to the business, finances and operations of Intrexon, and materials relating to the offer and sale of the Intrexon Shares and the Note that have been requested by ARES TRADING or its advisers and (ii) afforded the opportunity to ask questions of Intrexon's management concerning Intrexon, the Intrexon Shares, the Note and the activities of Intrexon under the Collaboration Agreement; provided, however, no investigation or due diligence review by ARES TRADING or any of its Affiliates shall alter, diminish or impair the right or ability of ARES TRADING to rely upon the representations and warranties of the Intrexon Parties;

6.3.4 ARES TRADING understands that, as of the date of this Agreement, the sale or re-sale of the Intrexon Shares, the Note and the Equity Securities issuable upon conversion thereof have not been Registered under the Securities Act or any applicable state securities laws, and the Intrexon Shares, the Note and the Equity Securities issuable upon conversion thereof may not be offered, sold or otherwise transferred unless (i) the Intrexon Shares, the Note or the Equity Securities

issuable thereunder, as applicable, are offered, sold or transferred pursuant to an effective registration statement under the Securities Act, or (ii) the Intrexon Shares, the Note or the Equity Securities issuable upon conversion thereof, as applicable, are offered, sold or transferred pursuant to an exemption from registration under the Securities Act and any applicable state securities laws;

6.3.5 neither ARES TRADING, nor any of its officers, directors, employees, agents, stockholders or partners has either directly or indirectly, including, through a broker or finder engaged in any general solicitation or published any advertisement in connection with the offer and sale of the Intrexon Shares or the Note;

6.3.6 the principal offices of ARES TRADING and the offices of ARES TRADING in which it made its decision to purchase the Intrexon Shares and the Note are located at the address set forth in Section 11.7;

6.3.7 it possesses sufficient rights to enable ARES TRADING to grant all rights it purports to grant to Intrexon under the Transaction Agreements;

6.3.8 it has not granted any right or license to any Third Party under the Collaboration Agreement that conflicts with the rights granted to Intrexon hereunder; and

6.3.9 [RESERVED]

6.4 Disclaimer of Representations and Warranties. EXCEPT AS EXPRESSLY STATED IN THIS ARTICLE 6 (A) NO REPRESENTATION, CONDITION OR WARRANTY WHATSOEVER IS MADE OR GIVEN BY OR ON BEHALF OF INTREXON OR ARES TRADING AND (B) ALL OTHER CONDITIONS AND WARRANTIES WHETHER ARISING BY OPERATION OF LAW OR OTHERWISE ARE HEREBY EXPRESSLY EXCLUDED, INCLUDING ANY CONDITIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT.

6.5 Compliance with Collaboration Agreement. During the period beginning on the Agreement Date and ending on the Closing Date (the "**Pre-Closing Period**"), each of the Intrexon Parties and ARES TRADING (each, a "**Collaboration Agreement Party**" and, collectively, the "**Collaboration Agreement Parties**") (a) shall comply with all terms and conditions of the Collaboration Agreement in all material respects; and (b) shall not take any action or omit to take any action that would reasonably be expected to constitute a breach or default by such Collaboration Agreement Party or its Affiliates of or under the Collaboration Agreement. Any breach or default by a Collaboration Agreement Party or its Affiliates of this Section 6.5 which (i) could reasonably be expected to result in a Collaboration Agreement Party or its Affiliates losing any licensing or sublicensing rights under the Collaboration Agreement or (ii) remains uncured beyond the applicable cure period, is uncurable or gives rise to a right of termination in favor of any Third Party thereunder shall constitute a material breach of this Agreement. Each Collaboration Agreement Party shall, subject to the terms of the Collaboration Agreement, promptly notify the other Collaboration

Agreement Parties in writing of any written allegations of breach or default under the Collaboration Agreement by any other party thereto, to the extent such a breach or default would reasonably be expected to adversely affect the rights and licenses granted to such party pursuant to this Agreement. No Collaboration Agreement Party may amend, modify or supplement the terms of, or waive any rights under, or terminate the Collaboration Agreement without the prior written consent of the other Collaboration Agreement Parties where and to the extent that any such amendment, modification, supplement, waiver or termination would reasonably be expected to adversely affect the rights and licenses granted to such other Collaboration Agreement Party pursuant to this Agreement.

6.6 Mutual Release and Covenant Not to Sue.

6.6.1 Each of the Collaboration Agreement Parties, on behalf of itself, its predecessors, successors, direct and indirect parent companies, direct and indirect subsidiary companies, companies under common control with any of the foregoing, affiliates and assigns, and its and their past, present, and future officers, directors, shareholders, interest holders, members, partners, attorneys, agents, employees, insurers, managers, representatives, assigns and successors in interest, and all persons acting by, through, under or in concert with them, and each of them, hereby irrevocably and forever release and discharge the other Collaboration Agreement Parties, together with their predecessors, successors, direct and indirect parent companies, direct and indirect subsidiary companies, companies under common control with any of the foregoing, affiliates and assigns and its and their past, present, and future officers, directors, shareholders, interest holders, members, partners, attorneys, agents, employees, managers, representatives, assigns and successors in interest, and all persons acting by, through, under or in concert with them, and each of them (the "**Releasees**," as applicable), from all known and unknown charges, complaints, claims, grievances, liabilities, obligations, promises, agreements, controversies, damages, actions, causes of action, suits, rights, demands, costs, losses, debts, penalties, fees, wages, medical costs, pain and suffering, mental anguish, emotional distress, expenses (including attorneys' fees and costs actually incurred) and punitive damages, of any nature whatsoever, known or unknown, which any Collaboration Agreement Party has, or may have had, against any other Collaboration Agreement Party, whether or not apparent or yet to be discovered, or which may hereafter develop ("**Potential Claims**"), for any acts or omissions, prior to the Closing Date, related to or arising from the Collaboration Agreement (the "**Released Claims**"). For avoidance of doubt, the Released Claims shall not include any Potential Claims: (a) for acts or omissions that occur on or after the Effective Date; or (b) related to or arising from any rights or obligations set forth in the Transaction Agreements, including Article 8 hereof.

6.6.2 Each Collaboration Agreement Party agrees and hereby covenants that it will not, directly or indirectly, on its own behalf or acting on behalf of or through any other person or entity, initiate or maintain any lawsuit, arbitration or other proceeding, whether legal or equitable, against any other Collaboration Agreement Party or its or their Releasees, arising from or related to the Released Claims.

6.7 Reasonable Efforts; HSR.

6.7.1 The Parties agree to use all commercially reasonable efforts to take or cause to be taken all actions necessary, proper or advisable to: (i) consummate the transactions contemplated in the Transaction Agreements; (ii) to conduct the Closing on December 28, 2018. The Parties shall use all commercially reasonable efforts to obtain the authorizations, consents, waiting period expirations, orders and approvals of federal, state, and local Governmental Authorities and officials and other persons as may be necessary for the performance of its obligations pursuant to the Transaction Agreements. The Parties shall each use their respective reasonable efforts to cooperate and furnish the other such necessary information and reasonable assistance as the other may reasonably request in connection with obtaining as expeditiously as possible all necessary authorizations, approvals, waiting period expirations, consents or waivers ("**Consents**") from relevant Governmental Authorities. No Party will take any action that will have the effect of delaying, impairing or impeding the receipt of any required regulatory approvals and will use its reasonable efforts to secure such approvals as promptly as possible.

6.7.2 The Parties acknowledge that they have filed the notification and report forms required for the transactions contemplated hereby pursuant to the Hart-Scott-Rodino Antitrust Improvements Act of 1976, as amended (the "**HSR Act**"), with the U.S. Federal Trade Commission (the "**FTC**") and the United States Department of Justice (the "**DOJ**"). The Parties shall file any supplemental information reasonably requested in connection with such filings by the U.S. Federal Trade Commission or the United States Department of Justice and cooperate and consult with each other in the making of all such filings and notifications; provided, that, to the extent reasonably requested by the filing Party, the non-filing Parties shall agree to arrangements to preserve any confidentiality or privilege that might apply to the filing. Without limiting the generality of the foregoing, each Party shall provide to the other (or the other's respective advisors) upon request copies of all correspondence between such Party and the FTC and DOJ relating to the transactions contemplated by this Agreement. The Parties may, as they deem advisable and necessary, designate any competitively sensitive materials provided to the other under this Section 6.7.2 as "outside counsel only." Such materials and the information contained therein shall be given only to outside counsel of the recipient and will not be disclosed by such outside counsel to employees, officers, or directors of the recipient without the advance written consent of the Party providing such materials. In addition, to the extent reasonably practicable, all discussions, telephone calls, and meetings with the FTC or DOJ regarding the transactions contemplated by this Agreement shall include representatives of both Parties. Subject to applicable Law, the Parties will consult and cooperate with each other in connection with any analyses, appearances, presentations, memoranda, briefs, arguments, and proposals made or submitted to the FTC or DOJ regarding the transactions contemplated by this Agreement by or on behalf of any Party.

6.8 Access. ARES TRADING shall give Intrexon and its representatives reasonable access, during normal business hours and without undue interruption of ARES TRADING's business throughout the period prior to the Closing, to all of the key personnel conducting activities under

the Collaboration Agreement between the date hereof and Closing, and will furnish, at Intrexon's expense, Intrexon and its representatives during such period such information concerning the conduct of the activities under the Collaboration Agreement between the date hereof and Closing, as Intrexon may reasonably request, provided that this Section 6.8 shall not entitle Intrexon or its representatives to contact any Third Party doing business with ARES TRADING. Intrexon will hold in confidence all information so obtained.

6.9 Regulatory Matters. ARES TRADING shall provide the Intrexon Parties and the Intrexon Parties shall provide ARES TRADING with copies of any communications or filings made with any Governmental Authority between signing and Closing with respect to its activities under the Collaboration Agreement, including any communications with patent and trademark offices in the Territory.

6.10 Post-Closing Covenants.

6.10.1 Following the Closing, Intrexon agrees to enforce on behalf of ARES TRADING any rights of ARES TRADING accruing prior to the Closing Date under Article 9 or 10 of the Collaboration Agreement.

6.10.2 With respect to any of the Shares issued to ARES TRADING or its Affiliates pursuant to the Transaction Agreements, beginning 180 days after Closing and ending 24 months after the receipt of such Shares, Intrexon (and, following registration of its Shares under the Exchange Act, Precigen) shall use their commercially reasonable efforts to timely file (or obtain extensions in respect thereof and file within the applicable grace period) all reports required to be filed by such Party after the date hereof pursuant to the Exchange Act, even if Intrexon or Precigen, as applicable, is no longer subject to the reporting requirements of the Exchange Act.

6.10.3 Intrexon and Precigen shall not sell, offer for sale or solicit offers to buy or otherwise negotiate in respect of any security (as defined in Section 2 of the Securities Act) that will be integrated with the offer or sale of any Shares of capital stock of Intrexon or Precigen, as the case may be, in a transaction not involving a public offering pursuant to the Transaction Agreements in a manner that would require the registration under the Securities Act of the sale of such Shares to ARES TRADING, or that will be integrated with the offer or sale of any Shares of capital stock of Intrexon or Precigen pursuant to the Transaction Agreements for purposes of the rules and regulations of the Nasdaq Stock Market such that it would require stockholder approval prior to the closing of such other transaction unless stockholder approval is obtained before the closing of such subsequent transaction.

6.10.4 If, at any time ARES TRADING or any of its Affiliates holds the Note following the Closing, Precigen prepares and submits to the SEC a confidential draft Registration Statement on Form S-1 relating to a contemplated initial public offering of Shares of Precigen Common Stock, the Intrexon Parties shall provide to ARES TRADING or such Affiliate, as applicable, on a confidential basis, **[*****]**, no less than **[*****]** prior to the date of the first public

filing of such Registration Statement with the SEC. The Intrexon Parties shall promptly thereafter, at a mutually agreeable time and place, provide an opportunity for ARES TRADING to conduct a confidential informational meeting with Precigen management. The Intrexon Parties shall cooperate with ARES TRADING's (or, in its capacity as holder of the Note, Ares' Affiliate's) reasonable requests for information and shall provide ARES TRADING (or such Affiliate) at least **[*****]** Trading Days' advance notice of the anticipated date of effectiveness of the public offering. For the avoidance of doubt, ARES TRADING acknowledges that any information delivered to it pursuant to this Section 6.10.4 will be deemed Confidential Information for purposes of this Agreement.

6.10.5 From time to time after the Closing, and for no further consideration, each of the Parties shall, and shall cause its Affiliates to, execute, acknowledge and deliver such assignments, transfers, consents, assumptions and other documents and instruments and take such other commercially reasonable actions as may reasonably be requested to more effectively assign, convey or transfer to or vest in Intrexon, all rights, title and interests in, to and under the Collaboration Agreement contemplated by the Transaction Agreements to be transferred or assumed at the Closing.

Article 7
CONDITIONS TO CLOSING

7.1 Conditions to Obligations of ARES TRADING. The obligations of ARES TRADING to consummate the transactions contemplated by this Agreement are, at its option, subject to the fulfillment or waiver, prior to or on the Closing Date, of each of the following conditions:

7.1.1 All Consents of Governmental Authorities to the assignment and assumption of the Collaboration Agreement and the other transactions contemplated herein shall have been obtained and all such Consents shall be in full force and there shall be in effect no preliminary or permanent injunction or other order of any Governmental Authority of competent jurisdiction directing that the transactions contemplated herein or therein, or any of them, not be consummated, and the waiting period under the HSR Act shall have terminated or expired;

7.1.2 The representations and warranties of Intrexon and Precigen contained in the Transaction Agreements and in any certificate delivered by any officer of Intrexon or Precigen pursuant hereto shall be true and correct, individually and in the aggregate, in all respects at the date hereof and at and as of the Closing Date, with the same force and effect as if made at and as of the Closing Date (except for those representations and warranties that relate to a particular date, which shall be true and correct as of such date). Each of the Intrexon Parties shall have performed or complied with all covenants and agreements required by the Transaction Agreements to be performed or complied with by such Party on or prior to the Closing Date in all respects;

7.1.3 Intrexon shall have submitted a Listing of Additional Shares Notification with the Nasdaq Stock Market covering all of the Intrexon Shares;

7.1.4 The Intrexon Parties shall have delivered to ARES TRADING the following:

(a) the Intrexon Shares in book-entry form, free and clear of all restrictive and other legends (except as expressly provided in Section 5.1 of this Agreement or with respect to the Lock-up Period);

(b) the Note, duly executed by each of the Intrexon Parties;

(c) certificates of the President or Chief Executive Officer of each of Intrexon and Precigen, dated as of the Closing Date, certifying that each of the conditions specified in Section 7.1.2 have been satisfied and that the release set forth in Section 6.6.1 and the covenant set forth in Section 6.6.2 are effective as of the Closing Date;

(d) a certificate of the Secretary or Assistant Secretary of Intrexon, dated as of the Closing Date, (a) certifying the resolutions adopted by the Board of Directors of Intrexon or a duly authorized committee thereof approving the transactions envisioned hereby, the execution and delivery of the Note and the issuance of the Intrexon Shares and Precigen Shares issuable upon conversion of the Note, and, in its capacity as sole stockholder of Precigen, the issuance of Precigen Shares upon conversion of the Note, (b) certifying the current articles of incorporation, as amended, and by-laws of Intrexon and (c) certifying as to the signatures and authority of persons signing the Note and related documents on behalf of Intrexon;

(e) a certificate of the Secretary or Assistant Secretary of Precigen, dated as of the Closing Date, (a) certifying the resolutions adopted by the Board of Directors of Precigen or a duly authorized committee thereof approving the transactions envisioned hereby and the execution and delivery of the Note and the issuance of Precigen Shares upon conversion of the Note, (b) certifying the current versions of the certificate of incorporation, as amended, and by-laws of Precigen and (c) certifying as to the signatures and authority of persons signing the Note and related documents on behalf of Precigen, and

7.1.5 ARES TRADING shall have obtained all internal approvals and consents required to permit it to conduct the Closing and make the representations set forth in Sections 6.1.2, 6.1.4 and 6.1.6 hereof.

7.2 Conditions to Obligations of the Intrexon Parties. The obligations of the Intrexon Parties to consummate the transactions contemplated by this Agreement are, at their option, subject to the fulfillment or waiver, prior to or on the Closing Date, of each of the following conditions:

7.2.1 All consents of Governmental Authorities to the assignment and assumption of the Collaboration Agreement and the other transactions contemplated herein shall have been obtained and all such Consents shall be in full force and there shall be in effect no preliminary or permanent injunction or other order of any Governmental Authority of competent jurisdiction

directing that the transactions contemplated herein or therein, or any of them, not be consummated, and the waiting period under the HSR Act shall have terminated or expired.

7.2.2 The representations and warranties of ARES TRADING contained in the Transaction Agreements and in any certificate delivered by any officer of ARES TRADING pursuant hereto shall be true and correct, individually and in the aggregate, in all respects at the date hereof and at and as of the Closing Date, with the same force and effect as if made at and as of the Closing Date (except for those representations and warranties that relate to a particular date, which shall be true and correct as of such date). ARES TRADING shall have performed or complied with all covenants and agreements required by the Transaction Agreements to be performed or complied with it on or prior to the Closing Date in all respects.

7.2.3 ARES TRADING shall have delivered to the Intrexon Parties a certificate, dated the Closing Date, of an officer of ARES TRADING to the effect that the conditions specified in Section 7.2.2 have been satisfied and that the release set forth in Section 6.6.1 and the covenant set forth in Section 6.6.2 are effective as of the Closing Date.

Article 8
INDEMNIFICATION AND LIMITATION OF LIABILITY

8.1 Indemnification by Intrexon and Precigen. Intrexon and Precigen shall defend, indemnify and hold ARES TRADING, its Affiliates and its and their respective trustees, officers, directors, agents and employees (the "**ARES Indemnitees**") harmless from and against any and all Losses arising under or related to the Transaction Agreements against them to the extent arising or resulting from: (a) the breach of any of the representations or warranties made by Intrexon or Precigen under the Transaction Agreements, (b) any breach by Intrexon or Precigen of its obligations pursuant to the Transaction Agreements, or obligation, liability or responsibility assumed by Intrexon or Precigen pursuant to the Transaction Agreements, including (without limitation) any failure by them to perform, assume, discharge or satisfy any of ARES TRADING's or its Affiliates' obligations or liabilities under the Collaboration Agreement or otherwise pursuant to Section 2.1 hereof, (c) any Claim or Claims by any Third Party that Section 2.1 hereof is ineffective or unenforceable as to them, including, without limitation, that ARES TRADING or its Affiliates retain any obligations or liabilities after the Closing Date to such Third Party pursuant to the Collaboration Agreement, (d) any Claim or Claims arising under or relating to the Collaboration Agreement except and solely to the extent that it is finally determined pursuant to a final, non-appealable order of a court of competent jurisdiction that the Losses incurred by any relevant ARES Indemnitee with respect to any such Claim or Claims resulted from the material breach by any ARES Indemnitee of the Collaboration Agreement, or (e) obligations or liabilities or any Losses of or experienced by any ARES Indemnitee arising under or relating to the Collaboration Agreement on or after the Closing Date, except in the case of subsections (a), (b) and this (e), to the extent such Losses result from the material breach by any ARES Indemnitee of any covenant, representation, warranty or

other agreement made by ARES TRADING in the Transaction Agreements or the gross negligence or willful misconduct of any ARES Indemnitee.

8.2 Indemnification by ARES TRADING. ARES TRADING shall indemnify and hold Intrexon, Precigen and its and their Affiliates and its and their respective trustees, officers, directors, agents and employees (the "**Intrexon Indemnitees**") harmless from and against any and all Losses arising under or resulting from: (a) the breach of any of the representations or warranties made by ARES TRADING under the Transaction Agreements, (b) any breach by ARES TRADING of its obligations pursuant to the Transaction Agreements or (c) obligations or liabilities accrued or incurred by ARES TRADING to Third Parties under the Collaboration Agreement prior to the Closing Date, except in each case, to the extent such Losses result from the material breach by any Intrexon Indemnitee of any covenant, representation, warranty or other agreement made by Intrexon or Precigen in the Transaction Agreements or the gross negligence or willful misconduct of any Intrexon Indemnitee.

8.3 Indemnification Procedure. If any Party is seeking indemnification under Section 8.1 or 8.2 (the "**Indemnified Party**"), it shall inform the Party against which indemnification is sought (the "**Indemnifying Party**") of the Losses giving rise to the obligation to indemnify pursuant to Section 8.1 or 8.2, as applicable, as soon as reasonably practicable after receiving notice of the Losses. The Indemnifying Party shall have the right to assume the defense of any Claim for which it is obligated to indemnify the Indemnified Party. The Indemnified Party shall cooperate with the Indemnifying Party and the Indemnifying Party's insurer at the Indemnifying Party's reasonably request, and at the Indemnifying Party's cost and expense. The Indemnifying Party shall have the right to participate, at its own expense and with counsel of its choice, in the defense of any Claim that has been assumed by the Indemnifying Party. The Indemnifying Party shall not have the obligation to indemnify an Indemnified Party in connection with any settlement made without the Indemnifying Party's written consent, which consent shall not be unreasonably withheld or delayed. If the Parties cannot agree as to the application of Section 8.1 or 8.2 as to any Claim, the Parties may conduct separate defenses of such Claims, with the Indemnified Party retaining the right to claim indemnification from the Indemnifying Party in accordance with Section 8.1 or 8.2 upon resolution of the underlying Claim.

8.4 Mitigation of Loss. Each Indemnified Party shall take and shall procure that its Affiliates take all such reasonable steps as are reasonably necessary or as the Indemnifying Party may reasonably require in order to mitigate any Claims (or potential Losses) under this Article 8. Nothing in the Transaction Agreements shall or shall be deemed to relieve any Party of any common law or other duty to mitigate any losses incurred by it.

8.5 LIMITATION OF LIABILITY. NO PARTY SHALL BE LIABLE TO ANY OTHER PARTY FOR ANY SPECIAL, CONSEQUENTIAL, INCIDENTAL, PUNITIVE, OR INDIRECT DAMAGES ARISING FROM OR RELATING TO ANY BREACH OF THIS AGREEMENT, REGARDLESS OF ANY NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

NOTWITHSTANDING THE FOREGOING, NOTHING IN THIS SECTION 8.5 IS INTENDED TO OR SHALL LIMIT OR RESTRICT THE INDEMNIFICATION RIGHTS OR OBLIGATIONS OF ANY PARTY UNDER SECTION 8.1 or 8.2, OR DAMAGES AVAILABLE FOR A PARTY'S BREACH OF CONFIDENTIALITY OBLIGATIONS IN ARTICLE 10.

Article 9
TERMINATION

9.1 Termination Rights.

9.1.1 The Intrexon Parties shall have the right to terminate this Agreement in its entirety prior to the Closing immediately upon written notice to ARES TRADING if ARES TRADING materially breaches its obligations under this Agreement and, after receiving written notice identifying such material breach in reasonable detail, fails to cure such material breach within ninety (90) days from the date of such notice (or within thirty (30) days from the date of such notice in the event such material breach is solely based on the ARES TRADING's failure to pay any amounts due hereunder).

9.1.2 ARES TRADING shall have the right to terminate this Agreement in its entirety prior to the Closing immediately upon written notice to the Intrexon Parties if either of the Intrexon Parties materially breaches its obligations under this Agreement and, after receiving written notice identifying such material breach in reasonable detail, fails to cure such material breach within ninety (90) days from the date of such notice (or within thirty (30) days from the date of such notice in the event such material breach is solely based on the breaching Party's failure to pay any amounts due hereunder).

9.1.3 In the event that any Party that has allegedly materially breached this Agreement disputes such breach, and the resulting termination of this Agreement pursuant to Section 9.1.1 or 9.1.2 in good faith, then any consequences of termination in this Article 9 shall only apply from and after such time as such termination has been upheld in a final judgment from which no appeal can be taken, or that is unappealed within the time allowed for appeal or such time as the Party allegedly in material breach is no longer disputing such termination. It is understood and agreed that during the pendency of such dispute, all of the terms and conditions of this Agreement shall remain in effect and the Parties shall continue to perform all of their respective obligations hereunder.

9.1.4 Each of the Intrexon Parties and ARES TRADING shall have the right to terminate this Agreement upon written notice to the other Parties if the Closing has not occurred by March 31, 2019; provided, however, that the right to terminate this Agreement under this Section 9.1.4 shall not be available to any party if any action or failure to act by such party has been a principal cause of or principally resulted in the failure of the Closing to occur on or before such date and such action or failure to act constitutes a material breach of this Agreement.

9.2 Effects of Termination.

9.2.1 Notwithstanding the termination of this Agreement as a whole, the following provisions shall survive such termination: Section 5.3 and Articles 10 and 11.

9.2.2 Termination of this Agreement shall not relieve the Parties of any obligation or liability that, at the time of termination, has already accrued hereunder, or which is attributable to a period prior to the effective date of such termination. Termination of this Agreement shall not preclude the Parties from pursuing all rights and remedies they may have hereunder or at Law or in equity with respect to any breach of this Agreement nor prejudice any Party's right to obtain performance of any obligation.

Article 10
CONFIDENTIALITY

10.1 Confidentiality. Subject to the other provisions of this Article 10:

10.1.1 all Confidential Information of a Party (the "**Disclosing Party**") or its Affiliates under the Transaction Agreements shall be maintained in confidence and otherwise safeguarded by each other Party receiving such Confidential Information (each such Party a "**Receiving Party**") and its and their Affiliates, in the same manner and with the same protection as such Receiving Party maintains its own confidential information, but with not less than reasonable diligence;

10.1.2 the Receiving Party may only use any such Confidential Information for the purposes of performing its obligations or exercising its rights under the Transaction Agreements;

10.1.3 the Receiving Party may disclose Confidential Information of the Disclosing Party to: (i) its Affiliates and sublicensees; and (ii) employees, directors, agents, contractors, consultants and advisers of the Receiving Party and its Affiliates and sublicensees (such persons specified in clauses (i) and (ii) of this Section 10.1.3, "**Representatives**"), in each case to the extent reasonably necessary for the purposes of, and for those matters undertaken pursuant to, the Transaction Agreements; provided that such persons are bound to maintain the confidentiality of the Confidential Information in a manner consistent with the confidentiality provisions of the Transaction Agreements (and the Receiving Party shall be responsible and liable for the conduct and compliance of its Representatives); and

10.1.4 ARES TRADING acknowledges that the Confidential Information of the Intrexon Parties may contain material, non-public information regarding the Intrexon Parties and that the United States securities laws prohibit any person who has such material, non-public information from purchasing or selling securities of the Intrexon Parties (other than with the Intrexon Parties or Persons who have such information) on the basis of such information or from communicating such information to any Person (other than with the Intrexon Parties or Persons

who have such information) under circumstances in which it is reasonably foreseeable that such person is likely to purchase or sell such securities on the basis of such information, and ARES TRADING agrees to comply with the applicable United States securities laws with respect to trading in the securities of the Intrexon Parties.

10.2 Exceptions. The foregoing obligations as to particular Confidential Information of a Disclosing Party shall not apply to the extent that such Confidential Information:

10.2.1 is known by the Receiving Party at the time of its receipt without an obligation of confidentiality, and not through a prior disclosure by the Disclosing Party, as documented by the Receiving Party's business records;

10.2.2 is in the public domain before its receipt from the Disclosing Party, or thereafter enters the public domain through no fault of the Receiving Party;

10.2.3 is subsequently disclosed to the Receiving Party by a Third Party who may lawfully do so and is not under an obligation of confidentiality to the Disclosing Party; or

10.2.4 is developed by the Receiving Party independently and other than in performing its obligations under the Transaction Agreements and without use of or reference to any Confidential Information received from the Disclosing Party, as documented by the Receiving Party's business records.

10.2.5 Any combination of features or disclosures shall not be deemed to fall within the foregoing exclusions merely because individual features are published or available to the general public or in the rightful possession of the Receiving Party unless the combination itself and principle of operation are published or available to the general public or in the rightful possession of the Receiving Party.

10.3 Authorized Disclosures. Notwithstanding the obligations set forth in Section 10.1, a Party may disclose another Party's Confidential Information (including this Agreement and the terms herein) to the extent:

10.3.1 such disclosure: (i) is reasonably necessary for prosecuting or defending litigation as contemplated by the Transaction Agreements; or (ii) is made to any Third Party bound by written obligation of confidentiality and non-use substantially consistent with those set forth under this Article 10, to the extent otherwise necessary or appropriate in connection with the exercise of its rights or the performance of its obligations hereunder;

10.3.2 such disclosure is reasonably necessary to such Party's directors, attorneys, independent accountants or financial advisors for the sole purpose of enabling such directors, attorneys, independent accountants or financial advisors to provide advice to such Party, provided that in each such case on the condition that such directors, attorneys, independent accountants and

financial advisors are bound by confidentiality and non-use obligations at least as restrictive as those contained in this Agreement; provided, however, that the term of confidentiality for such directors, attorneys, independent accountants and financial advisors shall be no less than ten (10) years; or

10.3.3 such disclosure is required by judicial or administrative process; provided that in such event such Party shall promptly inform the Disclosing Party of such required disclosure and provide the Disclosing Party an opportunity to challenge or limit the disclosure obligations. Confidential Information that is disclosed by judicial or administrative process shall remain otherwise subject to the confidentiality and non-use provisions of this Article 10, and the Party disclosing Confidential Information pursuant to law or court order shall take all steps reasonably necessary, including seeking of confidential treatment or a protective order, to ensure, to the extent available, the continued confidential treatment of such Confidential Information.

Article 11
ADDITIONAL PROVISIONS

11.1 Successors and Assigns. The Transaction Agreements may not be assigned or otherwise transferred (including in connection with the sale of all or substantially all of the assets to which the Transaction Agreements relate or in connection with any merger or consolidation to which a Party is a party), nor may any right or obligation thereunder be assigned or transferred, by any Party without the prior written consent of the other Parties; provided, however, that, following the Closing, no such consent shall be unreasonably withheld or delayed in connection with any such assignment or transfer of the Transaction Agreements and such assigning Party's respective rights and obligations hereunder or thereunder (i) in whole or in part to an Affiliate of such Party, (ii) in whole to such Party's successor in interest in connection with the sale of all or substantially all of the assets to which the Transaction Agreements relate, or (iii) occurring by operation of law in connection with any merger or consolidation to which the Party making the assignment is a party; provided however, that in each of the foregoing circumstances, any assignee or transference of any such rights and obligations shall assume, and shall be reasonably capable of performing, all obligations of the assignor or transferor under this Agreement. Notwithstanding the foregoing, Intrexon may assign or transfer the Transaction Agreements or any of its rights and obligations thereunder to Precigen without the consent of ARES TRADING, provided; however, that (x) at the time of such assignment or transfer, the Board of Directors of Intrexon determines reasonably and in good faith that Precigen is able to perform the obligations of Intrexon under the Transaction Agreements and is reasonably capable of performing such obligations until they are fully performed; and (y) Intrexon may not assign or transfer to Precigen, without the prior written consent of ARES TRADING, Intrexon's rights and obligations as they specifically relate to the issuance or registration of any shares of Intrexon Common Stock issued or issuable pursuant to the terms of the Transaction Agreements hereunder or, prior to the sixth anniversary of the Closing Date, under Article 8 hereof. Intrexon and Precigen may assign or transfer (including through a license) its rights to Specified CAR-T Products, in whole or in part, without the consent of ARES TRADING provided that such

assignment or transfer complies with the terms of Annex I, including, without limitation, Section 2.6 thereof, and that Intrexon and Precigen make all payments to ARES TRADING required by the terms of Annex I. Any attempted assignment not in accordance with this Section 11.1 shall be null and void and of no legal effect. Any permitted assignee shall assume all assigned obligations of its assignor under the Transaction Agreements. The terms and conditions of the Transaction Agreements shall be binding upon, and shall inure to the benefit of, the Parties and their respective successors and permitted assigns.

11.2 Further Actions. Each Party agrees to execute, acknowledge and deliver such further instruments and to do all such other acts as may be necessary or appropriate in order to carry out the express purposes and clear intent of the Transaction Agreements.

11.3 Entire Agreement of the Parties; Amendments. This Agreement, and the Exhibits, Annexes and Schedules hereto and thereto constitute and contain the entire understanding and agreement of the Parties respecting the subject matter hereof and cancel and supersede any and all prior negotiations, correspondence, understandings and agreements between the Parties, whether oral or written, regarding such subject matter. No modification or amendment of any provision of this Agreement shall be valid or effective unless made in a writing referencing this Agreement and signed by a duly authorized officer of each Party.

11.4 Governing Law. This Agreement shall be governed by and interpreted in accordance with the Laws of New York, excluding application of any conflict of laws principles that would require application of the Law of a jurisdiction other than the Laws of New York.

11.5 Dispute Resolution. If a dispute arises between any of the Parties concerning this Agreement, then such Parties will confer, as soon as practicable, in an attempt to resolve the dispute. If the Parties are unable to resolve such dispute within thirty (30) days, then the Parties will submit to the exclusive jurisdiction of, and venue in, the courts of competent jurisdiction located in New York, New York. Notwithstanding anything in this Agreement to the contrary, a Party may seek a temporary restraining order or a preliminary injunction from any court of competent jurisdiction, at any time, in order to prevent immediate and irreparable injury, loss, or damage on a provisional basis, pending the resolution of any dispute hereunder, including under this Section 11.5.

11.6 Notices and Deliveries. All notices which are required or permitted hereunder shall be in writing and sufficient if delivered personally, sent by nationally-recognized overnight courier or sent by registered or certified mail, postage prepaid, return receipt requested, addressed as follows.

If to Intrexon:

Intrexon Corporation
20374 Seneca Meadows Parkway
Germantown, MD 20876
USA
Attn: Legal Department

with a copy to:

Hogan Lovells US LLP
100 International Drive, Suite 2000
Baltimore, Maryland 21202
Attn: William I. Intner
Asher M. Rubin

If to Precigen:

Precigen, Inc.
20374 Seneca Meadows Parkway
Germantown, MD 20876
USA
Attn: Legal Department

With a copy to:

Hogan Lovells US LLP
100 International Drive, Suite 2000
Baltimore, Maryland 21202
Attn: William I. Intner
Asher M. Rubin

If to ARES TRADING:

ARES TRADING S.A.
Zone Industrielle de L'Ouriettaz
1170 Aubonne
Switzerland
Attn: Legal Department

with a copy to:

Merck KGaA
Frankfurter Straβe 250
64293 Darmstadt
Germany
Attn: Merck Serono Legal Department

or to such other address(es) as the Party to whom notice is to be given may have furnished to the other Parties in writing in accordance herewith. Any such notice shall be deemed to have been given: (a) when delivered if personally delivered on a Trading Day (or if delivered on a non-Trading Day, then on the next Trading Day); (b) on the Trading Day after dispatch if sent by nationally-recognized overnight courier; or (c) on the fifth (5^{th}) Trading Day following the date of the mailing, if sent by mail.

11.7 Intrexon Guarantee. For so long as Intrexon or any of its direct or indirect subsidiaries collectively beneficially own (within the meaning of SEC Rule 13d-3) **[*****]** of the voting Equity Securities of Precigen, Intrexon hereby unconditionally guarantees and undertakes to ARES TRADING that Precigen will duly and punctually observe and perform all the undertakings, covenants and obligations of Precigen under the Transaction Agreements and under any agreements between the Parties (or any of them) which are expressly supplemental to this Agreement or which the Transaction Agreements requires to be executed (the "**Obligations**") to the intent that if Precigen (or any assignee or successor in interest thereto) shall fail for whatever reason so to observe and perform any Obligations, Intrexon shall be liable to perform the same in all respects as if Intrexon was the party principally bound thereby in place of Precigen on demand from ARES TRADING, provided that Intrexon shall be deemed to have any defenses or excuses for nonperformance that Precigen would have had to such Obligations. The liability of Intrexon under the Transaction Agreements shall be as primary obligor as regards ARES TRADING and not merely as surety and no modification, variation or addition to any of the Obligations, no time or other indulgence given by ARES TRADING to Precigen nor any neglect, failure or forbearance on the part of ARES TRADING to enforce the performance or observance of any of the Obligations shall in any way release, lessen or affect the liability of Intrexon. This is a continuing guarantee and Intrexon's undertakings to guarantee Precigen's undertakings under the Transaction Agreements shall remain in full force and effect until the earlier of: (a) the date on which Intrexon or any of its direct or indirect subsidiaries collectively do not beneficially own (within the meaning of SEC Rule 13d-3) **[*****]** of the voting Equity Securities of Precigen; (b) the final performance in full of the Obligations; or (c) Precigen's consummation of a Qualified IPO. In addition, until the termination of this guarantee, Intrexon will not divest, restructure, reorganize or reclassify Precigen with any intent in whole or in part to avoid, reduce or eliminate its obligations under the Transaction Agreements.

11.8 Severability. If any one or more of the provisions of this Agreement is held to be invalid or unenforceable by any court of competent jurisdiction from which no appeal can be or is taken, the provision shall be considered severed from this Agreement and shall not serve to invalidate any remaining provisions hereof. The Parties shall make a good faith effort to replace any invalid or unenforceable provision with a valid and enforceable one such that the objectives contemplated by the Parties when entering this Agreement may be realized.

11.9 No Strict Construction; Headings. This Agreement has been prepared jointly by the Parties and shall not be strictly construed against any Party. Ambiguities, if any, in this Agreement shall not be construed against any Party, irrespective of which Party may be deemed to have authored the ambiguous provision. The headings of each Article and Section in this Agreement have been inserted for convenience of reference only and are not intended to limit or expand on the meaning of the language contained in the particular Article or Section. Except where the context otherwise requires, the use of any gender shall be applicable to all genders, and the word "or" is used in the inclusive sense (and/or). The term "including" as used herein means including, without limiting the generality of any description preceding such term.

11.10 No Waiver. Any delay in enforcing a Party's rights under this Agreement or any waiver as to a particular default or other matter shall not constitute a waiver of such Party's rights to the future enforcement of its rights under this Agreement, except with respect to an express written and signed waiver relating to a particular matter for a particular period of time.

11.11 Specific Performance. The parties hereby acknowledge and agree that if any party refuses or otherwise fails to act, or to cause its Affiliates to act, in accordance with the provisions of this Agreement, such refusal or failure could result in irreparable injury to the other parties, the exact amount of which would be difficult to ascertain or estimate and the remedies at law for which would not be reasonable or adequate compensation. Accordingly, if any party refuses or otherwise fails to act, or to cause its Affiliates to act, in accordance with the provisions of this Agreement, then, in addition to any other remedy which may be available to any damaged party at law or in equity, such damaged party will be entitled to seek specific performance and injunctive relief, without posting bond or other security, and without the necessity of proving actual or threatened damages, which remedy such damaged party will be entitled to seek in any court of competent jurisdiction.

11.12 Cumulative Remedies. No remedy referred to in this Agreement is intended to be exclusive, but each shall be cumulative and in addition to any other remedy referred to in this Agreement or otherwise available under law or in equity.

11.13 Trading Day Requirements. In the event that any notice or other action or omission is required to be taken by a Party under this Agreement on a day that is not a Trading Day then such notice or other action or omission shall be deemed to be required to be taken on the next occurring Trading Day.

[SIGNATURE PAGE FOLLOWS]

IN WITNESS WHEREOF, duly authorized representatives of the Parties have executed this Agreement as of the date first written above.

INTREXON CORPORATION

By: _____
Name:
Title:

ARES TRADING S.A.

By: _____
Name:
Title:

PRECIGEN, INC.

By: _____
Name:
Title:

EXHIBIT A

Collaboration Agreement

(See attached)*

***** *Previously filed on April 2, 2015 as an exhibit to Intrexon Corporation's Current Report on Form 8-K.*

EXHIBIT B

Deed of Assignment

(See attached)

DATED

Intrexon Corporation (1)

- and -

Precigen, Inc. (2)

- and -

ARES Trading S.A. (3)

Deed of Assignment

THIS DEED OF ASSIGNMENT is made on

BETWEEN:

(1) **ARES TRADING S.A.**, a corporation organized and existing under the laws of Switzerland, having offices at Zone Industrielle de L'Ouriettaz, 117 Aubonne, Switzerland (the "**Ares Trading**");

(2) ***Intrexon Corporation***, a corporation organized and existing under the laws of Virginia, USA, having its principal place of business at 20374 Seneca Meadows Parkway, Germantown, MD 20876, USA ("**Intrexon**"); and

(3) **Precigen, Inc.**, a Delaware corporation, having its principal place of business at, 20358 Seneca Meadows Parkway, Germantown, MD 20876, USA ("**Precigen**").

BACKGROUND:

(A) Ares Trading, Intrexon and Ziopharm entered into the Agreement (as defined in clause 1 of this Deed). Intrexon has assigned and transferred its rights and obligations under the Agreement to Precigen.

(B) Pursuant to a Securities Purchase, Assignment and Assumption Agreement entered into between Ares Trading and the Intrexon Parties on [INSERT DATE] (the "**Assignment and Assumption Agreement**"), Ares Trading agreed to assign and transfer all of its rights and obligations under the Agreement to Intrexon with effect from the Closing Date (as defined in the Assignment and Assumption Agreement), and the parties wish to give effect to that assignment by Ares Trading and assumption of obligations by Intrexon in accordance with the terms of this Deed (and without prejudice to the provisions of the Assignment and Assumption Agreement).

OPERATIVE PROVISIONS:

1. **DEFINITIONS AND INTERPRETATION**

In this Deed:

"**Agreement**" means the License and Collaboration Agreement dated 27 March 2015 originally between Ares Trading, Intrexon and Ziopharm;

"**Effective Date**" means the date of this Deed;

"**Intrexon Parties**" means each of Intrexon and Precigen;

"**Liabilities**" means any liabilities (including without limitation any remedy, damages, losses, costs, lawyers' and court fees and expenses, penalties, indemnified sums, profits, unjust enrichment, financial consequences and costs and expenses incurred in enforcing rights of indemnification and contribution, and the burden of any claims, assertion or demands in contract, tort or otherwise and including without limitation claims for negligence and misrepresentation) arising under or in consequence of the Agreement (including any performance or non-performance thereunder);

"**Obligations**" means any performance obligations (including without limitation duties of care, good faith, obligation to grant any licence, observance of any negative covenants and restrictions as well as contractual obligations) arising under or in consequence of the Agreement;

"**Rights**" means any rights (including without limitation contractual rights, tortious rights, licences, permissions and any chose in action, enforcement right or remedy) arising under or in consequence of the Agreement;

"**Ziopharm**" means ZIOPHARM Oncology, Inc., a corporation organized and existing under the laws of Delaware, USA, having its principal place of business at One First Avenue, Parris Building 34, Navy Yard Plaza, Boston, MA 02129, USA.

2. ASSIGNMENT, TRANSFER AND RELEASE

2.1 Subject to clause 2.2, all of Ares Trading's Rights and Obligations under the Agreement are assigned and transferred from Ares Trading to Intrexon such that with effect from the Effective Date:

(a) all of Ares Trading's Rights (whether past, present or future) are hereby assigned to Intrexon, and Intrexon accepts this assignment subject to the remainder of this clause 2.1;

(b) all of the Intrexon Parties' Rights (whether past, present or future, and whether known or unknown) enforceable as against Ares Trading are fully and irrevocably released and discharged forever by the Intrexon Parties;

(c) all of Ares Trading's (on the one hand) and the Intrexon Parties' (on the other hand) respective Obligations to each other are fully and irrevocably released and discharged forever by each of Ares Trading and the Intrexon Parties respectively;

(d) Intrexon covenants, represents and undertakes to Ares Trading that it will duly and promptly perform on time and in accordance with the provisions of the Agreement all of Ares Trading's Obligations to Ziopharm arising with effect from the Effective Date as if they were Obligations originally accepted and contracted to be performed directly by Intrexon to Ziopharm;

(e) all Liabilities arising prior to the Effective Date will be retained by the party that owes such Liabilities to the extent set forth in the Assignment and Assumption Agreement; and

(f) all Liabilities of Ares Trading arising on or after the Effective Date shall be met, satisfied and discharged in full by Intrexon and in respect of which Intrexon shall on demand fully indemnify and hold harmless Ares Trading, provided that, except in accordance with the Agreement or the Assignment and Assumption Agreement, Ares Trading shall not take any actions to perform or purport to perform the Agreement without the consent of Intrexon or to wilfully frustrate Intrexon's

performance of the Agreement (and if it does take any such actions, any Liabilities that arise therefrom will not be covered by the indemnity in this clause 2.1(f)).

2.2 Nothing in this Deed will extinguish or vary any Rights, Obligations or Liabilities owed by or to Ziopharm, save that as between the parties Ares Trading's responsibility for its Obligations and Liabilities shall be assumed by Intrexon and/or Precigen in accordance with clause 2.1.

3. **FURTHER ASSURANCE**

Each of Ares Trading and the Intrexon Parties shall do all acts and things as may reasonably be required to give full effect to the provisions of this Deed.

4. **MISCELLANEOUS**

4.1 This Agreement shall be read in conjunction with and operate alongside the provisions of the Assignment and Assumption Agreement but shall not vary, amend or limit in any way the provisions of the Assignment and Assumption Agreement. If there is any conflict between this Agreement and the Assignment and Assumption Agreement, the Assignment and Assumption Agreement will prevail.

4.2 A variation of this Deed is valid only if it is in writing and signed by all of the parties or their respective duly authorised representatives.

4.3 Failure to exercise, or a delay in exercising, a right or remedy provided by this Deed or by law does not constitute a waiver of the right or remedy or a waiver of other rights or remedies. No single or partial exercise of a right or remedy provided by this Deed or by law prevents the further exercise of the right or remedy or the exercise of another right or remedy. A waiver of a breach of this Deed does not constitute a waiver of a subsequent or prior breach of this Deed.

4.4 If a provision of this Deed is found to be illegal, invalid or unenforceable, then to the extent it is illegal, invalid or unenforceable, that provision will be given no effect and will be treated as though it were not included in this Deed, but the validity or enforceability of the remaining provisions of this Deed will not be affected.

4.5 This Deed may be entered into in any number of counterparts and any party to this Deed may enter into this Deed by executing any counterpart. A counterpart constitutes an original of this Deed and all executed counterparts together have the same effect as if each to this Deed had executed the same document.

4.6 A person who is not a party to this Deed has no right under the Contracts (Rights of Third Parties) Act 1999 to enforce this Deed.

5. **GOVERNING LAW AND JURISDICTION**

5.1 This Deed, the jurisdiction clause contained in it and all non-contractual obligations arising in any way whatsoever out of this Deed are governed by, construed and take effect in accordance with English law excluding application of any conflict of laws principles that would require application of the law of a different jurisdiction.

5.2 The courts of England have exclusive jurisdiction to settle any claim, dispute or matter of difference which may arise in any way whatsoever out of this Deed or the legal relationships established by this Deed, provided that the courts of England will not have jurisdiction in respect of, or any jurisdiction to prevent, a claim made under the Assignment and Assumption Agreement.

This document has been executed as a deed and delivered on the date stated at the beginning of it.

Executed and delivered as a deed by **ARES TRADING S.A.**, a company incorporated in Switzerland, acting by the authorised signatory named below who is permitted to execute for **ARES TRADING S.A.** under the laws of Switzerland

Name of authorised signatory:

_____
Authorised signature

Witness name:

_____
Witness signature

Witness address:

Name of authorised signatory:

_____
Authorised signature

Witness name:

_____
Witness signature

Witness address:

Executed and delivered as a deed by **Precigen, Inc.**, a corporation incorporated in the State of Delaware, USA, acting by the authorised signatory named below who is permitted to execute for **Precigen Inc.** under the laws of Delaware, USA.

Name of authorised signatory:

_____
Authorised signature

Witness name:

_____
Witness signature

Witness address:

Executed and delivered as a deed by **Intrexon Corporation**, a corporation incorporated in the State of Virginia, USA, acting by the authorised signatory named below who is permitted to execute for **Intrexon Corporation** under the laws of Virginia, USA

Name of authorised signatory:

Authorised signature

Witness name:

Witness signature

Witness address:

EXHIBIT C

[RESERVED]

EXHIBIT D

Form of Note

(See attached)*

** Filed as a separate exhibit to Intrexon Corporation's Annual Report on Form 10-K for the fiscal year ended December 31, 2018. Portions of the exhibit have been omitted pursuant to a confidential treatment request filed with the Securities and Exchange Commission.*

ANNEX 1

Royalty Terms

Article I

DEFINITIONS

Capitalized terms used in this Annex shall have the meanings given them in the Transaction Agreements, including the following meanings:

"**Calendar Year**" means the period beginning on the 1st of January and ending on the 31st of December of the same year, provided however that (i) the first Calendar Year of the Term shall commence on the Effective Date and end on December 31, 2018, and (ii) the last Calendar Year of the Term shall commence on January 1 of the Calendar Year in which the Agreement and this Annex 1 terminates or expires and end on the date of termination or expiration of the Agreement and this Annex 1.

"**CAR**" means **[*****]**.

"**CAR-T**" means an engineered CAR modified T-Cell.

"**CAR-T Product**" means **[*****]**.

"**Earned Royalty**" means a royalty of ten percent (10%) of the Net Sales proceeds of each Specified CAR-T Product sold, transferred or otherwise disposed of by or for any Intrexon Party or any of their Affiliates (but, for clarity, not by any Sublicensee who is not an Intrexon Party or one of their Affiliates).

[*****].

"**First Commercial Sale**" means, with respect to any Specified CAR-T Product in any country or jurisdiction, the first commercial transfer or disposition for value of such Specified CAR-T Product to a Third Party by any Intrexon Party or one of their Affiliates or a Sublicensee in such country or jurisdiction after the Regulatory Approvals have been obtained for such Specified CAR-T Product in such country or jurisdiction.

"**Net Sales"** means, with respect to any Specified CAR-T Product, the gross amount invoiced by any Intrexon Party or their Affiliates or sublicensees for sales of such Specified CAR-T Product to independent or unaffiliated Third Party purchasers less the following deductions, with respect to such sales to the extent that such amounts are either included in the billing as a line item as part of the gross amount invoiced, or otherwise documented in accordance with IFRS to be specifically attributable to actual sales of such Specified CAR-T Product:

(a) trade discounts, including trade, cash and quantity discounts or rebates, credits or refunds (including inventory management fees, discounts or credits);

(b) allowances or credits actually granted upon claims, returns or rejections of products, including recalls, regardless of the party requesting such recall;

(c) bad debts or provisions for bad debts, provided that if any bad debt is subsequently collected, it shall be added to Net Sales;

(d) charges included in the gross sales price for freight, insurance, transportation, postage, handling and any other charges relating to the sale, transportation, delivery or return of such Specified CAR-T Product;

(e) customs duties, sales, excise and use taxes and any other governmental charges (including value added tax) actually paid in connection with the transportation, distribution, use or sale of such Specified CAR-T Product (but excluding what is commonly known as income taxes);

(f) rebates and chargebacks or retroactive price reductions made to federal, state or local governments (or their agencies), or any Third Party payor, administrator or contractor, including managed health organizations; and

(g) commissions related to import, distribution or promotion of the Specified CAR-T Product paid to Third Parties (specifically excluding any commissions paid to sales personnel, sales representatives and sales agents who are employees or consultants of the selling Party or its Affiliates or any sublicensees).

For the avoidance of doubt, if a single item falls into more than one of the categories set forth in clauses above, such item may not be deducted more than once.

Sales between Intrexon and Precigen and their Affiliates and sublicensees shall be disregarded for purposes of calculating Net Sales except if such purchaser is an end user.

In the case of any pharmaceutical composition, branded or generic, containing a Specified CAR-T Product in combination with any other clinically active ingredient(s) that is not a Specified CAR-T Product, whether packaged together or in the same therapeutic formulation, in any country, Net Sales for such combination product in such country shall be calculated as follows:

If a Specified CAR-T Product under this Agreement and Annex 1 is sold in form of a Combination Product, then Net Sales for such Combination Product shall be determined on a country-by-country basis by mutual agreement of the Parties in good faith taking into account the respective market prices of all components described in the single package insert or equivalent (a "**Combination Product**"). In case of disagreement, an independent expert agreed upon by ARES TRADING and the Intrexon Parties or, failing such agreement, designated by the International Chamber of Commerce, shall determine such relative value contributions and such determination shall be final and binding upon the Parties.

In the event a Specified CAR-T Product is "bundled" for sale together with one or more other products in a country (a "**Product Bundle**"), then Net Sales for such Specified CAR-T Product shall be determined on a country-by-country basis by mutual agreement of ARES TRADING and the Intrexon Parties in good faith taking into account the relative value contributions of the Specified CAR-T Product and the other products in the Product Bundle, as reflected in their individual sales prices. In case of disagreement, an independent expert agreed upon by ARES TRADING and the Intrexon Parties or, failing such agreement, the International Chamber of Commerce shall determine such relative value contributions and such determination shall be final and binding upon the Parties.

For clarification, sale of a Specified CAR-T Products by any Intrexon Party, their Affiliates or sublicensee to another of these entities for resale by such entity to a Third Party shall not be deemed a sale for purposes of this definition of "Net Sales". Further, transfers or dispositions of the Specified CAR-T Products:

(i) in connection with patient assistance programs,

(ii) for charitable or promotional purposes,

(iii) for preclinical, clinical, regulatory or governmental purposes or under so-called "named patient" or other limited access programs, or

(iv) for use in any tests or any other pre- and post-approval studies reasonably necessary to comply with any Law, regulation or request by a Regulatory Authority shall not, in each case, be deemed sales of such Specified CAR-T Products for purposes of this definition of "Net Sales." For clarification, any post-approval study materials shown as Net Sales by any Intrexon Party or their Affiliates in their external reporting shall be deemed as Net Sales.

[*****].

"**Specified CAR-T Products"** or **"Specified CAR-T Product"** means any pharmaceutical product containing a CAR-T Product developed by or on behalf of any Intrexon Party or any of their Affiliates that is directed to a Target.

"**Sublicensee**" means a Third Party to which any Intrexon Party or any of their Affiliates grants a license, covenant not to sue, or similar right under any patent or other intellectual property rights (including know-how) owned or otherwise controlled by any Intrexon Party or any of their Affiliates with respect to any Specified CAR-T Product.

"**Sublicensing Royalty**" means a royalty of ten per cent (10%) of (a) any and all payments (or the fair market value of any non-cash consideration) actually received by any Intrexon Party or any of their Affiliates from a Sublicensee in consideration for the sublicensing of any patent or other intellectual property rights owned or otherwise controlled by any Intrexon Party or any of their Affiliates relating to a Specified CAR-T Product, including but not limited to up-front payments, issuance payments, maintenance fees, and milestone payments; and (b)

any royalty or similar payments paid to any Intrexon Party or any of their Affiliates based on sale proceeds generated by Sublicensees of any Specified CAR-T Product.

"Target" means either the target, **[*****]** or **[*****]**.

"**T-Cell**" means autologous patient derived T-Cells and patient-non-specific T-Cells.

"Third Party Royalties" means all acquisition costs, including, without limitation, up-front payments, milestone payments and royalties, owing to any Third Party to the extent that such costs are reasonably necessary in order for the Intrexon Parties or their Affiliates to sell, transfer or otherwise dispose of any Specified CAR-T Product.

"**Valid Claim**" means: (a) a claim of an issued and unexpired patent (as may be extended through supplementary protection certificate or patent term extension or the like) that has not been revoked, held invalid or unenforceable by a patent office, court or other governmental agency of competent jurisdiction in a final and non-appealable judgment (or judgment from which no appeal was taken within the allowable time period) and which claim has not been disclaimed, denied or admitted to be invalid or unenforceable through reissue, re-examination or disclaimer or otherwise; or (b) a pending claim of an unissued patent application, which application has not been pending for more than **[*****]** since its earliest claimed priority date, provided that such **[*****]** period shall be tolled for the duration of any proceeding (e.g. an opposition or interference proceeding) with respect to such patent application.

Article II

ROYALTY TERMS

2.1 Royalty Payments for Products.

(a) **Royalty Rates.** Subject to the other terms of this Section 2.1, and pursuant to Section 3.3 of the Agreement, during the Royalty Term, Intrexon shall pay ARES TRADING the Earned Royalty and the Sublicensing Royalty on each Specified CAR-T Product on a country-by-country basis. Such payments shall be made quarterly, shall be payable within forty-five (45) days after the quarter in which the related amounts were received by Intrexon or its Affiliates, and shall be non-refundable and non-creditable.

(b) **Royalty Stacking.** The Intrexon Parties and their Affiliates shall be entitled to a credit against the Earned Royalty due under the Agreement and this Annex 1 with respect to any Specified CAR-T Product for **[*****]** of all Third Party Royalties paid by the Intrexon Parties or their Affiliates with respect to such Specified CAR-T Product; provided, however, that (i) the application of any such credit shall not reduce the Earned Royalty payable by the Intrexon Parties or their Affiliates under this Annex with respect to any given quarter by more than **[*****]** of what would otherwise be payable without giving effect to this Section 2.1 (b) and (ii) if the Intrexon Parties or their Affiliates are unable to deduct any such credit related to

Third Party Royalties in any given quarter (a **"Credit Shortfall Quarter"**) because of the limitation set forth in subsection (i) above, the Intrexon Parties or their Affiliates may deduct such credit from any Earned Royalty payment owed by them for any subsequent quarter concluding in the same calendar year as the Credit Shortfall Quarter, provided that the application of any such credit shall not reduce the Earned Royalty payable by the Intrexon Parties or their Affiliates under this Annex with respect to any such subsequent quarter by more than **[*****]**.

(c) **Reductions from Sublicensing Royalty.** The Intrexon Parties and their Affiliates shall be entitled to deduct from the Sublicensing Royalty due under this Agreement such amounts which ARES TRADING and the Intrexon Parties agree, acting reasonably and in good faith, were received from a Sublicensee (i) reasonably on account of the granting of a license, sublicense, covenant not to sue or similar right to intellectual property rights not owned or controlled by the Intrexon Parties or their Affiliates, or (ii) that are reasonably (both with regard to the purpose and amount of the expenditure) to be used to conduct research or development activities for Specified CAR-T Products pursuant to an agreement or arrangement with a Sublicensee.

(d) **Royalty Term**. For each Specified CAR-T Product, on a country-by-country basis, the Intrexon Parties' royalty payment obligations under this Section 2.1(c) shall commence upon the First Commercial Sale of such Specified CAR-T Product in such country and expire upon the latest of: (i) the expiration of the last-to-expire Valid Claim included in any issued patent or pending patent application owned or controlled by any Intrexon Party or any of their Affiliates in such country claiming and covering any Specified CAR-T Product; and (ii) the **[*****]** anniversary of the First Commercial Sale of any such Specified CAR-T Product in such country ("**Royalty Term**"). For clarity, if no such Valid Claim exists as of the **[*****]** anniversary of such First Commercial Sale, but later comes into being, the Royalty Term shall be reinstated for the term of such Valid Claim.

(e) **Royalty Reports and Payment.** Within forty-five (45) days after each calendar quarter, commencing with the calendar quarter during which the First Commercial Sale of a Product is made, Intrexon shall provide ARES TRADING with a report that contains the following information for the applicable calendar quarter, on a Product-by-Product and country-by-country basis: (i) the amount of Net Sales of the Products, (ii) a calculation of the royalty payment due on such sales, and (iii) the exchange rate for such country. Concurrent with the delivery of the applicable quarterly report, Intrexon shall pay in USD all royalties due to ARES TRADING with respect to Net Sales by Intrexon, its Affiliates and their respective sublicensees for such calendar quarter.

2.2 Currency; Exchange Rate. All payments to be made by Intrexon to ARES TRADING under the Agreement and this Annex 1 shall be made in USD by bank wire transfer in

immediately available funds to a bank account designated by written notice from ARES TRADING. With respect to sales not denominated in USD, Intrexon shall convert each applicable quarterly sales in foreign currency into USD by using the then current and reasonable standard exchange rate methodology applied to its external reporting. Based on the resulting sales in USD, the then applicable royalties shall be calculated.

2.3 Late Payments. All payments under this Annex 1 shall earn interest from the date due until paid at a per annum rate equal to the lesser of (a) the maximum rate permissible under applicable Law and (b) one (1) percent (1%) above the monthly Reuters 01 EURIBOR, measured at 2 p.m. Frankfurt/Germany time on the date payment is due. Interest will be calculated on a 365/360 basis.

2.4 Taxes.

(a) **Taxes on Income.** Except as provided in Section 2.4 (c) below, each Party shall be solely responsible for the payment of all taxes imposed on it under applicable law whether arising directly or indirectly from the activities of the Parties under this Annex 1.

(b) **Tax Cooperation.** The Parties agree to cooperate with one another and use reasonable efforts to reduce or eliminate tax withholding or similar obligations in respect of royalties paid by Intrexon to ARES TRADING under this Annex 1. To the extent Intrexon is required under applicable law to deduct and withhold taxes on any payment to ARES TRADING, Intrexon shall first give ARES TRADING written notice of its intent to withhold so that ARES TRADING may provide Intrexon any tax forms that may be reasonably necessary in order for Intrexon not to withhold tax or to withhold tax at a reduced rate under any applicable double tax treaty. If Intrexon is still required under applicable law to withhold, it pay the amounts of such taxes to the proper Governmental Authority in a timely manner and promptly transmit to ARES TRADING an official tax certificate or other evidence of such withholding sufficient to enable ARES TRADING to claim credit for such payment of taxes. Each Party shall provide the other with reasonable assistance to avoid (or reduce) or to enable the recovery, as permitted by applicable Laws, of withholding taxes, value added taxes, or similar obligations resulting from payments made under this Annex 1, such recovery to be for the benefit of the Party bearing such withholding tax or value added tax. If reasonably necessary, Intrexon shall require its sublicensees in the Territory to cooperate with ARES TRADING in a manner consistent with this Section 2.4(b).

(c) **Taxes Resulting from Intrexon Action or ARES TRADING Action.** If either Intrexon or ARES TRADING is required to make a payment to the other Party that is subject to a deduction or withholding of tax, then (i) if such withholding or deduction obligation arises as a result of any action by Intrexon or ARES TRADING, including any assignment or sublicense other than to Merck KGaA, or any failure on the part of Intrexon or ARES TRADING to comply with applicable Laws or filing

or record retention requirements, that has the effect of modifying the tax treatment of the Parties hereto (a "**Intrexon or ARES TRADING Withholding Tax Action**"), then the sum payable by Intrexon or ARES TRADING (in respect of which such deduction or withholding is required to be made) shall be increased to the extent necessary to ensure that Intrexon or ARES TRADING receives or pays a sum equal to the sum which it would have received or paid had no such Intrexon or ARES TRADING Withholding Tax Action occurred provided however, that the receiver of the payment has cooperated in a reasonable manner required to limit any additional burden for the payer and in accordance with Section 2.4(b); (ii) otherwise, the sum payable by Intrexon or ARES TRADING (in respect of which such deduction or withholding is required to be made) shall be made directly to Intrexon or ARES TRADING after deduction of the amount required to be so deducted or withheld, which deducted or withheld amount shall be remitted to the proper Governmental Authority in accordance with applicable Laws.

(d) **Certification.** A Party receiving a payment pursuant to this Annex 1 shall provide the remitting Party appropriate certification from relevant Governmental Authorities that such Party is a tax resident of that jurisdiction, if such receiving Party wishes to claim the benefits of an income tax treaty to which that jurisdiction is a party.

2.5 Records and Audit Rights. During the Royalty Term and for three (3) Calendar Years thereafter, upon the written request of ARES TRADING, and not more than once in each Calendar Year, Intrexon shall permit, and shall cause its Affiliates or Sublicensee to permit, an independent certified public accounting firm of nationally recognized standing selected by ARES TRADING, and reasonably acceptable to Intrexon or such Affiliate or Sublicensee, to have access to and to review, during normal business hours upon reasonable prior written notice, the applicable records of Intrexon and its Affiliates or Sublicensee to verify the accuracy of the royalty payments under this Annex 1; provided, that ARES TRADING may not have access to or review any records of Intrexon relating to any Calendar Year more than three (3) Calendar Years following the completion of such Calendar Year. Any such auditor shall not disclose Intrexon's Confidential Information to ARES TRADING, except to the extent such disclosure is necessary to verify the accuracy of the financial reports furnished by Intrexon or the amount of payments by Intrexon under this Annex 1. Any amounts shown to be owed but unpaid, or overpaid and in need of reimbursement, shall be paid or refunded (as the case may be) within thirty (30) days after the accountant's report, plus interest (as set forth in Section 2.3 and solely with respect to underpayments) from the original due date (unless challenged in good faith by Intrexon in which case any dispute with respect thereto shall be resolved in accordance with Section 11.5 of the Agreement). ARES TRADING shall bear the full cost of such audit unless such audit reveals an underpayment by Intrexon that resulted from a discrepancy in the financial report provided by Intrexon for the audited period, which underpayment was more than five percent (5%) of the amount set forth in such report, in which case Intrexon shall reimburse ARES TRADING for the costs for such audit.

2.6 Assignment and Notice of Sublicense. The Intrexon Parties may not assign or otherwise transfer (including in connection with the sale of all or substantially all of the assets to which this Annex 1 relates or in connection with any merger or consolidation to which any Intrexon Party is a party) any rights or obligations with respect to any Specified CAR-T Product, nor may any such right or obligation hereunder be assigned or transferred, without the prior written consent of ARES TRADING if such assignment or transfer would materially prejudice the rights of ARES TRADING under this Annex 1. Any assignee or transferee of a Specified CAR-T Product or other rights or obligations under this Annex 1 shall assume all obligations of its assignor or transferor under the Agreement and this Annex 1 (in addition to such assignor or transferor remaining liable vis a vis ARES TRADING in the event the assignee or transferee fails to perform such assumed obligations), including, without limitation, the obligations to pay the Specified CAR-T royalties pursuant to Section 3.3 of the Agreement and this Annex 1 thereto. The terms and conditions of this Agreement and this Annex 1 thereto shall be binding upon, and shall inure to the benefit of, the Parties and their respected successors and permitted assigns. Any references to the Intrexon Parties herein shall be deemed to include any successor or assign of an Intrexon Party. The Intrexon Parties shall provide ARES TRADING with prompt Notice of any sublicense relating to or concerning any Specified CAR-T Product that is reasonably likely to result in the payment of a Sublicensing Royalty and of any assignment or transfer of any rights or obligations hereunder. Such Notice shall identify all parties to such sublicense, or assignment or transfer agreement, shall include a copy of the relevant agreements and shall set forth any terms of the relevant agreements not set forth in such agreements; provided, that such Notice may redact from such agreements any information not applicable to the rights of ARES TRADING under the Agreement or this Annex 1.

Schedule X

[*****]

Annex I-9

Schedule Y

[*****]

Annex I-10

Schedule 6.2.5

1. Form 10-Q/A filed with the SEC on August 13, 2018.

Confidential

Exhibit 10.23

THE SECURITY REPRESENTED HEREBY HAS NOT BEEN REGISTERED UNDER THE SECURITIES ACT OF 1933, AS AMENDED, OR APPLICABLE STATE SECURITIES LAWS. THE SECURITY HAS BEEN ACQUIRED FOR INVESTMENT AND MAY NOT BE OFFERED FOR SALE, SOLD, TRANSFERRED OR ASSIGNED IN THE ABSENCE OF AN EFFECTIVE REGISTRATION STATEMENT UNDER THE SECURITIES ACT OF 1933, AS AMENDED, OR APPLICABLE STATE SECURITIES LAWS, OR UNLESS AN EXEMPTION FROM SUCH REGISTRATION IS AVAILABLE AND REGISTRATION IS THEREFORE NOT REQUIRED UNDER SAID ACT OR APPLICABLE STATE SECURITIES LAWS.

INTREXON CORPORATION AND PRECIGEN, INC.

CONVERTIBLE NOTE

DECEMBER 28, 2018 **$25,000,000**

FOR VALUE RECEIVED, INTREXON CORPORATION, a Virginia corporation (the **"Company"**), and **PRECIGEN, INC.**, a Delaware corporation ("**Precigen**"), jointly and severally hereby promise to pay to the order of **ARES TRADING S.A.**, a corporation organized under the laws of Switzerland, or its assigns (**"ARES"** and, with the Company and Precigen, the **"Parties"**) the aggregate principal amount of Twenty-Five Million Dollars ($25,000,000), on June 28, 2021 (the **"Maturity Date"**), or upon acceleration or by conversion in accordance with the terms hereof.

1. Certain Defined Terms. Capitalized terms used in this Note shall have the meanings given them in the Agreement. In addition, the following terms shall have the following meanings:

(a) **"Bankruptcy Law"** has the meaning set forth in Section 4(a).

(b) **"Antitrust Clearance"** has the meaning set forth in Section 3(a).

(c) **"Antitrust Law"** has the meaning set forth in Section 3(a).

(d) **"ARES"** has the meaning set forth in the Preamble.

(e) **"Borrowers"** means the Company and Precigen, each of which is a "**Borrower.**"

(f) **"Borrower Confirmation of Conversion Notice"** has the meaning set forth in Section 3(g)(ii).

(g) **"CFIUS"** means the Committee on Foreign Investment in the United States.

(h) **"CFIUS Clearance"** means that any review or investigation (if any) by CFIUS of any Note Conversion shall have been concluded and: (i) the Parties shall have received written notice from CFIUS that CFIUS has concluded that the Note Conversion is not a "covered transaction" under Section 721 of the DPA; (ii) the Parties shall have received written notice from CFIUS that CFIUS shall have determined that there are no unresolved national security concerns with respect to such

Note Conversion and that all action under Section 721 of the DPA with respect to such Note Conversion, and any investigation related thereto, has been concluded; or (iii) CFIUS shall have referred the Note Conversion to the President of the United States (the "**President**") for action or sent a report to the President requesting a decision on the CFIUS declaration or notice submitted by the Parties and the President shall have announced a decision not to exercise his authority under Section 721(d) of the DPA with respect to such Note Conversion.

(i) **"Common Stock Conversion Amount"** has the meaning set forth in Section 3(a).

(j) **"Company"** has the meaning set forth in the Preamble.

(k) **"Company Common Stock"** has the meaning set forth in Section 3(a).

(l) **"Conversion Amount"** means the portion of the principal amount of this Note submitted for conversion into Equity Securities of the Company or Precigen pursuant to the applicable Conversion Notice.

(m) **"Conversion Date"** means the actual date that ARES submits a Conversion Notice to the Company or Precigen to convert any outstanding principal amount of this Note into shares of Equity Securities of the Company or Precigen so long as ARES shall provide (or otherwise deliver) to the Company or Precigen (as applicable) such Conversion Notice on such date in a manner constituting Notice.

(n) **"Conversion Notice"** means a fully executed notice of conversion in the form attached hereto as Exhibit I.

(o) **"Conversion Price"** means, as of any applicable Conversion Date, Mandatory Conversion Time, or other date of determination, the volume weighted-average price of Company Common Stock on the Nasdaq Stock Market for the **[*****]** Trading Days immediately prior to the Conversion Date, Mandatory Conversion Time, or other relevant date of determination as reported by Bloomberg, L.P. in respect of the period from the scheduled open of trading until the scheduled close of trading of the primary trading sessions on each such Trading Day.

(p) **"Custodian"** has the meaning set forth in Section 4(a).

(q) **"DPA"** means the Defense Production Act of 1950, as amended.

(r) **"DTC"** has the meaning set forth in Section 3(g)(ii).

(s) **"Event of Default"** has the meaning set forth in Section 4(a).

(t) **"Excluded Registration"** means (i) a registration relating to the sale or grant of securities to employees of Precigen or a subsidiary pursuant to a stock option, stock purchase, equity incentive or similar plan; (ii) a registration relating to an SEC Rule 145 transaction; or (iii) a registration in which the only Precigen Equity Securities being registered are Precigen Equity Securities issuable upon conversion of debt securities (other than this Note) that are being registered.

(u) **"Form S-1"** means such form under the Securities Act as in effect on the date hereof or any successor registration form under the Securities Act subsequently adopted by the SEC.

(v) **"IPO"** has the meaning set forth in Section 5(b).

(w) **"IPO Conversion Notice Date"** means the date which is no more than thirty (30) days after receipt of the Precigen IPO Notice.

(x) **"IPO Conversion Price"** means (A) the per share offering price to the public of the Equity Securities offered in a Qualified IPO **[*****]**.

(y) **"Issuance Date"** means the date hereof.

(z) **"Mandatory Conversion Amount"** has the meaning set forth in Section 3(e).

(aa) **"Mandatory Conversion Notice"** has the meaning set forth in Section 3(g)(iii).

(bb) **"Mandatory Conversion Time"** has the meaning set forth in Section 3(e).

(cc) **"Material Adverse Effect"** means any event, occurrence, fact, condition or change that is materially adverse to (i) the business, results of operations, financial condition or assets of all or a substantial part of the business of Borrowers, taken as a whole, or (ii) the ability of Borrowers to consummate the transactions (including the conversion of this Note to Equity Securities of the Company or Precigen) contemplated hereby. Solely with regard to subsection (i) above, any adverse change, event, development, or effect arising from or relating to any of the following shall not be deemed to constitute, and none of the following shall be taken into account in determining whether there has been or may be, a Material Adverse Effect: (A) general business, industry or economic conditions affecting the marketplace generally, including such conditions which relate to the business of Borrowers, (B) national or international political or social conditions, including the engagement by the United States in hostilities, whether or not pursuant to the declaration of a national emergency or war, or the occurrence of any military or terrorist attack upon the United States or any of its territories, possessions, or diplomatic or consular offices or upon any military installation, equipment or personnel, or the escalation of any of the foregoing, or any act of God or national or international calamity, (C) changes in United States generally accepted accounting principles, (D) changes in laws, statutes, rules, ordinances and regulations promulgated by any court or governmental body, any subdivision, agency, commission or authority thereof, or any quasi-governmental or private body exercising any regulatory or taxing authority thereunder in any applicable jurisdiction, (E) any flood, earthquake, hurricane or other natural disaster, weather-related conditions, explosions or fires, or any force majeure events in any country or region in which either of the Borrowers have material operations, (F) any change, effect, occurrence, state of facts or development to the extent attributable to the announcement or disclosure of the transactions set forth in this Note or the compliance with the terms and conditions of this Note, (G) any change, effect, event, occurrence, state of facts or development resulting from the taking of any action required by, or the failure to take any action prohibited by, this Note, or (H) any failure to meet projections or forecasts (provided that the underlying cause of such failures, subject to the other provisions of this definition, shall not be excluded); *provided*, *however*, that, to the extent that an effect or change listed in (A) through (E) affects either Borrower's business in a disproportionately adverse manner relative to other businesses in the industries and markets in which such Borrower operates, such changes and events shall be taken into account in determining whether a Material Adverse Effect has occurred.

(dd) **"Maturity Date"** has the meaning set forth in the Preamble.

(ee) "**Nasdaq Stock Market**" means the National Association of Securities Dealers Automated Quotations National Market or any successor national securities exchange or over-the-counter trading market in the United States.

(ff) **"Note Conversion"** has the meaning set forth in Section 5(c).

(gg) **"Note Indemnified Party"** and **"Note Indemnified Parties"** has the meaning set forth in Section 16.

(hh) **"Notice"** means notice served, given or delivered in accordance with Section 16 hereof.

(ii) **"Obligors"** has the meaning set forth in Section 12.

(jj) **"Outside Conversion Date"** means the first Trading Day following the second anniversary of the Issuance Date, as such date may be extended pursuant to the terms of this Note.

(kk) **"Parties"** has the meaning set forth in the Preamble.

(ll) **"Pilot Program Covered Transaction"** has the meaning set forth in Section 4(a)(viii).

(mm) **"PIK Amount"** has the meaning set forth in Section 2(c).

(nn) **"PIK Interest"** has the meaning set forth in Section 2(c).

(oo) **"Precigen Financing"** shall mean a transaction or series of transactions pursuant to which Precigen issues and sells shares of its Equity Securities with the principal purpose of raising capital for the benefit of Precigen, with a portion of the gross proceeds provided by a Person or Persons who is not an Affiliate of the Company or Precigen.

(pp) **"Precigen Financing Conversion Amount"** has the meaning set forth in Section 3(c).

(qq) "**Precigen Financing Conversion Price**" shall mean a price equal to **[*****]**.

(rr) "**Precigen Financing Stock**" shall mean the type and series of Equity Securities of Precigen issued and sold by Precigen in a Precigen Financing.

(ss) **"Precigen IPO Effectiveness Notice"** has the meaning set forth in Section 5(b).

(tt) **"Precigen IPO Notice"** has the meaning set forth in Section 5(b).

(uu) **"Precigen IPO Registration Statement"** has the meaning set forth in Section 5(b).

(vv) "**Qualified Company Financing**" shall mean the sale of shares of Company Equity Securities to the public in an underwritten public offering, with the principal purpose of raising capital for the benefit of the Company, pursuant to an effective registration statement under the Securities Act resulting in gross proceeds of at least **[*****]**, net of underwriting discount and commissions, to the Company and in connection with such offering, Company Equity Securities are listed on the Nasdaq Stock Market, New York Stock Exchange or another exchange or marketplace approved by ARES.

(ww) **"Qualified Company Financing Conversion Amount"** has the meaning set forth in Section 3(b).

(xx) "**Qualified Company Financing Conversion Price**" shall mean **[*****]**.

(yy) "**Qualified Company Financing Stock**" shall mean the Company Common Stock issued and sold by the Company in a Qualified Company Financing.

(zz) "**Qualified IPO**" shall mean the sale of shares of Precigen Equity Securities to the public in a firm-commitment underwritten public offering pursuant to an effective registration statement under the Securities Act resulting in at least **[*****]** of gross proceeds, net of underwriting discount and commissions, to Precigen and in connection with such offering, Precigen Equity Securities are listed on the Nasdaq Stock Market, New York Stock Exchange or another exchange or marketplace approved by ARES.

(aaa) "**Qualified Precigen Financing**" shall mean a Precigen Financing pursuant to which Precigen issues and sells shares of its Equity Securities for aggregate gross proceeds of at least **[*****]**, including all proceeds from the incurrence of indebtedness that is converted into such Equity Securities, or otherwise cancelled in consideration for the issuance of such Equity Securities.

(bbb) **"Qualified Precigen IPO Conversion Amount"** has the meaning set forth in Section 3(d).

(ccc) "**Qualified Precigen IPO Stock**" shall mean the type and series of Equity Securities of Precigen listed in a Qualified IPO on the Nasdaq Stock Market, New York Stock Exchange or another exchange or marketplace approved by ARES.

(ddd) "**Rule**" has the meaning set forth in Section 5(c).

(eee) **"SEC Rule 145"** means Rule 145 promulgated by the SEC under the Securities Act.

(fff) "**Securities Purchase Agreement**" has the meaning set forth in Section 2(a).

(ggg) "**Trading Day**" has the meaning set forth in Section 2(a).

(hhh) **"Transfer Agent"** has the meaning set forth in Section 3(g)(ii).

2. Payments of Principal and Interest.

(a) All payments of principal on this Note shall be made in lawful money of the United States of America by wire transfer of immediately available funds to such account as ARES may from time to time designate by Notice. Whenever any amount expressed to be due by the terms of this Note is due on any day which is not a Trading Day, the same shall instead be due on the next succeeding day which is a Trading Day. For purposes of this Note, **"Trading Day"** shall mean any day on which the Nasdaq Stock Market is open for customary trading. This Note is issued pursuant to that certain Securities Purchase, Assignment and Assumption Agreement, dated December 19, 2018, by and between ARES, the Company and Precigen (as amended, restated, supplemented or otherwise modified from time to time, the **"Securities Purchase Agreement"**).

(b) Payment of Interest. Except as stated in Sections 2(c) and 4(b) hereof, the outstanding principal amount of this Note shall not bear interest.

(c) Precigen PIK Payment. The outstanding principal amount of this Note shall be deemed to accrue interest, for each day from the Issuance Date until its principal amount is paid in full or converted in full into Equity Securities of the Company or Precigen, at a rate per annum equal to five per cent (5%) **("PIK Interest")**. The PIK Interest shall be computed on the basis of a 360-day year and paid for the actual number of days elapsed. The accrued PIK Interest (the **"PIK Amount"**) shall only be payable to the extent and in the manner set forth herein. The PIK Amount shall only be paid when and if some or all of the outstanding principal amount of the Note is converted to Precigen Equity Securities pursuant to Section 3(c) or Section 3(d) hereof. The PIK Amount shall be paid by being included in the Precigen Financing Conversion Amount or Qualified Precigen IPO Conversion Amount, as applicable, to be converted pursuant to Section 3(c) or Section 3(d), as applicable. If ARES converts a portion of the principal of the Note into Precigen Equity Securities, the PIK Amount shall only be paid with respect to such converted amount. (In other words, the PIK Amount shall be the portion of the PIK Interest to have accrued on the principal amount so converted up to the applicable Conversion Date.) The PIK Amount shall not be payable to the extent the principal amount of the Note converts into Company Equity Securities pursuant to Section 3(a) or Section 3(b) hereof.

(d) This Note may not be prepaid or redeemed without the written consent of ARES.

3. Conversion of Note. Under the circumstances and according to the terms and conditions set forth herein and subject to Section 4.8 of the Securities Purchase Agreement, ARES shall have the right, at its sole option, to convert the principal amount of this Note into shares of the Company's Common Stock or Precigen's Equity Securities. Any principal amount of this Note outstanding on the Outside Conversion Date shall automatically convert into shares of Company Common Stock pursuant to Section 3(e) hereof.

(a) Conversion into Company Common Stock. Subject to Section 3(j) hereof, if this Note has not converted in full pursuant to the other provisions hereof, ARES shall have the right, at ARES's sole option, by delivering an irrevocable Conversion Notice pursuant to Section 17 hereof at any time prior to the Outside Conversion Date, to convert some or all of the then outstanding principal amount of this Note (the **"Common Stock Conversion Amount"**) into fully paid and nonassessable shares of the Company's common stock, no par value (the "**Company Common Stock")**; provided that such principal amount to be converted shall be at least the lesser of (i) the then aggregate outstanding principal amount of this Note or (ii) Five Million Dollars ($5,000,000). ARES shall have the registration rights with respect to the Company Common Stock set forth in the Securities Purchase Agreement. The number of shares of Company Common Stock issuable upon conversion of a Common Stock Conversion Amount pursuant to this Section 3(a) shall be determined according to the following formula:

Common Stock Conversion Amount
divided by
Conversion Price

If any Note Conversion would be (i) subject to advance filing requirements under the HSR Act or under any foreign antitrust, merger control, or competition laws (collectively with the HSR Act, the "**Antitrust Laws**"), or the receipt of any clearances, authorizations, approvals, or waiting period expirations or terminations under the Antitrust Laws (collectively, the "**Antitrust**

Clearances"), or (ii) a Pilot Program Covered Transaction, or if CFIUS or the President initiate a unilateral review of any Note Conversion pursuant to Section 721 of the DPA, then the Parties will cooperate, and use all commercially reasonable efforts, to obtain all such Antitrust Clearances and CFIUS Clearances and the applicable conversion will close as promptly as practicable following receipt of all such Antitrust Clearances and CFIUS Clearances.

(b) Conversion into Company Common Stock Issued in a Qualified Company Financing. Subject to Section 3(j) hereof, if this Note has not converted in full pursuant to the other provisions hereof, ARES shall have the right, at ARES' sole option, by delivering an irrevocable Conversion Notice pursuant to Section 17 hereof at any time prior to the consummation of a Qualified Company Financing, to convert some or all of the then outstanding principal amount of this Note (the **"Qualified Company Financing Conversion Amount"**) into fully paid and nonassessable shares of the Qualified Company Financing Stock. ARES shall have the registration rights with respect to the Qualified Company Financing Stock set forth in the Securities Purchase Agreement. The number of shares of Qualified Company Financing Stock issuable upon conversion of the Qualified Company Financing Conversion Amount pursuant to this Section 3(b) shall be determined according to the following formula:

Qualified Company Financing Conversion Amount
divided by
Qualified Company Financing Conversion Price

(c) Conversion into Precigen Equity Securities Issued in a Precigen Financing. Subject to Section 3(j) hereof, if this Note has not converted in full pursuant to the other provisions hereof, ARES shall have the right, at ARES' sole option, by delivering an irrevocable Conversion Notice pursuant to Section 17 hereof at any time prior to the consummation of a Precigen Financing, to convert some or all of the then outstanding principal amount of this Note plus the PIK Amount accrued and outstanding on such principal amount (the **"Precigen Financing Conversion Amount"**) into fully paid and nonassessable shares of the Precigen Financing Stock. ARES shall have the registration rights with respect to a Precigen Financing described in the Securities Purchase Agreement. The number of shares of Precigen Financing Stock issuable upon conversion of the Precigen Financing Conversion Amount pursuant to this Section 3(c) shall be determined according to the following formula:

Precigen Financing Conversion Amount
divided by
Precigen Financing Conversion Price

(d) Conversion into Precigen Equity Securities In Connection With a Qualified Precigen IPO. Subject to Section 3(j) hereof, if this Note has not converted in full pursuant to the other provisions hereof, ARES shall have the right, at ARES's sole option, by delivering an irrevocable Conversion Notice pursuant to Section 17 hereof at any time prior to the IPO Conversion Notice Date, to convert some or all of the then outstanding principal amount of this Note plus the PIK Amount accrued and outstanding on such principal amount (the **"Qualified Precigen IPO Conversion Amount"**) into fully paid and nonassessable shares of the Qualified Precigen IPO Stock. ARES shall have the registration rights with respect to a Qualified Precigen IPO set forth in the Securities Purchase Agreement. The number of shares of Qualified Precigen IPO Stock issuable upon conversion of a

Qualified Precigen IPO Conversion Amount pursuant to this Section 3(d) shall be determined according to the following formula:

Qualified Precigen IPO Conversion Amount
divided by
IPO Conversion Price

(e) Mandatory Conversion. Subject to Section 3(j) hereof, if this Note has not converted in full pursuant to the other provisions hereof, on the Outside Conversion Date (**"Mandatory Conversion Time"**) all outstanding principal under this Note shall automatically be converted (the **"Mandatory Conversion Amount"**) into fully paid and nonassessable shares of the Company Common Stock. ARES shall have the registration rights with respect to a Mandatory Conversion set forth in the Securities Purchase Agreement. The number of shares of Company Common Stock issuable upon conversion of a Mandatory Conversion Amount pursuant to this Section 3(e) shall be determined according to the following formula:

Mandatory Conversion Amount
Divided by
Conversion Price

(f) Fractional Shares. No fractional shares of Company or Precigen Equity Securities shall be issued upon conversion of this Note. In lieu of any fractional shares to which ARES would otherwise be entitled, the Company shall pay cash equal to such fraction multiplied by the Conversion Price, Qualified Company Financing Conversion Price, Precigen Financing Conversion Price or Qualified Precigen IPO Conversion Price, as applicable. Whether or not fractional shares would be issuable upon such conversion shall be determined on the basis of the total principal amount ARES is at the time converting into Company or Precigen Equity Securities and the aggregate number of shares of Company or Precigen Equity Securities issuable upon such conversion.

(g) **Mechanics of Conversion.** The conversion of this Note shall be conducted in the following manner:

(i) ARES's Delivery Requirements In Optional Conversion. To convert this Note into shares of Equity Securities of the Company or Precigen on any date pursuant to Section 3(a), Section 3(b), Section 3(c) or Section 3(d) hereof, ARES shall (A) deliver in the manner set forth in Section 17 hereof on such date, a copy of a fully executed Conversion Notice to the Company or Precigen (as applicable) and (B) subject to Section 3(g)(vi) hereof, surrender to a common carrier for delivery to the Company or Precigen (as applicable) as soon as practicable following such date the original Note being converted in whole or in part (or an indemnification undertaking with respect to such Note that is reasonably acceptable to the Borrowers in the case of its loss, theft or destruction).

(ii) Borrowers' Response to Conversion Notice in Optional Conversion. Upon receipt by the Company or Precigen of a copy of a Conversion Notice, the Company or Precigen (as applicable) shall as soon as practicable, but in no event later than two (2) Trading Days after receipt of such Conversion Notice, provide Notice confirming receipt of such Conversion Notice by countersigning the Conversion Notice in the area provided thereon (a "**Borrower Confirmation of Conversion Notice**") to ARES and the Company's or Precigen's designated

transfer agent, as and if applicable (**"Transfer Agent"**), which confirmation shall constitute an irrevocable instruction to the Transfer Agent to process such Conversion Notice in accordance with the terms herein.

a. If converting pursuant to Sections 3(a) or 3(b), upon receipt by the Transfer Agent of a copy of the executed Conversion Notice and a copy of the applicable Borrower Confirmation of Conversion Notice, the Transfer Agent shall, provided the Transfer Agent is participating in The Depository Trust Company ("**DTC**") Fast Automated Securities Transfer Program, upon the request of ARES, credit such aggregate number of shares of Equity Securities to which ARES shall be entitled, subject to Section 4.8 of the Securities Purchase Agreement, to ARES's or its designee's balance account with DTC through its Deposit Withdrawal Agent Commission system; provided, however, in the case of a conversion pursuant to Section 3(b), no Equity Securities shall be issued in advance of the closing of the Qualified Company Financing, and provided further that if the closing of the Qualified Company Financing does not occur within **[*****]** of the Borrower's receipt of the Conversion Notice, such Conversion Notice shall be deemed *void ab initio* and of no effect, ARES's conversion rights with respect to such Qualified Company Financing shall be deemed not to have been exercised and a Qualified Company Financing shall be deemed not to have occurred and Borrower shall be obligated to comply with its obligations under Section 5(a) below and to afford ARES with its full opportunity to exercise its rights pursuant to Section 3(b) above before Borrower may conduct a Qualified Company Financing.

b. If converting pursuant to Section 3(c), if Precigen has received the executed Conversion Notice prior to the closing of the Precigen Financing, Precigen shall cause the aggregate number of shares of Equity Securities to which ARES shall be entitled to be recorded in the appropriate stock ledger of the Company, subject to ARES' execution of all documents reasonably requested to be executed in connection with, and executed by other purchasers in, such Precigen Financing. If the closing of the Precigen Financing does not occur within **[*****]** of the Borrower's receipt of such Conversion Notice, such Conversion Notice shall be deemed *void ab initio* and of no effect, and ARES' conversion rights with respect to such Precigen Financing shall be deemed not to have been exercised, and a Qualified Precigen Financing pursuant to Section 3(j) shall not be deemed to have occurred.

c. If converting pursuant to Section 3(d), upon the later to occur of: (a) the Transfer Agent's receipt of a copy of the executed Conversion Notice and a copy of the applicable Borrower Confirmation of Conversion Notice and (b) the closing of the Qualified Precigen IPO, the Transfer Agent shall, provided the Transfer Agent is participating in the DTC Fast Automated Securities Transfer Program, upon the

request of ARES, credit such aggregate number of shares of Equity Securities to which ARES shall be entitled, subject to Section 4.8 of the Securities Purchase Agreement, to ARES's or its designee's balance account with DTC through its Deposit Withdrawal Agent Commission system.

d. If less than the full then-outstanding principal amount of this Note is submitted for conversion and (notwithstanding Section 3(g)(vi)) Borrowers have actually received the original Note pursuant to Section 3(g)(i), then the Borrowers shall, as soon as practicable and in no event later than five (5) Trading Days after receipt of the Note and at Borrowers' own expense, issue and deliver to ARES a new Note for the outstanding principal amount not converted.

e. In the event any shares of Equity Securities to which ARES is entitled upon conversion are not eligible to be credited to ARES's or its designee's balance account with DTC through its Deposit Withdrawal Agent Commission system as set forth in this Section 3(g), such Equity Securities shall be issued and promptly delivered to ARES in certificated form.

(iii) Procedural Requirements in Mandatory Conversion. On or no more than three (3) Trading Days prior to the Outside Conversion Date, the Company shall provide ARES and the Transfer Agent with Notice of the Mandatory Conversion Time (the **"Mandatory Conversion Notice"**), which Mandatory Conversion Notice shall constitute an irrevocable instruction to the Transfer Agent to process the Mandatory Conversion Notice in accordance with the terms herein. Upon receipt by the Transfer Agent of a copy of the executed Mandatory Conversion Notice, the Transfer Agent shall, provided the Transfer Agent is participating in The DTC Fast Automated Securities Transfer Program, upon the request of ARES, credit such aggregate number of shares of Equity Securities to which ARES shall be entitled, subject to Section 4.8 of the Securities Purchase Agreement, to ARES's or its designee's balance account with DTC through its Deposit Withdrawal Agent Commission system. Upon receipt of the Mandatory Conversion Notice, ARES shall surrender the Note (or provide an indemnification undertaking with respect to such Note that is reasonably acceptable to the Borrowers in the case of its loss, theft or destruction) to the Company at the place designated in such Notice. The Company shall pay cash as provided in Section 3(f) in lieu of any fraction of a share of Company Common Stock otherwise issuable upon such conversion.

(iv) Dispute Resolution. In the case of a dispute as to the determination or the arithmetic calculation of the Conversion Price, the Qualified Company Financing Conversion Price, the Precigen Financing Conversion Price or the Qualified Precigen IPO Conversion Price, the relevant Borrower shall instruct the Transfer Agent to issue to ARES the number of shares of Equity Securities that is not disputed and shall give ARES Notice of the disputed determinations or arithmetic calculations within three (3) Trading Days of receipt of ARES' Conversion Notice or of the Mandatory Conversion Time (as applicable). If ARES and the relevant Borrower are unable to agree upon the determination or arithmetic calculation of the relevant Conversion Price, Qualified Company Financing Conversion Price, Precigen

Financing Conversion Price or Qualified Precigen IPO Conversion Price within one (1) Trading Day of such disputed determination or arithmetic calculation being submitted to ARES, then the relevant Borrower shall within one (1) Trading Day submit the disputed determination or arithmetic calculation of the Conversion Price, the Qualified Company Financing Conversion Price, the Precigen Financing Conversion Price or the Qualified Precigen IPO Conversion Price, as applicable, to identify an independent investment bank of international standing. The relevant Borrower and ARES shall cause the investment bank to perform the determinations or calculations and notify the Borrower and ARES of the results no later than the fifth (5^{th}) day after the date it receives the disputed determinations or calculations. Such investment bank's determination or calculation, as the case may be, shall be binding upon all parties absent manifest error.

(v) Record Holder. The person or persons entitled to receive the shares of Equity Securities issuable upon a conversion of this Note shall be treated for all purposes as the record holder or holders of such shares of Equity Securities on the Conversion Date.

(vi) Book-Entry. Notwithstanding anything to the contrary set forth herein, upon conversion of any portion of this Note in accordance with the terms hereof, ARES shall not be required to physically surrender this Note to the relevant Borrower unless the full outstanding principal amount represented by this Note is being converted. ARES and the relevant Borrower shall each maintain records showing the aggregate principal amount outstanding and aggregate principal amount converted and the dates and applicable Company Common Stock Conversion Amount, Qualified Company Financing Conversion Amount, Precigen Financing Conversion Amount or Qualified Precigen IPO Conversion Amount for each conversion or shall use such other method, reasonably satisfactory to ARES and the Borrowers, so as not to require physical surrender of this Note upon each conversion. ARES and any assignee, by acceptance of this Note, acknowledge and agree that, by reason of the provisions of this paragraph, following conversion of any portion of this Note, the outstanding principal amount represented by this Note may be less than the principal amount set forth on the face hereof.

(h) Reserved.

(i) Withholding. The Company shall not deduct and withhold from amounts payable to ARES pursuant to the Note unless applicable U.S. tax law requires it to so deduct and withhold. If the Company is so required to deduct and withhold under applicable law, it shall first give ARES written notice as soon as possible and in any case before any such deduction or withholding and shall cooperate with ARES to mitigate any such requirement to the extent permitted by applicable law if, in the reasonable judgment of the Company, such action will not subject the Company to any unreimbursed cost or expense and will not otherwise be disadvantageous to the Company. To the extent any amounts are so deducted and withheld in accordance with the previous sentence, and duly and timely deposited with the appropriate governmental authority by the Company, such amounts shall be treated for purposes of the Note as having been paid to ARES in respect of which such deduction and withholding was made. Prior to, and in connection with, each conversion by, or payment made to, ARES under this Note, ARES will provide a Form W-8 and make any certifications under applicable tax treaties to eliminate any required tax withholding, to the extent such certifications are accurate.

(j) Termination of Conversion Rights. ARES' right to initiate conversion of the principal amount of this Note to shares of the Company's or Precigen's Equity Securities shall terminate upon the consummation of the mandatory conversion of this Note pursuant to Section 3(e) hereof. In addition, ARES' right to initiate conversion of some or all of the principal amount of this Note into shares of Precigen's Equity Securities shall expire upon the consummation of the first Qualified Precigen Financing to occur after the Issuance Date if (i) the Borrowers have materially complied with and performed all of their obligations hereunder, including, without limitation, under Section 5(a) hereof, and under the Securities Purchase Agreement relating to such Qualified Precigen Financing; and (ii) ARES has not initiated conversion of at least **[*****]** of the then current outstanding principal amount of this Note into shares of Precigen Equity Securities pursuant to Section 3(c) in connection with such Qualified Precigen Financing. For the avoidance of doubt, the termination pursuant to the prior sentence of ARES' right to convert some or all of the principal amount of this Note into shares of Precigen Equity Securities shall not terminate ARES' right to convert some or all of the principal amount of this Note into shares of Equity Securities of the Company pursuant to the terms hereof.

4. Defaults and Remedies.

(a) Events of Default. An "**Event of Default**" shall be deemed to have occurred at such time as any of the following events:

(i) After, and only after, the expiration of the Lock-Up Period (as defined in the Securities Purchase Agreement) and while any registration statement under the Securities Act is required to be maintained effective pursuant to the terms of the Securities Purchase Agreement defining the registration rights of ARES, the effectiveness of such registration statement lapses for any reason (including, without limitation, the issuance of a stop order) or is unavailable to ARES for sale of all of the Registrable Securities (as defined in the Securities Purchase Agreement) in accordance with the terms of the Securities Purchase Agreement, and such lapse or unavailability continues for a period of fifteen (15) consecutive Trading Days or for more than an aggregate of sixty (60) Trading Days in any 365-day period;

(ii) any Borrower's or any Transfer Agent's notice to ARES, including by way of public announcement, at any time, of its intention not to comply with a proper request for conversion of the Note into shares of Equity Securities; the failure of a Borrower to deliver a Borrower Confirmation of Conversion Notice to ARES and to the Transfer Agent in accordance with the provisions of this Note within two (2) Trading Days after the receipt by the Borrower of a Conversion Notice (subject to extension in accordance with Section 3(g)(iii) for a good faith dispute made in accordance with the terms of Section 3(g)(iii));

(iii) any Borrower breaches any covenant or other term or condition of the Securities Purchase Agreement, this Note or any other agreement, document, certificate or other instrument delivered in connection with the transactions contemplated thereby and hereby if such breach would reasonably be expected to have a Material Adverse Effect and except, in the case of a breach of a covenant which is reasonably curable, only if such breach continues for a period of at least ten (10) Trading Days;

(iv) any representation or warranty made by any Borrower in the Securities Purchase Agreement, this Note or any other agreement, document, certificate or other

instrument delivered in connection with the transactions contemplated thereby and hereby was false when made or as of any time period such representation or warranty is in effect and the matter, event, occurrence, fact, or condition regarding which it was false is or would be reasonably likely to constitute a Material Adverse Effect;

(v) if any Person credibly threatens by way of any public announcement to commence a proceeding against the Company pursuant to or within the meaning of any Bankruptcy Law (as defined below);

(vi) if any Borrower pursuant to or within the meaning of any Bankruptcy Law; (A) commences a voluntary case, (B) consents to the entry of an order for relief against it in an involuntary case, (C) consents to the appointment of a Custodian of it or for all or substantially all of its property, (D) makes a general assignment for the benefit of its creditors, (E) becomes insolvent, or (F) is generally unable to pay its debts as the same become due;

(vii) a court of competent jurisdiction enters an order or decree under any Bankruptcy Law that; (A) is for relief against any Borrower in an involuntary case and that remains undismissed for a period of sixty (60) days or more, (B) appoints a Custodian of any Borrower or for all or substantially all of its property, or (C) orders the liquidation of any Borrower or any subsidiary; or

(viii) any failure to obtain CFIUS Clearance if a Note Conversion is a pilot program covered transaction, as defined at 31 C.F.R. §801.210, or otherwise requires the filing of a mandatory declaration with CFIUS ("**Pilot Program Covered Transaction**"), or if CFIUS or the President initiate a unilateral review of such Note Conversion pursuant to Section 721 of the DPA, including any failure to obtain any such CFIUS Clearance due to any Party's reasonable determination or to any Intrexon Party's unreasonable determination that compliance with requirements or conditions required by CFIUS in order to obtain CFIUS Clearance would be materially adverse to the business, financial condition, or results of operations of such Party.

The term **"Bankruptcy Law"** means Title 11, U.S. Code, or any similar federal or state law for the relief of debtors. The term **"Custodian"** means any receiver, trustee, assignee, liquidator or similar official under any Bankruptcy Law.

(b) Remedies. If an Event of Default occurs from events described in clauses (i) through and (v) of Section 4(a) and is continuing, in addition to any remedy ARES may have under this Note and the Securities Purchase Agreement, ARES of this Note may at any time thereafter declare the entire principal balance of this Note to be due and payable immediately. In the case of an Event of Default arising from events described in clauses (vi) and (viii) of Section 4(a), this Note shall automatically become due and payable without further action or notice. Should any action be commenced between the parties hereto, or their personal representatives, concerning or relating to an Event of Default or the rights and duties of any person relative thereto, the prevailing party shall be entitled to recover, as an element of their costs of suit or as damages, reasonable attorneys' fees.

5. Notices of and Obligations With Respect To Certain Transactions.

(a) Material Transactions. In case:

(i) the Company shall set a record date for the holders of its capital stock for the purpose of entitling or enabling them to receive any dividend or other distribution, or to receive any right to subscribe for or purchase any shares of Equity Securities, or to receive any other right, to subscribe for or purchase any Equity Securities, or

(ii) the Company or Precigen shall set an effective date of any capital reorganization of the Company or Precigen, any reclassification of the capital stock of the Company or Precigen, or any Change of Control of the Company or Precigen, or

(iii) the Company shall set an effective date of any redemption of any capital stock of the Company, or

(iv) the Company shall effect any Qualified Company Financing, or Precigen or the Company shall effect any Precigen Financing, then, and in each such case, the Company and or Precigen, as applicable, will give ARES Notice specifying, as the case may be, (i) the record date for the purpose of such dividend, distribution or right, and stating the amount and character of such dividend, distribution or right, or (ii) the effective date on which such Change of Control, reorganization, reclassification, dissolution, liquidation, winding-up, redemption, conversion, Qualified Company Financing or Precigen Financing is to take place, and the time, if any is to be fixed, as of which the holders of record of Equity Securities (or the Equity Securities at the time deliverable upon such Change of Control, reorganization, reclassification, dissolution, liquidation, winding-up, redemption, conversion, Qualified Company Financing or Precigen Financing) are to be determined. Such notice shall be given at least **[*****]** Trading Days prior to the record date or effective date for the event specified in such notice or such lesser period in the event **[*****]** Trading Days is impracticable in the circumstances, provided, however, that such period shall not be less than **[*****]** Trading Days with respect to a Qualified Precigen Financing. Such Notice shall specify all material terms of the event specified in such Notice. If any material term materially changes after such Notice is given, or such Notice fails to include any such material term, the Borrowers shall promptly provide an updated Notice reflecting such material changes or omitted material term to ARES. Such Notice and all information provided therein and in connection therewith shall constitute Confidential Information of the Company as defined in and pursuant to the Securities Purchase Agreement.

The Company and Precigen shall provide ARES with the opportunity to perform reasonable due diligence in connection with any Qualified Company Financing or Precigen Financing (including the opportunity to ask questions of Precigen's management as referenced in Section 15c concerning Precigen), which is commensurate with the due diligence provided to the other potential investors in such Qualified Company or Precigen Financing. All due diligence information so provided to ARES shall constitute Confidential Information of the Company as defined in and pursuant to the Securities Purchase Agreement.

Notwithstanding anything to the contrary above, if ARES' conversion rights have terminated pursuant to Section 3(j) with respect to Precigen Equity Securities, neither the Company nor Precigen shall have any further obligation to provide ARES any of the above referenced notices with respect to Precigen or its Equity Securities.

(b) Precigen IPO.

(i) The Borrowers shall provide ARES with Notice no less than **[*****]** (the **"Precigen IPO Notice"**) prior to the date on which a Form S-1 (or other available form) (a **"Precigen IPO Registration Statement"**) is first filed with the SEC other than on a confidential basis in reliance on Section 6(e) of the Securities Act registering equity securities of Precigen for sale to the public (other than in an Excluded Registration) (an **"IPO"**). When providing the Precigen IPO Notice, the Borrowers shall furnish copies to ARES of **[*****]**. To the extent that **[*****]** is available on the SEC's Electronic Data Gathering Analytics and Retrieval System, Borrowers shall be relieved of their obligation to furnish copies thereof to ARES.

(ii) No less than **[*****]** Trading Days prior to Precigen's submission to the SEC of a request for acceleration of the effectiveness of the Registration Statement for any Precigen IPO, Borrowers will give ARES Notice of Precigen's intention to make such acceleration request (the **"Precigen IPO Effectiveness Notice"**). The Precigen IPO Effectiveness Notice will Notify ARES of the date Borrowers request the Precigen IPO Registration Statement will become effective.

(c) Compliance with Rules and Regulations Upon Conversion of Note. If any conversion of any principal amount of this Note to shares of the Company's or Precigen's Equity Securities ("**Note Conversion**") requires prior compliance with any law, statute, rule, regulation, or order ("**Rule**"), including, without limitation, the obtaining of any Antitrust Clearances or CFIUS Clearances or approval from any Governmental Authority, the Company and/or Precigen, as applicable, and ARES will use commercially reasonable efforts to comply with such Rule and ARES, the Company and/or Precigen, as applicable, will consult with and cooperate in good faith with one another to achieve compliance by ARES, the Company and/or Precigen, as applicable, with such Rule and to obtain any such approvals, including, without limitation, any such other Antitrust Clearances or CFIUS Clearances (if the Note Conversion is a Pilot Program Covered Transaction) or approvals from any Governmental Authority. Without limiting the foregoing, each of the Company, Precigen, and ARES shall take such actions and agree to such requirements or conditions to mitigate any national security concerns as may be requested or required by CFIUS in connection with, or as a condition of, obtaining CFIUS Clearance, provided that (subject to Section 4 hereof) the obligations of this Section 5(c) shall not require any action that, in any Party's reasonable determination, would be materially adverse to the business, financial condition, or results of operations of such Party and, provided further, that the requirement by CFIUS or the President to implement written procedures at the Company and/or Precigen to prevent the release to ARES or any other foreign person, as defined at 31 C.F.R. §800.216, of (A) critical technologies, as defined at 31 C.F.R. §801.204, or (B) sensitive personal data of United States citizens that may be exploited in a manner than threatens national security, shall not be deemed to be materially adverse to the business, financial condition or results of operations of the Company and/or Precigen. The Parties shall work in good faith to take such actions as are necessary to assure that ARES' right to convert the Note pursuant to Section 3 hereof or to have the Mandatory Conversion occur are not prevented by reason of any delay occasioned by the process of obtaining any Antitrust Clearance or CFIUS Clearance. Any timing requirements, provisions or deadlines set forth in the Transaction Agreements related to a conversion of this Note to shares of the Company's or Precigen's Equity Securities or other actions required by ARES as set forth herein shall be extended for such period as reasonably necessary to allow for compliance with any such Rule and the obtaining of any approvals described in this Section 5(c).

6. Reservation of Shares. The Company shall, so long as any principal amount of the Note is outstanding, reserve and keep available out of its authorized and unissued Company Common Stock, solely for the purpose of effecting the conversion of the Note, such number of shares of Company Common Stock as shall from time to time be sufficient to effect the conversion of the entire outstanding principal amount of the Note without regard to any restrictions or limitations on conversions. The Borrowers shall, so long as any principal amount of the Note is outstanding, take such actions as are necessary to assure that sufficient shares are available of Borrowers' authorized and unissued Equity Securities, solely for the purpose of effecting the conversion of the Note pursuant to Sections 3(b), 3(c) and 3(d) hereof, as shall from time to time be sufficient to effect the conversion of the entire outstanding principal amount of the Note pursuant to such Sections 3(b), 3(c) and 3(d) hereof, without regard to any restrictions or limitations on conversions.

7. Reissuance of Note. Subject to Section 3(g)(vi) in the event of a conversion pursuant to this Note of less than all of the outstanding principal amount represented by this Note, the Borrowers shall promptly cause to be issued and delivered to ARES, upon tender by ARES of the Note converted, a new Note of like tenor representing the remaining principal amount of this Note which has not been so converted. The date the Borrowers initially issue this Note will be deemed to be the Issuance Date hereof regardless of the number of times a new Note shall be issued, including, without limitation, any such reissuance under this Section 7 or Section 9 hereof.

8. Vote to Change the Terms of this Note. This Note and any provision hereof may only be amended by an instrument in writing signed by the Borrowers and ARES. The term "Note" and all reference thereto, as used throughout this instrument, shall mean this instrument as originally executed, or if later amended or supplemented, then as so amended or supplemented.

9. Lost or Stolen Note. Upon receipt by the Borrowers of evidence reasonably satisfactory to the Borrowers of the loss, theft, destruction or mutilation of any Note, and, in the case of loss, theft or destruction, of an indemnification undertaking by ARES to the Borrowers in a form reasonably acceptable to the Borrowers and, in the case of mutilation, upon surrender and cancellation of the Note, the Borrowers shall execute and deliver a new Note or Notes of like tenor and date; provided, however, the Borrowers shall not be obligated to re-issue a Note if ARES contemporaneously requests the Borrowers to convert such remaining principal amount pursuant to the provisions hereof.

10. Payment of Collection, Enforcement and Other Costs. In addition to all other amounts due hereunder, the Borrowers shall pay to ARES all reasonable cost and expenses including attorneys' fees, incurred in connection with: (i) the collection or enforcement of or under this Note; or (ii) any bankruptcy, reorganization, receivership or other proceedings affecting creditors' rights and involving a claim under this Note.

11. Cancellation and Surrender of Note. After the entire outstanding principal amount owed on this Note has been converted, redeemed or paid in full, this Note shall automatically be deemed canceled, shall be surrendered to the Borrowers for cancellation and shall not be reissued.

12. Joint and Several Liability, Waivers, Consents, Etc. Notwithstanding anything to the contrary contained herein, each Borrower hereby agrees that the obligations of each other Borrower hereunder shall be joint and several obligations of the Borrowers. The Borrowers are engaged in related businesses and the proceeds of the Note are being used to advance Precigen therapeutic programs, which will benefit the Borrowers. Each Borrower will derive substantial direct and indirect benefit from the extensions of credit hereunder. Each Borrower agrees that ARES shall have no duty to advise such Borrower of information

known to ARES regarding the condition of the other Borrower or of the risk of nonperformance by such other Borrower or to undertake any investigation regarding such matters. Additionally, each Borrower and any and all other endorsers, sureties or guarantors hereof and any and all others who are now or may become liable for all or part of the obligations of such Borrower under this Note (all of the foregoing being collectively referred to herein as "**Obligors**"), agree to be jointly and severally bound hereby and jointly and severally, waive presentment for payment, demand, notice of nonpayment, notice of dishonor, protest of any dishonor, notice of protest, and protest of this Note and, except as expressly provided to the contrary herein or in the Securities Purchase Agreement, all other notices in connection with the delivery, acceptance, performance, default, or enforcement of the payment of this Note, and agree that the liability of each of them shall be unconditional, joint and several, without regard to the liability of any other party and shall not in any manner be affected by any indulgence, extension of time, renewal, waiver or modification granted or consented to by ARES. Each Obligor hereby consents to any and all extensions of time, renewals, waivers, or modifications that may be granted by ARES with respect to the conversion or payment or other provisions of this Note, and agree that additional makers, endorsers, guarantors, or sureties may become parties hereto without notice to them or affecting their liability hereunder.

13. No Rights or Liabilities as Stockholder. This Note does not by itself entitle ARES to any voting rights or other rights as a stockholder of the Company or Precigen. In the absence of conversion of this Note, no provisions of this Note, and no enumeration herein of the rights or privileges of ARES, shall cause such ARES to be a stockholder of the Company or Precigen for any purpose.

14. Representations and Warranties of Borrowers. The Borrowers hereby represent and warrant, jointly and severally, to ARES that as of the date hereof, and continuing as long as any indebtedness evidenced hereby remains outstanding and as long as this Note remains in effect this Note is the legal, valid and binding obligation of each Borrower and is enforceable against such Borrower in accordance with its terms. The Borrowers hereby represent and warrant, jointly and severally, to ARES that as of the date hereof and after consummation of the transactions contemplated hereby, each Borrower is solvent, is able to pay their respective debts as they become due and has capital sufficient to carry on their respective businesses and all businesses in which they are about to engage, and now owns property having a value both at fair valuation and at present fair saleable value greater than the amount required to pay their respective debts. The representations and warranties set out in this Section 14 shall survive the satisfaction and performance and the termination and cancellation of this Note.

15. Representations and Warranties of ARES. ARES hereby represents and warrants to the Borrowers that:

a. ARES (or its designated Affiliate) will acquire any Equity Securities issuable upon conversion of the Note for its own account, for investment and not with a view to, or for sale in connection with, the distribution thereof within the meaning of the Securities Act;

b. At the time of acquiring any Equity Securities issuable upon conversion of the Note Ares (or its designated Affiliate) will be an "accredited investor," as that term is defined in Rule 501(a) of Regulation D under the Securities Act, will have sufficient knowledge and experience in financial and business matters to be capable of evaluating the merits and risks of its investment in the Equity Securities issuable upon conversion of the Note and will be capable of bearing the economic risks of such investment;

c. At the time of acquiring any Equity Securities issuable upon conversion of the Note, ARES and its advisers (or its designated Affiliate and its advisers) will have been, subject to Precigen's

compliance with Section 5(a) hereof, (i) furnished with all materials relating to the business, finances and operations of Precigen that have been requested by ARES or its advisers (or its designated Affiliate and its advisers) and (ii) afforded the opportunity to ask questions of Precigen's management concerning Precigen; provided, however, no investigation or due diligence review by ARES or any of its Affiliates shall alter, diminish or impair the right or ability of ARES (or its designated Affiliate) to rely upon the representations and warranties of the Borrowers;

d. ARES understands that, as of the date of conversion of this Note, the sale or re-sale of the Equity Securities issuable upon conversion thereof will not have been Registered under the Securities Act or any applicable state securities laws, and the Equity Securities issuable upon conversion thereof may not be offered, sold or otherwise transferred unless (i) the Equity Securities issuable thereunder, as applicable, are offered, sold or transferred pursuant to an effective registration statement under the Securities Act, or (ii) the Equity Securities issuable upon conversion hereof, as applicable, are offered, sold or transferred pursuant to an exemption from registration under the Securities Act and any applicable state securities laws; and

e. the principal offices of ARES (or its designated Affiliate) and the offices of ARES (or its designated Affiliate) in which it made its decision to convert the Note are located at the address set forth in the Conversion Notice.

16. Indemnification. Other than with respect to actions by the Borrowers to enforce this Note or the Securities Purchase Agreement regarding which a court of competent jurisdiction has issued a final, non-appealable order determining that Borrowers were not entitled to such enforcement, the Borrowers agree, jointly and severally, to defend, protect, indemnify and hold harmless ARES and each and its Affiliates and its and their shareholders, equity holders, owners, officers, directors, employees, attorneys and agents (each a "**Note Indemnified Party**" and collectively, the **"Note Indemnified Parties"**) from and against any and all liabilities, obligations, losses, damages, penalties, actions, judgments, suits, claims, costs, expenses and disbursements of any kind or nature whatsoever (including, without limitation, the reasonable fees and disbursements of counsel for the Note Indemnified Parties in connection with any investigative, administrative or judicial proceeding, whether or not the Note Indemnified Parties shall be designated as a party thereto), which may be imposed on, incurred by, or asserted against any Note Indemnified Party (whether direct, indirect or consequential and whether based on any federal or state laws or other statutory regulations, under common law or at equitable cause, or on contract or otherwise) in any manner relating to or arising out of this Note or the Transaction Agreements, or any act, event or transaction related or attendant thereto, the making and the management of the Note or the use or intended use of the proceeds of the Note hereunder. The provisions of and undertakings and indemnifications set out in this Section 16 shall survive the satisfaction, payment, termination and cancellation of this Note.

17. Notice. Except as otherwise expressly provided herein, any notice required or desired to be served, given or delivered hereunder shall be in writing, and shall be deemed to have been validly served, given or delivered upon the earlier of (a) personal delivery to the address set forth below, and (b) in the case of notice by Federal Express or other reputable overnight courier service, three (3) Trading Days after delivery to such courier service, addressed to the party to be notified as follows:

(a) If to ARES, at:

ARES TRADING S.A.
Zone Industrielle de L'Ouriettaz
1170 Aubonne
Switzerland
Attn: Legal Department

with a copy to:
Merck KGaA
Frankfurter Straâe 250
64293 Darmstadt
Germany
Attn: Merck Serono Legal Department

(b) If to the Company, at:

Intrexon Corporation
20374 Seneca Meadows Parkway
Germantown, MD 20876
Attention: Legal Department

(c) If to Precigen, at:

Precigen, Inc.
20358 Seneca Meadows Parkway
Germantown, MD 20876
Attention: Legal Department

or to such other address as each party designates to the other in the manner herein prescribed.

18. Governing Law; Venue. THE VALIDITY OF THIS NOTE, ITS CONSTRUCTION, INTERPRETATION, AND ENFORCEMENT, AND THE RIGHTS OF THE BORROWERS AND ARES SHALL BE DETERMINED UNDER, GOVERNED BY, AND CONSTRUED IN ACCORDANCE WITH THE INTERNAL LAWS OF THE STATE OF NEW YORK, WITHOUT REGARD TO PRINCIPLES OF CONFLICTS OF LAW. TO THE MAXIMUM EXTENT PERMITTED BY LAW, ARES AND EACH BORROWER HEREBY AGREES THAT ALL ACTIONS OR PROCEEDINGS ARISING IN CONNECTION WITH THIS NOTE SHALL BE TRIED AND DETERMINED ONLY IN THE STATE OR FEDERAL COURTS LOCATED IN THE SOUTHERN DISTRICT OF NEW YORK. TO THE MAXIMUM EXTENT PERMITTED BY LAW, ARES AND EACH BORROWER HEREBY EXPRESSLY WAIVES ANY RIGHT IT MAY HAVE TO ASSERT THE DOCTRINE OF FORUM NON CONVENIENS OR TO OBJECT TO VENUE TO THE EXTENT ANY PROCEEDING IS BROUGHT IN ACCORDANCE WITH THIS PARAGRAPH.

19. **JURY WAIVER. TO THE MAXIMUM EXTENT PERMITTED BY LAW, EACH BORROWER AND, BY ITS ACCEPTANCE OF THIS NOTE, ARES HEREBY EXPRESSLY WAIVES ANY RIGHT TO TRIAL BY JURY OF ANY ACTION, CAUSE OF ACTION, CLAIM,**

DEMAND, OR PROCEEDING ARISING UNDER OR WITH RESPECT TO THIS NOTE, OR IN ANY WAY CONNECTED WITH, RELATED TO, OR INCIDENTAL TO THE DEALINGS OF ANY BORROWER AND ARES WITH RESPECT TO THIS NOTE, OR THE TRANSACTIONS RELATED HERETO, IN EACH CASE WHETHER NOW EXISTING OR HEREAFTER ARISING, AND WHETHER SOUNDING IN CONTRACT, TORT, OR OTHERWISE. TO THE MAXIMUM EXTENT PERMITTED BY LAW, ARES AND EACH BORROWER HEREBY AGREES THAT ANY SUCH ACTION, CAUSE OF ACTION, CLAIM, DEMAND OR PROCEEDING SHALL BE DECIDED BY A COURT TRIAL WITHOUT A JURY AND THAT EACH BORROWER AND ARES MAY FILE A COPY OF THIS NOTE WITH ANY COURT OR OTHER TRIBUNAL AS WRITTEN EVIDENCE OF THE CONSENT OF ARES AND ANY BORROWER TO THE WAIVER OF ITS RIGHT TO TRIAL BY JURY.

20. Remedies, Characterizations, Other Obligations, Breaches and Injunctive Relief. The remedies provided in this Note shall be cumulative and in addition to all other remedies available under this Note, at law or in equity (including a decree of specific performance and/or other injunctive relief), no remedy contained herein shall be deemed a waiver of compliance with the provisions giving rise to such remedy and nothing herein shall limit ARES's right to pursue actual damages for any failure by the Borrowers to comply with the terms of this Note. Amounts set forth or provided for herein with respect to payments, conversion and the like (and the computation thereof) shall be the amounts to be received by ARES thereof and shall not, except as expressly provided herein, be subject to any other obligation of the Borrowers (or the performance thereof). The Borrowers acknowledge that a breach by them of their obligations hereunder will cause irreparable harm to ARES and that the remedy at law for any such breach may be inadequate. The Borrowers therefore agree that, in the event of any such breach or threatened breach, ARES shall be entitled, in addition to all other available remedies, to an injunction restraining any breach, without the necessity of showing economic loss and without any bond or other security being required.

21. Entire Agreement. This Note, the schedules hereto, the Securities Purchase Agreement and the other Transaction Agreements constitute the full and entire understanding and agreement between the parties with regard to the subject matter hereof and thereof and no party shall be liable or bound to any other party in any manner by any representations, warranties, covenants and agreements except as specifically set forth herein.

22. Construction. This Note shall be deemed to be jointly drafted by the Borrowers and ARES and shall not be construed against any person as the drafter hereof.

23. Failure or Indulgence Not Waiver. No failure or delay on the part of ARES in the exercise of any power, right or privilege hereunder shall operate as a waiver thereof, nor shall any single or partial exercise of any such power, right or privilege preclude other or further exercise thereof or of any other right, power or privilege.

* * * *

IN WITNESS WHEREOF, this joint and several Convertible Note has been duly executed and delivered on the date first set forth above.

INTREXON CORPORATION

By: _____
Name:
Its:

PRECIGEN, INC.

By: _____
Name:
Its:

Accepted and Agreed to:

ARES TRADING S.A.

By: _____
Name:
Its:

EXHIBIT I

INTREXON CORPORATION AND PRECIGEN, INC.
FORM OF CONVERSION NOTICE

Reference is made to the Convertible Note (the "**Note**") issued by Intrexon Corporation (the "**Company**") and Precigen, Inc. (**"Precigen"** and, with the Company, the **"Borrowers"**) on _____. In accordance with and pursuant to the Note, the undersigned hereby elects to convert the portion of the principal amount of the Note indicated below into the type of Equity Securities of the Borrower specified below as of the date specified below. Capitalized terms not defined in this Conversion Notice shall have the meanings set forth in the Note.

Borrower Into Whose Equity Securities the Note Principal Will Convert: _____

Equity Security Into Which the Note Principal Will Convert: _____

Conversion Date: _____

Aggregate outstanding principal amount of
Note **prior to** this conversion: _____

Aggregate principal amount to be converted (Conversion Amount): _____

Aggregate outstanding principal amount of
Note **after** this conversion: _____

Please confirm the following information:

Conversion Price, Qualified Company Financing Conversion Price, Precigen Financing Conversion Price or Qualified Precigen IPO Conversion Price, as applicable: _____

Number of shares of Equity Securities to be issued: _____

Please issue the Equity Securities into which the portion of the principal amount of the Note is being converted in the following name and to the following address:

Issue to: _____

_____

_____

Authorized Signature: _____

Name: _____

Title: _____

Phone #: _____

Fax #: _____

Account Number
(if electronic book entry transfer): _____

Transaction Code Number
(if electronic book entry transfer): _____

The recipient referenced above represents and warrants to the Borrowers that all of the representations and warranties made by ARES Trading S.A. pursuant to Section 15 of the Note are true and correct as to such recipient as of the date hereof.

By: ARES TRADING S.A.

By: _____

Name:

Its:

Accepted and agreed:

INTREXON CORPORATION

By: _____

Name:

Its:

PRECIGEN, INC.

By: _____

Name:

Its:

Exhibit 21.1

List of Subsidiaries of Intrexon Corporation

Domestic	
ActoBio Therapeutics, Inc.	Delaware
ActoBio Therapeutics Holdings, Inc.	Delaware
AquaBounty Farms, Inc.	Delaware
AquaBounty Farms Indiana LLC	Delaware
AquaBounty Technologies, Inc.	Delaware
Biological & Popular Culture, Inc.	Delaware
CRS Bio, Inc.	Delaware
EnviroFlight, LLC	Delaware
Exemplar Genetics, LLC	Iowa
Fruit Orchard Holdings, Inc.	Delaware
Genomatix, Inc.	Delaware
Genten Therapeutics, Inc.	Delaware
GenVec LLC	Delaware
ILH Holdings, Inc.	Delaware
Intrexon AB, Co.	Delaware
Intrexon CEU, Inc.	Delaware
Intrexon Crop Protection, Inc.	Virginia
Intrexon EF Holdings, Inc.	Delaware
Intrexon Energy Partners, LLC	Delaware
Intrexon Energy Partners II, LLC	Delaware
Intrexon Environmental Medicine Partners, LLC	Delaware
Intrexon Produce Holdings, Inc.	Delaware
Intrexon T1D Partners, LLC	Delaware
Intrexon UK Holdings, Inc.	Delaware
MabLogix, LLC	Delaware
OvaXon, LLC	Delaware
Precigen, Inc.	Delaware
ProGentus, L.C.	Iowa
Relieve Genetics, Inc.	Delaware
Trans Ova Genetics, L.C.	Iowa
Unicell Bio International, LLC	Delaware
ViaGen, L.C.	Iowa
Xogenex LLC	Delaware
XON Cells, Inc.	Nevada
International	
ActoBio Laboratories Belgium BVBA *(besloten vennootschap met beperkte aansprakelijkheid)*	Belgium
AQUA Bounty Canada Inc.	Canada
Aqua Bounty Farms Chile Limitada	Chile
AquaBounty Brasil Participações Ltda.	Brazil
AquaBounty Panama, S. de R.L.	Panama
ER Cell LLC	Russia

Fruit Orchard Holdings Mexico	Mexico
Intrexon ActoBiotics NV *(naamloze vennootschap)*	Belgium
Intrexon BioInformatics Germany GmbH	Germany
Intrexon Laboratories Hungary, KFT *(korlátolt felelõsségû társaság)*	Hungary
Intrexon Labs Canada, Inc.	Canada
Intrexon UK Insect Holdings Limited	United Kingdom
Mosquito Technologies Limited Mexico	Mexico
Okanagan Specialty Fruits Inc.	British Columbia
Oxitec, Ltd	United Kingdom
Oxitec Australia Pty, Ltd.	Australia
Oxitec Sdn Bhd	Malaysia
Oxitec Cayman Limited	Cayman Islands
Oxitec (Singapore) PTE. Limited	Singapore
Oxitec do Brasil Tecnologia de Insetos Ltda	Brazil
Precision Biological Innovations SRL	Costa Rica

Exhibit 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We hereby consent to the incorporation by reference in the Registration Statements on Form S-8 (Nos. 333-190614, 333-196840, 333-205642, 333-213065, 333-219874, and 333-226821) and Form S-3 (No. 333-220326) of Intrexon Corporation of our report dated March 1, 2019, relating to the consolidated financial statements and the effectiveness of internal controls over financial reporting, which appears in this Form 10-K.

/s/ PricewaterhouseCoopers LLP

Raleigh, North Carolina
March 1, 2019

Exhibit 31.1

CERTIFICATION OF PRINCIPAL EXECUTIVE OFFICER PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002

I, Randal J. Kirk, certify that:

1. I have reviewed this Annual Report on Form 10-K of Intrexon Corporation;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

    a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

    b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

    c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

    d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

    a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

    b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 1, 2019

/s/ RANDAL J. KIRK

Randal J. Kirk
Chairman and Chief Executive Officer
(Principal Executive Officer)

Exhibit 31.2

CERTIFICATION OF PRINCIPAL FINANCIAL OFFICER PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002

I, Rick L. Sterling, certify that:

1. I have reviewed this Annual Report on Form 10-K of Intrexon Corporation;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

    a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

    b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

    c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

    d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

    a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

    b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 1, 2019

/s/ RICK L. STERLING

Rick L. Sterling
Chief Financial Officer
(Principal Financial Officer)

Exhibit 32.1

CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350
AS ADOPTED PURSUANT TO SECTION 906
OF THE SARBANES-OXLEY ACT OF 2002

I, Randal J. Kirk, Chairman and Chief Executive Officer of Intrexon Corporation (the "Company"), do hereby certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that to the best of my knowledge:

- the Annual Report on Form 10-K of the Company for the year ended December 31, 2018 (the "Report") fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

- the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: March 1, 2019

/s/ RANDAL J. KIRK

Randal J. Kirk
Chairman and Chief Executive Officer
(Principal Executive Officer)

A signed original of this written statement required by Section 906, or other document authenticating, acknowledging or otherwise adopting the signature that appears in typed form within the electronic version of this written statement required by Section 906, has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

This certification accompanies the Form 10-K to which it relates, is not deemed filed with the Securities and Exchange Commission and is not to be incorporated by reference into any filing of the Registrant under the Securities Act of 1933 or the Securities Exchange Act of 1934 (whether made before or after the date of the Form 10-K), irrespective of any general incorporation language contained in such filing.

Exhibit 32.2

CERTIFICATION PURSUANT TO
18 U.S.C. SECTION 1350
AS ADOPTED PURSUANT TO SECTION 906
OF THE SARBANES-OXLEY ACT OF 2002

I, Rick L. Sterling, Chief Financial Officer of Intrexon Corporation (the "Company"), do hereby certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that to the best of my knowledge:

- the Annual Report on Form 10-K of the Company for the year ended December 31, 2018 (the "Report") fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934; and

- the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: March 1, 2019

/s/ RICK L. STERLING

Rick L. Sterling
Chief Financial Officer
(Principal Financial Officer)

A signed original of this written statement required by Section 906, or other document authenticating, acknowledging or otherwise adopting the signature that appears in typed form within the electronic version of this written statement required by Section 906, has been provided to the Company and will be retained by the Company and furnished to the Securities and Exchange Commission or its staff upon request.

This certification accompanies the Form 10-K to which it relates, is not deemed filed with the Securities and Exchange Commission and is not to be incorporated by reference into any filing of the Registrant under the Securities Act of 1933 or the Securities Exchange Act of 1934 (whether made before or after the date of the Form 10-K), irrespective of any general incorporation language contained in such filing.