UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549
FORM 10-K

(Mark One)

☑ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**
For the fiscal year ended December 31, 2019
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: 001-33155

IPG PHOTONICS CORPORATION
(Exact name of registrant as specified in its charter)

Delaware	**04-3444218**
(State or other jurisdiction of incorporation or organization)	*(IRS Employer Identification No.)*
50 Old Webster Road, Oxford, Massachusetts	**01540**
(Address of principal executive offices)	*(Zip Code)*

Registrant's telephone number, including area code: **(508) 373-1100**

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

Title of Class	Trading Symbol	Name of Exchange on Which Registered
Common Stock, Par Value $0.0001 per share	**IPGP**	**The Nasdaq Stock Market LLC**

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

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☐ 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 ☑

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 ☑ 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 ☑ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or emerging growth company. See 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	☑	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 Act). Yes ☐ No ☑

The aggregate market value of the registrant's common stock held by non-affiliates of the registrant was approximately $5.1 billion, calculated based upon the closing price as reported by the Nasdaq Global Select Market on June 30, 2019. For purposes of this disclosure, shares of common stock held by persons who own 5% or more of the outstanding common stock and shares of common stock held by each officer and director have been excluded in that such persons may be deemed to be "affiliates" as that term is defined under the Rules and Regulations of the Exchange Act. This determination of affiliate status is not necessarily conclusive.

As of February 21, 2020, 53,058,726 shares of the registrant's common stock were outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement for its 2020 Annual Meeting of Stockholders to be filed pursuant to Regulation 14A within 120 days of the end of the registrant's fiscal year ended December 31, 2019 are incorporated by reference into Part III of this Annual Report on Form 10-K to the extent stated herein.

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This Annual Report on Form 10-K contains certain forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, and we intend that such forward-looking statements be subject to the safe harbors created thereby. For this purpose, any statements contained in this Annual Report on Form 10-K except for historical information are forward-looking statements. Without limiting the generality of the foregoing, words such as "may," "will," "expect," "believe," "anticipate," "intend," "target," "project," "intend," "plan," "seek," "strive," endeavor," goal," "could," "estimate," or "continue" or the negative or other variations thereof or comparable terminology are intended to identify forward-looking statements. In addition, any statements that refer to projections of our future financial performance, trends in our businesses, or other characterizations of future events or circumstances are forward-looking statements.

The forward-looking statements included herein are based on current expectations of our management based on available information and involve a number of risks and uncertainties, all of which are difficult or impossible to accurately predict and many of which are beyond our control. As such, our actual results may differ significantly from those expressed in any forward-looking statements. Factors that may cause or contribute to such differences include, but are not limited to, those discussed in more detail in Item 1 (Business) and Item 1A (Risk Factors) of Part I and Item 7 (Management's Discussion and Analysis of Financial Condition and Results of Operations) of Part II of this Annual Report on Form 10-K. Readers should carefully review these risks, as well as the additional risks described in other documents we file from time to time with the Securities and Exchange Commission (the "SEC"). In light of the significant risks and uncertainties inherent in the forward-looking information included herein, the inclusion of such information should not be regarded as a representation by us or any other person that such results will be achieved, and readers are cautioned not to rely on such forward-looking information. We undertake no obligation to revise the forward-looking statements contained herein to reflect events or circumstances after the date hereof or to reflect the occurrence of unanticipated events.

PART I

ITEM 1. *BUSINESS*

Our Company

IPG Photonics Corporation ("IPG", the "Company", the "Registrant", "we", "us" or "our") develops, manufactures and sells high-performance fiber lasers, fiber amplifiers and diode lasers that are used for diverse applications, primarily in materials processing. Fiber lasers are a type of laser that combine the advantages of semiconductor diodes, such as long life and high efficiency, with the high amplification and precise beam qualities of specialty optical fibers to deliver superior performance, reliability and usability.

Our portfolio of laser solutions are used in materials processing, communications, medical and advanced applications. We sell our products globally to original equipment manufacturers ("OEMs"), system integrators and end users. We market our products internationally, primarily through our direct sales force. Our major manufacturing facilities are located in the United States, Germany and Russia. We have sales service offices and applications laboratories worldwide.

We are vertically integrated such that we design and manufacture most of the key components used in our finished products, from semiconductor diodes to optical fiber preforms, finished fiber lasers and amplifiers. We also manufacture complementary products used with our lasers including optical delivery cables, fiber couplers, beam switches, optical processing heads, in-line sensors and chillers. In addition, we offer laser-based and non-laser based systems for certain markets and applications. Our vertically integrated operations allow us to reduce manufacturing costs, control quality, rapidly develop and integrate advanced products and protect our proprietary technology.

We are listed on the Nasdaq Global Select Market (ticker: IPGP). We began operations in 1990, and we were incorporated in Delaware in 1998. Our principal executive offices are located at 50 Old Webster Road, Oxford, Massachusetts 01540, and our telephone number is (508) 373-1100.

Industry Overview

Laser technology has revolutionized a broad range of applications and products in manufacturing, automotive, aerospace, medical, research, consumer electronics, semiconductors and communications. A laser converts electrical energy to optical energy that can be focused and shaped, creating a powerful, concentrated beam that causes materials to melt, vaporize or change their character. In a laser, an energy source excites or pumps a gain medium, which converts the energy from the source into an emission consisting of particles of light, called photons, at particular wavelengths. Lasers provide flexible, non-contact and high-speed ways to process and treat various materials and are a key enabler of automated production, miniaturization and increasing product complexity.

Lasers are utilized in materials processing applications requiring very high power densities, such as cutting, welding, marking and engraving, additive manufacturing, ablation, printing, drilling and cladding. Historically, machine tools such as grinding machines, mechanical saws, milling machines, lathes and presses have been used to cut, form or otherwise process metal in the production of finished goods such as automobiles, consumer appliances, electronics and heavy machinery. Laser-based systems are increasingly gaining share within the materials processing market because of the greater precision, processing speeds and flexibility enabled by this technology. Beyond materials processing, lasers are well-suited for imaging and inspection applications and the ability to confine laser light to narrow wavelengths makes them particularly effective in medical and sensing applications.

Fiber Lasers

Fiber lasers use semiconductor diodes as the energy source to pump a gain medium consisting of specialty optical fibers, which are infused with rare earth ions. These fibers are called active fibers and are comparable in diameter to a human hair. The laser emission is created within optical fibers and delivered through a flexible optical fiber cable. As a result of their different design and components, fiber lasers are more reliable, efficient, robust, compact and easier to operate than gas, crystal and solid state lasers that were initially used in industrial applications. In addition, fiber lasers free the end users from fine mechanical adjustments and the high maintenance costs that are typical for other laser technologies.

Although low power fiber lasers were introduced four decades ago, their increased adoption in the last fifteen years has been driven primarily by our improvements in their output power levels and cost, as well as their superior performance, lower cost of ownership and greater reliability compared with other laser technologies. We have successfully increased output power levels, efficiency and reliability by developing improved optical components such as diodes and active fibers that have increased their power capacities and improved their performance. Fiber lasers now offer output powers that exceed those of

other laser technologies in many categories. In addition, our semiconductor diodes have become more affordable and reliable due, in part, to substantial advancements in diode technology, packaging design and increased production volumes. Also, many optical components have been developed to be more efficient with greater capabilities. As a result, the average cost per watt of output power has decreased dramatically over the last fifteen years. Because of these improvements, our fiber lasers effectively compete with other laser technologies and non-laser solutions in many applications that did not use lasers historically. As a pioneer in the development and commercialization of fiber lasers, we have contributed to many advancements in fiber laser technology, components and solutions. We believe that fiber lasers provide a combination of benefits that include: superior performance; enhanced end user productivity; lower cost of ownership; greater ease of use; a more compact footprint; and greater choice of wavelengths and more precise beam control. There remain applications and processes where other laser and non-laser technologies may provide superior performance with respect to particular features or applications notwithstanding the benefits offered by fiber lasers.

Our Competitive Strengths

Our key strengths and competitive advantages include the following:

World's Leading Producer of Fiber Laser Technology. As a pioneer and technology leader in fiber lasers, we are able to leverage our scale to reduce costs for our customers and drive the proliferation of fiber lasers in existing and new applications.

Vertically Integrated Development and Manufacturing. We develop and manufacture most of our key high-volume specialty components, along with optical heads and other products used in conjunction with our lasers, which we believe enhances our ability to meet customer requirements, reduce costs and accelerate product development.

Manufacturing Scale. We have invested extensively in our production capabilities allowing us to deliver large volumes of fiber lasers in short delivery cycles which provide us with a competitive advantage.

Breadth and Depth of Expertise. Our extensive know-how in materials sciences and experience in optical, electrical, mechanical and semiconductor engineering enable us to develop and manufacture proprietary components, products, accessories and systems and assist customers in improving their manufacturing using our fiber lasers.

Broad Product Portfolio and Ability to Meet Customer Requirements. Our broad range of standard and custom fiber lasers operating at various wavelengths and pulse durations and our vertically integrated manufacturing, broad technology expertise allow us to design, prototype and commence high-volume production of our products rapidly.

Diverse Customer Base, End Markets and Applications. Our diverse customer base, end markets and applications provide us with many growth opportunities. In 2019, we shipped products to over 5,100 customers worldwide. Our principal end markets and representative applications within those markets include:

Materials Processing Markets

End Market	Applications	Principal Products
General manufacturing	Flat sheet, tube and 3D cutting	Continuous Wave ("CW") lasers (1-20 kW)
	Welding, brazing and hardening	CW lasers (1-100 kW)
	Marking, engraving and printing	Nanosecond ("NS") pulsed lasers (10-100 W)
	3D printing	CW lasers (200-1,000 W)
	Ablation and cleaning	NS pulsed lasers (100-2000 W)
Automotive	Cutting of high-strength steel and aluminum	CW lasers (1-20 kW)
	Welding tailored blanks, frames and auto parts	CW lasers (1-50 kW)
	Seam welding and brazing	CW lasers and IPG systems
	Electric vehicle battery processing	CW lasers and NS pulsed lasers
Consumer goods	Micro welding, cutting and marking	Quasi-CW ("QCW") lasers and NS pulsed lasers
	Marking of plastic and non-metal material	Ultraviolet pulsed lasers
Medical devices	Stent, pacemaker and device manufacturing	CW lasers and NS pulsed lasers
Energy	Hardening and welding of pipes	CW lasers (4-50 kW)
	Cladding of turbine blades and drill bits	CW lasers (1-20 kW) and IPG systems
Aerospace, rail and shipbuilding	Welding titanium, welding/cutting thick plates	CW lasers (1-50 kW) and IPG systems
	Percussion drilling of parts	QCW lasers
	Non-destructive inspection	Genesis systems
Micro electronics	Wafer inspection and annealing	CW lasers and NS pulsed lasers
	Solar cell processing	Green pulsed lasers
	Processing of glass, ceramics, sapphire, silicon	Picosecond ("PS") pulsed lasers

Other Markets

End Market	Applications	Principal Products
Aerospace and defense	Directed energy	Single-Mode CW lasers, amplifiers and diodes
Entertainment	Laser cinema projection	RGB luminaire laser system
Scientific	Sensing, spectroscopy and research	Mid-infrared and other lasers
Medical procedures	General surgery, urology and soft tissue	Thulium lasers
	Skin, wrinkle/hair removal, dental	Erbium and diode lasers
Communications	Datacom and telecom network infrastructure	Optical transceivers
	Terrestrial and satellite broadband	Optical amplifiers and raman lasers

Products

We design and manufacture a broad range of high-performance fiber lasers and amplifiers. We also make packaged diodes, direct diode lasers, laser and non-laser systems and communications components and systems. Many of our products are designed to be used as general-purpose energy or light sources, making them useful in diverse applications and markets.

Our laser products are based on a common proprietary technology platform using many of the same core components, such as semiconductor diodes and specialty fibers, which we configure to our customers' specifications. Our engineers and scientists work closely with OEMs, system integrators and end users to develop and customize our products for their needs. Because of our flexible and modular product architecture, we offer products in different configurations according to the desired application, including modules, rack-mounted units and tabletop units. Our engineers and other technical experts work directly with the customer in our application and development centers to develop and configure the optimal solution for each customer's manufacturing requirements. We also manufacture certain complementary products that are used with our lasers, such as optical delivery cables, fiber couplers, beam switches, optical processing heads and chillers.

Our products are used in a broad range of applications. The major application is materials processing, comprising 94% of our sales in both 2019 and 2018 and 95% of our sales in 2017. Our products also address other applications, including advanced applications (3% of sales in 2019, 2018, and 2017), communications (2% of sales in 2019, 2018, and 2017) and medical (1% of sales in 2019, 2018, and 2017). For 2019 fiscal year, high power continuous wave ("CW") lasers accounted for 56% of revenue and were 62%, of revenue in both 2018 and 2017. Pulsed lasers accounted for 11% of revenue in each of the three years. For the 2019, 2018 and 2017 fiscal years, laser and non-laser systems accounted for 11%, 4%, and 3%, respectively, of revenues.

Lasers

Our laser products include medium (1 to 999 watts) and high (1,000 watts and above) output power lasers from 0.3 to 4.5 microns in wavelength. These lasers may be CW, QCW or pulsed. Our pulsed line includes NS, PS and femtosecond lasers. We offer several different types of lasers, which are defined by the type of gain medium they use. These are ytterbium, erbium and thulium, as well as Raman and hybrid fiber-solid state lasers using our crystal technology. We produce hybrid fiber-solid state lasers at green and ultraviolet wavelengths for a range of micro processing applications and in the mid-IR spectrum for sensing, imaging and spectroscopy applications. We also sell fiber pigtailed packaged diodes and fiber coupled direct diode laser systems that use semiconductor diodes rather than optical fibers as their gain medium. In addition, we offer high-energy pulsed lasers, multi-wavelength lasers, tunable lasers, single-polarization and single-frequency lasers, as well as other versions of our products.

We believe that we produce the highest power solid-state lasers in the industry. Our ytterbium fiber lasers reach power levels of up to 120,000 watts. We also make single-mode and low-mode output ytterbium fiber lasers with power levels of up to 20,000 watts and single-mode, erbium and thulium fiber lasers with power levels of up to 500 watts.

Accessories

We sell our own family of high power optical fiber delivery cables, fiber couplers, beam switches, chillers, scanners and other accessories for our fiber lasers. We are expanding our line of cutting and welding optical processing heads for use with our fiber lasers, including in-line coherent monitoring for welding.

Systems

Besides selling laser sources, we also offer integrated laser systems for particular geographic markets or custom-developed for a customer's manufacturing requirements. We offer 2D compact flat sheet cutter systems and multi-axis systems for fine welding, cutting and drilling. We produce high precision laser systems for the medical device industry. We also offer a welding seam stepper and picker, which is an automated fiber laser welding tool providing customers increased processing speeds, better quality and the elimination of certain clamping tools. In 2018, we acquired Genesis Systems Group LLC (United States), a leader in the integration of laser and non-laser robotic welding and automation solutions, and robot concept GmbH (Germany), an integrator of laser-based systems. IPG also develops and sells specialized fiber laser systems for unique material processing applications as requested by customers desiring a complete laser-based solution, including orbital welding, pipe welding and remote welding. The platforms include robotic and multi-axis workstations for welding, cutting and cladding, flatbed cutting systems, and diode markers.

Other Products

We produce optical amplifiers, which are predominantly deployed in broadband networks, ranging from milliwatts to up to 1,500 watts of output power from 1 to 2 microns in wavelength. We offer erbium-doped fiber amplifiers ("EDFAs"), Raman amplifiers and integrated communications systems that incorporate our amplifiers. We also offer ytterbium and thulium specialty fiber amplifiers and broadband light sources that are used in advanced applications. Our fiber amplifiers offer some of the highest output power levels and highest number of optical outputs in the industry.

We also sell optical transceiver and transponder modules for communications applications. These optical subsystems provide the interface for interconnecting electronic equipment including Ethernet switches, IP routers and SONET/SDH optical transport modules within telecommunications, cable multi-system operator ("MSO") and data center networking applications.

Our Markets

Materials Processing

The most significant materials processing applications for fiber lasers are cutting, welding and brazing, marking and engraving, additive manufacturing such as 3D printing and ablation. Other applications include precision processing, surface treatment, drilling and annealing.

Cutting and Welding Applications. Laser-based cutting technology has several advantages compared to alternative technologies. Laser cutting is fast, flexible and highly precise and can be used to cut complex contours on flat, tubular or three-dimensional materials. The laser source can be programmed to process many different kinds of materials such as steel, aluminum, brass, copper, glass, ceramic and plastic at various thicknesses. Laser cutting technology is a non-contact process that is easy to integrate into an automated production line and is not subject to wear of the cutting medium. We sell low, mid and high power ytterbium fiber lasers for laser cutting. High electrical efficiency, low maintenance and operating cost, high beam quality, wide operating power range, power stability and small spot size are some of the qualities offered by IPG fiber lasers for many cutting applications, which enable customers to cut a variety of materials faster.

Laser welding offers several important advantages compared to conventional welding technology as it is non-contact, easy to automate, provides high process speed and results in narrow-seamed, high-quality welds that generally require little or no post-processing machining. The high beam quality of our fiber lasers coupled with high CW power offer deep penetration welding as well as shallow conduction mode welding. In addition, fiber lasers enable remote welding "on the fly," a flexible method of three-dimensional welding in which the laser beam is positioned by a robot-guided scanner. Such remote welding stations equipped with fiber lasers are used for welding door panels and seat backs, the multiple welding of spot and lap welds over the entire auto body frame, tailor blank welding and welding "body-in-white," which is welding pieces of metal with different thicknesses for automotive applications. Our products are used also for laser brazing of visible joints in automobiles such as tailgates, roof joints and columns. Brazing is a method of joining sheet metal by using a melted filler material similar to soldering but requiring higher temperatures.

3D Printing. Historically, metalworking has been performed with processes that remove material to produce component parts. The development of 3D printing technology enables the production of three-dimensional objects from digital design data through an additive manufacturing process, which builds up components in layers using materials that are available in fine powder form. 3D printers take advantage of improvements in computing power and motion and process control to deposit a range of materials, including metals, plastics and composite materials, accurately at high speed. Within metal-based 3D printing processes that include laser metal deposition (LMD) and selective laser melting (SLM), a laser beam is used to fuse metallic powder at points defined by computer-generated design data. 3D printing permits highly complex structures, with a high degree of customization capability and significantly less waste than subtractive manufacturing processes.

Marking and Engraving. With the increasing need for source traceability, component identification and product tracking as a means of reducing product liability and preventing falsification, as well as the demand for modern robotic production systems, manufacturers increasingly demand marking systems capable of applying serialized alphanumeric, graphic or bar code identifications directly onto their manufactured components. Laser engraving is similar to marking but forms deeper grooves in the material. In contrast to conventional acid etching and ink-based technologies, lasers can mark a wide variety of metal and non-metal materials, such as ceramic, glass and plastic surfaces, at high speeds and without contact by changing the surface structure of the material or by engraving. Laser marking systems can be easily integrated into a customer's production process and do not subject the item being marked to mechanical stress. In addition, we make high powered lasers for ablation and cleaning applications.

In the semiconductor industry, lasers typically are used as the light source in microlithography and for annealing, dicing, drilling, lift-off and marking of wafers. In the electronics industry, lasers typically are used to cut, join, mark, scribe or otherwise process a variety of materials that include ceramics, metals, plastics, silicon, and sapphire among others. Consumer electronic devices such as mobile phones, computers and handheld computers contain many parts that are laser-cut, marked or welded. In the photovoltaic or solar panel industry, pulsed lasers are used to remove materials and to scribe, or cut, solar cells. The high beam quality, increased peak output powers, flexible fiber delivery and competitive price of fiber lasers have accelerated the adoption of fiber lasers in these low power applications.

Precision Processing. The trend toward miniaturization in numerous industries such as consumer electronics, as well as innovations in materials and structures, is driving end users to utilize lasers in processing and fabrication. The ability of lasers to cut, weld, drill, ablate, etch and add materials on a fine scale is enabling new technologies and products across many industries. Our low power CW and QCW lasers are used to cut medical stents and weld medical batteries. In photovoltaic manufacturing, our lasers etch and perform edge isolation processes. The aerospace industry requires precise manufacturing of

engine parts so that cooling is effective and aerospace manufacturers use lasers to conduct percussion drilling. Processing of plastics and semi-conductors require short pulse and high energy lasers, in the green, UV and mid-IR wavelengths.

Advanced Applications

Our fiber lasers and amplifiers are utilized by commercial firms and by academic and government institutions worldwide for manufacturing of commercial systems, directed energy applications and for research in advanced technologies and products. These markets may use specialty products developed by us or commercial versions of our products. Representative applications include design, test and characterization of components and systems, remote sensing and LIDAR, and materials testing. Our visible lasers can be used in cinema projection, amusement parks, planetariums and light shows.

Communications

We design and manufacture optical amplifiers and optical transceiver and transponder modules for communications applications. IPG's fiber amplifiers are deployed in some of the world's largest broadband networks, supporting high speed data, voice, video on demand and high definition television applications. We provide a broad range of high power products for these applications including erbium doped fiber amplifiers and Raman lasers. We also produce optical transceiver and transponder modules based upon proprietary mixed signal ASIC designs, intended to simplify optical networks and reduce customer capital costs. These configurable modules are designed to operate at 100G coherent transmission rates, with higher speed modules under development. These products are deployed in data center operations and optical network systems.

Medical

We sell our commercial fiber and diode laser modules, subassemblies and complete systems to OEMs that incorporate our products into their medical products. Our ultrafast, CW and QCW ytterbium, erbium and thulium fiber lasers from 1 to 200 watts and diode laser systems can be used in various medical and biomedical applications. Aesthetic applications addressed by lasers include skin rejuvenation, hair removal, and treatment of pigmented and vascular lesions. We have also developed and are now selling a medical laser system and consumables for surgical applications, including benign prostatic hyperplasia and lithotripsy, as an OEM and IPG-branded product.

Technology

Our products are based on our proprietary technology platform that we have developed and refined since our formation. The following technologies are key elements in our products.

Specialty Optical Fibers

We have extensive expertise in the disciplines and techniques that form the basis for the multi-clad active and passive optical fibers used in our products. We believe that our large portfolio of specialty active and passive optical fibers has a number of advantages as compared to other commercially available optical fibers.

Semiconductor Diode Laser Processing and Packaging Technologies

We use multiple multi-mode, or broad area, single-emitter diodes rather than diode bars or stacks as a pump source. We believe that multi-mode single-emitter diodes are efficient and reliable pumping source presently available, surpassing diode bars and stacks in efficiency, brightness and reliability. Single-emitter diodes have substantially reduced cooling requirements and typically have long lifetimes at high operating currents, compared to typical lifetimes of diode bars.

We developed advanced molecular beam epitaxy techniques to grow alumina indium gallium arsenide wafers for our diodes. This method yields high-quality optoelectronic material for low-defect density and high uniformity of optoelectronic parameters. In addition, we have developed numerous proprietary wafer processes and testing and qualification procedures in order to create a high energy output in a reliable and high power diode. Our diode is packaged to dissipate heat produced by the diode and withstands vibration, shock, high temperature, humidity and other environmental conditions, enabling world-class reliability and efficiency of the products.

Specialty Components and Combining Techniques

We developed a wide range of advanced optical components that are capable of handling high optical power levels and contribute to the superior performance, efficiency and reliability of our products. In addition to fibers and diodes, our optical component portfolio includes fiber gratings, couplers, isolators, combiners, and crystals. We also developed special methods and expertise in splicing fibers together with low optical energy loss and on-line loss testing. We believe that our internal

development and manufacturing of key optical components allows us to lower our manufacturing costs and improve product performance.

Side Pumping of Fibers and Fiber Block Technologies

Our technology platform allows us to efficiently combine a large number of multi-mode single-emitter semiconductor diodes with our active optical fibers that are used in all of our products. A key element of this technology is that we pump our fiber lasers through the cladding surrounding the active core. We splice our specialty active optical fibers with other optical components and package them in a sealed box, which we call a fiber block. The fiber blocks are compact and are designed to eliminate the risk of contamination or misalignment due to mechanical vibrations and shocks as well as temperature or humidity variations. Our design is scalable and modular, permitting us to make products with high output power by coupling a large number of diodes with fiber blocks, which can be combined in parallel and serially.

High-Stress Testing

We employ high-stress techniques in testing components and final products that help increase reliability and accelerate product development. For example, we test all of our diodes with high current and temperatures to accelerate aging. We also have built a large database of diode test results that allows us to predict the estimated lifetime of our diodes. This testing allows us to eliminate defective diodes prior to further assembly and thus increase reliability.

Research and Development

We focus our research and development efforts on designing and introducing new and improved standard and customized products and complementary products, and the mass production of components for our products. In addition to our cladding-pumped specialty fiber platform, we have core competencies in high power multi-mode and single-mode semiconductor laser diodes, diode packaging, specialty active and passive optical fibers, high-performance optical components, crystal growth and processing, fiber gain blocks and fiber modules, thin film optical coatings, as well as splicing and combining techniques and high-stress test methods. The strategy of developing our proprietary components has allowed us to leverage our optical experience and large volume requirements to lower the cost of our products.

Our research and development efforts are also directed at expanding our product line by increasing power levels, improving beam quality and electrical efficiency, decreasing the size of our products and lowering the cost per watt. We also are engaged in research projects to expand the spectral range of products that we offer. We are also investing our research and development funds on laser systems, products for medical applications, and telecommunications products and components. We have assembled a team of scientists and engineers with specialized experience and knowledge in fiber lasers and amplifiers, materials science, optics, critical components, testing and manufacturing process design, and laser application development. Our team of experienced scientists and engineers works closely with many of our customers to develop and introduce custom products and laser processing that address specific applications and performance requirements.

We incurred research and development costs of approximately $130.0 million, $122.8 million and $100.9 million for the years ended December 31, 2019, 2018 and 2017, respectively. We expect to continue our commitment to research and development and to introduce new products, systems and complementary products. See Item 7, "Management's Discussion and Analysis of Financial Condition of Results of Operations."

Intellectual Property

We rely on the technical expertise, creativity, and knowledge of our personnel, and therefore, we utilize trade secret, patent, trademark, copyright and contractual protections to maintain our competitive position and protect our proprietary rights in our products and technology. While our intellectual property rights are important to our success, we believe that our business as a whole is not materially dependent on any particular patent, trademark, copyright or other intellectual property right. IPG has used, registered or applied to register a number of trademark registrations in the United States and in other countries.

As of December 31, 2019, we have over 400 patents issued and over 450 pending patent applications worldwide. Intellectual property rights, including those that we own, those that we license and those of others, involve significant risks. See Item 1A, "Risk Factors-In the past, we were subject to litigation alleging that we infringed third-party intellectual property rights. Intellectual property claims could result in costly litigation and harm our business" and "Risk Factors-Our inability to protect our intellectual property and proprietary technologies could result in the unauthorized use of our technologies by third parties, hurt our competitive position and adversely affect our operating results."

Manufacturing

Vertical integration is one of our core business strategies through which we control our proprietary processes and technologies as well as the supply of key components and assemblies. Our vertically integrated manufacturing operations include optical preform making, specialty fiber drawing, semiconductor wafer growth, diode processing and packaging, specialty optical component manufacturing, fiber block and fiber module assembly for different power units, circuit boards, software and electronics development and production including power supplies, crystal growth, cleaning and polishing, chiller production, fabrication of metal parts, housings, cabinets and casings, and final assembly of finished product. In addition, we make some of the testing, tool manufacturing and automated production systems that we use in our own manufacturing processes. Over the last several years, we added additional production capabilities, including multi-wafer growth reactors, diode test stations, fiber preform and fiber drawing equipment and low, mid and high power laser production and testing, in order to increase our capacity as well as reduce the risks associated with our production process.

We operate our own semiconductor foundry for the production of the multi-mode single-emitter diodes. We also process, package and extensively test all of our diodes. We developed proprietary components and accessories, manufacturing tools, equipment and techniques over many years in an effort to address the major issues that had been inhibiting the development of fiber laser technology and to provide products that differentiate us from our competitors. In addition, we have acquired the technology to produce additional components, such as volume Bragg gratings and crystals. Using our technology platform, we configure standard laser and amplifier products based upon each customer's specifications. We have developed proprietary testing methodologies that allow us to develop higher power components and products in short periods of time, enable us to introduce products to the market more quickly, capitalize on new opportunities and provide superior service to our customers. In our materials process systems business, we manufacture standard configuration systems and also systems customized for specific customer requirements. We purchase common and specialized mechanical, electrical and optical parts and raw materials from vendors.

Sales, Marketing and Support

We market our products internationally primarily through our direct sales force. Our direct sales force sells to end users, OEMs and systems integrators. Once our fiber laser products are designed into an OEMs' system, the OEM's sales force markets its systems, allowing us to take advantage of numerous OEMs' sales forces, each typically having several sales persons in locations other than where our sales offices are located. We have sales offices in the countries in which we have major manufacturing: United States, Germany and Russia.

We also have sales and service offices and application development centers in the Americas, Europe and Asia. To a lesser extent, we market through agreements with independent sales representatives and distributors.

Customers

We sell our products globally to OEMs, system integrators and end users in a wide range of diverse markets who have the in-house engineering capability to integrate our products into their own systems. We also sell complete laser and non-laser solutions to end users for their production needs. We have thousands of customers worldwide. We estimate that in 2019, approximately 49%, 17% and 8% of our net sales were generated from sales for cutting, welding and brazing, and marking and engraving applications, respectively. In 2018, approximately 57%, 16% and 9% and in 2017, approximately 54%, 20% and 9% of our net sales were generated from sales for cutting, welding and brazing, and marking and engraving applications, respectively. These estimates are based upon customer information and when customer information has not been provided, upon our best information and belief.

The following table shows the allocation of our net sales (in thousands) among our principal markets:

	Year Ended December 31,					
	2019		2018		2017	
		% of Total		% of Total		% of Total
Materials processing	$ 1,229,211	93.5 %	$ 1,374,448	94.1 %	$ 1,332,607	94.6 %
Other applications	85,370	6.5	85,426	5.9	76,282	5.4
Total	$ 1,314,581	100.0 %	$ 1,459,874	100.0 %	$ 1,408,889	100.0 %

One of our customers, Han's Laser, headquartered in China, accounted for 9%, 12% and 13% of our net sales in 2019, 2018 and 2017, respectively. No other customer accounted for 10% or more of our net sales in 2019, 2018 or 2017.

Competition

Our markets are highly competitive and characterized by rapidly changing technology, continuously evolving customer requirements and reduced average selling prices over time. In the materials processing market, we compete with makers of fiber lasers and other lasers, such as Coherent, Inc., Laserline GmbH, Lumentum Holdings Inc., Maxphotonics Co., Ltd., nLight, Inc., Raycus Fiber Laser Technologies Co. Ltd., and Trumpf GmbH + Co. KG, as well as other smaller competitors. Our current or potential customers may develop and produce products for their own use which are competitive to our products. Such vertical integration could reduce the market opportunity for our products. Many of our fiber laser competitors are increasing the output powers of their fiber lasers to compete with our products.

We also compete with end users that produce their own laser technology as well as with manufacturers of non-laser methods and tools, such as traditional non-laser welding and cutting dies in the materials processing market. Some of our competitors are larger than we are and have substantially greater financial, managerial and technical resources, more extensive distribution and service networks, greater sales and marketing capacity, and larger installed customer bases than we do.

Backlog

At December 31, 2019, our backlog of orders (generally scheduled for shipment within one year) was approximately $693.4 million compared to $712.3 million at December 31, 2018. At December 31, 2019, our backlog included $285.1 million of orders with firm shipment dates and $408.3 million of frame agreements that we expect to ship within one year, compared to $338.7 million of orders with firm shipment dates and $373.6 million of frame agreements at December 31, 2018. Frame agreements are non-binding indications of customer pricing and volume levels but are not firm customer purchase obligations. Orders used to compute backlog are generally cancellable without substantial penalties or any penalties. We anticipate shipping a substantial majority of the present backlog during fiscal year 2020. However, our backlog at any given date is not necessarily indicative of actual sales for any future period.

Employees

As of December 31, 2019, we had approximately 5,960 full-time employees, including 670 in research and development, 4,490 in manufacturing and service operations, 350 in sales and marketing, and 450 in general and administrative functions. Of our total full-time employees at our principal facilities, approximately 2,120 were in the United States, 1,220 were in Germany, 1,770 were in Russia and 230 were in China. We have never experienced a work stoppage, and none of our employees are subject to a collective bargaining agreement. We believe that our current relations with our employees are good.

Executive Officers of the Registrant

The following table sets forth certain information regarding our executive officers as of February 20, 2020:

Name	Age	Position with the Company
Valentin P. Gapontsev, Ph.D.	80	Chief Executive Officer and Chairman of the Board
Eugene A. Scherbakov, Ph.D.	72	Chief Operating Officer, Managing Director of IPG Laser GmbH, Senior Vice President, Europe, and Director
Timothy P.V. Mammen	50	Chief Financial Officer and Senior Vice President
Angelo P. Lopresti	56	General Counsel, Secretary and Senior Vice President
Alexander Ovtchinnikov, Ph.D.	59	Senior Vice President, Components
Trevor D. Ness	47	Senior Vice President, World Wide Sales and Marketing
Igor Samartsev	56	Chief Technology Officer and Director
Felix Stukalin	58	Senior Vice President, North America Operations

Valentin P. Gapontsev, Ph.D. has been the Chief Executive Officer and Chairman of the Board of IPG since our inception. Prior to founding the company in 1990, Dr. Gapontsev served as senior scientist in laser material physics and head of the laboratory at the Soviet Academy of Science's Institute of Radio Engineering and Electronics in Moscow. In 2006 he was awarded the Ernst & Young® Entrepreneur of the Year Award for Industrial Products and Services in New England and in 2009, he was awarded the Arthur L. Schawlow Award by the Laser Institute of America. In 2011 he received the Russian Federation National Award in Science and Technology, and he was selected as a Fellow of the Optical Society of America. Dr. Gapontsev holds a Ph.D. in Laser Materials from the Moscow Institute of Physics and Technology.

Eugene A. Scherbakov, Ph.D. has served as Chief Operating Officer since February 2017, Managing Director of IPG Laser GmbH, our German subsidiary, since August 2000 and Senior Vice President, Europe, since 2013. He served as the Technical Director of IPG Laser from 1995 to August 2000. From 1983 to 1995, Dr. Scherbakov was a senior scientist in fiber optics and head of the optical communications laboratory at the General Physics Institute, Russian Academy of Science in

Moscow. Dr. Scherbakov graduated from the Moscow Physics and Technology Institute with an M.S. in Physics. In addition, Dr. Scherbakov attended the Russian Academy of Science in Moscow, where he received a Ph.D. in Quantum Electronics from its Lebedev Physics Institute and a Dr.Sci. degree in Laser Physics from its General Physics Institute.

Igor Samartsev has served as our Chief Technology Officer since 2011. Prior to that, he was the Deputy General Manager of our Russian subsidiary, NTO IRE-Polus since 2005 and after having served in technical leadership roles at NTO IRE-Polus. Mr. Samartsev holds an M.S. in Physics from the Moscow Institute of Physics and Technology.

Timothy P.V. Mammen has served as our Chief Financial Officer since July 2000 and as Vice President since November 2000. He was promoted to Senior Vice President in February 2013. Between May 1999 and July 2000, Mr. Mammen served as the Group Finance Director and General Manager of the United Kingdom operations for IPFD. Mr. Mammen was Finance Director and General Manager of United Partners Plc, a commodities trading firm, from 1995 to 1999 and, prior to that, he worked in the finance department of E.I. du Pont de Nemours and Company. Mr. Mammen holds an Upper Second B.Sc. Honours degree in International Trade and Development from the London School of Economics and Political Science. He is a Chartered Accountant and a member of the Institute of Chartered Accountants of Scotland.

Angelo P. Lopresti has served as our General Counsel and Secretary and one of our Vice Presidents since February 2001. He was promoted to Senior Vice President in February 2013. Prior to joining us, Mr. Lopresti was a partner at the law firm of Winston & Strawn LLP from 1999 to 2001. He was a partner at the law firm of Hertzog, Calamari & Gleason from 1998 to 1999 and an associate there from 1991 to 1998. He is on the board of Coastway Bancorp, Inc., the holding company of Coastway Community Bank. Mr. Lopresti holds a B.A. in Economics from Trinity College and a J.D. from the New York University School of Law.

Alexander Ovtchinnikov, Ph.D., has served as our Vice President, Components, since September 2005 and as Director of Material Sciences from October 2001 to September 2005. He was promoted to Senior Vice President in February 2013. Prior to joining us, Dr. Ovtchinnikov was Material Science Manager of Lasertel, Inc., a maker of high-power semiconductor lasers, from 1999 to 2001. For 15 years prior to joining Lasertel, Inc., he worked on the development and commercialization of high power diode pump technology at the Ioffe Institute, Tampere University of Technology, Coherent, Inc. and Spectra-Physics Corporation. He holds an M.S. in Electrical Engineering from the Electrotechnical University of St. Petersburg, Russia, and a Ph.D. from Ioffe Institute of the Russian Academy of Sciences.

Trevor D. Ness has served as our Senior Vice President, World Wide Sales and Marketing, since February 2013. From January 2011 until February 2013, he served as our Vice President-Asian Operations. Prior to joining us, Mr. Ness was Director of GSI Precision Technologies China from May 2005 to December 2010 and prior to that he held technical sales management roles with GSI Group, Inc. and Cobham Plc, located in UK, Japan and Taiwan. Mr. Ness holds a B.S. in Geology from Imperial College, a H.N.C. from Bournemouth University and an M.B.A. from The Open University.

Felix Stukalin has served as our Senior Vice President, North America Operations, since February 2013. From March 2009 until February 2013, he served as our Vice President, Devices. Prior to joining us, he was Vice President, Business Development of GSI Group Inc. from April 2002 to September 2008, and from March 2000 to April 2002 he was Vice President of Components and President of the Wave Precision divisions of GSI Lumonics, Mr. Stukalin holds a B.S. in Mechanical Engineering from the University of Rochester and he is a graduate of the Harvard Business School General Management Program.

Seasonality

Our net sales can fluctuate from quarter to quarter with general economic trends, specific industry cycles, holidays in foreign countries such as Lunar New Year in the first quarter of our fiscal year and the timing of capital expenditures by our customers. Historically, our net sales have been higher in the second half of the year than in the first half of the year, although that trend did not occur in 2018 and 2019 due to a decrease in capital equipment spending in Europe and China caused by slower macro-economic growth and uncertainty caused by the trade war between the United States and China.

Government Regulation

Regulatory Compliance

The majority of our laser and amplifier products sold in the United States are classified as Class IV Laser Products under the applicable rules and regulations of the Center for Devices and Radiological Health ("CDRH") of the U.S. Food and Drug Administration ("FDA"). The same classification system is applied in the European markets. Safety rules are formulated with "Deutsche Industrie Norm" (i.e., German Industrial Standards) or International Organization for Standardization ("ISO") standards, which are internationally harmonized. CDRH regulations generally require a self-certification procedure pursuant to

which a manufacturer must submit a filing to the CDRH with respect to each product incorporating a laser device, make periodic reports of sales and purchases and comply with product labeling standards, product safety and design features and informational requirements.

Environmental Regulation

Our operations are subject to various federal, state, local and international laws governing the environment, including those relating to the storage, use, discharge, disposal, product composition and labeling of, human exposure to and hazardous and toxic materials. In the event of an accident involving such materials, we could be liable for damages and such liability could exceed the amount of our liability insurance coverage and the resources of our business.

We face increasing complexity in our product design and procurement operations due to the evolving nature of environmental compliance regulations and standards, as well as specific customer compliance requirements. These regulations and standards have an impact on the material composition of our products entering specific markets. For example, the European Union ("EU") adopted the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), and China enacted the Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation (China-RoHS). In addition to these regulations and directives, we may face costs and liabilities in connection with product take-back legislation.

Availability of Reports

Our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and any amendments to such reports are available free of charge on our web site at www.ipgphotonics.com as soon as reasonably practicable after such reports are electronically filed with, or furnished to, the Securities and Exchange Commission ("SEC"). The SEC maintains an internet site that contains reports, proxy and information statements and other information regarding issuers that file electronically with the SEC at www.sec.gov. We will also provide electronic or paper copies of such reports free of charge, upon request made to our Corporate Secretary. The information included on our website is not a part of, nor is it incorporated by reference into, this annual report on Form 10-K.

ITEM 1A. *RISK FACTORS*

The factors described below are the principal risks that could materially adversely affect our operating results and financial condition. Other factors may exist that we do not consider significant based on information that is currently available. In addition, new risks may emerge at any time and we cannot predict those risks or estimate the extent to which they may affect us.

Downturns in the markets we serve, particularly materials processing, could have a material adverse effect on our sales and profitability.

Our business depends substantially upon capital expenditures by manufacturers in the materials processing market, which includes general manufacturing, automotive, aerospace, other transportation, heavy industry, electronics and photovoltaic industries. Approximately 94% of our revenues in 2019 were from customers in the materials processing market. Although applications in this market are broad, sales for these applications are cyclical and have historically experienced sudden and severe downturns and periods of oversupply, resulting in significantly reduced demand for capital equipment, including the products that we manufacture and market. For example, our sales decreased by 25% in the materials processing market in 2009 as a result of the global economic recession and our material processing sales declined 10% in the second half of 2018 and 11% in the 2019 fiscal year, in part due to decreased capital equipment demand stemming from adverse changes to U.S.-China relations, including rounds of tariff increases and retaliations. For the foreseeable future, our operations will continue to depend upon capital expenditures by customers in these industries or markets, which, in turn, depend upon the demand, as well as forecasted demand, for their products or services. A softening of demand for our customers' products and services, whether caused by a weakening of the U.S. or global economies or other factors, may result in decreased revenue or growth for our customers and may lead to decreased demand for our products, which would reduce our sales and margins. We may not be able to respond by decreasing our expenses quickly enough or sufficiently, due in part, to our fixed overhead structure related to our vertically integrated operations and our commitments to continuing investment in research and development and infrastructure for long term growth.

Uncertainty and adverse changes in the general economic conditions of markets in which we participate negatively affect our business.

Current and future conditions in the economy have an inherent degree of uncertainty. As a result, it is difficult to estimate the level of growth or contraction for the economy as a whole. It is even more difficult to estimate growth or contraction in

various parts, sectors and regions of the economy, including the materials processing, telecommunications, advanced and medical markets and applications in which we participate. Because all components of our budgeting and forecasting are dependent upon estimates of growth or contraction in the markets and applications we serve and demand for our products, the prevailing economic uncertainties render estimates of future income and expenditures very difficult to make. A significant portion of our sales are to customers in China, which accounted for 37%, 43% and 44% in 2019, 2018 and 2017, respectively. A slowing of economic growth or recession, tariff-trade wars or other adverse economic developments or uncertainty in any of our key markets, including in China, may result in a decrease in our sales. Adverse changes have occurred and may occur in the future as a result of declining or flat global or regional economic conditions, fluctuations in currency and commodity prices, wavering confidence, capital expenditure reductions, unemployment, declines in stock markets, contraction of credit availability, declines in real estate values, or other factors affecting economic conditions generally. These changes may negatively affect the sales of our products, increase exposure to losses from bad debts, increase the cost and decrease the availability of financing, increase the risk of loss on investments, or increase costs associated with manufacturing and distributing products. An economic downturn could have a material adverse effect on our business, financial condition and results of operations.

The markets for our products are highly competitive and increased competition could result in reduced sales, reduced gross margins or the loss of market share.

The industries in which we operate are characterized by significant price and technological competition. We compete with makers of fiber lasers, solid-state lasers, direct diode lasers, high power CO_2, YAG and disc lasers. These include public and private companies such as Coherent, Inc., Laserline GmbH, Lumentum Holdings Inc., Maxphotonics Co., Ltd., nLight, Inc., Raycus Fiber Laser Technologies Co. Ltd., and Trumpf GmbH + Co. KG, as well as other smaller competitors. Many of our fiber laser competitors are increasing the output powers and improving quality of their fiber lasers and decreasing prices to compete with our products. Several of these are larger and have substantially greater financial, managerial and technical resources, more extensive distribution and service networks, greater sales and marketing capacity, and larger installed customer bases than we do. Also, we compete with widely used non-laser production methods, such as water-jet cutting and resistance welding. Our current or potential customers may determine to develop and produce products for their own use which are competitive to our products. Such vertical integration could reduce the market opportunity for our products. We also compete in the materials processing, advanced and medical applications markets with end users that produce their own solid-state and gas lasers as well as with manufacturers of non-laser methods and tools, such as traditional non-laser welding and cutting dies in the materials processing market and scalpels in the medical market.

We may not be able to successfully differentiate our current and proposed products from our competitors' products and current or prospective customers may not consider our products to be superior to competitors' products. To maintain our competitive position, we believe that we will be required to continue a high level of investment in research and development, application development, manufacturing facilities and customer service and support, and to react to market pricing conditions. As a result of the foregoing factors, we expect that competitive pressures may result in price reductions, reduced margins, loss of sales and loss of market share.

The laser and amplifier industries are experiencing declining average selling prices, which could cause our gross margins to decline and harm our operating results.

Our products are experiencing and may in the future continue to experience a significant decline in average selling prices ("ASPs") as a result of new product and technology introductions, increased competition and price pressures from significant customers. Newer market participants, particularly in China, have reduced and may continue to reduce, prices of competing products to gain market share. If the ASPs of our products decline further and we are unable to increase our unit volumes, introduce new or enhanced products with higher margins or reduce manufacturing costs to offset anticipated decreases in the prices of our existing products, our operating results may be adversely affected. In addition, because of our significant fixed costs, we are limited in our ability to reduce total costs quickly in response to any revenue shortfalls. Because of these factors, we have experienced and we may experience in the future material adverse fluctuations in our operating results on a quarterly or annual basis if the ASPs of our products continue to decline.

Our level of sales depends upon our ability to penetrate new applications and end markets for fiber lasers and increase our market share in existing applications.

Our level of sales will depend on our ability to generate sales of fiber lasers in new and developing markets and applications for lasers where they have not been used previously and in applications in which other lasers, such as CO_2 and YAG lasers, have been used. To date, a significant portion of our revenue growth has been derived from sales of fiber lasers primarily for applications where CO_2 and YAG lasers historically have been used. We have made significant sales into the

cutting, welding and marking and engraving applications, large applications where the use of other laser technologies was well established. As fiber lasers reach higher levels of penetration in core materials processing applications, the development of new applications, end markets and products outside our core applications becomes more important to our ability to generate sales. In order to maintain or increase market demand for our products, we will need to devote substantial resources to:

- demonstrate the effectiveness of fiber lasers in new applications for materials processing, medical, communications or other applications such as cinema and projection;
- successfully develop new product lines, such as UV, visible and ultrafast fiber lasers, with competitive features that extend our product line;
- increase our direct and indirect sales efforts;
- effectively meet growing competition and pricing pressures; and
- continue to reduce our manufacturing costs and enhance our competitive position.

Potential customers may have substantial investments and know-how related to their existing laser and non-laser technologies. They may perceive risks relating to the reliability, quality, usefulness and profitability of integrating of fiber lasers in their systems when compared to other laser or non-laser technologies available in the market or that they manufacture themselves. Despite fiber lasers having better performance and prices compared to other lasers or tools, OEM customers may be reluctant to switch incumbent suppliers or we may miss the design cycles of our customers. Many of our target markets, such as the automotive, machine tool and other manufacturing, communications and medical industries, have historically adopted new technologies slowly. These markets often require long test and qualification periods or lengthy government approval processes before adopting new technologies.

If we are unable to successfully implement our strategy to develop new applications and end markets for our products or develop new products, our revenues, operating results and financial condition could be adversely affected. In addition, any newly developed or enhanced products may not achieve market acceptance or may be rendered obsolete or less competitive by the introduction of new products by other companies.

Our vertically integrated business results in high levels of fixed costs and inventory levels that may adversely impact our gross profits and our operating results in the event that demand for our products declines or we maintain excess inventory levels.

We have a high fixed cost base due to our vertically integrated business model, including the fact that approximately 75% of our approximately 5,960 employees as of December 31, 2019 were employed in our manufacturing operations. We may not adjust these fixed costs quickly enough or sufficiently to adapt to rapidly changing market conditions. Our gross profit, in absolute dollars and as a percentage of net sales, is impacted by our sales volume, the corresponding absorption of fixed manufacturing overhead expenses and manufacturing yields. In addition, because we are a vertically integrated manufacturer and design and manufacture our key specialty components, insufficient demand for our products may subject us to the risks of high inventory carrying costs and increased inventory obsolescence. If our capacity and production levels are not properly sized in relation to expected demand, we may need to record write-downs for excess or obsolete inventory. Because we are vertically integrated, the rate at which we turn inventory has historically been low when compared to our cost of sales. We do not expect this to change significantly in the future and believe that we will have to maintain a relatively high level of inventory compared to our cost of sales. As a result, we expect to have a significant amount of working capital invested in inventory. Changes in our level of inventory lead to an increase in cash generated from our operations when inventory is sold or a decrease in cash generated from our operations at times when the amount of inventory increases. Decreases in inventory may decrease our overhead absorption and decrease our gross margins and profitability.

Our manufacturing capacity and operations may not be appropriate for future levels of demand and may adversely affect our gross margins.

We have added and are continuing to add substantial manufacturing capacity at our facilities in the United States, Germany, Russia and Belarus. A significant portion of our manufacturing facilities and production equipment, such as our semiconductor production and processing equipment, diode packaging equipment and diode burn-in stations, are special-purpose in nature and cannot be adapted easily to make other products. If the demand for fiber lasers or amplifiers does not increase or if our revenue decreases from current levels, we may have significant excess manufacturing capacity and under-absorption of our fixed costs, which could in turn adversely affect our gross margins and profitability.

To maintain our competitive position and to meet anticipated demand for our products, we invest significantly in the expansion of our manufacturing and operations throughout the world and may do so in the future. We had capital expenditures

of $134 million and $160 million in 2019 and 2018, respectively, and we expect to incur approximately $115 million to $125 million in capital expenditures, excluding acquisitions, in 2020. In connection with these projects, we may incur cost overruns, construction delays, project cancellations, labor difficulties or regulatory issues which could cause our capital expenditures to be higher than what we currently anticipate, possibly by a material amount, which would in turn adversely impact our operating results. Moreover, we may experience higher costs due to yield loss, production inefficiencies and equipment problems until any operational issues associated with the opening of new manufacturing facilities are resolved.

A few customers account for a significant portion of our sales, and if we lose any of these customers or they significantly curtail their purchases of our products, our results of operations could be adversely affected.

We rely on a few customers for a significant portion of our sales. In the aggregate, our top five customers accounted for 21%, 26% and 28% of our consolidated net sales in 2019, 2018 and 2017, respectively. Our largest customer is located in China and accounted for 9%, 12% and 13% of sales in 2019, 2018 and 2017, respectively. A few of our larger customers are making fiber lasers or announced plans to develop fiber lasers. We generally do not enter into agreements with our customers obligating them to purchase our fiber lasers or amplifiers. Our business is characterized by short-term purchase orders and shipment schedules. If any of our principal customers discontinues its relationship with us, replaces us as a vendor for certain products or suffers downturns in its business, our business and results of operations could be adversely affected.

Foreign currency risk may negatively affect our net sales, cost of sales and operating margins and could result in exchange losses.

We conduct our business and incur costs in the local currency of most countries in which we operate. In 2019 our net sales outside the United States represented a substantial majority of our total sales. We incur currency transaction risk whenever one of our operating subsidiaries enters into either a purchase or a sales transaction using a different currency from the currency in which it operates or holds assets or liabilities in currencies different than their functional currency. Changes in exchange rates can also affect our results of operations when the value of sales and expenses of foreign subsidiaries are translated to U.S. dollars. We cannot accurately predict the impact of future exchange rate fluctuations on our results of operations. Further, given the volatility of exchange rates, we may not be able to effectively manage our currency risks, and any volatility in currency exchange rates may increase the price of our products in local currency to our foreign customers or increase the manufacturing cost of our products, which may have an adverse effect on our financial condition, cash flows and profitability.

Our inability to manage risks associated with our international customers and operations could adversely affect our business.

We have significant facilities in and our products are sold in numerous countries. Our principal markets include China, the United States, Germany, Switzerland, Japan, Italy, Korea, Turkey and Russia. A substantial majority of our revenues are derived from customers outside the United States. In addition, we have substantial tangible assets outside of the United States. We anticipate that foreign sales will continue to account for a significant portion of our revenues in the foreseeable future. Our operations and sales in these markets are subject to risks inherent in international business activities, including the following and others mentioned in the Risk Factors:

- fluctuations in the values of foreign currencies;
- changes, including recession, and other general economic uncertainties affecting the macroeconomic and local economic communities in which we and our customers operate or serve;
- longer accounts receivable collection periods and less developed credit assessment and collection procedures;
- compliance with domestic and foreign laws and regulations, unexpected changes in those laws and regulatory requirements, including uncertainties regarding taxes, tariffs, quotas, export controls, export licenses, trade sanctions and other trade barriers, and any corresponding retaliatory actions by affected countries, including China and Russia;
- certification requirements;
- less effective protection of intellectual property rights in some countries;
- potentially adverse tax consequences;
- different capital expenditure and budget cycles for our customers, which affect the timing of their spending;
- political, legal and economic instability, foreign conflicts, labor unrest and the impact of regional and global infectious illnesses in the countries in which we and our customers, suppliers, manufacturers and subcontractors are located;
- preference for locally produced products;

- difficulties and costs of staffing and managing international operations across different geographic areas and cultures;
- seasonal reductions in business activities;
- fluctuations in freight rates and transportation disruptions;
- investment restrictions or requirements;
- repatriation restrictions or requirements;
- export and import restrictions; and
- limitations on the ability of our employees to travel without restriction to certain countries in which we operate.

Political, economic and monetary instability and changes in governmental regulations or policies, including trade tariffs and protectionism, could adversely affect both our ability to effectively operate our foreign sales offices and the ability of our foreign suppliers to supply us with required materials or services. Any interruption or delay in the supply of our required components, products, materials or services, or our inability to obtain these components, materials, products or services from alternate sources at acceptable prices and within a reasonable amount of time, could impair our ability to meet scheduled product deliveries to our customers and could cause customers to cancel orders.

We are subject to risks of doing business in Russia through our subsidiary, NTO IRE-Polus, which provides components and test equipment to us and sells finished fiber devices to customers in Russia and neighboring countries as well as finished lasers to China. Further, approximately 37% of our sales in 2019 were to customers in China. We are also investing in manufacturing facilities in Belarus. The results of our operations, business prospects and facilities in these three countries are subject to the economic and political environment in Russia, China and Belarus. In recent years, these countries have undergone substantial political, economic and social change. As is typical of an emerging economy, none of these three countries possess a well-developed business, financial, legal and regulatory infrastructure that would generally exist in a more mature free market economy. In addition, tax, currency and customs legislation is subject to varying interpretations and changes, which can occur frequently. The future economic direction of these emerging market countries remains largely dependent upon the effectiveness of economic, financial and monetary measures undertaken by the government, together with tax, legal, regulatory and political developments. Our failure to manage the risks associated with our operations in Russia, China and Belarus and our other existing and potential future international business operations could have a material adverse effect upon our results of operations.

We must comply with and could be impacted by various export controls and trade and economic sanctions laws and regulations that are fluid and may change due to diplomatic and political considerations outside of our control.

Our business activities are subject to various export controls and trade and economic sanctions laws and regulations, including, without limitation, the U.S. Commerce Department’s Export Administration Regulations, the U.S. Treasury Department’s Office of Foreign Assets Control’s trade and economic sanctions programs, the U.S. Department of State’s Nonproliferation Sanctions, as well as those of the European Community and Germany, which we collectively refer to as Trade Controls.

We have a large manufacturing facility and research and development operations in Russia which supplies components to our U.S. and German manufacturing facilities and finished lasers to our subsidiary in China. In addition, we supply components from our U.S. and German manufacturing facilities to our Russian facility. Should there be any disruption of our supplies from or to our Russian operations, or should the United States, the European Union or Russia implement new or broad-based Trade Controls, our production and/or deliveries as well as results of operations would be affected. Although we have implemented compliance measures designed to prevent transactions prohibited by current or future Trade Controls, our failure to successfully comply with applicable Trade Controls may expose us to negative legal and business consequences, including civil or criminal penalties, government investigations, and reputational harm.

In addition, Trade Controls and their implementation are fluid and may change due to diplomatic and political considerations outside of our control. Such changes, including the potential expansion of sanctions and sanctions designations, as well as public statements by government officials, could be significant, require us to take certain actions to be in compliance, adversely affect prevailing market prices of our common stock, have a reputational impact, or otherwise have a material adverse impact on us, our business, and our ability to raise capital.

We have experienced, and expect to experience in the future, fluctuations in our quarterly operating results. These fluctuations may increase the volatility of our stock price and may be difficult to predict.

We have experienced, and expect to continue to experience, fluctuations in our quarterly operating results. We believe that fluctuations in quarterly results may cause the market price of our common stock to fluctuate, perhaps substantially. Factors which may have an influence on our operating results in a particular quarter include those below and others included in the Risk Factors:

- general economic conditions and uncertainties in the macroeconomic and local economies in which we or our customers operate and serve;
- the increase, decrease, cancellation or rescheduling of significant customer orders;
- the timing of revenue recognition based on the installation or acceptance of certain products shipped to our customers;
- the timing of customer qualification of our products and commencement of volume sales of systems that include our products;
- the gain or loss of a key customer;
- product or customer mix;
- competitive pricing pressures and new market entrants;
- our ability to design, manufacture and introduce new products on a cost-effective and timely basis;
- our ability to manage our inventory levels and any provisions for excess or obsolete inventory;
- our ability to collect outstanding accounts receivable balances;
- incurring expenses to develop and improve application and support capabilities, the benefits of which may not be realized until future periods, if at all;
- incurring expenses related to impairment of values for goodwill, intangibles and other long-lived assets;
- different capital expenditure and budget cycles for our customers, which affect the timing of their spending;
- expenses associated with acquisition-related activities;
- foreign currency fluctuations;
- health pandemic; and
- our ability to control expenses.

These factors make it difficult for us to accurately predict our operating results. In addition, our ability to accurately predict our operating results is complicated by the fact that many of our products have long sales cycles, some lasting as long as twelve months or more. Once a sale is made, our delivery schedule typically ranges from four weeks to four months, and therefore our sales will often reflect orders shipped in the same quarter that they are received and will not enhance our ability to predict our results for future quarters. In addition, long sales cycles may cause us to incur significant expenses without offsetting revenues since customers typically expend significant effort in evaluating, testing and qualifying our products before making a decision to purchase them. Moreover, customers may cancel or reschedule shipments, and production difficulties could delay shipments. Accordingly, our results of operations are subject to significant fluctuations from quarter to quarter, and we may not be able to accurately predict when these fluctuations will occur.

Because we lack long-term purchase commitments from our customers, our sales can be difficult to predict, which could lead to excess or obsolete inventory and adversely affect our operating results.

We generally do not enter into long-term agreements with our customers obligating them to purchase our fiber lasers or amplifiers. Our business is characterized by short-term purchase orders and shipment schedules and, in some cases, orders may be canceled or delayed without significant penalty or any penalty. As a result, it is difficult to forecast our revenues and to determine the appropriate levels of inventory required to meet future demand. In addition, due to the absence of long-term volume purchase agreements, we forecast our revenues and plan our production and inventory levels based upon the demand forecasts of our OEM customers, end users and distributors, which are highly unpredictable and can fluctuate substantially. This could lead to increased inventory levels and increased carrying costs and risk of excess or obsolete inventory due to unanticipated reductions in purchases by our customers. In addition, provisions have been recorded as a result of changes in market prices of certain components, the value of those inventories that was realizable through finished product sales due to declines in certain end market demand and uncertainties related to the recoverability of the value of inventories due to technological and product changes, and excess quantities. In this regard, we recorded provisions for slow-moving, obsolete or excess inventory totaling $38.9 million, $13.0 million and $16.9 million in 2019, 2018 and 2017, respectively. If our OEM customers, end users or distributors fail to accurately forecast the demand for our products, fail to accurately forecast the timing

of such demand, or are unable to consistently negotiate acceptable purchase order terms with customers, our results of operations may be adversely affected.

We are highly dependent on the significant experience and specialized expertise of our CEO, COO and other senior management and scientific staff. The unavailability or loss of one or more of these key employees or our failure to attract other highly skilled personnel necessary to compete successfully could harm our business and results of operations.

Our future success is substantially dependent on the continued service and performance of our executive officers, particularly our founder and chief executive officer, Dr. Valentin P. Gapontsev, age 80, and our chief operating officer, Dr. Eugene Scherbakov, age 72. They play key roles setting our strategic direction, directing the development of new technologies and maintaining our culture. The unavailability of either key executive could have a material impact on our business. Although the board engages in executive succession planning, our inability to effectively and immediately transition knowledge or responsibilities to their successors in the event of an unexpected absence or departure could harm our business and disrupt our operations. We also rely on our highly trained team of scientists, many of whom have numerous years of experience and specialized expertise in optical fibers, semiconductors and optical component technology, and other key engineering, sales, marketing, manufacturing and support personnel, any of whom may depart for a variety of reasons, which could harm our business. The members of our scientific staff who are expected to make significant individual contributions to our business are also members of our executive management team. We will need to continue to recruit and retain highly skilled scientists and engineers for certain functions. Competition for qualified personnel in our industry is intense, particularly for physicists, software engineers and other technical staff. If we fail to attract, integrate and retain the necessary personnel, it could delay the development or introduction of new products, negatively impact our ability to market, sell or support our products, and significantly harm our business.

We pursue acquisitions and investments in new businesses, products, patents or technologies. These involve risks which could disrupt our business and may harm our financial results and condition.

We make acquisitions of and investments in new businesses, products, patents and technologies and expand into new geographic areas, or we may acquire operations, products or technologies that expand our current capabilities. Although we have pursued acquisitions small in size in the past, we may pursue larger transactions in the future. Acquisitions present a number of potential risks and challenges that could, if not met, disrupt our business operations, increase our operating costs, reduce consolidated margins, cause us to incur impairment charges and reduce the value of the acquired company, asset or technology to us. We may not be able to effectively integrate acquired businesses, business cultures, products, patents or technologies into our existing business and products, or retain key employees. As a result of the rapid pace of technological change in our industry, we may misjudge the long-term potential of an acquired business, product, patent or technology, or the acquisition may not be complementary to our existing business. Furthermore, potential acquisitions and investments, whether or not consummated, may divert our management's attention, require considerable cash outlays at the expense of our existing operations, incur unanticipated costs or liabilities, including the costs associated with improving the internal controls of the acquired company. In addition, to complete future acquisitions, we may issue equity securities, incur debt, assume contingent liabilities or have amortization expenses and write-downs of acquired assets, which could adversely affect our profitability and result in dilution to our existing and future stockholders.

We may incur impairments to goodwill or long-lived assets, which would negatively affect our results of operations.

We review our goodwill for impairment annually and other long-lived assets, including intangible assets identified in business combinations whenever events or changes in circumstances indicate that the carrying amount of these assets may not be recoverable. Negative industry or economic trends, including reduced estimates of future cash flows, disruptions to our business, slower growth rates, lack of growth in our relevant business units or differences in the estimated product acceptance rates could lead to impairment charges against our long-lived assets, including goodwill and other intangible assets. For example, we recorded a non-cash impairment charge of $37.1 million in 2019.

Our valuation methodology for assessing impairment requires management to make significant judgments and assumptions based on historical experience and to rely heavily on projections of future operating performance at many points during the analysis. Also, the process of evaluating the potential impairment of goodwill is subjective. We operate in a highly competitive environment and projections of future operating results and cash flows may vary significantly from actual results. Additionally, if our analysis indicates potential impairment to goodwill in one or more of our business units, we may be required to record additional charges to earnings in our financial statements, which could negatively affect our results of operations.

In the past, we were subject to litigation alleging that we infringed third-party intellectual property rights. Intellectual property claims could result in costly litigation and harm our business.

There has been significant litigation involving intellectual property rights in many technology-based industries, including our own. We face risks and uncertainties in connection with such litigation, including the risk that patents issued to others may harm our ability to do business; that there could be existing patents of which we are unaware that could be pertinent to our business; and that it is not possible for us to know whether there are patent applications pending that our products might infringe upon. Moreover, the frequency with which new patents are granted and the diversity of jurisdictions in which they are granted make it impractical and expensive for us to monitor all patents that may be relevant to our business.

From time to time, we have been notified of allegations and claims that we may be infringing patents or intellectual property rights owned by third parties. We have defended against several patent infringement litigations in the past and we engage in patent office opposition proceedings internationally for patents owned by others.

There can be no assurance that we will be able to dispose without a material effect any claims or other allegations made or asserted in the future. Even if we ultimately are successful on the merits of any such litigation or re-examination, legal and administrative proceedings related to intellectual property are typically expensive and time-consuming, generate negative publicity and divert financial and managerial resources. Some litigants may have greater financial resources than we have and may be able to sustain the costs of complex intellectual property litigation more easily than we can.

If we do not prevail in any intellectual property litigation brought against us, it could affect our ability to sell our products and materially harm our business, financial condition and results of operations. These developments could adversely affect our ability to compete for customers and increase our revenues. Plaintiffs in intellectual property cases often seek, and sometimes obtain, injunctive relief. Intellectual property litigation commenced against us could force us to take actions that could be harmful to our business, including the following:

- stop selling our products or using the technology that contains the allegedly infringing intellectual property;
- pay actual monetary damages, royalties, lost profits or increased damages and the plaintiff's attorneys' fees; and
- attempt to license the relevant intellectual property which may not be available on reasonable terms.

In addition, intellectual property lawsuits can be brought by third parties against OEMs and end users that incorporate our products into their systems or processes. In some cases, we indemnify OEMs against third-party infringement claims relating to our products and we often make representations affirming, among other things, that our products do not infringe the intellectual property rights of others. As a result, we may incur liabilities in connection with lawsuits against our customers. Any such lawsuits, whether or not they have merit, could be time-consuming to defend, damage our reputation or result in substantial and unanticipated costs.

Our inability to protect our intellectual property and proprietary technologies could result in the unauthorized use of our technologies by third parties, hurt our competitive position and adversely affect our operating results.

We rely on patents, trade secret laws, contractual agreements, technical know-how and other unpatented proprietary information to protect our products, product development and manufacturing activities from unauthorized copying by third parties. Our patents do not cover all of our technologies, systems, products and product components and may not prevent third parties from unauthorized copying of our technologies, products and product components. We have significant international operations and are subject to foreign laws which differ in many respects from U.S. laws. Policing unauthorized use of our trade secret technologies throughout the world and proving misappropriation of our technologies are particularly difficult, especially due to the number of our employees and operations in numerous foreign countries. The steps that we take to acquire ownership of our employees' inventions and trade secrets in foreign countries may not have been effective under all such local laws, which could expose us to potential claims or the inability to protect intellectual property developed by our employees. Furthermore, any changes in, or unexpected interpretations of, the trade secret and other intellectual property laws in any country in which we operate may adversely affect our ability to enforce our trade secret and intellectual property positions. Costly and time-consuming litigation could be necessary to determine the scope of our confidential information and trade secret protection. However, there can be no assurance that confidentiality agreements we enter into with consultants, suppliers, employees and others will not be breached, that we will be able to effectively enforce them or that we will have adequate remedies for any breach.

Given our reliance on trade secret laws, others may independently develop similar or alternative technologies or duplicate our technologies and commercialize discoveries that we have made. Therefore, our intellectual property efforts may be insufficient to maintain our competitive advantage or to stop other parties from commercializing similar products or technologies. Many countries outside of the United States afford little or no protection to trade secrets and other intellectual

property rights. Intellectual property litigation can be time-consuming and expensive, and there is no guarantee that we will have the resources to fully enforce our rights. If we are unable to prevent misappropriation or infringement of our intellectual property rights, or the independent development or design of similar technologies, our competitive position and operating results could suffer.

We depend upon internal production and on outside single or limited-source suppliers for many of our key components and raw materials, including cutting-edge optics and materials. Any interruption in the supply of these key components and raw materials could adversely affect our results of operations.

We rely exclusively on our own production capabilities to manufacture certain of our key components, such as semiconductor diodes, specialty optical fibers and optical components. We do not have redundant production lines for some of our components, such as our diodes, specialty optical fibers and some other components, which are made at a single manufacturing facility. These are not readily available from other sources at our current costs any may not be available at all. If our manufacturing activities were obstructed or hampered significantly, it could take a considerable length of time, or it could increase our costs, for us to resume manufacturing or find alternative sources of supply. Many of the tools and equipment we use are custom-designed, and it could take a significant period of time to repair or replace them. Our three major manufacturing facilities are located in Massachusetts, Germany and Russia. We are building additional manufacturing in Belarus. Despite our efforts to mitigate the impact of any flood, fire, natural disaster, political unrest, act of terrorism, war, outbreak of disease or other similar event, our business could be adversely affected to the extent that we do not have redundant production capabilities if any of our major manufacturing facilities or equipment should become inoperable, inaccessible, damaged or destroyed.

Also, we purchase certain raw materials used to manufacture our products and other components, such as semiconductor wafer substrates, diode packages, modulators, micro-optics, bulk optics and high power beam delivery products, from single or limited-source suppliers. We typically purchase our components and materials through purchase orders or agreed-upon terms and conditions and we do not have guaranteed supply arrangements with many of these suppliers. These suppliers are relatively small private companies that may discontinue their operations at any time and may be particularly susceptible to prevailing economic conditions. Some of our suppliers are also our competitors. Some of our suppliers may not be able to meet demand from our growing business or because of global demand for their components. As a result, we experienced and may in the future experience longer lead times or delays in fulfillment of our orders. Furthermore, other than our current suppliers, there are a limited number of entities from whom we could obtain these supplies. We do not anticipate that we would be able to purchase these components or raw materials that we require in a short period of time or at the same cost from other sources in commercial quantities or that have our required performance specifications. Any interruption or delay in the supply of any of these components or materials, or the inability to obtain these components and materials from alternate sources at acceptable prices and within a reasonable amount of time, could adversely affect our business. If our suppliers face financial or other difficulties, if our suppliers do not maintain sufficient inventory on hand or if there are significant changes in demand for the components and materials we obtain from them, they could limit the availability of these components and materials to us, which in turn could adversely affect our business.

We depend on our OEM customers and system integrators to incorporate our products into their systems.

Our sales depend in part on our ability to maintain existing and secure new OEM customers. Our revenues also depend in part upon the ability of our current and potential OEM customers and system integrators to incorporate our laser and amplifier products. The commercial success of these systems depends to a substantial degree on the efforts of these OEM customers and system integrators to develop and market products that incorporate our technologies. Relationships and experience with traditional laser makers, limited marketing resources, reluctance to invest in research and development and other factors affecting these OEM customers and third-party system integrators could have a substantial impact upon our financial results. If OEM customers or integrators are not able to adapt existing tools or develop new systems to take advantage of the features and benefits of fiber lasers or if they perceive us to be an actual or potential competitor, then the opportunities to increase our revenues and profitability may be severely limited or delayed. In addition, some of our OEM customers are developing their own fiber laser sources. If they are successful, this may reduce our sales to these customers. Furthermore, if our OEM customers or third-party system integrators experience financial or other difficulties that adversely affect their operations, our financial condition or results of operations may also be adversely affected.

Changes in tax rates, tax liabilities or tax accounting rules could affect future results.

As a global company, we are subject to taxation in the United States and various other countries and jurisdictions. Significant judgment is required to determine worldwide tax liabilities. Our future tax rates could be affected by changes in the composition of earnings in countries or states with differing tax rates, transfer pricing rules, changes in the valuation of our deferred tax assets and liabilities, or changes in the tax laws. In addition, we are subject to regular examination of our income

tax returns by the Internal Revenue Service ("IRS") and other tax authorities. From time to time the United States, foreign and state governments make substantive changes to tax rules and the application of rules to companies, including various announcements from the United States government potentially impacting our ability to defer taxes on international earnings. We regularly assess the likelihood of favorable or unfavorable outcomes resulting from these examinations to determine the adequacy of our provision for income taxes. Although we believe our tax estimates are reasonable, there can be no assurance that any final determination will not be materially different than the treatment reflected in our historical income tax provisions and accruals, which could materially and adversely affect our operating results and financial condition.

Our products could contain defects, which may reduce sales of those products, harm market acceptance of our fiber laser and other products or result in claims against us.

The manufacture of our products involves highly complex and precise processes. Despite testing by us and our customers, errors have been found, and may be found in the future, in our products. These defects may cause us to incur significant warranty, support and repair costs, incur additional costs related to a recall, divert the attention of our engineering personnel from our product development efforts and harm our relationships with our customers. These problems could result in, among other things, loss of revenues or a delay in revenue recognition, loss of market share, harm to our reputation or a delay or loss of market acceptance of our fiber laser products. Additionally, a recall, particularly in our products used or incorporated in medical devices, could result in significant costs and lost sales and customers, enforcement actions and/or investigations by state and federal governments or other enforcement bodies, as well as negative publicity and damage to our reputation that could reduce future demand for our products. The development and sale of medical devices and component products involves an inherent risk of product liability claims. Defects, integration issues or other performance problems in our fiber laser and other products could also result in personal injury or financial or other damages to our customers, which in turn could damage market acceptance of our products and result in significant product liability claims being brought against us. A product liability claim brought against us, even if unsuccessful, could be time-consuming and costly to defend. If a product liability action were determined against us, it could result in significant damages, including punitive damages, and our consolidated financial position, results of operations or cash flows could be materially adversely affected.

If we or our third-party vendors fail to comply with FDA regulations or similar legal requirements in foreign jurisdictions relating to the manufacturing of our products or any component part, we may be subject to fines, injunctions and penalties, and our ability to commercially distribute and sell our products may be negatively impacted.

We sell our commercial fiber and diode laser modules, subassemblies and systems to OEMs that incorporate them into their medical products. Our ultrafast, CW and QCW fiber lasers and diode laser systems can be used in various medical and biomedical applications. With respect to such products, some of our manufacturing facilities, and the manufacturing facilities of any of our third-party component manufacturers or critical suppliers, are required to comply with the FDA’s Quality System Regulation (“QSR”), which sets forth minimum standards for the procedures, execution and documentation of the design, testing, production, control, quality assurance, labeling, packaging, sterilization, storage, and shipping of the products we sell in the medical industry, and related regulations, including Medical Device Reporting (“MDR”) regulations regarding reporting of certain malfunctions and adverse events potentially associated with our products. The FDA may evaluate our compliance with the QSR, MDR and other regulations, among other ways, through periodic announced or unannounced inspections which could disrupt our operations and interrupt our manufacturing. If in conducting an inspection of our manufacturing facilities, or the manufacturing facilities of any of our third-party component manufacturers or critical suppliers, an FDA investigator observes conditions or practices believed to violate the QSR, the investigator may document their observations on a Form FDA 483 that is issued at the conclusion of the inspection. A manufacturer that receives an FDA 483 may respond in writing and explain any corrective actions taken in response to the inspectional observations. The FDA will typically review the facility’s written response and may re-inspect to determine the facility’s compliance with the QSR and other applicable regulatory requirements. Failure to take adequate and timely corrective actions to remedy objectionable conditions listed on an FDA 483 could result in the FDA taking administrative or enforcement actions. Among these may be the FDA’s issuance of a Warning Letter to a manufacturer, which informs it that the FDA considers the observed violations to be of “regulatory significance” that, if not corrected, could result in further enforcement action.

FDA enforcement actions, which include seizure, injunction, criminal prosecution, and civil penalties, could result in total or partial suspension of a facility’s production and/or distribution, product recalls, fines, suspension of the FDA’s review of product applications, and/or the FDA’s issuance of adverse publicity. Thus, an adverse inspection could force a shutdown of our manufacturing operations for products servicing the medical industry or a recall of such products. Adverse inspections could also delay FDA approval of our products for the medical industry.

We may experience lower than expected manufacturing yields, which would adversely affect our gross margins.

The manufacture of semiconductor diodes and the packaging of them is a highly complex process. Manufacturers often encounter difficulties in achieving acceptable product yields from diode and packaging operations. We have from time to time experienced lower than anticipated manufacturing yields for our diodes and packaged diodes. This occurs during the production of new designs and the installation and start-up of new process technologies and new equipment. If we do not achieve planned yields, our product costs could increase resulting in lower gross margins, and key component availability would decrease.

Failure to maintain effective internal controls may cause a loss of investor confidence in the reliability of our financial statements or to cause us to delay filing our periodic reports with the SEC and adversely affect our stock price.

The SEC, as directed by Section 404 of the Sarbanes-Oxley Act of 2002, adopted rules requiring public companies to include a report of management on internal control over financial reporting in their annual reports on Form 10-K that contain an assessment by management of the effectiveness of our internal control over financial reporting. In addition, our independent registered public accounting firm must attest to and report on the effectiveness of our internal control over financial reporting. We have experienced rapid growth and have extensive and complex international manufacturing and sales and service locations which may make us more vulnerable to weaknesses in our internal controls. Although we test our internal control over financial reporting in order to ensure compliance with the Section 404 requirements, our failure to maintain adequate internal controls over financial reporting could result in an adverse reaction in the financial marketplace due to a loss of investor confidence in the reliability of our financial statements or a delay in our ability to timely file our periodic reports with the SEC, which ultimately could negatively impact our stock price.

Our information systems are subject to cyber-attacks, interruptions and failures. If unauthorized access is obtained to our information systems, we may incur significant legal and financial exposure and liabilities.

Like many multinational corporations, we maintain several information technology systems, including software products licensed from third parties. These systems vary from country to country. Any system, network or internet failures, misuse by system users, the hacking into or disruption caused by the unauthorized access by third parties or loss of license rights could disrupt our ability to timely and accurately manufacture and ship products or to report our financial information in compliance with the timelines mandated by the SEC. Any such failure, misuse, hacking, disruptions or loss would likely cause a diversion of management's attention from the underlying business and could harm our operations. In addition, a significant failure of our various information technology systems could adversely affect our ability to complete an evaluation of our internal controls and attestation activities pursuant to Section 404 of the Sarbanes-Oxley Act of 2002 under the updated framework issued in 2013.

As part of our day-to-day business, we store our data and certain data about our customers, employees and service providers in our information technology system. While our system is designed with access security, if a third party gains unauthorized access to our data or technology, including information regarding our customers, employees and service providers, such security breach could expose us to a risk of loss of this information, loss of business, litigation and possible liability. Our security measures may be breached as a result of third-party action, including intentional misconduct by computer hackers, employee error, malfeasance or otherwise. Additionally, third parties may attempt to fraudulently induce employees or customers into disclosing sensitive information such as user names, passwords or other information in order to gain access to our customers' data or our data, including our intellectual property and other confidential business information, employee information or our information technology systems. Because the techniques used to obtain unauthorized access, or to sabotage systems, change frequently and generally are not recognized until launched against a target, we may be unable to anticipate or detect these techniques or to implement adequate preventative measures. Any unauthorized access could result in a loss of confidence by our customers, damage our reputation, disrupt our business, result in a misappropriation of our assets (including cash), lead to legal liability and negatively impact our future sales. Additionally, such actions could result in significant costs associated with loss of our intellectual property, impairment of our ability to conduct our operations, rebuilding our network and systems, prosecuting and defending litigation, responding to regulatory inquiries or actions, paying damages or taking other remedial steps. In addition, we may incur significant costs designed to prevent or mitigate the damage related to cybersecurity incidents. For instance, we may retain additional employees or consultants, implement new policies and procedures, and install information technology to detect and prevent identity theft, data breaches, or system disruptions. We would incur any such costs with the intent that proactively preventing a cybersecurity incident ultimately helps to mitigate potential cybersecurity liability.

The costs to address the foregoing security problems and security vulnerabilities before or after a cyber-incident could be significant. Our remediation efforts may not be successful and could result in interruptions, delays, a cessation of service, and a loss of existing or potential customers, impeding our sales, manufacturing, distribution, and other critical functions.

We may face particular privacy, data security and data protection risks due to laws and regulations regulating the protection or security of personal and other sensitive data.

We may face particular privacy, data security and data protection risks due to laws and regulations regulating the protection or security of personal and other sensitive data, including in particular several laws and regulations that have recently been enacted or adopted or are likely to be enacted or adopted in the future. For instance, effective May 25, 2018, the European General Data Protection Regulation ("GDPR") imposes additional obligations and risk upon our business and increases substantially the penalties to which we could be subject in the event of any non-compliance. GDPR requires companies to satisfy new requirements regarding the handling of personal data (generally, of EU residents), including its use, protection and the rights of affected persons regarding their data. Failure to comply with GDPR requirements could result in penalties of up to 4% of worldwide revenue. In addition, several other jurisdictions around the world have recently enacted privacy laws or regulations similar to GDPR. For instance, California enacted the California Consumer Privacy Act ("CCPA"), which is effective January 1, 2020 and which gives consumers many of the same rights as those available under GDPR. Several laws similar to the CCPA have been proposed in the United States at both the federal and state level. GDPR and other similar laws and regulations, as well as any associated inquiries or investigations or any other government actions, may be costly to comply with, result in negative publicity, increase our operating costs, require significant management time and attention, and subject us to remedies that may harm our business. We are evaluating its processes and taking measures to ensure compliance with all applicable privacy and data protection-related laws and regulations. Due to the lack of experience with the interpretation and enforcement of many of these laws and regulations, some measures initially might not satisfy standard or best practices that will be established in the coming years.

We are subject to government regulations, including tariffs, duties and export control regulations, that could restrict our international sales and negatively affect our business.

A significant part of our business involves the export and import of components and products among many countries, including the U.S., Germany, Russia and China. The U.S. government has in place a number of laws and regulations that control the export, re-export or transfer of U.S.-origin products, software and technology. The governments of other countries in which we do business have similar regulations regarding products, software and technology originating in those countries. These laws and regulations may require that we obtain a license before we can export, re-export or transfer certain products, software or technology. The requirement to obtain a license could put us at a competitive disadvantage by restricting our ability to sell products to customers in certain countries or by giving rise to delays or expenses related to obtaining a license. We have experienced and, in the future, may experience delays in obtaining export licenses based on issues solely within the control of the applicable government agency. Licenses may also include conditions that limit the use, resale, transfer, re-export, modification, disassembly, or transfer of a product, software or technology after it is exported without first obtaining permission from the relevant government agency. Failure to comply with these laws and regulations could result in government sanctions, including substantial monetary penalties, denial of export privileges, debarment from government contracts and a loss of revenues. Delays in obtaining or failure to obtain required export licenses may require us to defer shipments for substantial periods or cancel orders. Any of these circumstances could adversely affect our operations and, as a result, our financial results could suffer.

The United States, Germany, the European Union, China, Japan, South Korea and many other foreign governments impose tariffs and duties on the import and export of products, including some of those which we sell. The U.S. has recently instituted and proposed changes in trade policies that include the negotiation or termination of trade agreements, the imposition of higher tariffs on imports into the United States, including, in particular, on Chinese goods, economic sanctions on individuals, corporations or countries and other government regulations affecting trade between the United States and other countries where we conduct our business. We have seen a drop in demand for our products, particularly in the materials processing market as result.

These policy changes and proposals could require time-consuming and expensive alterations to our business operations and may result in greater restrictions and economic disincentives on international trade, which could negatively impact our competitiveness in jurisdictions around the world as well as lead to an increase in costs in our supply chain. We are a multinational corporation, with manufacturing located both in the United States and internationally and with approximately 80% of our net sales arising from foreign customers. As such, we may be more susceptible to negative impacts from these tariffs or change in trade policies than other less internationally focused enterprises. In addition, new tariffs and other changes in U.S. trade policy could trigger retaliatory actions by affected countries, and certain foreign governments, including the Chinese government (which has imposed retaliatory tariffs on a range of U.S. goods including certain optical and electronic products and components), have instituted or are considering imposing trade sanctions on certain U.S. manufactured goods. Such changes by the United States and other countries have the potential to adversely impact U.S. and worldwide economic conditions, our industry and the global demand for our products, and as a result, could negatively affect our business, financial condition and results of operations.

We are subject to various environmental laws and regulations that could impose substantial costs upon us and may adversely affect our business, operating results and financial condition.

Some of our operations use substances regulated under various federal, state, local and international laws governing the environment, including those relating to the storage, use, discharge, disposal, product composition and labeling of, and human exposure to, hazardous and toxic materials. We could incur costs, fines and civil or criminal sanctions, third-party property damage or personal injury claims, or could be required to incur substantial investigation or remediation costs, if we were to violate or become liable under environmental laws. Compliance with current or future environmental laws and regulations could restrict our ability to expand our facilities or require us to acquire additional expensive equipment, modify our manufacturing processes, or incur other significant expenses in order to remain in compliance with such laws and regulations. There can be no assurance that violations of environmental laws or regulations will not occur in the future as a result of the lack of, or failure to obtain, permits, human error, accident, equipment failure or other causes.

We are exposed to credit risk and fluctuations in the market values of our cash, cash equivalents and marketable securities.

Given the global nature of our business, we have both domestic and international investments. At December 31, 2019, 63% of our cash, cash equivalents and marketable securities were in the United States and 37% were outside the United States. Credit ratings and pricing of our investments can be negatively affected by liquidity, credit deterioration, prevailing interest rates, financial results, economic risk, political risk, sovereign risk or other factors. Also, our investments may be negatively affected by events that impact the banks or depositories that hold our investments. As a result, the value and liquidity of our cash, cash equivalents and marketable securities may fluctuate substantially. Therefore, although we have not realized any significant losses on our cash, cash equivalents and marketable securities, future fluctuations in their value could result in a significant realized loss.

Our ability to access financial markets to raise capital or finance a portion of our working capital requirements and support our liquidity needs may be adversely affected by factors beyond our control and could negatively impact our ability to finance our operations, meet certain obligations, implement our operating strategy or complete acquisitions.

We occasionally borrow under our existing credit facilities to fund operations, including working capital investments. Our major credit lines in the United States and Germany expire in April 2020 and July 2020, respectively. Uncertainty or disruptions in financial markets may negatively impact our ability to access additional financing or to refinance our existing credit facilities or existing debt arrangements on favorable terms or at all, which could negatively affect our ability to fund current and future expansion as well as future acquisitions and development. These disruptions may include turmoil in the financial services industry, unprecedented volatility in the markets where our outstanding securities trade, changes in reference rates for interest such as the scheduled discontinuation of LIBOR in 2021 and general economic downturns in the areas where we do business. If we are unable to access funds at competitive rates, or if our short-term or long-term borrowing costs increase, our ability to finance our operations, meet our short-term obligations and implement our operating strategy could be adversely affected. We also may in the future be required to raise capital through public or private financing or other arrangements. Such financing may not be available on acceptable terms, or at all, and our failure to raise capital when needed could harm our business.

Dr. Valentin P. Gapontsev, our Chairman and Chief Executive Officer, and three trusts he created collectively control approximately 31% of our voting power and have a significant influence on the outcome of director elections and other matters requiring stockholder approval, including a change in corporate control.

Dr. Valentin P. Gapontsev, our Chairman and Chief Executive Officer, and IP Fibre Devices (UK) Ltd., of which Dr. Gapontsev is the managing director, together with three trusts he created beneficially own approximately 31% of our common stock. Trustees of the trusts are officers or employees of the Company. Dr. Gapontsev and the trusts have a significant influence on the outcome of matters requiring stockholder approval, including election of our directors and approval of significant corporate transactions. Dr. Gapontsev and the trusts may vote their shares of our common stock in ways that are adverse to the interests of other holders of our common stock. These significant ownership interests could delay, prevent or cause a change in control of the Company and might affect the market price of our common stock.

Provisions in our charter documents and Delaware law, and our severance arrangements, could prevent or delay a change in control of our company, even if a change in control would be beneficial to our stockholders.

Provisions of our certificate of incorporation and by-laws, including certain provisions that will take effect when Dr. Valentin P. Gapontsev (together with his affiliates and associates) ceases to beneficially own an aggregate of 25% or more

of our outstanding voting securities, may discourage, delay or prevent a merger, acquisition or change of control, even if it would be beneficial to our stockholders. The existence of these provisions could also limit the price that investors might be willing to pay in the future for shares of our common stock. These provisions include:

- authorizing the issuance of "blank check" preferred stock;
- establishing a classified board and providing that directors thereon may only be removed for cause;
- providing that directors fill board vacancies;
- prohibiting stockholder action by written consent;
- limiting the ability of stockholders to call a special meeting of stockholders;
- establishing advance notice requirements for nominations for election to the board of directors and for proposing matters to be submitted to a stockholder vote;
- supermajority stockholder approval to change certificate of incorporation and by-laws and
- lack of cumulative voting for director elections.

Section 203 of the Delaware General Corporation Law, which will apply to the Company following such time as Dr. Gapontsev (together with his affiliates and associates) ceases to beneficially own 25% or more of the total voting power of our outstanding shares, may prohibit business combinations with stockholders owning 15% or more of our outstanding voting stock. The terms of our employment agreements and severance plan with executives include change-of-control severance provisions which provide for the payment of cash following a termination of employment following a change of control. These provisions may discourage, delay or prevent a merger or acquisition, make a merger or acquisition costlier for a potential acquirer, or make removal of incumbent directors or officers more difficult.

ITEM 1B. *UNRESOLVED STAFF COMMENTS*

None.

ITEM 2. *PROPERTIES*

Our significant facilities at December 31, 2019 include the following:

Location	Owned or Leased	Lease Expiration	Approximate Size (sq. ft.)	Primary Activity
Oxford, Massachusetts	Owned	—	502,300	Diodes, components, complete device manufacturing, R&D, administration
Burbach, Germany	Owned	—	499,500	Optical fiber, components, final assembly, complete device manufacturing, R&D administration
Fryazino, Russia	Owned	—	473,700	Manufacturing, R&D, administration
	Leased	January 2020 - June 2021	88,900	Components, complete device manufacturing
Davenport, Iowa	Owned	—	160,300	Systems manufacturing, administration
	Leased	March 2020	46,500	Systems manufacturing, sales, administration
Marlborough, Massachusetts	Owned	—	227,000	Components, manufacturing, applications, sales, R&D, administration

Our corporate headquarters is in Oxford, Massachusetts. As of December 31, 2019, we occupied more than 2.8 million square feet of facilities worldwide. Of this we own 2.2 million square feet and lease 0.6 million square feet of building space, of which the majority is used for manufacturing. We operate three principal manufacturing facilities for fiber lasers, laser systems, fiber amplifiers, and related optical components, which are located in the United States, Germany, and Russia, and we are developing a fourth principal manufacturing location in Belarus. We conduct our major research and development activities in Oxford and Marlborough, Massachusetts; Burbach, Germany; and Fryazino, Russia.

We own additional facilities and land for various purposes, such as sales and support and applications labs. We believe the existing facilities are in good operating condition and are suitable for the conduct of our operations. The productive capacity at our current facilities is substantially utilized. We plan to continue the expansion of our operations and build manufacturing in Germany, the United States and Belarus to meet the demand for our products and our sales and support needs.

ITEM 3. *LEGAL PROCEEDINGS*

From time to time, we are party to various legal claims and legal proceedings and other disputes incidental to our business, such as employment, intellectual property or product issues. For a discussion of the risks associated with intellectual property legal proceedings and other disputes, see Item 1A. "Risk Factors — We are subject to litigation alleging that we are infringing third-party intellectual property rights. Intellectual property claims could result in costly litigation and harm our business."

ITEM 4. *MINE SAFETY DISCLOSURES*

Not applicable.

PART II

ITEM 5. *MARKET FOR THE REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES*

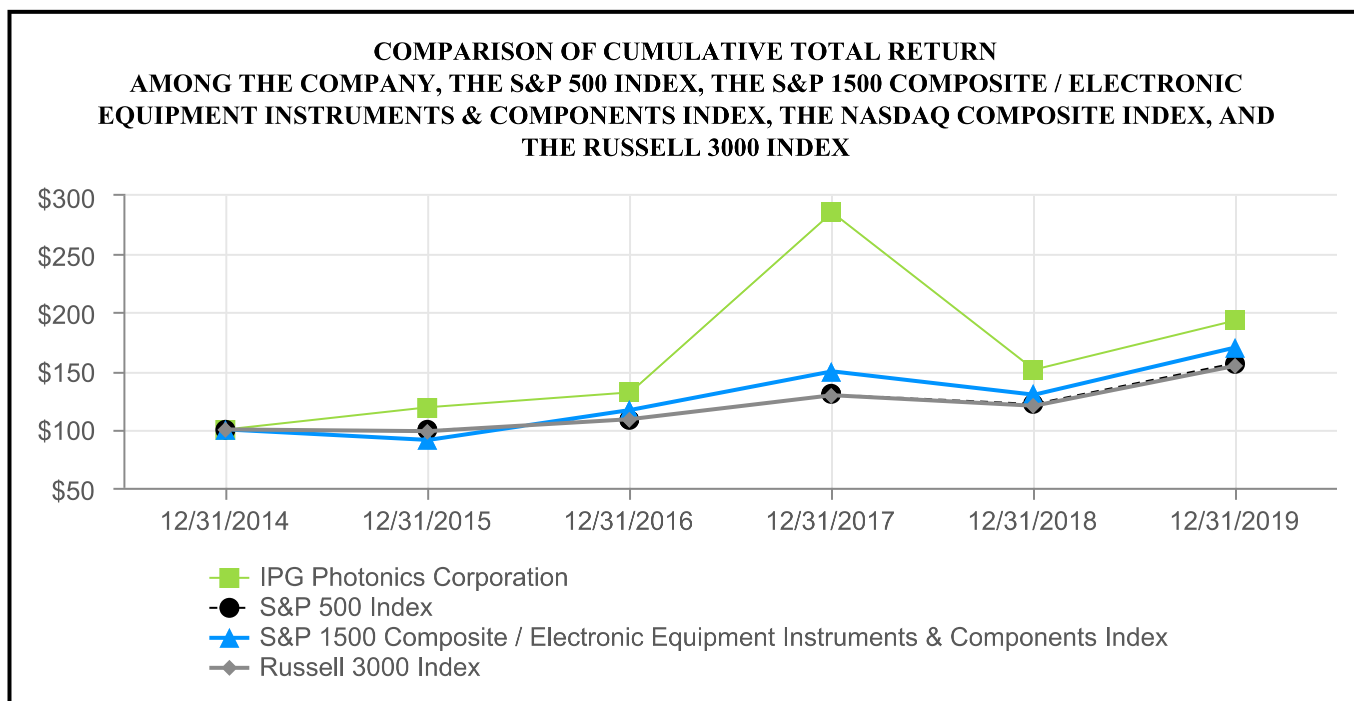
Our common stock is quoted on the Nasdaq Global Select Market under the symbol "IPGP". As of February 21, 2020, there were 53,058,726 shares of our common stock outstanding held by approximately 35 holders of record, which does not include beneficial owners of common stock whose shares are held in the names of various securities brokers, dealers and registered clearing agencies.

Stock Price Performance Graph

The following Stock Price Performance Graph and related information includes comparisons required by the SEC. The graph does not constitute "soliciting material" and should not be deemed "filed" or incorporated by reference into any other filings under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended, except to the extent that we specifically incorporate this information by reference into such filing.

The following graph presents the cumulative shareholder returns for our Common Stock compared with the S&P 500 Index, the S&P 1500 Composite 1500 / Electronic Equipment Instruments & Components Index, and the Russell 3000 Index. We include the S&P 500 Index because we became a member of this index in 2018. We include the Russell 3000 Index and the S&P Composite 1500 / Electronic Equipment Instruments & Components Index because outstanding performance stock units awarded to executive officers use these indexes when comparing total shareholder return. Additionally, we include the S&P Composite 1500 / Electronic Equipment Instruments & Components Index due to being an index member, industry similarities, our internal use to monitor executive compensation, and the fact that it contains several direct competitors.

COMPARISON OF CUMULATIVE TOTAL RETURN AMONG THE COMPANY, THE S&P 500 INDEX, THE S&P 1500 COMPOSITE / ELECTRONIC EQUIPMENT INSTRUMENTS & COMPONENTS INDEX, THE NASDAQ COMPOSITE INDEX, AND THE RUSSELL 3000 INDEX



	Base Period	5-Year Cumulative Total Return				
	12/31/2014	12/31/2015	12/31/2016	12/31/2017	12/31/2018	12/31/2019
IPG Photonics Corporation	$ 100.00	$ 119.01	$ 131.75	$ 285.81	$ 151.21	$ 193.43
S&P 500 Index	$ 100.00	$ 99.27	$ 108.74	$ 129.86	$ 121.76	$ 156.92
S&P 1500 Composite / Electronic Equipment Instruments & Components Index	$ 100.00	$ 91.00	$ 116.67	$ 149.76	$ 129.73	$ 170.33
Russell 3000 Index	$ 100.00	$ 98.53	$ 108.79	$ 129.30	$ 120.26	$ 154.58

The above graph represents and compares the value, through December 31, 2019, of a hypothetical investment of $100 made at the closing price on December 31, 2014 in each of (i) our common stock, (ii) S&P 500 Index, (iii) the S&P 1500 Composite / Electronic Equipment Instruments & Components Index, and (iv) the Russell 3000 Index, in each case assuming the reinvestment of dividends. The stock price performance shown in this graph is not necessarily indicative of, and not is intended to suggest, future stock price performance.

Dividends

We anticipate that we will retain future earnings to support operations, fund acquisitions and to finance the growth and development of our business. Therefore, we do not expect to pay cash dividends in the foreseeable future. Our payment of any future dividends will be at the discretion of our Board of Directors after taking into account any business conditions, any contractual and legal restrictions on our payment of dividends, and our financial condition, operating results, cash needs, growth plans and other factors. In addition, a current agreement with one lender contains a restrictive covenant that prohibits us from paying cash dividends, making any distribution on any class of stock or making stock repurchases if a breach of a financial covenant or an event of default exists or would result from the dividend, distribution or repurchase.

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

There have been no sales of unregistered securities during the past year.

Issuer Purchases of Equity Securities

The following table shows repurchases of our common stock in the fiscal quarter ended December 31, 2019:

Date	Total Number of Shares (or Units) Purchased		Average Price Paid per Share (or Unit)	Total Number of Shares (or Units) Purchased as Part of Publicly Announced Plans or Programs	Maximum Number (or Approximate Dollar Value) of Shares (or Units) that May Yet Be Purchased Under the Plans or Programs
October 1, 2019 — October 31, 2019	26,218	(1), (2)	$ 134.82	26,000	$ 95,573
November 1, 2019 — November 30, 2019	38,569	(1), (2)	141.90	37,767	90,212
December 1, 2019 — December 31, 2019	41,495	(1), (2)	143.25	41,495	84,268
Total	106,282		$ 140.68	105,262	$ 84,268

(1) In 2012, our Board of Directors approved "withhold to cover" as a tax payment method for vesting of restricted stock awards for certain employees. Pursuant to the "withhold to cover" method, we withheld from such employees the shares noted in the table above to cover tax withholding related to the vesting of their awards. For the fourth quarter of 2019, the Company withheld 1,020 shares at an average price of $138.38.

(2) On February 12, 2019, we announced that our Board of Directors authorized a new anti-dilutive stock repurchase program (the "2019 Program"). Under the 2019 Program, we are authorized to repurchase shares of common stock in an amount not to exceed the lesser of (a) the number of shares issued to employees and directors under the Company's various employee and director equity compensation and employee stock purchase plans from January 1, 2019 through December 31, 2020 and (b) $125 million, exclusive of any fees, commissions or other expenses. Share repurchases may be made periodically in open-market transactions using the Company's working capital, and are subject to market conditions, legal requirements and other factors. The 2019 Program authorization does not obligate us to repurchase any dollar amount or number of our shares, and repurchases may be commenced or suspended from time to time without prior notice. We repurchased 105,262 shares in the fourth quarter of 2019 under the 2019 Program.

Information Regarding Equity Compensation Plans

The following table sets forth information with respect to securities authorized for issuance under our equity compensation plans as of December 31, 2019:

Plan Category	Number of Securities to be Issued upon Exercise of Outstanding Options, RSUs and PSUs (a)	Weighted-Average Exercise Price of Outstanding Options, RSUs and PSUs (b)	Number of Securities Remaining Available for Future Issuance under Equity Compensation Plans (Excluding Securities Reflected in Column (a)) (c)
Equity Compensation Plans Approved by Security Holders[1]	2,249,122	$ 117.96	3,508,130
Equity Compensation Plans Not Approved by Security Holders	—		—
Total	2,249,122		3,508,130

[1] As of December 31, 2019, there were 3,172,643 shares available for future issuance under the 2006 Incentive Compensation Plan and 335,487 shares available for future issuance under the employee stock purchase plan.

ITEM 6. *SELECTED FINANCIAL DATA*

The following selected consolidated financial data should be read in conjunction with, and is qualified by reference to, our consolidated financial statements and related notes and Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations" included elsewhere in this Annual Report on Form 10-K. The data as of December 31, 2019 and 2018, and for the years ended December 31, 2019, 2018 and 2017, is derived from our audited consolidated financial statements and related notes included elsewhere in this Annual Report on Form 10-K. The data as of December 31, 2017, 2016 and 2015, and for the years ended December 31, 2016 and 2015, is derived from our audited consolidated financial statements and related notes not included in this Annual Report on Form 10-K. Our historical results are not necessarily indicative of the results for any future period.

	Year Ended December 31,				
	2019	2018	2017	2016	2015
	(In thousands, except per share data)				
Consolidated Statement of Income Data:					
Net sales	$ 1,314,581	$1,459,874	$1,408,889	$1,006,173	$ 901,265
Cost of sales	708,372	659,606	611,978	453,933	409,388
Gross profit	606,209	800,268	796,911	552,240	491,877
Operating expenses:					
Sales and marketing	77,745	57,815	49,801	38,393	31,868
Research and development	129,997	122,769	100,870	78,552	63,334
General and administrative	107,597	102,429	80,668	66,486	57,192
Goodwill impairment	37,120	—	—	—	—
Impairment of long-lived assets and other restructuring charges	7,130	—	—	—	—
Loss (gain) on foreign exchange	12,827	(6,150)	14,460	4,496	(2,560)
Total operating expenses	372,416	276,863	245,799	187,927	149,834
Operating income	233,793	523,405	551,112	364,313	342,043
Interest income (expense), net	14,238	9,057	737	1304	(301)
Other income (expense), net	345	1,933	22	948	(125)
Income before provision for income taxes	248,376	534,395	551,871	366,565	341,617
Provision for income taxes	68,115	130,226	204,283	105,849	99,590
Net income	180,261	404,169	347,588	260,716	242,027
Less: Net income (loss) attributable to non-controlling interests	27	142	(26)	(36)	(127)
Net income attributable to IPG Photonics Corporation	180,234	404,027	347,614	260,752	242,154
Net income attributable to common shareholders	$ 180,234	$ 404,027	$ 347,614	$ 260,752	$ 242,154
Net income per share:					
Basic	$ 3.40	$ 7.55	$ 6.50	$ 4.91	$ 4.60
Diluted	$ 3.35	$ 7.38	$ 6.36	$ 4.85	$ 4.53
Weighted-average shares outstanding:					
Basic	53,061	53,522	53,495	53,068	52,676
Diluted	53,839	54,726	54,699	53,797	53,427
Dividends per common share	$ —	$ —	$ —	$ —	$ —

	As of December 31,				
	2019	2018	2017	2016	2015
	(In thousands)				
Consolidated Balance Sheet Data:					
Cash and cash equivalents	$ 680,070	$ 544,358	$ 909,900	$ 623,855	$ 582,532
Short-term investments	502,546	500,432	206,257	206,779	106584
Working capital, excluding cash and cash equivalents and short-term investments	522,114	514,860	438,950	312,053	271,683
Total assets	2,730,436	2,574,450	2,367,255	1,789,999	1,453,429
Other long-term liabilities	98,121	80,734	100,652	36,365	33,307
Long-term debt, including current portion	41,708	45,378	48,982	40,823	19,667
Non-controlling interests and redeemable non-controlling interests	717	687	—	166	1,137
IPG Photonics Corporation equity	2,401,726	2,205,548	2,022,322	1,557,558	1,259,528

ITEM 7. *MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS*

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with Item 6, "Selected Financial Data" and our consolidated financial statements and related notes included in this Annual Report on Form 10-K. This discussion 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, but not limited to, those discussed under Item 1A, "Risk Factors."

Overview

We develop, manufacture and sell high-performance fiber lasers, fiber amplifiers and diode lasers that are used for diverse applications, primarily in materials processing. We also manufacture and sell complementary products used with our lasers including optical delivery cables, fiber couplers, beam switches, optical processing heads, in-line sensors and chillers. In addition, we offer laser-based and non-laser based systems for certain markets and applications. Our portfolio of laser solutions are used in materials processing, communications, medical and advanced applications. We sell our products globally to original equipment manufacturers ("OEMs"), system integrators and end users. We market our products internationally, primarily through our direct sales force. Our major manufacturing facilities are located in the United States, Germany and Russia. We have sales service offices and applications laboratories worldwide.

We are vertically integrated such that we design and manufacture most of the key components used in our finished products, from semiconductor diodes to optical fiber preforms, finished fiber lasers, amplifiers and complementary products. Our vertically integrated operations allow us to reduce manufacturing costs, control quality, rapidly develop and integrate advanced products and protect our proprietary technology.

Description of Our Net Sales, Costs and Expenses

Net sales. We derive net sales primarily from the sale of fiber lasers, diode lasers, laser and non-laser based systems, amplifiers and complementary products. We sell our products to OEMs that supply materials processing laser systems, communications systems, medical laser systems and other laser systems to end users. We also sell our laser products and laser and non-laser based systems to end users. Our scientists and engineers work closely with OEMs, systems integrators and end users to analyze their system requirements and match appropriate fiber laser, amplifier or system specifications to those requirements. Our sales cycle varies substantially, ranging from a period of a few weeks to as long as one year or more, but is typically several months.

Sales of our products are generally recognized upon shipment, provided that no obligations remain and collection of the receivable is reasonably assured. Sales of customized robotic systems are recognized over time. Our sales typically are made on a purchase order basis rather than through long-term purchase commitments.

We develop our products to standard specifications and use a common set of components within our product architectures. Our major products are based upon a common technology platform. We continually enhance these and other products by improving their components and developing new components and new product designs.

Cost of sales. Our cost of sales consists primarily of the cost of raw materials and components, direct labor expenses and manufacturing overhead. We are vertically integrated and currently manufacture all critical components for our products as well as assemble finished products. We believe our vertical integration allows us to increase efficiencies, leverage our scale and lower our cost of sales. Cost of sales also includes personnel costs and overhead related to our manufacturing, engineering and service operations, related occupancy and equipment costs, shipping costs and reserves for inventory obsolescence and for warranty obligations. Inventories are written off and charged to cost of sales when identified as excess or obsolete.

Due to our vertical integration strategy and ongoing investment in plant and machinery, we maintain a relatively high fixed manufacturing overhead. We may not be able to or choose not to adjust these fixed costs to adapt to rapidly changing market conditions. Our gross margin is therefore significantly affected by our sales volume and the corresponding utilization of capacity and absorption of fixed manufacturing overhead expenses.

Sales and marketing. Our sales and marketing expense consists primarily of costs related to compensation, trade shows, professional and technical conferences, travel, facilities, depreciation of equipment used for demonstration purposes and other marketing costs.

Research and development. Our research and development expense consists primarily of compensation, development expenses related to the design of our products and certain components, the cost of materials and components to build prototype devices for testing and facilities costs. Costs related to product development are recorded as research and development expenses in the period in which they are incurred.

General and administrative. Our general and administrative expense consists primarily of compensation and associated costs for executive management, finance, legal, human resources, information technology and other administrative personnel, outside legal and professional fees, insurance premiums and fees, allocated facilities costs and other corporate expenses such as charges and benefits related to the change in allowance for doubtful debt.

Factors and Trends That Affect Our Operations and Financial Results

In reading our financial statements, you should be aware of the following factors and trends that our management believes are important in understanding our financial performance.

Net sales. Our net sales grew from $1,006.2 million in 2016 to $1,314.6 million in 2019, representing a three year compound annual growth rate of approximately 9%. Net sales growth was driven by increasing demand for our products, partially offset by declines in average sales prices, the introduction of new products, including laser and non-laser systems, high power and ultra-fast pulsed lasers, optical heads and other accessories and the development of new applications for our products some of which displace non-laser technologies. Our annual revenue growth rates have varied. Net sales decreased by 10% in 2019 and increased by 4% and 40%, 2018 and 2017, respectively.

Our business depends substantially upon capital expenditures by end users, particularly by manufacturers using our products for materials processing, which includes general manufacturing, automotive, other transportation, aerospace, heavy industry, consumer, semiconductor and electronics. Approximately 94% of our revenues in 2019 were from customers using our products for materials processing. Although applications within materials processing are broad, the capital equipment market in general is cyclical and historically has experienced sudden and severe downturns. For the foreseeable future, our operations will continue to depend upon capital expenditures by end users of materials processing equipment and will be subject to the broader fluctuations of capital equipment spending.

Our net sales have historically fluctuated from quarter to quarter. The increase or decrease in sales from a prior quarter can be affected by the timing of orders received from customers, the shipment, installation and acceptance of products at our customers' facilities, the mix of OEM orders and one-time orders for products with large purchase prices, competitive pressures, acquisitions, economic and political conditions in a certain country or region and seasonal factors such as the purchasing patterns and levels of activity throughout the year in the regions where we operate. Net sales can be affected by the time taken to qualify our products for use in new applications in the end markets that we serve. The adoption of our products by a new customer or qualification in a new application can lead to an increase in net sales for a period, which may then slow until we penetrate new markets or obtain new customers.

In the recent years, our net sales have been susceptible to negative impacts of tariffs. New tariffs and other changes in U.S. trade policy could trigger retaliatory actions by affected countries, and certain foreign governments, including the Chinese government (which has imposed retaliatory tariffs on a range of U.S. goods including certain optical and electronic products and components). We have seen a drop in demand for our products, particularly in the materials processing market as result.

We are also susceptible to global or regional disruptions such as political instability, geopolitical conflicts, acts of terrorism, significant fluctuations in currency values, natural disasters, macroeconomic concerns and particularly the impact of the 2019 novel coronavirus outbreak that affect the level of capital expenditures or global commerce. The novel coronavirus outbreak is understood to have started in China, which is a large and important market for IPG, with repercussions for other markets. With respect to the 2019 novel coronavirus outbreak specifically, we currently expect that our first quarter 2020 financial results will be negatively impacted, potentially to a material degree. In addition, as of the time of this Annual Report on Form 10-K, we expect that the 2019 novel coronavirus could continue to negatively impact our businesses beyond the first quarter of 2020, but the extent and duration of such impacts over the longer term remain uncertain and dependent on future developments that cannot be accurately predicted at this time, such as the severity and transmission rate of the coronavirus, the extent and effectiveness of containment actions taken, including mobility restrictions and work restrictions, and the impact of these and other factors on our customer base and general commercial activity.

The average selling prices of our products generally decrease as the products mature. These decreases result from factors such as increased competition, decreased manufacturing costs and increases in unit volumes. We may also reduce selling prices in order to penetrate new markets and applications. Furthermore, we may negotiate discounted selling prices from time to time with certain customers that place high unit volume orders.

The secular shift to fiber laser technology in large materials processing applications, such as cutting applications, had a positive effect on our sales trends in the past such that our sales trends were often better than other capital equipment manufacturers in both positive and negative economic cycles. As the secular shift to fiber laser technology matures in such applications, our sales trends are more susceptible to economic cycles which affect other capital equipment manufacturers.

Gross margin. Our total gross margin in any period can be significantly affected by total net sales in any period, by competitive factors, by product mix, and by other factors such as changes in foreign exchange rates relative to the U.S. Dollar, some of which are not under our control. For instance,

- As our products mature, we can experience additional competition which tends to decrease average selling prices and affects gross margin;
- Our gross margin can be significantly affected by product mix. Within each of our product categories, the gross margin is generally higher for devices with greater average power. These higher power products often have better performance, more difficult specifications to attain and fewer competing products in the marketplace;
- Higher power lasers also use a greater number of optical components, improving absorption of fixed overhead costs and enabling economies of scale in manufacturing;
- The gross margin for certain specialty products may be higher because there are fewer or sometimes no equivalent competing products;
- Customers that purchase devices in greater unit volumes generally receive lower prices per device than customers that purchase fewer units. These lower selling prices to high unit volume customers may be partially offset by the improved absorption of fixed overhead costs associated with larger product volumes, which drive economies of scale in manufacturing; and finally,
- Gross margin on systems and communication components can be lower than margins for our laser and amplifier sources, depending on the configuration, volume and competitive forces, among other factors.

We expect that some new technologies, products and systems will have returns above our cost of capital but may have gross margins below our corporate average. If we are able to develop opportunities that are significant in size, competitively advantageous or leverage our existing technology base and leadership, our current gross margin levels may not be maintained. Instead, we aim to deliver industry-leading levels of gross and operating margins by growing our market position across the broader markets we serve.

We invested $133.5 million, $160.3 million and $126.5 million in capital expenditures in 2019, 2018 and 2017, respectively. Most of this investment relates to expansion of our manufacturing capacity and, to a lesser extent, research and development and sales-related facilities.

A high proportion of our costs is fixed so costs are generally difficult to adjust or may take time to adjust in response to changes in demand. In addition, our fixed costs increase as we expand our capacity. If we expand capacity faster than is required by sales growth, gross margins could be negatively affected. Gross margins generally decline if production volumes are lower as a result of a decrease in sales or a reduction in inventory because the absorption of fixed manufacturing costs will be reduced. Gross margins generally improve when the opposite occurs. If both sales and inventory decrease in the same period, the decline in gross margin may be greater if we cannot reduce fixed costs or choose not to reduce fixed costs to match the decrease in the level of production. If we experience a decline in sales that reduces absorption of our fixed costs, or if we have production issues, our gross margins will be negatively affected.

We also regularly review our inventory for items that are slow-moving, have been rendered obsolete or are determined to be excess. Any provision for such slow-moving, obsolete or excess inventory affects our gross margins. For example, we recorded provisions for slow-moving, obsolete or excess inventory totaling $38.9 million, $13.0 million and $16.9 million in 2019, 2018 and 2017, respectively.

Selling and general and administrative expenses. In the past, the Company has invested in selling and general and administrative costs in order to support continued growth in the company. As the secular shift to fiber laser technology matures, our sales growth becomes more susceptible to the cyclical trends typical of capital equipment manufacturers. Accordingly, our future management of and investments in selling and general and administrative expenses will also be influenced by these trends, although we may still invest in selling or general and administrative functions to support certain initiatives even in economic down cycles. Certain general and administrative expenses are not related to the level of sales and may vary quarter to quarter based primarily upon the level of acquisitions and litigation.

Research and development expenses. We plan to continue to invest in research and development to improve our existing components and products and develop new components, products, systems and applications technology. We believe that these investments will sustain our position as a leader in the fiber laser industry and will support development of new products that can address new markets and growth opportunities. The amount of research and development expense we incur may vary from period to period.

Cost reduction program. During the fourth quarter of 2019, IPG implemented a cost reduction program in response to continued global macroeconomic, competitive and geopolitical headwinds. The Company expects to reduce annualized manufacturing and operating expenses by approximately $30 million. As part of this program the Company will reduce global headcount by more than 300 positions and decrease other direct labor costs and expenses. IPG has implemented a hiring freeze and expects limited replacement of workforce attrition to result in further headcount reductions. Refer to Note 6, "Restructuring," for discussion of the 2019 charges associated with this program.

Long-lived assets impairments. We review our intangible assets and property, plant and equipment for impairment when events or changes in circumstances indicate the carrying value may not be recoverable. Goodwill is required to be tested for impairment at least annually. Negative industry or economic trends, including reduced estimates of future cash flows, disruptions to our business, slower growth rates, lack of growth in our relevant business units or differences in the estimated product acceptance rates could lead to impairment charges against our long-lived assets, including goodwill and other intangible assets.

Our valuation methodology for assessing impairment requires management to make significant judgments and assumptions based on historical experience and to rely heavily on projections of future operating performance at many points during the analysis. Also, the process of evaluating the potential impairment of goodwill is subjective. We operate in a highly competitive environment and projections of future operating results and cash flows may vary significantly from actual results. If our analysis indicates potential impairment to goodwill in one or more of our reporting units, we may be required to record charges to earnings in our financial statements, which could negatively affect our results of operations. Further discussion of impairment charges recorded during 2019 can be found in Note 6, "Restructuring," and Note 7, "Goodwill and Intangible Assets."

Foreign exchange. Because we are a U.S. based company doing business globally, we have both translational and transactional exposure to fluctuations in foreign currency exchange rates. Changes in the relative exchange rate between the U.S. dollar and the foreign currencies in which our subsidiaries operate directly affects our sales, costs and earnings. Differences in the relative exchange rates between where we sell our products and where we incur manufacturing and other operating costs (primarily in the U.S., Germany and Russia) also affects our costs and earnings. Certain currencies experiencing significant exchange rate fluctuations like the Euro, the Russian Ruble, the Japanese Yen and Chinese Yuan have had and could have an additional significant impact on our sales, costs and earnings. Our ability to adjust the foreign currency selling prices of products in response to changes in exchange rates is limited and may not offset the impact of the changes in exchange rates on the translated value of sales or costs. In addition, if we increase the selling price of our products in local currencies, this could have a negative impact on the demand for our products.

Major customers. While we have historically depended on a few customers for a large percentage of our annual net sales, the composition of this group can change from year to year. Net sales derived from our five largest customers as a percentage of our annual net sales were 21%, 26% and 28% in 2019, 2018 and 2017, respectively. Our largest customer accounted for 9%, 12% and 13% of our net sales in 2019, 2018 and 2017, respectively. We seek to add new customers and to expand our relationships with existing customers. We anticipate that the composition of our significant customers will continue to change. We generally do not enter into agreements with our customers obligating them to purchase a fixed number or large volume of our fiber lasers or amplifiers. If any of our significant customers were to substantially reduce their purchases from us, our results would be adversely affected.

Critical Accounting Policies and Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States ("GAAP") requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of net sales and expenses. By their nature, these estimates and judgments are subject to an inherent degree of uncertainty. We base our estimates and judgments on our historical experience and on other assumptions that we believe are reasonable under the circumstances, the results of which form the basis for making the judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results could differ from those estimates, which may materially affect our operating results and financial position. We have identified the following items that require the most significant judgment and often involve complex estimation: revenue recognition, inventory valuation, warranty, and accounting for income taxes.

Revenue Recognition — Revenue is recognized when transfer of control to the customer occurs in an amount reflecting the consideration that we expect to be entitled. In order to achieve this core principle, we apply the following five step approach: (1) identify the contract with a customer, (2) identify the performance obligations in the contract, (3) determine the transaction price, (4) allocate the transaction price to the performance obligations in the contract, and (5) recognize revenue when a performance obligation is satisfied.

We allocate the transaction price to each distinct product based on its relative standalone selling price, as more fully described in Note 1, "Nature of Business and Summary of Significant Accounting Policies - Revenue Recognition," in our consolidated financial statements. Revenue is generally recognized when control of the product is transferred to the customer (i.e., when our performance obligation is satisfied), which typically occurs at shipment but which can occur over time for certain of our systems contracts. When goods or services have been delivered to the customer, but all conditions for revenue recognition have not been met, deferred revenue and deferred costs are recorded on our consolidated balance sheet. With the acquisition of Genesis Systems in December 2018, we enter into contracts to sell customized robotic systems, for which revenue is generally recognized over time, depending on the terms of the contract. Recognizing revenue over time for these contracts is based on our judgment that the customized robotic system does not have an alternative use and we have an enforceable right to payment for performance completed to date. Recognizing revenue over time also requires estimation of the progress towards completion based on the projected costs for the contract.

Inventory — Inventory is stated at the lower of cost (first-in, first-out method) or market value. Inventory includes parts and components that may be specialized in nature and subject to rapid obsolescence. We maintain a reserve for excess or obsolete inventory items. The reserve is based upon a review of inventory materials on hand, which we compare with historic usage, estimated future usage and age. In addition, we review the inventory and compare recorded costs with estimates of current market value. Write-downs are recorded to reduce the carrying value to the net realizable value with respect to any part with costs in excess of current market value. Estimating demand and current market values is inherently difficult, particularly given that we make highly specialized components and products. We determine the valuation of excess and obsolete inventory by making our best estimate considering the current quantities of inventory on hand and our forecast of the need for this inventory to support future sales of our products. We often have limited information on which to base our forecasts. If future sales differ from these forecasts, the valuation of excess and obsolete inventory may change and additional inventory provisions may be required. Because of our vertical integration, a significant or sudden decrease in sales could result in a significant change in the estimates of excess or obsolete inventory valuation.

Warranty — We maintain an accrual for warranty claims for units sold that are subject to warranty. We estimate this accrual considering past claims experience, the number of units still carrying warranty coverage and the average life of the remaining warranty period. A change in the rate of warranty repairs or when warranty is generally incurred during the warranty period could change our estimated warranty accrual and associated warranty expense.

Income Taxes and Deferred Taxes — Our annual tax rate is based on our income, statutory tax rates and tax planning opportunities available to us in the various jurisdictions in which we operate. We file federal and state income tax returns in the United States and tax returns in numerous international jurisdictions. We must estimate our income tax expense after considering, among other factors, if inter-company transactions have been made on an arm’s length basis, differing tax rates between jurisdictions, allocation factors, tax credits, nondeductible items and changes in enacted tax rates. Significant judgment is required in determining our annual tax expense and in evaluating our tax positions. As we continue to expand globally, there is a risk that, due to complexity within and diversity among the various jurisdictions in which we do business, a governmental agency may disagree with the manner in which we have computed our taxes. Additionally, due to the lack of uniformity among all of the foreign and domestic taxing authorities, there may be situations where the tax treatment of an item in one jurisdiction is different from the tax treatment in another jurisdiction or that the transaction causes a tax liability to arise in another jurisdiction.

We provide reserves for potential payments of tax to various tax authorities related to uncertain tax positions and other issues. Reserves recorded are based on a determination of whether and how much of a tax benefit taken by us in our tax filings or positions is "more likely than not" to be realized following resolution of any potential contingencies present related to the tax benefit, assuming that the matter in question will be raised by the tax authorities. Potential interest and penalties associated with such uncertain tax positions is recorded as a component of income tax expense. At December 31, 2019, we had unrecognized tax benefits of approximately $11.4 million that, if recognized, would be recorded as a reduction in income tax expense.

Goodwill and Long-lived Asset Impairment — We perform our annual goodwill impairment review as of the first day of our fourth quarter, or more frequently if events or circumstances indicate it is more likely than not that the fair value of a reporting unit is less than its carrying amount. Such events and circumstances could include significant and sustained reductions in sales volume, margin, profitability or cash flows of the reporting unit or changes in market dynamics, including technology or product changes. We test reporting units for impairment by comparing the estimated fair value of each reporting unit with its carrying amount. Intangible assets and other long-lived assets are also subject to an impairment test if there is an indicator of impairment.

Fair value determinations require considerable judgment and are sensitive to changes in underlying assumptions, estimates, and market factors. Estimating the fair value of individual reporting units requires us to make assumptions and estimates regarding our future plans, as well as industry, economic, and regulatory conditions. These assumptions and estimates

include estimated future annual net cash flows, income tax considerations, discount rates, growth rates, royalty rates, contributory asset charges, and other market factors. Assumptions used in impairment testing are made at a point in time and require significant judgment; therefore, they are subject to change based on the facts and circumstances present at each annual and interim impairment test date. Additionally, these assumptions are generally interdependent and do not change in isolation. If current expectations of future growth rates and margins are not met, if market factors outside of our control, such as discount rates, change, or if management's expectations or plans otherwise change, then one or more of our reporting units might become impaired in the future. As detailed in Note 7, "Goodwill and Intangible Assets," we recorded goodwill impairment losses totaling $37.1 million for the year ended December 31, 2019, which related to our SND and telecommunications reporting units. Further, the estimated fair value of our Genesis reporting unit, which was acquired in December 2018, approximates the carrying value, which is expected for a recent acquisition. We will continue to monitor this reporting unit during 2020. If our estimates of future performance are reduced or if other market assumptions change such that the fair value of the reporting unit is reduced, impairment charges may be incurred. The value of goodwill associated with the Genesis reporting unit is $44.4 million at December 31, 2019.

Definite-lived intangible assets are amortized on a straight-line basis over the estimated useful life. We review definite-lived intangible assets for impairment when conditions exist that indicate the carrying amount of the assets may not be recoverable. Such conditions could include significant adverse changes in the business climate, current-period operating or cash flow losses, significant declines in forecasted operations, or a current expectation that an asset group will be disposed of before the end of its useful life. We perform undiscounted operating cash flow analyses to determine if an impairment exists. When testing for impairment of definite-lived intangible assets held for use, we group assets at the lowest level for which cash flows are separately identifiable. If an impairment is determined to exist, the loss is calculated based on estimated fair value.

Results of Operations

The following table sets forth selected statement of operations data for the periods indicated in dollar amounts and expressed as a percentage of net sales:

	Year Ended December 31,					
	2019		2018		2017	
	(In thousands, except percentages and per share data)					
Net sales	$ 1,314,581	100.0 %	$ 1,459,874	100.0 %	$ 1,408,889	100.0 %
Cost of sales	708,372	53.9	659,606	45.2	611,978	43.4
Gross profit	606,209	46.1	800,268	54.8	796,911	56.6
Operating expenses:						
Sales and marketing	77,745	5.9	57,815	4.0	49,801	3.5
Research and development	129,997	9.9	122,769	8.4	100,870	7.2
General and administrative	107,597	8.2	102,429	7.0	80,668	5.7
Goodwill impairment	37,120	2.8	—	—	—	—
Impairment of long-lived assets and other restructuring charges	7,130	0.5	—	—	—	—
Loss (gain) on foreign exchange	12,827	1.0	(6,150)	(0.4)	14,460	1.0
Total operating expenses	372,416	28.3	276,863	19.0	245,799	17.4
Operating income	233,793	17.8	523,405	35.9	551,112	39.1
Interest income (expense), net	14,238	1.1	9,057	0.6	737	0.1
Other income (expense), net	345	—	1,933	0.1	22	—
Income before provision for income taxes	248,376	18.9	534,395	36.6	551,871	39.2
Provision for income taxes	68,115	5.2	130,226	(8.9)	204,283	(14.5)
Net income	180,261	13.7	404,169	27.7	347,588	24.7
Less: Net income (loss) attributable to non-controlling interest	27	—	142	—	(26)	—
Net income attributable to IPG Photonics Corporation	$ 180,234	13.7 %	$ 404,027	27.7 %	$ 347,614	24.7 %
Net income attributable to IPG Photonics Corporation per share:						
Basic	$ 3.40		$ 7.55		$ 6.50	
Diluted	$ 3.35		$ 7.38		$ 6.36	
Weighted-average shares outstanding:						
Basic	53,061		53,522		53,495	
Diluted	53,839		54,726		54,699	

Comparison of Year Ended December 31, 2019 to Year Ended December 31, 2018

Net sales. Net sales decreased by $145.3 million, or 10.0%, to $1,314.6 million in 2019 from $1,459.9 million in 2018. The table below sets forth sales by application:

	Year Ended December 31,				Change	
	2019		2018			
	(In thousands, except for percentages)					
Sales by Application		% of Total		% of Total		
Materials Processing	$ 1,229,211	93.5 %	$ 1,374,448	94.1 %	$ (145,237)	(10.6)%
Other Applications	85,370	6.5 %	85,426	5.9 %	(56)	(0.1)%
Total	$ 1,314,581	100.0 %	$ 1,459,874	100.0 %	$ (145,293)	(10.0)%

The table below sets forth sales by type of product and other revenue:

	Year Ended December 31,				Change	
	2019		2018			
	(In thousands, except for percentages)					
Sales by Product		% of Total		% of Total		
High Power Continuous Wave ("CW") Lasers	$ 734,745	55.9 %	$ 909,726	62.3 %	$ (174,981)	(19.2)%
Medium Power CW Lasers	56,625	4.3 %	95,764	6.6 %	(39,139)	(40.9)%
Pulsed Lasers	137,675	10.5 %	162,048	11.1 %	(24,373)	(15.0)%
Quasi-Continuous Wave ("QCW") Lasers	56,440	4.3 %	66,700	4.6 %	(10,260)	(15.4)%
Laser and Non-Laser Systems	141,647	10.8 %	59,330	4.1 %	82,317	138.7 %
Other Revenue including Amplifiers, Service, Parts, Accessories and Change in Deferred Revenue	187,449	14.2 %	166,306	11.3 %	21,143	12.7 %
Total	$1,314,581	100.0 %	$1,459,874	100.0 %	$ (145,293)	(10.0)%

Sales for materials processing applications decreased due to lower sales of high power, medium power, pulsed, and QCW lasers, partially offset by an increase in sales of laser and non-laser systems and other revenue.

- High power laser sales decreased primarily due to lower sales of lasers used for cutting, welding, and laser sintering applications. Within cutting applications, decreased sales were driven by lower average selling prices and weaker demand in China and Europe. The decrease in sales of high power lasers used in welding applications was driven by lower sales into automotive and EV battery applications. Within the laser sintering business, decreased sales were driven by weaker sales in Europe for metal based additive manufacturing.

- The decrease in medium power sales related to weakness in fine cutting applications and laser sintering for metal-based additive manufacturing. The reduced revenue in fine cutting applications was due in part to the ongoing transition to kilowatt scale high power lasers for these applications.

- The decrease in pulsed laser sales was due to lower sales of lasers used for marking and battery processing applications, partially offset by growth in green and ultrafast pulsed lasers.

- QCW laser sales decreased due to lower demand for consumer electronics and drilling applications.

- The increase in laser and non-laser systems sales was largely due to the acquisition of Genesis and partially driven by growth in macro-systems for welding applications.

- Other Revenue sales increased compared to last year due to the increased sales of parts, service, and accessories.

Sales for other applications remained consistent in 2019 as compared to 2018. Sales to telecom applications decreased, but was offset by increased sales in government and medical applications.

Our net sales were derived from customers in the following geographic regions:

	Year Ended December 31,				Change	
	2019		2018			
	(In thousands, except for percentages)					
Sales by Geography		% of Total		% of Total		
North America [1]	$ 280,886	21.4 %	$ 202,743	13.9 %	$ 78,143	38.5 %
Europe:						
Germany	81,365	6.2 %	111,259	7.6 %	(29,894)	(26.9)%
Other including Eastern Europe/CIS	249,871	19.0 %	296,917	20.3 %	(47,046)	(15.8)%
Asia and Australia:						
China	491,890	37.4 %	629,079	43.1 %	(137,189)	(21.8)%
Japan	71,757	5.5 %	87,619	6.0 %	(15,862)	(18.1)%
Other	121,586	9.2 %	127,251	8.7 %	(5,665)	(4.5)%
Rest of World	17,226	1.3 %	5,006	0.4 %	12,220	244.1 %
Total	$ 1,314,581	100.0 %	$ 1,459,874	100.0 %	$ (145,293)	(10.0)%

[1] The substantial majority of sales in North America are to customers in the United States.

Cost of sales and gross margin. Cost of sales increased by $48.8 million, or 7.4%, to $708.4 million in 2019 from $659.6 million in 2018. Our gross margin decreased to 46.1% in 2019 from 54.8% in 2018. Gross margin decreased mainly due to a decrease in average selling prices and higher inventory provisions. Expenses related to provisions for excess or obsolete inventory and other valuation adjustments increased by $25.9 million to $38.9 million, or 3.0% of sales, for the year ended December 31, 2019, as compared to $13.0 million, or 0.9% of sales, for the year ended December 31, 2018. Inventory provisions increased in 2019 due to review for slowing moving and excess inventory in light of lower sales during the year and the more volatile macroeconomic, geopolitical, and competitive environment in which we have recently been operating. In addition, gross margin was impacted by lower absorption of manufacturing expenses. Product mix also reduced gross margin because the systems sold by Genesis, a business that we acquired in December 2018, have a lower gross margin than the core laser business. The acquisition of Genesis reduced gross margin by 1.9% for the year ended December 31, 2019.

Sales and marketing expense. Sales and marketing expense increased by $19.9 million, or 34.4%, to $77.7 million in 2019 from $57.8 million in 2018, primarily as a result of sales and marketing expense for new acquisitions, including Genesis, as well as increases in salaries and benefits, depreciation and other selling expenses. As a percentage of sales, sales and marketing expense increased to 5.9% in 2019 from 4.0% in 2018.

Research and development expense. Research and development expense increased by $7.2 million, or 5.9%, to $130.0 million in 2019 from $122.8 million in 2018, primarily as a result of an increase in materials used for research and development, consultants, information technology, outside processing, leasing and depreciation, partially offset by reductions in personnel and contractors. Research and development continues to focus on developing new products, enhancing performance of existing components, improving production processes and developing manufacturing of new components such as crystals and refining production processes to improve manufacturing yields and productivity. New products include lasers that operate at different wavelengths such as UV, visible and mid-IR, lasers with ultrafast pulses, laser based systems for material processing, projection, display and medical as well as accessories such as welding and cutting heads. In addition to new products, research and development is focused on enhancing the performance of our existing products by improving their electrical efficiency and increasing their average power. As a percentage of sales, research and development expense increased to 9.9% in 2019 from 8.4% in 2018. We expect to continue to invest in research and development and that research and development expense will increase in the aggregate.

General and administrative expense. General and administrative expense increased by $5.2 million, or 5.1%, to $107.6 million in 2019 from $102.4 million in 2018, primarily as a result of the acquisition of Genesis and increased expenses for information technology, depreciation and insurance, partially offset by lower banking fees, personnel and legal expenses. As a percentage of sales, general and administrative expense increased to 8.2% in 2019 from 7.0% in 2018.

Effect of exchange rates on sales, gross margin and operating expenses. We estimate that if exchange rates had been the same as one year ago, sales in 2019 would have been $44.5 million higher, gross margin would have been $23.9 million higher and operating expenses in total would have been $5.8 million higher. These estimates assume constant exchange rates between fiscal year 2019 and fiscal year 2018 and are calculated using the average exchange rates for the twelve-month period ended December 31, 2018 for the respective currencies, which were US$1=Euro 0.85, US$1=Japanese Yen 110, US$1=Chinese Yuan 6.62 and US$1=Russian Ruble 63.

Goodwill impairment, impairment of long-lived assets and other restructuring charges. During 2019, we incurred non-cash goodwill impairment losses of $37.1 million, non-cash impairment losses of long-lived assets of $5.3 million and other restructuring charges of $1.8 million in total.

As a result of our 2019 annual impairment test for our transceivers reporting unit, we recognized a non-cash impairment loss of $19.3 million, which was equal to the carrying value of goodwill prior to its impairment. The analysis considered lower than forecasted sales and profitability, as well as the impact of delays in new product launches.

In addition, during the fourth quarter of 2019, we decided to cease further development in our submarine network division ("SND") after assessing the additional investment required to enter and obtain significant market share in this industry. As of December 31, 2019, we incurred cumulative pre-tax costs of $21.2 million, which includes a non-cash goodwill impairment loss of $17.8 million and non-cash impairment loss for other assets of $2.9 million. In addition, $0.2 million of severance and employee benefit costs were incurred and $0.3 million related to contract cancellations.

We also implemented other restructuring programs globally, which were primarily focused on workforce reduction and facility consolidation. These programs resulted in expenses of $3.8 million, including $1.3 million of severance and employee benefit costs and $2.5 million of non-cash impairment loss for long lived assets.

Loss (gain) on foreign exchange. We incurred a foreign exchange loss of $12.8 million in 2019 as compared to a gain of $6.2 million in 2018. The change was primarily attributable to the appreciation of the Russian Ruble, the depreciation of the Chinese Yuan, and depreciation of the Brazilian Real as compared to the U.S. Dollar, which was partially offset by a gain attributed to the depreciation of the Euro as compared to the U.S. Dollar.

Interest income (expense), net. Interest income (expense), net increased to $14.2 million of income in 2019 compared to $9.1 million of income in 2018. In 2018, we repatriated $522.0 million of cash from Germany to the United States, which has been invested for the entirety of 2019, resulting in higher earnings.

Provision for income taxes. Provision for income taxes was $68.1 million in 2019 compared to $130.2 million in 2018, representing an effective tax rate of 27.4% in 2019 and 24.4% in 2018. The increased effective tax rate was primarily due to higher percent of earnings outside the U.S. taxed at higher rates and changes in discrete adjustments. Discrete adjustments in 2019 include (i) a decrease to tax expense of $5.1 million related to equity based compensation deductions for tax in excess of the deductions reflected in book income and (ii) an increase to tax expense of $10.0 million for goodwill impairments losses which were not deductible for tax. Discrete adjustments in 2018 include (i) a decrease to tax expense of $13.3 million related to equity based compensation deductions for tax in excess of the deductions reflected in book income; (ii) an increase to tax expense of $6.6 million related to U.S. tax on profits earned in 2017 calculated at the prior year federal rate of 35% flowing through consolidated income in 2018; and (iii) an increase in the valuation allowance of $7.4 million primarily for state credits.

Net income attributed to IPG Photonics Corporation. Net income attributable to IPG Photonics Corporation decreased by $223.8 million to $180.2 million in 2019 from $404.0 million in 2018. Net income attributable to IPG Photonics Corporation as a percentage of our net sales decreased by 14.0% to 13.7% in 2019 from 27.7% in 2018 due to the factors described above.

Comparison of Year Ended December 31, 2018 to Year Ended December 31, 2017

Net sales. Net sales increased by $51.0 million, or 3.6%, to $1,459.9 million in 2018 from $1,408.9 million in 2017. The table below sets forth sales by application:

	Year Ended December 31,				Change	
	2018		2017			
	(In thousands, except for percentages)					
Sales by Application		% of Total		% of Total		
Materials Processing	$ 1,374,448	94.1 %	$ 1,332,607	94.6 %	$ 41,841	3.1 %
Other Applications	85,426	5.9 %	76,282	5.4 %	9,144	12.0 %
Total	$ 1,459,874	100.0 %	$ 1,408,889	100.0 %	$ 50,985	3.6 %

The table below sets forth sales by type of product and other revenue:

	Year Ended December 31,				Change	
	2018		2017			
	(In thousands, except for percentages)					
Sales by Product		% of Total		% of Total		
High Power Continuous Wave ("CW") Lasers	$ 909,726	62.3 %	$ 867,464	61.6 %	$ 42,262	4.9 %
Medium and Low Power CW Lasers	95,764	6.6 %	118,705	8.4 %	(22,941)	(19.3)%
Pulsed Lasers	162,048	11.1 %	148,701	10.6 %	13,347	9.0 %
Quasi-Continuous Wave ("QCW") Lasers	66,700	4.6 %	88,329	6.3 %	(21,629)	(24.5)%
Laser and Non-Laser Systems	59,330	4.1 %	40,410	2.9 %	18,920	46.8 %
Other Revenue including Amplifiers, Service, Parts, Accessories and Change in Deferred Revenue	166,306	11.3 %	145,280	10.2 %	21,026	14.5 %
Total	$ 1,459,874	100.0 %	$1,408,889	100.0 %	$ 50,985	3.6 %

Sales for materials processing applications increased due to higher sales of high power and pulsed lasers and laser systems, partially offset by a decrease in sales of medium and low power lasers and QCW lasers.

- High power laser sales increased primarily due to growth in sales for cutting applications offset by declines in sales in welding applications. Within cutting applications, we continue to see a migration to lasers with higher output powers which improve processing speeds and enable processing of thicker materials. The shift towards lasers with higher output powers has also benefited sales due to their higher average selling prices.

- Medium and low power sales decreased due to lower sales for cutting and laser sintering applications partially offset by higher sales for welding applications. The decline in sales for cutting applications is largely due to the use of high power lasers instead of medium power lasers for these applications as the low cost cutting systems market has gravitated to higher power lasers as their selling price per watt has decreased.

- Pulsed laser sales increased due to growth in sales of high power pulsed lasers used for cutting, marking and engraving and cleaning applications partially offset by decreases in pulsed lasers used for ablation.

- QCW laser sales decreased due to lower sales for welding applications. Welding applications for QCW lasers are largely related to consumer electronics manufacturing and the investment cycle for this application was weaker in 2018 and 2017.

- Laser systems sales increased due to increases in sales for cutting systems, as well as incremental sales from the acquisition of ILT in July 2017 and the acquisition of Genesis in December 2018.

Sales for other applications increased due to higher sales of high power lasers and high power amplifiers used for advanced applications as well as increased sales of telecommunication components, including pluggable transceivers used in data transmission.

Our net sales were derived from customers in the following geographic regions:

	Year Ended December 31,					
	2018		2017		Change	
	(In thousands, except for percentages)					
Sales by Geography		% of Total		% of Total		
North America [1]	$ 202,743	13.9 %	$ 165,363	11.8 %	$ 37,380	22.6 %
Europe:						
Germany	111,259	7.6 %	114,608	8.1 %	(3,349)	(2.9)%
Other including Eastern Europe/CIS	296,917	20.3 %	290,067	20.6 %	6,850	2.4 %
Asia and Australia:						
China	629,079	43.1 %	621,283	44.1 %	7,796	1.3 %
Japan	87,619	6.0 %	80,612	5.7 %	7,007	8.7 %
Other	127,251	8.7 %	131,511	9.3 %	(4,260)	(3.2)%
Rest of World	5,006	0.4 %	5,445	0.4 %	(439)	(8.1)%
Total	$ 1,459,874	100.0 %	$ 1,408,889	100.0 %	$ 50,985	3.6 %

[1] The substantial majority of sales in North America are to customers in the United States.

Cost of sales and gross margin. Cost of sales increased by $47.6 million, or 7.8%, to $659.6 million in 2018 from $612.0 million in 2017. Our gross margin decreased to 54.8% in 2018 from 56.6% in 2017. Gross margin decreased due to lower absorption of manufacturing costs, decreases in average selling prices and changes in product sales mix. The impact to gross margin primarily occurred in the second half of the year in conjunction with the slowdown in sales and increased competition for certain products in China. Expenses related to provisions for excess or obsolete inventory and other valuation adjustments decreased by $3.9 million to $13.0 million, or 0.9% of sales, for the year ended December 31, 2018, as compared to $16.9 million, or 1.2% of sales, for the year ended December 31, 2017.

Sales and marketing expense. Sales and marketing expense increased by $8.0 million, or 16.1%, to $57.8 million in 2018 from $49.8 million in 2017, primarily as a result of an increase in personnel, depreciation, trade show and exhibitions, and travel expense. As a percentage of sales, sales and marketing expense increased to 4.0% in 2018 from 3.5% in 2017.

Research and development expense. Research and development expense increased by $21.9 million, or 21.7%, to $122.8 million in 2018 from $100.9 million in 2017, primarily as a result of an increase in personnel, materials, contractors, consultants, depreciation and other research and development expense. Research and development continues to focus on developing new products, enhancing performance of existing components, improving production processes and developing manufacturing of new components such as crystals and refining production processes to improve manufacturing yields and productivity. New products include lasers that operate at different wavelengths such as UV, visible and mid-IR, lasers with ultrafast pulses, laser based systems for material processing, projection, display and medical as well as accessories such as welding and cutting heads and components such as ASICs used in pluggable transceivers in the telecom industry. In addition to new products research and development is focused on enhancing the performance of our existing products by improving their electrical efficiency and increasing their average power. As a percentage of sales, research and development expense increased to 8.4% in 2018 from 7.2% in 2017.

General and administrative expense. General and administrative expense increased by $21.7 million, or 26.9%, to $102.4 million in 2018 from $80.7 million in 2017, primarily as a result of increased expenses for personnel, stock-based compensation, professional services expenses related to acquisitions, accounting legal and information technology expenses, and depreciation expense. As a percentage of sales, general and administrative expense increased to 7.0% in 2018 from 5.7% in 2017.

Effect of exchange rates on sales, gross margin and operating expenses. We estimate that if exchange rates had been the same as one year ago, sales in 2018 would have been $35.8 million lower, gross margin would have been $23.3 million lower and operating expenses in total would have been $1.3 million higher. These estimates assume constant exchange rates between fiscal year 2018 and fiscal year 2017 and are calculated using the average exchange rates for the twelve-month period ended December 31, 2017 for the respective currencies, which were US$1=Euro 0.89, US$1=Japanese Yen 112, US$1=Chinese Yuan 6.76 and US$1=Russian Ruble 58.

Loss (gain) on foreign exchange. We incurred a foreign exchange gain of $6.2 million in 2018 as compared to a loss of $14.5 million in 2017. The change was primarily attributable to the depreciation of the Euro as compared to the U.S. Dollar, which was partially offset by depreciation of the Chinese Yuan as compared to the U.S. Dollar.

Interest income (expense), net. Interest income (expense), net increased to $9.1 million of income in 2018 compared to $0.7 million of income in 2017. The increase of interest income was the result of the repatriation of $522 million of cash during the year from Germany to the United States and improved rate of return on U.S. Dollar denominated investments as compared to Euro denominated investments.

Provision for income taxes. Provision for income taxes was $130.2 million in 2018 compared to $204.3 million in 2017, representing an effective tax rate of 24.4% in 2018 and 37.0% in 2017. The decreased effective tax rate was primarily due to changes in the statutory tax rate in the United States from 35% to 21% resulting from the Tax Cuts and Jobs Act (the "Tax Act"). Discrete adjustments in 2018 include (i) a decrease to tax expense of $13.3 million related to equity based compensation deductions for tax in excess of the deductions reflected in book income; (ii) an increase to tax expense of $6.6 million related to U.S. tax on profits earned in 2017 calculated at the prior year federal rate of 35% flowing through consolidated income in 2018; and, (iii) an increase in the valuation allowance of $7.4 million primarily for state credits. Discrete adjustments in 2017 include (i) a decrease to tax expense of $14.0 million related to equity based compensation deductions for tax in excess of the deductions reflected in book income and (ii) an increase to tax expense of $48.1 million for a U.S. tax on cumulative foreign earnings as a result of the Tax Act.

On December 22, 2017, the U.S. government enacted the Tax Act. The Tax Act makes broad and complex changes to the U.S. tax code including, but not limited to: (i) reducing the U.S. federal corporate tax rate from 35% to 21%; (ii) requiring companies to pay a one-time transition tax on certain un-repatriated earnings of foreign subsidiaries; (iii) generally eliminating U.S. federal income taxes on dividends from foreign subsidiaries; (iv) providing an incentive benefit for U.S. income from intangibles (Foreign Derived Intangible Income); (v) increasing U.S. taxable income to include all income earned by foreign subsidiaries in excess of ten percent of the fixed assets in those entities (Global Intangible Low-taxed Income) and (vi) providing for bonus depreciation that will allow for full expensing of qualified property.

Our final calculation of the Deemed Repatriation Transition Tax ("Transition Tax") element of the Tax Act is a $43.4 million increase to the tax expense. At December 31, 2017, we calculated a provisional amount of tax for this at $48.1 million and have included a benefit of $4.7 million in 2018 income tax expense to reflect the impact of the decrease in liability. The federal Transition Tax is payable over eight years and $30.3 million of the liability is included in other long-term liabilities at December 31, 2018.

Net income. Net income attributable to IPG Photonics Corporation increased by $56.4 million to $404.0 million in 2018 from $347.6 million in 2017. Net income attributable to IPG Photonics Corporation as a percentage of our net sales increased by 3.0% to 27.7% in 2018 from 24.7% in 2017 due to the factors described above.

Liquidity and Capital Resources

The following table presents our principal sources of liquidity:

	As of December 31,	
	2019	**2018**
	(In thousands)	
Cash and cash equivalents	$ 680,070	$ 544,358
Short-term investments	502,546	500,432
Unused credit lines and overdraft facilities	105,469	107,412
Working capital (excluding cash and cash equivalents and short-term investments)	522,114	514,860

Short-term investments at December 31, 2019 consist of liquid investments including corporate notes, commercial paper and certificates of deposit with original maturities of greater than three months but less than one year. We also hold long-term investments, included in other assets on the consolidated balance sheets, which consist of auction rate securities totaling $0.6 million. See Note 3, "Fair Value Measurements" in the notes to the consolidated financial statements for further information about our short and long-term investments.

The following table details our line-of-credit facilities and long-term notes as of December 31, 2019:

Description	Total Facility/ Note	Interest Rate	Maturity	Security
U.S. Revolving Line of Credit [1]	$50.0 million	LIBOR plus 0.80% to 1.20%, depending on our performance	April 2020	Unsecured
Euro Credit Facility (Germany) [2]	Euro 50.0 million ($56.1 million)	Euribor plus 0.75% or EONIA plus 1.00%	July 2020	Unsecured, guaranteed by parent company and German subsidiary
Other Euro Facilities [3]	Euro 2.0 million ($2.2 million)	Euribor plus 0.89% to 1.78%	May 2020	Common pool of assets of Italian subsidiary
Long-term Secured Note [4]	$22.1 million	Fixed at 2.74%	July 2022	Secured by the corporate aircraft
Long-term Unsecured Note [5]	$19.6 million	1.20% above LIBOR, fixed using an interest rate swap at 2.85% per annum	May 2023	Unsecured

(1) This facility is available to certain foreign subsidiaries in their respective local currencies. At December 31, 2019, there were no amounts drawn on this line, however, there were $1.4 million of guarantees issued against the line which reduces total availability.

(2) This facility is available to certain foreign subsidiaries in their respective local currencies. At December 31, 2019, there were no drawings, however, there were $1.4 million of guarantees issued against the line which reduces total availability.

(3) At December 31, 2019, there were no drawings. This facility renews annually.

(4) At maturity, the outstanding note balance will be $15.4 million.

(5) At maturity, the outstanding note balance will be $15.4 million.

Our largest committed credit lines are with Bank of America N.A. and Deutsche Bank AG in the amounts of $50.0 million and $56.1 million (or 50 million Euro as described above), respectively, and neither of them is syndicated. We have initiated negotiations to renew the U.S. revolving line of credit and Euro credit facility, which both mature in 2020. We plan to seek amendments of our credit agreements and notes to modify LIBOR and Euribor reference rates as these rates are phased out as borrowing rates.

We are required to meet certain financial covenants associated with our U.S. revolving line of credit and long-term debt facilities. These covenants, tested quarterly, include a debt service coverage ratio and a funded debt to earnings before interest, taxes, depreciation and amortization ("EBITDA") ratio. The debt service coverage covenant requires that we maintain a trailing twelve month ratio of cash flow to debt service that is greater than 1.5:1. Debt service is defined as required principal and interest payments during the period. Debt service in the calculation is decreased by our cash held in the U.S.A. in excess of $50 million up to a maximum of $250 million. Cash flow is defined as EBITDA less unfunded capital expenditures. The funded debt to EBITDA covenant requires that the sum of all indebtedness for borrowed money on a consolidated basis be less than three times our trailing twelve-months EBITDA. We were in compliance with all such financial covenants as of and for the three months ended December 31, 2019.

The financial covenants in our loan documents may cause us to not take or to delay investments and actions that we might otherwise undertake because of limits on capital expenditures and amounts that we can borrow or lease. In the event that we do not comply with any one of these covenants, we would be in default under the loan agreement or loan agreements, which may result in acceleration of the debt, cross-defaults on other debt or a reduction in available liquidity, any of which could harm our results of operations and financial condition.

See Note 11, "Financing Arrangements" in the notes to the consolidated financial statements for further information about our facilities and term debt.

The following table presents cash flow activities:

	As of December 31,	
	2019	2018
	(In thousands)	
Cash provided by operating activities	$ 323,521	$ 393,301
Cash used by investing activities	(139,975)	(562,999)
Cash used by financing activities	(37,067)	(166,647)

Operating activities. Net cash provided by operating activities decreased by $69.8 million to $323.5 million in 2019 from $393.3 million in 2018. In 2019, net sales and net income decreased by 10% and 55%, respectively. As there were

decreases in net sales and net income, cash provided by net income after adding back non-cash charges decreased. This decrease has been partially offset by a decrease in the amount invested in working capital. Our largest working capital items typically are inventory and accounts receivable. Items such as accounts payable to third parties, prepaid expenses and other current assets and accrued expenses and other liabilities are not as significant as our working capital investment in accounts receivable and inventory because of the amount of value added within IPG due to our vertically integrated structure. Accruals and payables for personnel costs including bonuses and income and other taxes payable are largely dependent on the timing of payments for those items. The decrease in cash flow from operating activities in 2019 primarily resulted from a decrease in cash provided by net income after adding back non-cash charges, an increase in cash used by income and taxes payable; partially offset by, a decrease in cash used for inventory, and an increase in cash provided by accounts receivable.

Investing activities. Net cash used in investing activities was $140.0 million and $563.0 million in 2019 and 2018, respectively. The cash used in investing activities in 2019 related to $133.5 million for property, plant and equipment and $15.1 million for the acquisition of a business during 2019, net of cash acquired; partially offset by $7.8 million of net proceeds of investments. The cash used in investing activities in 2018 related to $295.0 million of net purchases of investments after the repatriation of cash from our German subsidiary, $160.3 million for property, plant and equipment, and $109.1 million for the acquisition of two businesses during 2018, net of cash acquired.

In 2020, we expect to incur approximately $115 million to $125 million in capital expenditures, excluding acquisitions. Capital expenditures include investments in property, facilities and equipment to add capacity worldwide to support anticipated revenue growth. The timing and extent of any capital expenditures in and between periods can have a significant effect on our cash flow. If we obtain financing for certain projects, our cash expenditures would be reduced in the year of expenditure. Many of the capital expenditure projects that we undertake have long lead times and are difficult to cancel or defer to a later period.

Financing activities. Net cash used in financing activities was $37.1 million and $166.6 million in 2019 and 2018, respectively. The cash used in financing activities in 2019 was primarily related to the purchase of treasury stock of $40.7 million and payments on our long-term borrowings of $3.7 million. These uses of cash were partially offset by net proceeds from the exercise of stock options net of amounts disbursed in relation to shares withheld to cover employee income taxes due upon the vesting and release of restricted stock units and shares issued under our employee stock purchase plan of $7.3 million. The cash used in financing activities in 2018 was primarily related to the purchase of treasury stock of $176.1 million and payments on our long-term borrowings of $3.6 million. These cash uses were partially offset by net proceeds of $12.2 million from the exercise of stock options net of amounts disbursed in relation to shares withheld to cover employee income taxes due upon the vesting and release of restricted stock units and shares issued under our employee stock purchase plan.

We believe that our existing cash and cash equivalents, short-term investments, our cash flows from operations and our existing lines of credit provide us with the financial flexibility to meet our liquidity and capital needs, as well as to complete certain acquisitions of businesses and technologies. We intend to continue to pursue acquisition opportunities based upon market conditions and the strategic importance and valuation of the target company. We may consider issuing debt to finance acquisitions depending on the timing and size of the acquisition among other reasons. Our future long-term capital requirements will depend on many factors including our level of sales, the impact of economic environment on our sales levels, the timing and extent of spending to support development efforts, the expansion of the global sales and marketing activities, government regulation including trade sanctions, the timing and introduction of new products, the need to ensure access to adequate manufacturing capacity and the continuing market acceptance of our products.

Contractual Obligations and Off-Balance Sheet Arrangements

As of December 31, 2019, we had no off-balance sheet arrangements that have, or are reasonably likely to have, a current or future material effect on our consolidated financial condition, results of operations, liquidity, capital expenditures or capital resources. The following summarizes our contractual obligations at December 31, 2019 and the effect such obligations are expected to have on our liquidity and cash flow in future periods:

	Payments Due in				
	Total	Less Than 1 Year	1-3 Years	3-5 Years	More Than 5 Years
	(In thousands)				
Operating lease obligations	$ 29,797	$ 6,004	$ 8,366	$ 5,100	$ 10,327
Purchase obligations	53,922	52,711	1,211	—	—
Long-term debt obligations (including interest)[(1)]	43,561	4,857	23,675	15,029	—
Contingent consideration	273	273	—	—	—
Total[(2)]	$ 127,553	$ 63,845	$ 33,252	$ 20,129	$ 10,327

[1] Interest for long-term debt obligations was calculated including the effect of our fixed rate amounts. The weighted average fixed rate amount was 2.79%.
[2] Excludes obligations related to ASC 740, reserves for uncertain tax positions, because we are unable to provide a reasonable estimate of the timing of future payments relating to the remainder of these obligations. See Note 17, "Income Taxes" to the consolidated financial statements.

Recent Accounting Pronouncements

See Note 1, "Nature of Business and Summary of Significant Accounting Policies" in the notes to the consolidated financial statements for a full description of recent accounting pronouncements, including the respective dates of adoption or expected adoption and effects on our consolidated financial statements contained in Part IV of this Annual Report.

ITEM 7A. ***QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK***

We are exposed to market risk in the ordinary course of business, which consists primarily of interest rate risk associated with our cash and cash equivalents and our debt and foreign exchange rate risk.

Interest rate risk. Our investments have limited exposure to market risk. We maintain a portfolio of cash, cash equivalents and short-term investments, consisting primarily of bank deposits, money market funds, certificates of deposit, and corporate notes. None of these investments have a maturity date in excess of one year. The interest rates are variable and fluctuate with current market conditions. Because of the short-term nature of these instruments, a sudden change in market interest rates would not be expected to have a material impact on our financial condition or results of operations.

We are also exposed to market risk as a result of increases or decreases in the amount of interest expense we must pay on our bank debt and borrowings on our bank credit facilities. Our interest obligations on our long-term debt are fixed. Although our U.S. revolving line of credit and our Euro credit facility have variable rates, we do not believe that a 10% change in market interest rates would have a material impact on our financial position or results of operations.

Exchange rates. Due to our international operations, a significant portion of our net sales, cost of sales and operating expenses are denominated in currencies other than the U.S. Dollar, principally the Euro, the Russian Ruble, the Chinese Yuan and the Japanese Yen. As a result, our international operations give rise to transactional market risk associated with exchange rate movements of the U.S. Dollar, the Euro, the Chinese Yuan, the Japanese Yen, and the Russian Ruble. In 2019 we incurred a loss on foreign exchange transactions of $12.8 million as compared to a gain of $6.2 million in 2018. Management attempts to minimize these exposures by partially or fully off-setting foreign currency denominated assets and liabilities at our subsidiaries that operate in different functional currencies. The effectiveness of this strategy can be limited by the volume of underlying transactions at various subsidiaries and by our ability to accelerate or delay inter-company cash settlements. As a result, we are unable to create a perfect offset of the foreign currency denominated assets and liabilities. Furthermore, if we expect a currency movement to be beneficial to us in the short or medium term, we have, on occasions, chosen not to hedge or otherwise off-set the underlying assets or liabilities. However, it is difficult to predict foreign currency movements accurately. At December 31, 2019, our material foreign currency exposure is net U.S. Dollar denominated assets at subsidiaries where the Euro or the Russian Ruble is the functional currency and U.S. Dollar denominated liabilities where the Chinese Yuan is the functional currency. The net U.S. Dollar denominated assets are comprised of cash, third party receivables, inter-company receivables and inter-company notes offset by third party and inter-company U.S. Dollar denominated payables. The U.S. Dollar denominated liabilities are comprised of inter-company payables. A 5% change in the relative exchange rate of the U.S. Dollar to the Euro applied to the net U.S. Dollar asset balances as of December 31, 2019, would result in a foreign exchange gain of $5.6 million if the U.S. Dollar appreciated and a $5.6 million foreign exchange loss if the U.S. Dollar depreciated. A 5% change in the relative exchange rate of the U.S. Dollar to the Ruble applied to the net U.S. Dollar asset balances as of December 31, 2019, would result in a foreign exchange gain of $4.4 million if the U.S. Dollar appreciated and a $4.4 million foreign exchange loss if the U.S. Dollar depreciated. A 5% change in the relative exchange rate of the U.S. Dollar to the Yuan applied to the net U.S. Dollar liability balances as of December 31, 2019, would result in a foreign exchange loss of $5.7 million if the U.S. Dollar appreciated and a $5.7 million foreign exchange gain if the U.S. Dollar depreciated.

In addition, we are exposed to foreign currency translation risk for those subsidiaries whose functional currency is not the U.S. Dollar as changes in the value of their functional currency relative to the U.S. Dollar can adversely affect the translated amounts of our revenue, expenses, net income, assets and liabilities. As discussed in our Results of Operations, this can, in turn, affect the reported value and relative growth of sales and net income from one period to the next. In addition changes in the translated value of assets and liabilities due to changes in functional currency exchange rates relative to the U.S. Dollar result in foreign currency translation adjustments that are a component of other comprehensive income or loss.

Foreign currency derivative instruments can also be used to hedge exposures and reduce the risks of certain foreign currency transactions; however, these instruments provide only limited protection and can carry significant cost. We have no foreign currency derivative instrument hedges as of December 31, 2019. We will continue to analyze our exposure to currency exchange rate fluctuations and may engage in financial hedging techniques in the future to attempt to minimize the effect of these potential fluctuations. Exchange rate fluctuations may adversely affect our financial results in the future.

ITEM 8. *FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA*

This information is incorporated by reference from pages F-1 through F-34 of this report.

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

Under the supervision of our Chief Executive Officer and our Chief Financial Officer, our management has evaluated the effectiveness of the design and operation of our "disclosure controls and procedures" (as defined in Rules 13a-15(e) and 15d-15(e) promulgated under the Securities Exchange Act of 1934, as amended (the "Exchange Act")), as of the end of the period covered by this Annual Report on Form 10-K (the "Evaluation Date") utilizing the Committee of Sponsoring Organizations of the Treadway Commission's Internal Control - Integrated Framework ("COSO") Updated Framework issued in 2013. Based upon that evaluation, our Chief Executive Officer and our Chief Financial Officer have concluded that, as of the Evaluation Date, our disclosure controls and procedures are effective to ensure that information we are required to disclose in reports that we file or submit 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 an issuer in the reports that it files or submits under the Exchange Act is accumulated and communicated to the issuer's management, including its principal executive and principal financial officers, or persons performing similar functions, as appropriate to allow timely decisions regarding required disclosure.

Management's Annual Report on Internal Control Over Financial Reporting

Our management, including our Chief Executive Officer and Chief Financial Officer, is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the Company and its subsidiaries. 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 management conducted an assessment of the effectiveness of our internal control over financial reporting as of the Evaluation Date based on criteria established in COSO utilizing the Updated Framework issued in 2013. Based on this assessment, our management concluded that, as of the Evaluation Date, our internal control over financial reporting was effective.

Our independent registered public accounting firm, Deloitte & Touche LLP, has audited our internal control over financial reporting, as stated in their report below.

Changes in Internal Controls

There was no change in our internal control over financial reporting (as defined in Rule 13a-15(f) under the Exchange Act) that occurred during the last fiscal quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Limitations on Effectiveness of Controls

Our management, including our Chief Executive Officer and Chief Financial Officer, does not expect that the disclosure controls and procedures or internal control over financial reporting will prevent or detect all error and all fraud. A control system, no matter how well designed and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Due to the inherent limitations in all control systems, no

evaluation of controls can provide absolute assurance that all control issues, errors and instances of fraud, if any, within the company have been or will be detected.

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Shareholders and the Board of Directors of
IPG Photonics Corporation
Oxford, Massachusetts

Opinion on Internal Control over Financial Reporting

We have audited the internal control over financial reporting of IPG Photonics Corporation and subsidiaries (the "Company") as of December 31, 2019, 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 Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by COSO.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated financial statements as of and for the year ended December 31, 2019, of the Company and our report dated February 24, 2020, expressed an unqualified opinion on those financial statements.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying "Management's Annual Report on Internal Control over Financial Reporting". Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the 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 audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects. Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

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 (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) 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 (3) 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/ DELOITTE & TOUCHE LLP

Boston, Massachusetts
February 24, 2020

ITEM 9B. *CONTROLS AND PROCEDURES*

None.

PART III

ITEM 10. *DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE*

Certain of the information required hereunder is incorporated herein by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A, which Proxy Statement is anticipated to be filed with the SEC within 120 days after December 31, 2019. Pursuant to General Instruction G(3) of Form 10-K, additional information required hereunder relating to our executive officers is contained in Part I of this Annual Report on Form 10-K under the caption "Executive Officers of the Registrant."

ITEM 11. *EXECUTIVE COMPENSATION*

The information required hereunder is incorporated herein by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A, which Proxy Statement is anticipated to be filed with the SEC within 120 days after December 31, 2019.

ITEM 12. *SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS*

The information required hereunder is incorporated herein by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A, which Proxy Statement is anticipated to be filed with the SEC within 120 days after December 31, 2019, with the exception of the information regarding securities authorized for issuance under our equity compensation plans, which is set forth in Item 5, "Market for the Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities Information Regarding Equity Compensation Plans" and is incorporated herein by reference.

ITEM 13. *CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE*

The information required hereunder is incorporated herein by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A, which Proxy Statement is anticipated to be filed with the SEC within 120 days after December 31, 2019.

ITEM 14. *PRINCIPAL ACCOUNTING FEES AND SERVICES*

The information required hereunder is incorporated herein by reference to our definitive Proxy Statement to be filed pursuant to Regulation 14A, which Proxy Statement is anticipated to be filed with the SEC within 120 days after December 31, 2019.

PART IV

ITEM 15. *EXHIBITS AND FINANCIAL STATEMENT SCHEDULES*

a. The following documents are filed as part of this Annual Report on Form 10-K:

1. Financial Statements.

   See Index to Financial Statements on page F-1.

2. Financial Statement Schedules.

   All schedules are omitted because they are not applicable or the required information is shown on the financial statements or notes thereto.

3. Exhibits.

Exhibit Number	Description
3.1	Form of Second Amended and Restated Certificate of Incorporation of the Registrant (incorporated by reference to Exhibit 3.2 to Registration Statement No. 333-136521 filed with the Securities and Exchange Commission (the "Commission") on August 11, 2006)
3.2	Amended and Restated By-laws of the Registrant (incorporated by reference to Exhibit 3.2 to the Registrant's current Report on Form 8-K filed with the Commission on March 7, 2019)
4.1	Specimen Stock Certificate (incorporated by reference to Exhibit 4.1 to Registration Statement No. 333-136521 filed with the Commission on November 14, 2006)
4.2	Description of the Registrant's Securities Registered under Section 12 of the Exchange Act
10.1†	2006 Incentive Compensation Plan, as amended (incorporated by reference to Exhibit 10.1 to the Registrant's Current Report on Form 8-K/A filed with the Commission on February 22, 2017)
10.2†	IPG Photonics Corporation Non-Employee Director Compensation Plan, as amended (incorporated by reference to Exhibit 10.1 to the Registrant's Current Report on Form 8-K filed with the Commission on February 21, 2020)
10.3†	Senior Executive Annual Incentive Plan, as amended (incorporated by reference to Exhibit 10.2 to the Registrant's Current Report on Form 8-K/A filed with the Commission on February 22, 2017)
10.4†	IPG Photonics Corporation 2008 Employee Stock Purchase Plan, as amended and restated effective December 1, 2018 (incorporated by reference to Exhibit 10.1 to the Registrant's Current Report on Form 8-K filed with the Commission on June 3, 2019)
10.5†	Employment Agreement dated May 30, 2019 between the Registrant and Dr. Valentin P. Gapontsev
10.6†	Service Agreement dated May 30, 2019 between IPG Laser GmbH and Dr. Eugene Scherbakov
10.7†	Form of Employment Agreement dated May 30, 2019 between the Registrant and each of Timothy P.V. Mammen, Angelo P. Lopresti and Alexander Ovtchinnikov
10.8†	Form of Confidentiality, Non-Competition and Confirmatory Assignment Agreement between the Registrant and each of the named executive officers and certain other executive officers, (incorporated by reference to Exhibit 10.4 to the Registrant's Current Report on Form 8-K filed with the Commission on October 15, 2013)
10.9†	Form of Letter amending Confidentiality, Non-Competition and Confirmatory Assignment Agreements between the Registrant and each of the named executive officers and certain other executive officers (incorporated by reference to Exhibit 10.4 to the Registrant's Current Report on Form 8-K/A filed with the Commission on February 22, 2017)
10.10†	Form of Indemnification Agreement between the Registrant and each of its Directors and Executive Officers (incorporated by reference to Exhibit 10.3 to Registrant's Current Report on Form 8-K/A filed with the Commission on February 22, 2017)
10.11†	Amended and Restated Loan Agreement between the Registrant and Bank of America, N.A., dated as of April 30, 2015 (incorporated by reference to Exhibit 10.1 to the Registrant's Quarterly Report on Form 10-Q filed with the Commission on May 6, 2015)
10.12	Revolving Credit Note by the Registrant dated as of April 30, 2015 (incorporated by reference to Exhibit 10.2 to the Registrant's Quarterly Report on Form 10-Q filed with the Commission on May 6, 2015)
10.13	First Amendment to the Amended and Restated Loan Agreement, between the Registrant and Bank of America, N.A. dated as of May 19, 2016 (incorporated by reference to Exhibit 10.3 to the Registrant's Current Report on Form 8-K filed with the Commission on May 20, 2016)
10.14	Term Note, between the Registrant and Bank of America, N.A., dated May 19, 2016 (incorporated by reference to Exhibit 10.4 to the Registrant's Current Report on Form 8-K filed with the Commission on May 20, 2016)

Exhibit Number	Description
10.15	Credit Facility Agreement between IPG Laser GmbH and Deutsche Bank AG, dated July 27, 2017 (incorporated by reference to Exhibit 10.1 on Current Report on Form 8-K filed with the Commission on August 1, 2017)
10.16	Annex I to Credit Facility Agreement between IPG Laser GmbH and Deutsche Bank AG, dated July 27, 2017 (incorporated by reference to Exhibit 10.2 on Current Report on Form 8-K filed with the Commission on August 1, 2017)
10.17	Guarantee of the Registrant to Deutsche Bank dated July 27, 2017 (incorporated by reference to Exhibit 10.3 on Current Report on Form 8-K filed with the Commission on August 1, 2017)
10.18	Loan and Aircraft Security Agreement between TVPX Aircraft Solutions, as Trustee under the Trust Pledge Agreement between Registrant and Trustee dated July 27, 2017, and Banc of America Leasing & Capital, LLC dated July 27, 2017 (incorporated by reference to Exhibit 10.22 to the Registrant's Annual Report on Form 10-K filed with the Commission on February 28, 2018)
10.19	Promissory Note between TVPX Aircraft Solutions dated July 27, 2017, as Trustee under the Trust Pledge Agreement between Registrant and Trustee dated July 27, 2017, and Banc of America Leasing & Capital, LLC dated July 27, 2017 (incorporated by reference to Exhibit 10.23 to the Registrant's Annual Report on Form 10-K filed with the Commission on February 28, 2018)
10.20	Guaranty of the Registrant to Banc of America Lease & Capital, LLC, dated July 27, 2017 (incorporated by reference to Exhibit 10.24 to the Registrant's Annual Report on Form 10-K filed with the Commission on February 28, 2018)
21.1	List of Subsidiaries
23.1	Consent of Deloitte & Touche LLP
31.1	Certification of Chief Executive Officer pursuant to Rule 13a-14(a) of the Securities Exchange Act of 1934, as amended
31.2	Certification of Chief Financial Officer pursuant to Rule 13a-14(a) of the Securities Exchange Act of 1934, as amended
32.1	Certification of Chief Executive Officer and Chief Financial Officer pursuant to Section 1350
101.INS	XBRL Instance Document - the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document
101.SCH	XBRL Taxonomy Extension Schema
101.CAL	XBRL Taxonomy Extension Calculation Linkbase
101.DEF	XBRL Taxonomy Definition Linkbase
101.LAB	XBRL Taxonomy Extension Label Linkbase
101.PRE	XBRL Taxonomy Extension Presentation Linkbase
104	Cover Page Interactive Data File (formatted as inline XBRL and contained in Exhibit 101)

† Identifies management contract or compensatory plans or arrangements required to be filed as an exhibit.

b. Exhibits.

See (a)(3) above.

c. Additional Financial Statement Schedules.

All schedules are omitted because they are not applicable or the required information is shown on the financial statements or notes thereto.

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, the Registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized, on February 24, 2020.

IPG PHOTONICS CORPORATION

By: /s/ Valentin P. Gapontsev
Valentin P. Gapontsev
Chief Executive Officer and
Chairman of the Board

Pursuant to the requirements of the Securities Exchange Act of 1934, 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	
/s/ Valentin P. Gapontsev Valentin P. Gapontsev	Chief Executive Officer, Chairman of the Board and Director (Principal Executive Officer)	February 24, 2020
/s/ Timothy P.V. Mammen Timothy P.V. Mammen	Senior Vice President, Chief Financial Officer (Principal Financial Officer)	February 24, 2020
/s/ Thomas J. Burgomaster Thomas J. Burgomaster	Vice President, Corporate Controller (Principal Accounting Officer)	February 24, 2020
/s/ Michael C. Child Michael C. Child	Director	February 24, 2020
/s/ Gregory P. Dougherty Gregory P. Dougherty	Director	February 24, 2020
/s/ Henry E. Gauthier Henry E. Gauthier	Director	February 24, 2020
/s/ Catherine P. Lego Catherine P. Lego	Director	February 24, 2020
/s/ Eric Meurice Eric Meurice	Director	February 24, 2020
/s/ John R. Peeler John Peeler	Director	February 24, 2020
/s/ Igor Samartsev Igor Samartsev	Director	February 24, 2020
/s/ Eugene A. Scherbakov Eugene Scherbakov	Director	February 24, 2020
/s/ Thomas J. Seifert Thomas J. Seifert	Director	February 24, 2020

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REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Shareholders and the Board of Directors of
IPG Photonics Corporation
Oxford, Massachusetts

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of IPG Photonics Corporation and subsidiaries (the "Company") as of December 31, 2019 and 2018, the related consolidated statements of income, comprehensive income, equity, and cash flows for each of the three years in the period ended December 31, 2019, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019, in conformity with accounting principles generally accepted in the United States of America.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission and our report dated February 24, 2020, expressed an unqualified opinion on the Company's internal control over financial reporting.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the 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 audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the 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 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 financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matter

The critical audit matter communicated below is a matter arising from the current-period audit of the financial statements that was communicated or required to be communicated to the audit committee and that (1) relates to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing a separate opinion on the critical audit matter or on the accounts or disclosures to which it relates.

Excess or Obsolete Inventory Reserve: Refer to Note 1 to the Financial Statements

Critical Audit Matter Description

The Company evaluates inventory each reporting period for excess quantities and obsolescence, establishing reserves when necessary based upon historic usage, estimated future usage and age. Once recorded, these reserves are considered permanent adjustments to the carrying value of inventory. As of December 31, 2019, the Company has inventories of $380.8 million, net of excess quantities and obsolescence reserves.

We identified the reserve for excess quantities and obsolete inventory as a critical audit matter because of the significant estimates and assumptions management makes to quantify and to record the reserve, including the determination of expected demand, especially when considering the vertically integrated nature of the Company as well as parts subject to technological obsolescence. This required a high degree of auditor judgment and an increased extent of effort when performing audit procedures to evaluate the methodology and the reasonableness of assumptions including expected demand.

How the Critical Audit Matter Was Addressed in the Audit

Our audit procedures related to management's judgments underlying the calculation of excess or obsolete inventory reserve, included the following, among others:

- We tested the effectiveness of controls over inventory, including those over the estimation of reserves for excess quantities and obsolescence.
- We evaluated the reasonableness of the Company's excess and obsolete inventory policy, considering historical experience and the underlying assumptions.
- We tested the calculation of the excess and obsolete reserve pursuant to the Company's policy, including the completeness and accuracy of the data used in the calculation.
- We evaluated management's ability to accurately estimate future demand by comparing actual inventory usage, on a sample basis, to estimates made in prior years.
- We considered the existence of contradictory evidence based on consideration of internal communication to management and the board of directors, Company press releases, and analysts' reports, as well as any changes within the business.

/s/ DELOITTE & TOUCHE LLP

Boston, Massachusetts
February 24, 2020

We have served as the Company's auditor since 1999.

IPG PHOTONICS CORPORATION

CONSOLIDATED BALANCE SHEETS

	December 31, 2019	December 31, 2018
	(In thousands, except share and per share data)	
ASSETS		
Current assets:		
Cash and cash equivalents	$ 680,070	$ 544,358
Short-term investments	502,546	500,432
Accounts receivable, net	238,479	255,509
Inventories	380,790	403,579
Prepaid income taxes	38,873	43,782
Prepaid expenses and other current assets	55,876	57,764
Total current assets	1,896,634	1,805,424
Deferred income taxes, net	31,395	19,165
Goodwill	82,092	100,722
Intangible assets, net	74,271	87,139
Property, plant and equipment, net	600,852	543,068
Other assets	45,192	18,932
Total assets	$ 2,730,436	$ 2,574,450
LIABILITIES AND EQUITY		
Current liabilities:		
Current portion of long-term debt	$ 3,740	$ 3,671
Accounts payable	27,329	36,302
Accrued expenses and other liabilities	149,782	154,640
Income taxes payable	11,053	51,161
Total current liabilities	191,904	245,774
Deferred income taxes and other long-term liabilities	98,121	80,734
Long-term debt, net of current portion	37,968	41,707
Total liabilities	327,993	368,215
Commitments and contingencies (Note 14)		
IPG Photonics Corporation equity:		
Common stock, $0.0001 par value, 175,000,000 shares authorized; 54,743,227 and 53,010,875 shares issued and outstanding, respectively, at December 31, 2019; 54,371,701 and 52,941,607 shares issued and outstanding, respectively, at December 31, 2018.	5	5
Treasury stock, at cost, 1,732,352 and 1,430,094 shares held at December 31, 2019 and December 31, 2018, respectively.	(265,730)	(224,998)
Additional paid-in capital	785,636	744,937
Retained earnings	2,028,734	1,848,500
Accumulated other comprehensive loss	(146,919)	(162,896)
Total IPG Photonics Corporation stockholders' equity	2,401,726	2,205,548
Non-controlling interests	717	687
Total equity	2,402,443	2,206,235
Total liabilities and equity	$ 2,730,436	$ 2,574,450

See notes to consolidated financial statements.

IPG PHOTONICS CORPORATION

CONSOLIDATED STATEMENTS OF INCOME

	Year Ended December 31,		
	2019	2018	2017
	(In thousands, except per share data)		
Net sales	$ 1,314,581	$ 1,459,874	$ 1,408,889
Cost of sales	708,372	659,606	611,978
Gross profit	606,209	800,268	796,911
Operating expenses:			
Sales and marketing	77,745	57,815	49,801
Research and development	129,997	122,769	100,870
General and administrative	107,597	102,429	80,668
Goodwill impairment	37,120	—	—
Impairment of long-lived assets and other restructuring charges	7,130	—	—
Loss (gain) on foreign exchange	12,827	(6,150)	14,460
Total operating expenses	372,416	276,863	245,799
Operating income	233,793	523,405	551,112
Other income, net:			
Interest income, net	14,238	9,057	737
Other income, net	345	1,933	22
Total other income	14,583	10,990	759
Income before provision for income taxes	248,376	534,395	551,871
Provision for income taxes	68,115	130,226	204,283
Net income	180,261	404,169	347,588
Less: net income (loss) attributable to non-controlling interests	27	142	(26)
Net income attributable to IPG Photonics Corporation	$ 180,234	$ 404,027	$ 347,614
Net income attributable to IPG Photonics Corporation per share:			
Basic	$ 3.40	$ 7.55	$ 6.50
Diluted	$ 3.35	$ 7.38	$ 6.36
Weighted average shares outstanding:			
Basic	53,061	53,522	53,495
Diluted	53,839	54,726	54,699

See notes to consolidated financial statements.

IPG PHOTONICS CORPORATION

CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME

	Year Ended December 31,		
	2019	2018	2017
		(In thousands)	
Net income	$ 180,261	$ 404,169	$ 347,588
Other comprehensive income (loss), net of tax:			
Foreign currency translation adjustments	15,997	(85,590)	100,999
Unrealized (loss) gain on derivatives	(17)	15	(58)
Effect of adopted accounting standards	—	10	—
Unrealized loss on available-for-sale investments	—	—	(240)
Loss on available-for-sale investments, net of tax reclassified to net income	—	—	538
Total other comprehensive income (loss)	15,980	(85,565)	101,239
Comprehensive income	196,241	318,604	448,827
Comprehensive gain attributable to non-controlling interest	30	129	31
Comprehensive income attributable to IPG Photonics Corporation	$ 196,211	$ 318,475	$ 448,796

See notes to consolidated financial statements.

IPG PHOTONICS CORPORATION

CONSOLIDATED STATEMENTS OF EQUITY

	Year Ended December 31,								
	Common Stock		Treasury Stock		Additional Paid In Capital	Retained Earnings	Accumulated Other Comprehensive (Loss) Income	Non-controlling Interest	Total Stockholders' Equity
(In thousands, except share data)	Shares	Amount	Shares	Amount					
Balance, January 1, 2017	**53,251,805**	**$ 5**	**(102,774)**	**$ (8,946)**	**$ 650,974**	**$1,094,108**	**$ (178,583)**	**$ 166**	**$ 1,557,724**
Exercise of stock options and vesting of RSU's and PSU's	617,662	—	—	—	25,062	—	—	—	25,062
Common stock issued under employee stock purchase plan	35,467	—	—	—	3,592	—	—	—	3,592
Purchased common stock	(275,495)	—	(275,495)	(39,987)	—	—	—	—	(39,987)
Stock-based compensation	—	—	—	—	23,021	—	—	—	23,021
Recently adopted accounting standards	—	—	—	—	2,078	2,145	—	—	4,223
Purchase of non-controlling interest	—	—	—	—	—	—	—	(197)	(197)
Net income	—	—	—	—	—	347,614	—	(26)	347,588
Foreign currency translation adjustments	—	—	—	—	—	—	100,999	57	101,056
Unrealized gain on derivatives, net of tax	—	—	—	—	—	—	(58)	—	(58)
Unrealized loss on available-for-sale investments, net of tax	—	—	—	—	—	—	(240)	—	(240)
Realized loss on available-for-sale investments, net of tax	—	—	—	—	—	—	538	—	538
Balance, December 31, 2017	**53,629,439**	**5**	**(378,269)**	**(48,933)**	**704,727**	**1,443,867**	**(77,344)**	**—**	**2,022,322**
Exercise of stock options and vesting of RSU's and PSU's	351,795	—	—	—	9,895	—	—	—	9,895
Common stock issued under employee stock purchase plan	12,198	—	—	—	2,288	—	—	—	2,288
Purchased common stock	(1,051,825)	—	(1,051,825)	(176,065)	—	—	—	—	(176,065)
Stock-based compensation	—	—	—	—	28,027	—	—	—	28,027
Recently adopted accounting standards	—	—	—	—	—	606	10	—	616
Purchase of non-controlling interest	—	—	—	—	—	—	—	558	558
Net income	—	—	—	—	—	404,027	—	142	404,169
Foreign currency translation adjustments	—	—	—	—	—	—	(85,577)	(13)	(85,590)
Unrealized loss on derivatives, net of tax	—	—	—	—	—	—	15	—	15
Balance, December 31, 2018	**52,941,607**	**5**	**(1,430,094)**	**(224,998)**	**744,937**	**1,848,500**	**(162,896)**	**687**	**2,206,235**
Exercise of stock options and vesting of RSU's and PSU's	319,211	—	—	—	805	—	—	—	805
Common stock issued under employee stock purchase plan	52,315	—	—	—	6,531	—	—	—	6,531
Purchased common stock	(302,258)	—	(302,258)	(40,732)	—	—	—	—	(40,732)
Stock-based compensation	—	—	—	—	33,363	—	—	—	33,363
Net income	—	—	—	—	—	180,234	—	27	180,261
Foreign currency translation adjustments	—	—	—	—	—	—	15,994	3	15,997
Unrealized gain on derivatives, net of tax	—	—	—	—	—	—	(17)	—	(17)
Balance, December 31, 2019	**53,010,875**	**$ 5**	**(1,732,352)**	**$(265,730)**	**$ 785,636**	**$2,028,734**	**$ (146,919)**	**$ 717**	**$ 2,402,443**

See notes to consolidated financial statements.

IPG PHOTONICS CORPORATION
CONSOLIDATED STATEMENTS OF CASH FLOWS

	Year Ended December 31,		
	2019	2018	2017
	(In thousands)		
Cash flows from operating activities:			
Net income	$ 180,261	$ 404,169	$ 347,588
Adjustments to reconcile net income to net cash provided by operating activities:			
Depreciation and amortization	96,268	80,271	64,568
Deferred income taxes	(15,489)	(4,576)	22,881
Stock-based compensation	33,363	28,027	23,021
Goodwill impairment	37,120	—	—
Impairment of long-lived assets	5,350	—	—
Unrealized losses (gains) on foreign currency transactions	11,004	(2,670)	7,949
Other	3,320	(3,586)	986
Provisions for inventory, warranty and bad debt	63,752	38,862	44,978
Changes in assets and liabilities that (used) provided cash, net of acquisitions:			
Accounts receivable	9,776	(18,814)	(63,225)
Inventories	(28,105)	(135,440)	(71,080)
Prepaid expenses and other current assets	18,405	(7,062)	(911)
Accounts payable	(10,257)	(1,426)	2,309
Accrued expenses and other liabilities	(37,310)	(19,666)	9,612
Income and other taxes payable	(43,937)	35,212	16,719
Net cash provided by operating activities	323,521	393,301	405,395
Cash flows from investing activities:			
Purchases of property, plant and equipment	(133,536)	(160,343)	(126,535)
Proceeds from sales of property, plant and equipment	661	1,026	15,882
Proceeds from short-term investments	768,078	470,328	212,515
Purchases of short and long-term investments	(760,300)	(765,310)	(211,832)
Acquisitions of businesses, net of cash acquired	(15,115)	(109,115)	(60,483)
Other	237	415	(352)
Net cash used in investing activities	(139,975)	(562,999)	(170,805)
Cash flows from financing activities:			
Proceeds from line-of-credit facilities	15	255	6,761
Payments on line-of-credit facilities	(15)	(255)	(6,761)
Proceeds on long-term borrowings	—	—	28,000
Principal payments on long-term borrowings	(3,671)	(3,604)	(19,842)
Proceeds from issuance of common stock under employee stock option and purchase plans less payments for taxes related to net share settlement of equity awards	7,336	12,183	28,654
Cash contributed by non-controlling interest	—	839	—
Purchase of non-controlling interests	—	—	(197)
Purchase of treasury stock, at cost	(40,732)	(176,065)	(39,987)
Net cash used in financing activities	(37,067)	(166,647)	(3,372)
Effect of changes in exchange rates on cash, cash equivalents and restricted cash	(7,853)	(29,197)	54,827
Net increase (decrease) in cash, cash equivalents and restricted cash	138,626	(365,542)	286,045
Cash and cash equivalents — Beginning of period	544,358	909,900	623,855
Cash, cash equivalents and restricted cash — End of period (Note 1)	$ 682,984	$ 544,358	$ 909,900
Supplemental disclosure of cash flow information:			
Cash paid for interest	$ 2,683	$ 3,052	$ 2,583
Cash paid for income taxes	$ 116,951	$ 112,762	$ 155,559
Non-cash transactions:			
Demonstration units transferred from inventory to other assets	$ 10,367	$ 6,270	$ 4,114
Property, plant and equipment transferred from inventory	$ 7,659	$ 2,535	$ 8,425
Changes in accounts payable related to property, plant and equipment	$ 1,304	$ (2,852)	$ 1,594
Leased assets obtained in exchange for new operating lease liabilities	$ 14,670	$ —	$ —

See notes to consolidated financial statements.

IPG PHOTONICS CORPORATION
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
(In thousands, except share and per share data)

1. NATURE OF BUSINESS AND SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Nature of Business — IPG Photonics Corporation (the "Company" or "IPG") develops, manufactures and sells high-performance fiber lasers, fiber amplifiers, diode lasers, laser systems, communications systems and optical accessories that are used for diverse applications, primarily in materials processing. The Company was incorporated as a Delaware corporation in December 1998. Its world headquarters are located in Oxford, Massachusetts. It also has facilities and sales offices elsewhere in North and South America, Europe and Asia.

Principles of Consolidation — The accompanying financial statements include the accounts of the Company and its majority-owned subsidiaries. All intercompany accounts and transactions have been eliminated.

Use of Estimates — The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenue and expenses during the reporting period. The Company bases its estimates on historical experience and on various other assumptions that are believed to be reasonable under the circumstances. Actual results could differ from those estimates.

Foreign Currency — The financial information for entities outside the United States is measured using local currencies as the functional currency. Assets and liabilities are translated into U.S. dollars at the exchange rate in effect on the respective balance sheet dates. Income and expenses are translated into U.S. dollars based on the average rate of exchange for the corresponding period. Exchange rate differences resulting from translation adjustments are accounted for directly as a component of accumulated other comprehensive loss.

Cash and Cash Equivalents and Short-Term and Long-Term Investments — Cash and cash equivalents consist primarily of highly liquid investments, such as bank deposits, mutual funds and marketable securities with maturities of three months or less at the date of purchase with insignificant interest rate risk. Short-term and long-term investments consist primarily of similar highly liquid investments and marketable securities with insignificant interest rate risks.

Accounts Receivable and Allowance for Doubtful Accounts — Accounts receivable include $16,484 and $27,335 of bank acceptance drafts at December 31, 2019 and 2018, respectively. Bank acceptance drafts are bank guarantees of payment on specified dates. The weighted average maturity of these bank acceptance drafts is less than 76 days. The Company maintains an allowance for doubtful accounts to provide for the estimated amount of accounts receivable that will not be collected. The allowance is based upon an assessment of customer creditworthiness, historical payment experience and the age of outstanding receivables.

Activity related to the allowance for doubtful accounts was as follows:

	2019	2018	2017
Balance at January 1	$ 1,731	$ 2,198	$ 2,016
Provision for bad debts, net of recoveries	677	14	51
Uncollectable accounts written off	(111)	(198)	(38)
Foreign currency translation	102	(283)	169
Balance at December 31	$ 2,399	$ 1,731	$ 2,198

Inventories — Inventories are stated at the lower of cost or market on a first-in, first-out basis. Inventories include parts and components that may be specialized in nature and subject to rapid obsolescence. The Company periodically reviews the quantities and carrying values of inventories to assess whether the inventories are recoverable. The costs associated with provisions for excess quantities, technological obsolescence, or component rejections are charged to cost of sales as incurred.

Goodwill — Goodwill is the amount by which the cost of the acquired net assets in a business acquisition exceeded the fair values of the net identifiable assets on the date of purchase. Goodwill is assessed for impairment at least annually, on a reporting unit basis, or more frequently when events and circumstances occur indicating that the recorded goodwill may be impaired. The process of evaluating the potential impairment of goodwill is subjective and requires significant judgment at many points during the analysis. If the book value of a reporting unit exceeds its fair value, the implied fair value of goodwill is compared with the carrying amount of goodwill. If the carrying amount of goodwill exceeds the implied fair value, an impairment loss is recorded in an amount equal to that excess. The results of the goodwill assessment for the year ended December 31, 2019 are discussed in Note 7.

Intangible Assets — Intangible assets result from the Company's various business acquisitions. Intangible assets are reported at cost, net of accumulated amortization, and are amortized on a straight-line basis either over their estimated useful lives of one year to thirteen years or over the period the economic benefits of the intangible asset are consumed.

Property, Plant and Equipment — Property, plant and equipment are stated at cost, less accumulated depreciation. Depreciation is determined using the straight-line method based on the estimated useful lives of the related assets. In the case of leasehold improvements, the estimated useful lives of the related assets do not exceed the remaining terms of the corresponding leases. The following table presents the assigned economic useful lives of property, plant and equipment:

Category	Economic Useful Life
Buildings	20-30 years
Machinery and equipment	5-7 years
Office furniture and fixtures	5-7 years

Expenditures for maintenance and repairs are charged to operating expense.

Long-Lived Assets — Long-lived assets, which consist primarily of property, plant and equipment and identifiable intangible assets, are reviewed by management for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. When undiscounted expected future cash flows are less than the carrying value, an impairment loss is recorded equal to the amount by which the carrying value exceeds the fair value of assets. Impairments of long-lived assets for the year ended December 31, 2019 are discussed in Note 7.

Included in other long-term assets is certain demonstration equipment. The demonstration equipment is amortized over the respective estimated economic lives, generally 3 years. The carrying value of the demonstration equipment totaled $7,591 and $7,037 at December 31, 2019 and 2018, respectively. Amortization expense of demonstration equipment for the years ended December 31, 2019, 2018 and 2017, was $4,364, $3,870 and $3,769, respectively.

Authorized Capital — The Company has authorized capital stock consisting of 175,000,000 shares of common stock, par value $0.0001 per share, and 5,000,000 shares of preferred stock, par value $0.0001 per share. There are no shares of preferred stock outstanding as of December 31, 2019.

Revenue Recognition — Revenue is recognized when transfer of control to the customer occurs in an amount reflecting the consideration that the Company expects to be entitled. In order to achieve this core principle, the Company applies the following five step approach: (1) identify the contract with a customer, (2) identify the performance obligations in the contract, (3) determine the transaction price, (4) allocate the transaction price to the performance obligations in the contract, and (5) recognize revenue when a performance obligation is satisfied.

The Company considers customer purchase orders, which in some cases are governed by master sales agreements, to be contracts with a customer. As part of its consideration of the contract, the Company evaluates certain factors including the customer's ability to pay (or credit risk). For each contract, the Company considers the promise to transfer products, each of which is distinct as the identified performance obligations. In determining the transaction price, the Company evaluates whether the price is subject to refund or adjustment to determine the net consideration to which the Company expects to be entitled. As the Company's standard payment terms are less than one year, the Company has elected the practical expedient under ASC 606-10-32-18 to not assess whether a contract has a significant financing component. The Company allocates the transaction price to each distinct product based on its relative standalone selling price. Revenue is recognized when control of the product is transferred to the customer (i.e., when the Company's performance obligation is satisfied), which typically occurs at shipment but which can occur over time for certain of the Company's systems contracts.

The Company often receives orders with multiple delivery dates that may extend across several reporting periods. The Company allocates the transaction price of the contract to each delivery based on the product standalone selling price. The Company invoices for each scheduled delivery upon shipment and recognizes revenues for such delivery at that point, assuming transfer of control has occurred. As scheduled delivery dates are generally within one year, under the optional exemption provided by ASC 606-10-50-14 revenues allocated to future shipments of partially completed contracts are not disclosed.

Rights of return generally are not included in customer contracts. Accordingly, upon application of steps one through five above, product revenue is recognized upon shipment and transfer of control. Returns are infrequent and are recorded as a reduction of revenue.

In certain subsidiaries the Company provides sales commissions to sales representatives based on sales volume. The Company has determined that the incentive portion of its sales commissions qualify as contract costs. The Company has elected the practical expedient in ASC 340-40-25-4 to expense sales commissions when incurred as the amortization period of the asset that would otherwise have been recognized is one year or less.

Revenue Recognition at a Point in Time — Revenues recognized at a point in time consist primarily of product, installation and service sales. The Company sells products to original equipment manufacturers ("OEMs") that supply materials processing laser systems, communications systems, medical laser systems and other laser systems for advanced applications to end users. The Company also sells products to end users that use IPG products directly to build their own systems, which incorporate or use IPG products as an energy or light source. The Company recognizes revenue for laser and spare part sales following the transfer of control of such products to the customer, which typically occurs upon shipment or delivery depending on the terms of the underlying contracts. Installation revenue is recognized upon completion of the installation service, which typically occurs within 90 days of delivery. For laser systems that carry customer specific processing requirements, revenue is recognized at the latter of customer acceptance date or shipment date if the customer acceptance is made prior to shipment. When sales contracts contain multiple performance obligations, such as the shipment or delivery of products and installation, the Company allocates the transaction price to each performance obligation identified in the contract based on relative standalone selling prices and recognizes the related revenue as control of each individual product or service is transferred to the customer, in satisfaction of the corresponding performance obligations.

Revenue Recognition over Time — Warranties are limited and provide that the product meets specifications and is free from defects in materials and workmanship. The Company also offers extended warranty agreements, which extend the standard warranty periods. Extended warranties are sold separately from products and represent a distinct performance obligation. Revenue related to the performance obligation for extended warranties is recognized over time as the customer simultaneously receives and consumes the benefits provided by the Company. The customer receives the assurance that the product will operate in accordance with agreed-upon specifications evenly during the extended warranty period regardless of whether they make a claim during that period, and therefore, revenue at time of sale is deferred and recognized over the time period of the extended warranty period.

With the acquisition of Genesis Systems Group, LLC in December 2018, the Company enters into contracts to sell customized robotic systems, for which revenue is generally recognized over time, depending on the terms of the contract. Recognizing revenue over time for these contracts is based on the Company’s judgment that the customized robotic system does not have an alternative use and the Company has an enforceable right to payment for performance completed to date.

The determination of the revenue to be recognized in a given period for performance obligations over time is based on the input method. The Company generally uses the total cost-to-cost input method of progress because it best depicts the transfer of control to the customer that occurs as costs are incurred. Under the cost-to-cost method, the extent of progress towards completion is measured based on the proportion of costs incurred to date to the total estimated costs at completion of the performance obligation.

Customer Deposits and Deferred Revenue — When the Company receives consideration from a customer or such consideration is unconditionally due prior to transferring goods or services under the terms of a sales contract, the Company records customer deposits or deferred revenue, which represent contract liabilities. The Company recognizes deferred revenue as net sales after control of the goods or services has been transferred to the customer and all revenue recognition criteria are met.

Warranties — The Company typically provides one to five-year parts and service warranties on lasers and amplifiers. Most of the Company's sales offices provide support to customers in their respective geographic areas. The Company estimates the warranty accrual considering past claims experience, the number of units still covered by warranty and the average life of the remaining warranty period. The warranty accrual has generally been sufficient to cover product warranty repair and replacement costs.

Stock-Based Compensation — The Company accounts for stock-based compensation expense using the fair value of the awards granted. The Company estimates the fair value of stock options granted using the Black-Scholes model, it values restricted stock units using the intrinsic value method, and it uses a Monte Carlo simulation model to estimate the fair value of market-based performance stock units. The Company accounts for forfeitures as they occur. The Company amortizes the fair value of stock options and awards on a straight-line basis over the requisite service periods of the awards, which are generally the vesting periods. Stock options and restricted stock units generally vest annually on the anniversary of the grant date over a

four-year period. Performance stock units cliff-vest on the third anniversary of the grant date based upon achievement of performance targets established at grant. The description of the Company's stock-based compensation plans and the assumptions it uses to calculate the fair value of stock-based compensation is more fully described in Note 15, "Stock-based Compensation."

Advertising Expense — The cost of advertising is expensed as incurred. The Company conducts substantially all of its sales and marketing efforts through trade shows, professional and technical conferences, direct sales and the Company's website. The Company's advertising costs were not material for the periods presented.

Research and Development — Research and development costs are expensed as incurred.

Restructuring — The Company records charges associated with approved restructuring plans to reorganize operations, to remove redundant headcount and infrastructure associated with business acquisitions or to improve the efficiency of business processes. Restructuring charges can include severance costs to eliminate a specific number of employees, infrastructure charges to vacate facilities and consolidate operations and contract cancellation costs. The Company records restructuring charges when they are probable and estimable. The Company accrues for severance and other employee separation costs under these plans when the employees accept the offer and the amount can be reasonably estimated.

Income Taxes — Deferred tax assets and liabilities are recognized for the future tax consequences of temporary differences between the financial statement carrying amounts and tax basis of assets and liabilities and net operating loss and credit carryforwards using enacted rates in effect when those differences are expected to reverse. Valuation allowances are provided against deferred tax assets that are not deemed to be recoverable. The Company recognizes tax positions that are more likely than not to be sustained upon examination by relevant tax authorities. The tax positions are measured at the greatest amount of tax benefit that is more than 50 percent likely to be realized upon ultimate settlement.

The Company provides reserves for potential payments of tax to various tax authorities related to uncertain tax positions and other issues. The reserves are based on a determination of whether and how much of a tax benefit taken in its tax filings or positions is more likely than not to be realized following resolution of uncertainties related to the tax benefit, assuming that the matter in question will be raised by the tax authorities.

Concentration of Credit Risk — Financial instruments that potentially subject the Company to credit risk consist primarily of cash and cash equivalents, short and long-term investments, auction rate securities and accounts receivable. The Company maintains substantially all of its cash, short-term and long-term investments and marketable securities in various financial institutions, which it believes to be high-credit quality financial institutions. The Company grants credit to customers in the ordinary course of business and provides a reserve for potential credit losses. Such losses historically have been within management's expectations.

One customer comprised 9%, 12% and 13% of net sales during the years ended December 31, 2019, 2018 and 2017 respectively. The same customer accounted for 24% and 25% of our net accounts receivable as of December 31, 2019 and 2018, respectively. The Company has historically depended on a few customers for a significant percentage of its annual net sales. The composition of this group can change from year to year. Net sales derived from the Company's five largest customers as a percentage of its annual net sales were 21%, 26% and 28% in 2019, 2018 and 2017, respectively.

Comprehensive Income — Comprehensive income includes charges and credits to equity that are not the result of transactions with stockholders. Included within comprehensive income is the cumulative foreign currency translation adjustment, change in carrying value of auction rate securities, unrealized gains or losses on derivatives and unrealized gains or losses on available-for-sale investments. These adjustments are accumulated within the consolidated statements of comprehensive income.

Total components of accumulated other comprehensive loss were as follows:

	December 31,	
	2019	**2018**
Foreign currency translation adjustments	$ (147,161)	$ (163,155)
Unrealized gain on auction rate securities	232	232
Unrealized gain on derivatives, net of tax of $3 and $4, respectively	10	27
Accumulated other comprehensive loss	$ (146,919)	$ (162,896)

Derivative Instruments — The Company's primary market exposures are to interest rates and foreign exchange rates. The Company from time to time may use certain derivative financial instruments to help manage these exposures. The Company executes these instruments with financial institutions it judges to be credit-worthy. The Company does not hold or issue derivative financial instruments for trading or speculative purposes. The Company recognizes all derivative financial instruments as either assets or liabilities at fair value in the consolidated balance sheets.

Business Segment Information — The Company operates in one segment which involves the design, development, production and distribution of fiber lasers, laser and non-laser systems, fiber amplifiers, and related optical components. The Company has a single, company-wide management team that administers all properties as a whole rather than as discrete operating segments. The chief operating decision maker, who is the Company's chief executive officer, measures financial performance as a single enterprise, and not on geography, legal entity, or end market basis. Throughout the year, the chief operating decision maker allocates capital resources on a project-by-project basis across the Company's entire asset base to maximize profitability without regard to geography, legal entity, or end market basis. The Company operates in a number of countries throughout the world in a variety of product lines. Information regarding product lines and geographic financial information is provided in Note 2, "Revenue from Contracts with Customers" and Note 8, "Property, Plant and Equipment."

Earnings Per Share — Basic net income per share is computed by dividing net income attributable to shareholders of the Company by the weighted-average number of common shares outstanding during the reporting period. Diluted net income per share is computed similarly to basic net income per share, except that it includes the potential dilution that could occur if dilutive securities were exercised. Information about potentially dilutive and antidilutive shares for the reporting period is provided in Note 18, "Net Income Attributable to IPG Photonics Corporation Per Share."

Leases — The Company determines if an arrangement is a lease at inception. Operating leases are included in other assets, other current liabilities, and other long-term liabilities on the Company's consolidated balance sheets.

Right of use ("ROU") assets and lease liabilities are recognized based on the present value of the future minimum lease payments over the lease term at commencement date. As most of the Company's leases do not provide an implicit rate, IPG uses its incremental borrowing rate based on the information available at commencement date in determining the present value of future payments. The ROU assets also include any lease payments made and initial direct costs incurred and exclude lease incentives. Lease terms may include options to extend or terminate the lease when it is reasonably certain that we will exercise that option. Lease expense for minimum lease payments is recognized on a straight-line basis over the lease term. Leases with an initial term of 12 months or less are not recorded on the balance sheet; the Company recognizes lease expense for these leases on a straight-line basis over the lease term. The Company has lease agreements with lease and non-lease components, which are accounted for as a single lease component.

Recent Accounting Pronouncements

Adopted Pronouncements — In February 2016, the Financial Accounting Standards Board (“FASB”) issued a new standard related to leases to increase transparency and comparability among organizations by requiring the recognition of ROU assets and lease liabilities on the balance sheet. Most prominent among the changes in the standard is the recognition of ROU assets and lease liabilities by lessees for those leases classified as operating leases. The Company adopted ASC 842, as of January 1, 2019, using the modified retrospective approach as of the date of adoption. Under this approach, comparative periods have not been restated. In addition, IPG elected the package of three practical expedients permitted under the transition guidance within the new standard, which among other things, allowed for the carry forward of the historical lease classification.

The cumulative effect of the changes made to the Company's consolidated January 1, 2019 balance sheet for the adoption of ASC 842 related to operating leases was as follows:

	Balance at December 31, 2018	Adoption of ASC 842	Balance at January 1, 2019
Balance Sheet			
Prepaid expenses and other current assets	$ 57,764	$ (324)	$ 57,440
Other assets	18,932	19,463	38,395
Accrued expenses and other current liabilities	154,640	5,292	159,932
Deferred income taxes and other long-term liabilities	80,734	13,847	94,581

On January 1, 2018, the Company adopted FASB ASU No. 2016-18, "Statement of Cash Flows (Topic 230): Restricted Cash" ("ASU 2016-18"), which enhances and clarifies the guidance on the classification and presentation of restricted cash in the statement of cash flows and requires additional disclosure about restricted cash balances. The Company considers cash to be restricted when withdrawal or general use is legally restricted. The Company records restricted cash in other assets on the consolidated balance sheets and determines classification as current or long-term based on the expected duration of the restriction.

The reconciliation of the Company's cash and cash equivalents in the consolidated balance sheets to cash, cash equivalents and restricted cash in the consolidated statement of cash flows is as follows:

	Balance at December 31, 2019	Balance at December 31, 2018
Cash and cash equivalents	$ 680,070	$ 544,358
Restricted cash included in other assets	2,914	—
Cash, cash equivalents and restricted cash	$ 682,984	$ 544,358

Also on January 1, 2018, the Company adopted ASC 606 "Revenue from Contracts with Customers," ("ASC 606" or the "new revenue standard") and all related amendments using the modified retrospective method for contracts that were not completed as of the date of initial application. The Company recognized the cumulative effect of initially applying the new revenue standard as an adjustment to the opening balance of retained earnings. The comparative information has not been restated and continues to be reported under the accounting standards in effect for those periods.

A majority of revenue continues to be recognized at a point in time when control transfers based on the terms of underlying contact. Under the new revenue standard, the Company changed from deferring revenue for installation services in an amount equal to the greater of the cash received related to installation or the fair value to deferring the standalone selling price for these services.

In February 2018, the FASB issued ASU No. 2018-02, "Income Statement - Reporting Comprehensive Income (Topic 220): Reclassification of Certain Tax Effects from Accumulated Other Comprehensive Income" ("ASU 2018-02"). ASU 2018-02 allowed a reclassification from accumulated other comprehensive income to retained earnings for stranded tax effects resulting from the Tax Cuts and Jobs Act ("the Act"). The Company adopted this standard during the first quarter of 2018, which resulted in the reclassification of $10 related to the tax effect of unrealized gains on derivatives.

In October 2016, the FASB issued ASU No. 2016-16, "Income Taxes (Topic 740) - Intra-Entity Transfers of Assets other than Inventory" ("ASU 2016-16"). ASU 2016-16 eliminated the exception that prohibited the recognition of current and deferred income tax consequences for intra-entity asset transfers (other than inventory) until the asset has been sold to an outside party. The amendments have been applied on a modified retrospective basis through a cumulative effect adjustment to retained earnings. The Company adopted this standard during the first quarter of 2018, which resulted in the reclassification of prepaid income taxes, deferred income taxes and retained earnings.

In January 2017, the FASB issued ASU No. 2017-04, "Intangibles—Goodwill and Other (Topic 350)" ("ASU 2017-04"). ASU 2017-04 simplified the accounting for goodwill impairments by eliminating step 2 from the goodwill impairment test. The Company early adopted this standard, which was applied prospectively, during the first quarter of 2018. The Company performs its annual goodwill impairment assessment on October 1 of each year.

The cumulative effect of the changes made to the Company's consolidated January 1, 2018 balance sheet for the adoption of ASC 606, ASU 2018-02 and ASU 2016-16 was as follows:

	Balance at 12/31/2017	Adoption of ASC 606	Adoption of ASU 2018-02	Adoption of ASU 2016-16	Balance at 1/1/2018
Balance Sheet					
Prepaid income taxes	$ 44,944	$ —	$ —	$ (1,203)	$ 43,741
Deferred income tax assets	26,976	(55)	—	1,229	28,150
Customer deposits and deferred revenue (short-term)	47,324	(816)	—	—	46,508
Income taxes payable	15,773	37	—	—	15,810
Deferred income tax liabilities	21,362	134	—	—	21,496
Retained earnings	1,443,867	590	(10)	26	1,444,473
Accumulated other comprehensive loss	(77,344)	—	10	—	(77,334)

In March 2016, the FASB issued ASU No. 2016-09, "Compensation - Stock Compensation (Topic 718): Improvements to Employee Share-Based Payment Accounting" ("ASU 2016-09"). ASU 2016-09 was intended to simplify several areas of accounting for share-based compensation arrangements, including income tax impact and classification on the consolidated statement of cash flows. ASU 2016-09 was effective for fiscal years, and interim periods within those years, beginning after December 15, 2016, and the Company adopted this statement effective January 1, 2017. Under ASU 2016-09, excess tax benefits and deficiencies as a result of stock option exercises and restricted stock unit vesting are being recognized as discrete items within income tax expense or benefit in the consolidated statements of comprehensive income in the reporting period in which they occur.

The adoption of ASU 2016-09 also required the cumulative effect of initially applying the standard to be recorded as an adjustment to the opening balance of retained earnings of the annual reporting period that included the date of initial application. This resulted in a cumulative effect increase of $3,464 to retained earnings and deferred tax assets. Also, as a result of the adoption of ASU 2016-09, the Company made an accounting policy election to record forfeitures as they occur rather than by estimating expected forfeitures. The calculated cumulative effect was a decrease in retained earnings of $1,319 and an increase in deferred tax assets and additional paid-in capital of $759 and $2,078, respectively, as of January 1, 2017.

Other Pronouncements Currently Under Evaluation — In June 2016, the FASB issued ASU No. 2016-13, "Measurement of Credit Losses on Financial Instruments" ("ASU 2016-13"), which adds an impairment model (known as the current expected credit loss ("CECL") model) that is based on expected losses rather than incurred losses. Under the new guidance, an entity recognizes as an allowance its estimate of expected credit losses, which the FASB believes will result in more timely recognition of such losses. The ASU is also intended to reduce the complexity by decreasing the number of credit impairment models that entities use to account for debt instruments. ASU 2016-03, along with its subsequent clarifications, is effective for fiscal years beginning after December 15, 2019. The Company does not expect this standard will have a material impact to net income.

2. REVENUE FROM CONTRACTS WITH CUSTOMERS

Sales are derived from products for different applications: fiber lasers, diode lasers, diodes and systems for materials processing, fiber lasers and amplifiers for advanced applications, fiber amplifiers for communications applications, and fiber lasers for medical applications. The following tables represent a disaggregation of revenue from contracts with customers for the years ended December 31, 2019 and 2018:

	Twelve Months Ended December 31,	
	2019	2018
Sales by Application		
Materials processing	$ 1,229,211	$ 1,374,448
Other applications	85,370	85,426
Total	$ 1,314,581	$ 1,459,874

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	Twelve Months Ended December 31,	
	2019	2018
Sales by Product		
High Power Continuous Wave ("CW") Lasers	$ 734,745	$ 909,726
Medium and Low Power CW Lasers	56,625	95,764
Pulsed Lasers	137,675	162,048
Quasi-Continuous Wave ("QCW") Lasers	56,440	66,700
Laser and Non-Laser Systems	141,647	59,330
Other Revenue including Amplifiers, Service, Parts, Accessories and Change in Deferred Revenue	187,449	166,306
Total	$ 1,314,581	$ 1,459,874
Sales by Geography		
North America	$ 280,886	$ 202,743
Europe:		
Germany	81,365	111,259
Other including Eastern Europe/CIS	249,871	296,917
Asia and Australia:		
China	491,890	629,079
Japan	71,757	87,619
Other	121,586	127,251
Rest of World	17,226	5,006
Total	$ 1,314,581	$ 1,459,874
Timing of Revenue Recognition		
Goods and services transferred at a point in time	$ 1,233,065	$ 1,447,343
Goods and services transferred over time	81,516	12,531
Total	$ 1,314,581	$ 1,459,874

The Company enters into contracts to sell lasers and spare parts, for which revenue is generally recognized upon shipment or delivery, depending on the terms of the contract. The Company also provides installation services and extended warranties. The Company frequently receives consideration from a customer prior to transferring goods to the customer under the terms of a sales contract. The Company records customer deposits related to these prepayments, which represent a contract liability. The Company also records deferred revenue related to installation services when consideration is received before the services have been performed. The standalone selling price for installation services is determined based on the estimated number of days of service technician time required for installation at standard service rates. The Company recognizes customer deposits and deferred revenue as net sales after control of the goods or services has been transferred to the customer and all revenue recognition criteria is met. The Company bills customers for extended warranties upon entering into the agreement with the customer, resulting in deferred revenue. The timing of customer payments on contracts for the sale of customized robotic systems generally differs from the timing of revenue recognized, resulting in contract assets and liabilities. Contract assets are included within prepaid expense and other current assets on the consolidated balance sheets. Contract liabilities are included within accrued expenses and other current liabilities on the consolidated balance sheets.

The following table reflects the changes in the Company's contract assets and liabilities for the years ended December 31, 2019 and 2018:

	December 31, 2019	December 31, 2018	Change	December 31, 2018	January 1, 2018	Change
Contract assets						
Contract assets	$ 9,645	$ 10,102	$ (457)	$ 10,102	$ —	$ 10,102
Contract liabilities						
Contract liabilities - current	59,531	52,606	6,925	52,606	46,508	6,098
Contract liabilities - long-term	1,820	1,413	407	1,413	182	1,231

During the year ended December 31, 2019 and 2018, the Company recognized revenue of $45,223 and $40,944, respectively, that was included in the contract liabilities at the beginning of the period.

The Company has elected the practical expedient in ASC 606-10-50-14, whereby the performance obligations for contracts with an original expected duration of one year or less are not disclosed. The following table represents the Company's remaining performance obligations from contracts that are recognized over time as of December 31, 2019:

	Remaining Performance Obligations						
	2020	2021	2022	2023	2024	2025	Total
Revenue expected to be recognized for extended warranty agreements	$ 4,105	$ 914	$ 498	$ 301	$ 87	$ 18	$ 5,923
Revenue to be earned over time from contracts to sell robotic systems	28,170	1,325	—	—	—	—	29,495
Total	$ 32,275	$ 2,239	$ 498	$ 301	$ 87	$ 18	$ 35,418

3. FAIR VALUE MEASUREMENTS

The Company's financial instruments consist of cash equivalents, short-term investments, accounts receivable, auction rate securities, accounts payable, drawings on revolving lines of credit, long-term debt, interest rate swaps and contingent purchase consideration.

The valuation techniques used to measure fair value are based upon observable and unobservable inputs. Observable inputs reflect market data obtained from independent sources, while unobservable inputs reflect internal market assumptions. These two types of inputs create the following fair value hierarchy: Level 1, defined as observable inputs such as quoted prices for identical instruments in active markets; Level 2, defined as inputs other than quoted prices in active markets that are either directly or indirectly observable; and Level 3, defined as unobservable inputs for which little or no market data exists, therefore requiring an entity to develop its own assumptions.

The carrying amounts of money market fund deposits, term deposits, accounts receivable, accounts payable and drawings on revolving lines of credit are considered reasonable estimates of their fair market value due to the short maturity of most of these instruments or as a result of the competitive market interest rates, which have been negotiated. The Company's bond securities are reported at fair value based upon quoted prices for instruments with identical terms in active markets. The Company's commercial paper securities reported at fair value are based upon model-driven valuations in which all significant inputs are observable or can be derived from or corroborated by observable market data for substantially the full term of the asset or liability, and are therefore classified as Level 2. At December 31, 2019, the Company's long-term notes consisted of a variable rate note and a fixed rate note, and the book value is considered a reasonable estimate of fair market value.

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The following table presents fair value information related to the Company's assets and liabilities measured at amortized cost on the Consolidated Balance Sheets with the exception of the interest rate swap, which is measured at fair value:

	Fair Value Measurements at December 31, 2019			
	Total	Level 1	Level 2	Level 3
Assets				
Cash equivalents:				
Money market fund deposits and term deposits	$ 155,080	$ 155,080	$ —	$ —
Commercial paper	54,712	—	54,712	—
Short-term investments:				
Corporate bonds	259,422	259,422	—	—
Commercial paper	236,752	—	236,752	—
Certificate of deposit	6,501	6,501	—	—
Long-term investments and other assets:				
Auction rate securities	592	—	—	592
Interest rate swap	12	—	12	—
Total assets	$ 713,071	$ 421,003	$ 291,476	$ 592
Liabilities				
Long-term notes	$ 42,004	$ —	$ 42,004	$ —
Contingent purchase consideration	273	—	—	273
Total liabilities	$ 42,277	$ —	$ 42,004	$ 273

	Fair Value Measurements at December 31, 2018			
	Total	Level 1	Level 2	Level 3
Assets				
Cash equivalents:				
Money market fund deposits and term deposits	$ 180,965	$ 180,965	$ —	$ —
U.S. Treasury and agency obligations	6,495	6,495	—	—
Commercial paper	78,948	—	78,948	—
Short-term investments:				
U.S. Treasury and agency obligations	116,800	116,800	—	—
Corporate bonds	227,009	227,009	—	—
Commercial paper	156,321	—	156,321	—
Long-term investments and other assets:				
Corporate bonds	3,859	3,859	—	—
Auction rate securities	847	—	—	847
Interest rate swap	31	—	31	—
Total assets	$ 771,275	$ 535,128	$ 235,300	$ 847
Liabilities				
Long-term notes	$ 45,378	$ —	$ 45,378	$ —
Contingent purchase consideration	898	—	—	898
Total liabilities	$ 46,276	$ —	$ 45,378	$ 898

Short-term investments consist of liquid investments including U.S. government and government agency notes, corporate bonds, commercial paper and certificates of deposit with original maturities of greater than three months but less than one year and are recorded at amortized cost. The fair value of the short-term investments considered held-to-maturity as of December 31, 2019 and December 31, 2018 was $502,675 and $500,130, respectively, which represents an unrealized gain of $129 and unrealized loss of $302, respectively, as compared to the book value recorded on the consolidated balance sheets for the same

periods. There were no long-term investments considered held-to-maturity as of December 31, 2019. The fair value of the long-term investments considered held-to-maturity as of December 31, 2018 was $3,859, which represents the book value recorded on the consolidated balance sheets for the same period. There were no impairments for the investments considered held-to-maturity at December 31, 2019 and December 31, 2018.

The Company entered into an interest rate swap that is designated as a cash flow hedge associated with a new long-term note issued during the second quarter of 2016 that will terminate with the long-term note in May 2023. The fair value at December 31, 2019 for the interest rate swap considered pricing models whose inputs are observable for the securities held by the Company.

Auction rate securities and contingent consideration are measured at fair value on a recurring basis using significant unobservable inputs (Level 3). The fair value of the auction rate securities was determined using prices observed in inactive markets with limited observable data for the securities held by the Company. The auction rate securities are considered available-for-sale securities. They had a cost basis of $592 and $847 at December 31, 2019 and December 31, 2018, respectively. There were no impairments for the available-for-sale securities at December 31, 2019 and December 31, 2018.

The fair value of contingent consideration was determined using an income approach at the respective business combination date and at the reporting date. That approach is based on significant inputs that are not observable in the market and include key assumptions such as assessing the probability of meeting certain milestones required to earn the contingent consideration.

The following table presents information about the Company's movement in Level 3 assets and liabilities measured at fair value:

	2019	2018	2017
Auction rate securities			
Balance, January 1	$ 847	$ 1,016	$ 1,144
Period transactions	(264)	(207)	—
Change in fair value	9	38	(128)
Balance, December 31	$ 592	$ 847	$ 1,016
Contingent purchase consideration			
Balance, January 1	$ 898	$ 902	$ —
Period transactions	—	—	902
Cash payments	(632)	—	—
Change in fair value	(29)	48	—
Foreign exchange adjustment	36	(52)	—
Balance, December 31	$ 273	$ 898	$ 902

The following table presents the effective maturity dates of debt investments as of December 31, 2019 and December 31, 2018:

	December 31, 2019		December 31, 2018	
	Book Value	Fair Value	Book Value	Fair Value
Investment maturity				
Held-to-maturity				
Less than 1 year	$ 502,546	$ 502,675	$ 585,875	$ 585,573
1 through 5 years	—	—	3,859	3,859
Total	$ 502,546	$ 502,675	$ 589,734	$ 589,432
Available-for-sale				
Greater than 5 years	$ 592	$ 592	$ 847	$ 847

4. INVENTORIES

Inventories consist of the following:

	December 31,	
	2019	2018
Components and raw materials	$ 200,390	$ 233,594
Work-in-process	49,620	66,498
Finished goods	130,780	103,487
Total	$ 380,790	$ 403,579

The Company recorded inventory provisions totaling $38,902, $12,981 and $16,946 for the years ended December 31, 2019, 2018 and 2017, respectively. These provisions relate to the recoverability of the value of inventories due to technological changes and excess quantities. These provisions are reported as a reduction to components and raw materials and finished goods.

5. BUSINESS COMBINATIONS

During the first quarter of 2019, the Company acquired a provider of submarine networking technology and services based in Brazil ("SND") for $19,560, which represents the fair value on that date. Of the purchase price, $1,956 ($1,861 at December 31, 2019) was held back for potential post-closing adjustments related to government approval of licenses. This balance is included within accrued expenses and other liabilities on the consolidated balance sheets. In addition, $2,934 ($2,914 at December 31, 2019) was held back in a restricted bank account for potential post-closing adjustments related to seller indemnities. This restricted cash balance is included within other assets, and the liability related to the amount due to the sellers if the indemnities are satisfied is included within deferred income taxes and other long-term liabilities on the consolidated balance sheets. During the fourth quarter of 2019, the Company finalized the purchase price allocations related to the acquisition, which resulted in adjusting the amounts that were provisionally reported as intangible assets for production know-how and customer relationships to goodwill. This adjustment reduced intangible assets by $9,650 and increased goodwill by the same amount. Additionally, the change in the provisional amounts resulted in a decrease in amortization expense and accumulated amortization of $848, which relates to the previous quarters. After completion of the purchase price allocations, the $19,076 excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed was recorded to goodwill. The goodwill arising from this acquisition will not be deductible for tax purposes.

During the fourth quarter of 2018, the Company acquired 100% of the membership units of Genesis System Group, LLC (“Genesis Systems”). Genesis Systems is based in Davenport, Iowa, and has production facilities in the United States, Mexico, and Japan. Genesis Systems develops innovative robotic system solutions for applications that include welding, non-destructive inspection, machine vision, materials handling, removal and dispensing. The Company paid $107,987 to acquire Genesis Systems, which represents the fair value on that date. The purchase price includes $448, which was paid for the working capital adjustment finalized in the first quarter of 2019. Of the purchase price, $1,350 remains in escrow for indemnities provided by the seller. As a result of the acquisition, the Company recorded intangible assets of $32,350 related to customer relationships with a weighted-average estimated useful life of 11 years and $11,350 related to technology, trademark and tradename with a weighted-average estimated useful life of 6 years. Any excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed is allocated to goodwill, which amounted to $45,684, most of which will be deductible for tax purposes.

During the second quarter of 2018, the Company acquired 100% of the shares of robot concept GmbH (“RC”). RC is located near Munich, Germany, designs and manufactures customized laser systems. The purchase price was $4,453, which represents the fair value on that date. As a result of the acquisition, the Company recorded intangible assets of $111 related to customer relationships with a weighted-average estimated useful life of 1 year and $594 related to technology, trademark and tradename with a weighted-average estimated useful life of 10 years. Any excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed is allocated to goodwill, which amounted to $4,072. The goodwill arising from this acquisition will not be deductible for tax purposes.

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The fair values of net tangible assets and intangible assets acquired were based upon the Company's estimates and assumptions at the acquisition dates. The following table summarizes the allocation of the assets acquired and liabilities assumed at the acquisition dates for the year ended December 31, 2018:

	Genesis Systems	RC	Total
Cash and cash equivalents	$ 2,847	$ 30	$ 2,877
Assets acquired excluding cash and cash equivalents and deferred tax assets	39,262	2,151	41,413
Liabilities assumed excluding deferred tax liabilities	(23,506)	(1,932)	(25,438)
Deferred tax liabilities, net	—	(573)	(573)
Intangible assets	43,700	705	44,405
Total identifiable net assets	62,303	381	62,684
Goodwill	45,684	4,072	49,756
Total purchase price	$ 107,987	$ 4,453	$ 112,440

The operating results of Genesis Systems are included in the consolidated results of operations from the date of acquisition. The impact of earnings from Genesis Systems from January 1, 2017 to the date of acquisition were not material to the Company. The following table presents consolidated pro forma information as if the acquisition had occurred on January 1, 2017:

	Pro forma (Unaudited)	
	Years ended December 31,	
	2018	2017
Net sales	$ 1,551,373	$ 1,511,051

During the fourth quarter of 2017, the Company acquired 100% of the shares of Laser Depth Dynamics Inc. ("LDD"). LDD, located in Kingston, Ontario, Canada, provides in-process quality monitoring and control solutions for laser-based welding applications. The purchase price was $9,992, which represents the fair value on that date. As a result of the acquisition, the Company recorded intangible assets of $1,006 related to customer relationships with a weighted-average estimated useful life of 6 years and $2,608 related to technology, trademark and tradename with a weighted-average estimated useful life of 6 years. Any excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed is allocated to goodwill, which amounted to $5,276. The goodwill arising from this acquisition will be deductible for tax purposes.

During the third quarter of 2017, the Company acquired 100% of the membership units of Innovative Laser Technologies, LLC ("ILT") located in Minneapolis, Minnesota. ILT produces high precision laser-based systems for the medical device industry and other end user markets. The Company paid $40,256 to acquire ILT, which represents the fair value on that date. As a result of the acquisition, the Company recorded intangible assets of $11,660 related to customer relationships with an estimated useful life of 13 years and $7,480 related to technology, trademark and tradename with a weighted-average estimated useful life of 8 years. Any excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed is allocated to goodwill, which amounted to $19,467. The majority of goodwill arising from this acquisition will not be deductible for tax purposes.

During the second quarter of 2017, the Company acquired 100% of the shares of OptiGrate Corporation ("OptiGrate") located in Oviedo, Florida. OptiGrate is a developer and manufacturer of volume Bragg gratings used in the production of lasers and laser diodes. The Company paid $16,870 to acquire OptiGrate, which represents the fair value on that date. As a result of the acquisition, the Company recorded intangible assets of $1,010 related to customer relationships with an estimated useful life of 4 years and $4,650 related to technology, trademark and tradename with a weighted-average estimated useful life of 9 years. Any excess of the acquisition consideration over the fair value of assets acquired and liabilities assumed is allocated to goodwill, which amounted to $8,900. The goodwill arising from this acquisition will not be deductible for tax purposes.

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The following table summarizes the allocation of the assets acquired and liabilities assumed at the acquisition dates for the year ended December 31, 2017:

	LDD	ILT	OptiGrate	Total
Cash and cash equivalents	$ 1,002	$ 969	$ 3,714	$ 5,685
Assets acquired excluding cash and cash equivalents and deferred tax assets	1,346	14,353	1,351	17,050
Liabilities assumed excluding deferred tax liabilities	(708)	(11,669)	(687)	(13,064)
Deferred tax liabilities, net	(538)	(2,004)	(2,068)	(4,610)
Intangible assets	3,614	19,140	5,660	28,414
Total identifiable net assets	4,716	20,789	7,970	33,475
Goodwill	5,276	19,467	8,900	33,643
Total purchase price	$ 9,992	$ 40,256	$ 16,870	$ 67,118

Results of operations for the businesses acquired above have been included in the Company's consolidated financial statements after the date of such acquisitions. Also, pro forma results of operations in accordance with authoritative guidance for prior periods have not been presented because the effect of the acquisitions were not material to the Company's prior period consolidated financial results.

6. RESTRUCTURING

In the second half of 2019, the Company undertook a strategic analysis of investments in new markets and solutions, including the additional investment required to enter and obtain significant market share in the submarine telecommunications industry. As a result of this analysis, in the fourth quarter of 2019, the Company decided to cease further investment in SND and is pursuing strategic alternatives for this business. As of December 31, 2019, the Company incurred cumulative pre-tax charges of $21,163, which includes a non-cash goodwill impairment loss of $17,795 and non-cash asset-related costs of $2,852. In addition, $202 of severance and employee benefit costs were incurred and $314 related to contract cancellations.

In addition to the SND plan discussed above, the Company also implemented other restructuring programs globally, which were primarily focused on workforce reduction and facility consolidation. These programs resulted in expenses of $3,762, including $1,264 of severance and employee benefit costs and $2,498 of non-cash asset-related costs.

The following table summarizes the Company's restructuring accrual at December 31, 2019 and changes during the year ended December 31, 2019:

	Severance and Employee Benefit Costs	Contract Cancellations	Total
Balance at January 1, 2019	$ —	$ —	$ —
Charges	1,466	314	1,780
Cash payments	(1,317)	(275)	(1,592)
Balance at December 31, 2019	$ 149	$ 39	$ 188

7. GOODWILL AND INTANGIBLE ASSETS

The following table sets forth the changes in the carrying amount of goodwill for the years ended December 31, 2019 and 2018:

	2019	2018
Balance at January 1	$ 100,722	$ 55,831
Adjustments to goodwill during the measurement period	448	(2,362)
Goodwill arising from business combinations	19,076	47,705
Impairment losses	(37,120)	—
Foreign exchange adjustment	(1,034)	(452)
Balance at December 31	$ 82,092	$ 100,722

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The Company tests its reporting units for impairment annually as of the first day of the fourth quarter, or more frequently if events or circumstances indicate it is more likely than not that the fair value of a reporting unit is less than its carrying amount. The Company performed the 2019 annual impairment test as of October 1, 2019. For certain reporting units, the Company performed a quantitative assessment using the discounted cash flow method under the income approach to estimate the fair value. As a result of the 2019 annual impairment test for the transceivers reporting unit, the Company recognized a non-cash impairment loss of $19,325, which was equal to the goodwill carrying amount prior to its impairment. The analysis considered lower than forecasted sales and profitability, as well as the impact of delays in new product launches.

As part of the restructuring of the submarine telecommunications reporting unit discussed in Note 6, the Company recognized a non-cash impairment loss of $17,795, which decreases the net assets to the estimated net realizable value as of December 31, 2019. The carrying balance of goodwill at December 31, 2019 was net of accumulated impairments of $37,120.

Intangible assets, subject to amortization, consisted of the following:

	December 31, 2019				December 31, 2018			
	Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount	Weighted-Average Lives	Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount	Weighted-Average Lives
Customer relationships	$ 57,866	$ (11,993)	$ 45,873	11 years	$ 57,849	$ (6,427)	$ 51,422	11 years
Technology, trademark and trade name	41,297	(16,128)	25,169	7 years	41,184	(10,474)	30,710	7 years
Production know-how	9,180	(7,415)	1,765	7 years	9,211	(6,212)	2,999	7 years
Patents	8,036	(6,572)	1,464	8 years	8,036	(6,028)	2,008	8 years
Total	$ 116,379	$ (42,108)	$ 74,271		$ 116,280	$ (29,141)	$ 87,139	

Amortization expense for the years ended December 31, 2019, 2018 and 2017 was $12,945, $8,170 and $5,899, respectively.

The estimated future amortization expense for intangibles as of December 31, 2019 is as follows:

2020	2021	2022	2023	2024	Thereafter	Total
$ 12,059	$ 11,692	$ 10,783	$ 9,855	$ 7,515	$ 22,367	$ 74,271

8. PROPERTY, PLANT AND EQUIPMENT

Property, plant, and equipment consist of the following:

	December 31, 2019	December 31, 2018
Land	$ 45,676	$ 41,937
Buildings	400,617	332,150
Machinery and equipment	449,783	384,259
Office furniture and fixtures	70,001	65,775
Construction-in-progress	44,201	54,454
Total property, plant and equipment	1,010,278	878,575
Accumulated depreciation	(409,426)	(335,507)
Total property, plant and equipment — net	$ 600,852	$ 543,068

The Company recorded depreciation expense of $78,959, $68,231 and $54,900 for the years ended December 31, 2019, 2018 and 2017, respectively.

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Long-lived assets include property, plant and equipment, related deposits on such assets and demonstration equipment. The geographic locations of the Company's long-lived assets, net, based on physical location of the assets, as of December 31, 2019 and 2018 are as follows:

	December 31,	
	2019	2018
United States	$ 366,059	$ 346,343
Germany	86,881	81,218
Russia	84,471	76,359
China	8,933	9,123
Other	71,616	40,689
Total	$ 617,960	$ 553,732

9. ACCRUED EXPENSES AND OTHER LIABILITIES

Accrued expenses and other liabilities consist of the following:

	December 31,	
	2019	2018
Accrued compensation	$ 48,881	$ 60,107
Contract liabilities	59,531	52,606
Current portion of accrued warranty	23,114	23,106
Short-term lease liabilities	5,300	—
Other	12,956	18,821
Total	$ 149,782	$ 154,640

10. PRODUCT WARRANTIES

Activity related to the warranty accrual was as follows:

	2019	2018	2017
Balance at January 1	$ 51,422	$ 47,517	$ 33,978
Provision for warranty accrual	22,613	24,948	26,995
Warranty claims	(24,826)	(18,922)	(16,250)
Foreign currency translation and other	(343)	(2,121)	2,794
Balance at December 31	$ 48,866	$ 51,422	$ 47,517

Accrued warranty reported in the accompanying consolidated financial statements as of December 31, 2019 and December 31, 2018 consists of $23,114 and $23,106 in accrued expenses and other liabilities and $25,752 and $28,316 in other long-term liabilities, respectively.

11. FINANCING ARRANGEMENTS

The Company's borrowings under existing financing arrangements consist of the following:

	December 31,	
	2019	2018
Term debt:		
Long-term notes	$ 41,708	$ 45,378
Less: current portion	(3,740)	(3,671)
Total long-term debt	$ 37,968	$ 41,707

Term Debt:

Long-Term Notes — At December 31, 2019, the outstanding principal balance on the long-term notes was $41,708 of which $3,740 is the current portion. The Company has an unsecured long-term note of $19,594 of which $1,188 is the current portion. The interest on this unsecured long-term note is variable at 1.20% above LIBOR and is fixed using an interest rate swap at 2.85% per annum. The unsecured long-term note matures in May 2023, at which time the outstanding principal balance will be $15,438. The Company has another note that is secured by the corporate aircraft with an outstanding principal balance of $22,114 of which $2,552 is the current portion. The interest on this collateralized long-term note is fixed at 2.74% per annum. The collateralized long-term note matures in July 2022, at which time the outstanding principal balance will be $15,375.

The future principal payments for the Company's Notes as of December 31, 2019 are as follows:

2020	$ 3,740
2021	3,810
2022	18,126
2023	16,032
Total	$ 41,708

Revolving Line of Credit Facilities:

U.S. Line of Credit — The Company maintains an unsecured revolving line of credit with available principal of up to $50,000, expiring in April 2020. The line of credit bears interest at a variable rate of LIBOR plus 0.80% to 1.20% depending on the Company's financial performance. Part of this credit facility is available to the Company's foreign subsidiaries including those in India, China, Japan and South Korea based on management discretion. At December 31, 2019, there were no outstanding drawings, however, there were $1,426 of guarantees issued against the line which reduced the total availability. At December 31, 2019, the remaining availability under this line was $48,574.

The Company is required to meet certain financial covenants associated with its U.S. line of credit and collateralized long-term note. These covenants, tested quarterly, include a debt service coverage ratio and a funded debt to earnings before interest, taxes, depreciation and amortization ("EBITDA") ratio. The debt service coverage covenant requires the Company to maintain a trailing twelve month ratio of cash flow to debt service that is greater than 1.5:1. Debt service in the calculation is decreased by cash held in the U.S. in excess of $50,000 up to a maximum of $250,000. Cash flow is defined as EBITDA less unfunded capital expenditures. The funded debt to EBITDA covenant requires that the sum of all indebtedness for borrowed money on a consolidated basis be less than three times the Company's trailing twelve months EBITDA.

Euro Line of Credit — The Company maintains an unsecured revolving line of credit with a principal amount of Euro 50,000 ($56,074 at December 31, 2019), expiring in July 2020. The line of credit bears interest at various rates based upon the type of loan. This credit facility is available to the Company's foreign subsidiaries including those in Germany, Russia, China and Italy based on management discretion. At December 31, 2019, there were no drawings, however, there were $1,422 of guarantees issued against the line which reduced the total availability. At December 31, 2019, the remaining availability under this line was $54,652.

Other European Facilities — The Company maintains two Euro credit lines in Italy with aggregate available principal of Euro 2,000 ($2,243 as of December 31, 2019), with no expiration date, which bear interest at market rates that reset at the beginning of each quarter. At December 31, 2019, there were no outstanding drawings and the aggregate remaining availability under these lines was $2,243. These facilities are collateralized by a common pool of the assets of the Company's Italian subsidiary.

12. DERIVATIVE INSTRUMENTS

The Company's only outstanding derivative financial instrument is an interest rate swap that is classified as a cash flow hedge of its variable rate debt. The fair value amounts in the consolidated balance sheets were:

Notional Amounts[1]		Other Assets	
December 31,		December 31,	
2019	2018	2019	2018
$ 19,594	$ 20,781	$ 13	$ 31

1. Notional amounts represent the gross contract/notional amount of the derivative outstanding.

The derivative gains and losses in the consolidated financial statements for the years ended December 31, 2019, 2018 and 2017, related to the Company's current and previous interest rate swap contracts were as follows:

	Year Ended December 31,		
	2019	2018	2017
Effective portion recognized in other comprehensive income (loss), pretax:			
Interest rate swap	$ (18)	$ 15	$ (61)

During the year ended December 31, 2018, the Company also entered into foreign currency forward contracts to hedge the value of intercompany dividends declared and paid in Euros by the Company's German subsidiary. These contracts were not designated as hedging instruments for accounting purposes and were fully settled during 2018.

Losses associated with derivative instruments not designated as hedging instruments were as follows:

		Year Ended December 31,		
	Classification	2019	2018	2017
Losses recognized in income	Gain (loss) on foreign exchange	$ —	$ (19)	$ —

13. LEASES

The Company leases certain warehouses, office spaces, land, vehicles and equipment under operating lease agreements. The remaining terms of these leases range from less than 1 year to 46 years. The operating lease expense for the years ended December 31, 2019, 2018 and 2017, totaled $8,800, $6,175 and $8,095, respectively. The cash paid for amounts included in the measurement of lease liabilities included in the operating cash flows from operating leases was $6,802 for the year ended December 31, 2019. The Company does not have any finance lease arrangements.

The Company's operating lease assets and lease liabilities consist of the following as of December 31, 2019:

Account	Classification	Amount
Right-of-use assets	Other assets	$ 23,028
Short-term lease liabilities	Accrued expenses and other liabilities	5,300
Long-term lease liabilities	Deferred income taxes and other long-term liabilities	20,410
Total lease liabilities		$ 25,710

The table below presents the future minimum lease payments to be made under non-cancelable operating leases as of December 31, 2018:

Years ending December 31,		
2019	$	6,314
2020		4,603
2021		3,358
2022		2,596
2023		2,078
Thereafter		11,340
Total	$	30,289

The table below presents the maturities of operating lease liabilities as of December 31, 2019:

2020	$	6,004
2021		4,785
2022		3,581
2023		2,964
2024		2,136
Thereafter		10,327
Total future minimum lease payments		29,797
Less: imputed interest		(4,087)
Present value of lease liabilities	$	25,710

Other information relevant to the Company's operating leases consist of the following as of December 31, 2019:

Weighted-average remaining lease term	9 years
Weighted-average discount rate	3.58 %

14. COMMITMENTS AND CONTINGENCIES

Employment Agreements — The Company has entered into employment agreements with certain members of senior management. The terms of these agreements are up to three years and include non-competition, non-solicitation and nondisclosure provisions, as well as provisions for defined severance for terminations of employment under certain conditions and a change of control of the Company. The Company also maintains a severance plan for certain of its senior management providing for defined severance for terminations of employment under certain conditions and a change of control of the Company.

Contractual Obligations — The Company has entered into various purchase obligations that include agreements for construction of buildings, raw materials and equipment. Obligations under these agreements were $53,922 and $114,396 as of December 31, 2019 and 2018, respectively.

Legal proceedings — From time to time, the Company may be involved in disputes and legal proceedings in the ordinary course of its business. These proceedings may include allegations of infringement of intellectual property, commercial disputes and employment matters. As of December 31, 2019 and through the date of the Company's subsequent review period of February 24, 2020, the Company has no legal proceedings ongoing that management estimates could have a material effect on the Company's Consolidated Financial Statements.

15. STOCK-BASED COMPENSATION

Stock-based compensation is included in the following financial statement captions:

	Year Ended December 31,		
	2019	2018	2017
Cost of sales	$ 9,249	$ 6,535	$ 5,863
Sales and marketing	3,815	2,550	2,041
Research and development	7,690	6,410	5,001
General and administrative	12,824	12,532	10,116
Total stock-based compensation	33,578	28,027	23,021
Tax benefit recognized	(5,114)	(6,632)	(7,367)
Net stock-based compensation	$ 28,464	$ 21,395	$ 15,654

Incentive Plans — In February 2006, the Company's board of directors adopted the 2006 Incentive Compensation Plan (the "2006 Plan"), which provides for the issuance of stock options, restricted stock units, performance stock units, other equity-based awards and cash awards to the Company's directors, employees, consultants and advisors. In June 2006, the Company's board of directors adopted the Non-Employee Directors Stock Plan (the "Directors Plan") for non-employee directors, which was subsequently merged into the 2006 Plan. A total of 10,363,465 shares are reserved under the 2006 Plan. At December 31, 2019, 3,172,643 shares of the Company's stock were available for future grant under the 2006 Plan. The Company may grant stock options only at an exercise price equal to or greater than the fair market value of its common stock on the date of grant. Equity awards generally become exercisable over periods of one to four years and generally expire ten years after the date of the grant. The vesting of awards under the 2006 Plan accelerate following the occurrence of certain change of control events, if the participant's employment is terminated within two years without cause or if the successor entity does not agree to assume existing awards or replace with equivalent value awards. Awards granted to non-employee directors automatically become exercisable upon a change of control. All shares issued under the 2006 Plan and Directors Plan are registered shares, newly issued by the Company.

The Company grants performance stock units to executive officers. The performance stock unit agreements provide for the award of performance stock units with each unit representing the right to receive one share of the Company's common stock to be issued after the applicable award vesting period. The final number of units awarded, if any, for these performance grants will be determined as of the vesting dates, based upon the Company's total shareholder return over the performance period compared to the Russell 3000 Index for those awards granted prior to 2019 or compared to the S&P 1500 Composite / Electronic Equipment Instruments & Components Index for awards granted in 2019 and could range from between 0% and 200% of the amount of awarded units.

The assumptions used in the Black-Scholes model for the calculation of compensation were as follows for the years ended December 31:

	2019	2018	2017
Expected term	4.3 - 5.1 years	4.1 - 4.9 years	3.8 - 5.0 years
Volatility	37% - 38%	31% - 36%	31% - 35%
Risk-free rate of return	1.66% - 2.55%	2.54% - 3.01%	1.57% - 1.97%
Dividend yield	0.25%	0.25%	0.25%
Forfeiture rate	—%	—%	—%

The following table summarizes the option activity for the years ended December 31:

	Number of Options	Weighted-Average Exercise Price	Weighted-Average Remaining Contractual Life (In years)	Aggregate Intrinsic Value (In thousands)
Outstanding — January 1, 2017	2,064,253	$ 60.65		
Granted	293,284	124.57		
Exercised	(546,931)	50.50		
Forfeited	(13,113)	90.81		
Outstanding — December 31, 2017	1,797,493	73.95	6.02	$ 251,970
Granted	257,111	232.26		
Exercised	(282,720)	58.94		
Forfeited	(24,810)	131.36		
Outstanding — December 31, 2018	1,747,074	98.93	5.80	$ 58,084
Granted	334,740	153.78		
Exercised	(192,533)	56.58		
Forfeited	(46,839)	149.64		
Outstanding — December 31, 2019	1,842,442	$ 112.03	5.73	$ 85,110
Unvested — December 31, 2019	797,960	$ 149.66	7.96	$ 14,576
Exercisable — December 31, 2019	1,044,482	$ 83.29	4.02	$ 70,534

The intrinsic value of the options exercised during the years ended December 31, 2019, 2018 and 2017, was $17,891, $51,266 and $50,131, respectively. The weighted-average grant fair value per share for options granted during the years ended December 31, 2019, 2018 and 2017, was $53.52, $71.06 and $38.01, respectively. The total compensation cost related to non-vested awards not yet recorded at December 31, 2019 was $25,517 which is expected to be recognized over a weighted-average of 2.6 years.

The following table summarizes the restricted stock units ("RSU's") activity for the years ended December 31:

	Number of Shares	Weighted-Average Grant-Date Fair Value	Weighted-Average Remaining Contractual Life (In years)	Aggregate Intrinsic Value (In thousands)
Outstanding — January 1, 2017	366,770	$ 79.72		
Granted	106,764	127.29		
Vested	(90,385)	66.18		
Canceled	(4,888)	90.54		
Outstanding — December 31, 2017	378,261	96.23	2.55	$ 80,997
Granted	80,254	227.45		
Vested	(97,997)	91.62		
Canceled	(9,497)	121.37		
Outstanding — December 31, 2018	351,021	126.93	2.62	$ 39,767
Granted	120,090	151.94		
Vested	(147,606)	120.58		
Canceled	(16,667)	139.73		
Outstanding — December 31, 2019	306,838	$ 139.09	2.57	$ 44,467

The intrinsic value of the RSU's that vested during the years ended December 31, 2019, 2018 and 2017, was $22,638, $22,978 and $11,684, respectively. The weighted-average grant fair value per share for RSU's granted during the years ended December 31, 2019, 2018 and 2017, was $151.94, $227.45 and $127.29, respectively. The total compensation cost related to non-vested awards not yet recorded at December 31, 2019 was $26,231 which is expected to be recognized over a weighted-average of 2.6 years. The aggregate fair value of awards vested during the year ended December 31, 2019 was $17,799.

The weighted-average fair value of the performance units was determined using the Monte Carlo simulation model incorporating the following weighted-average assumptions:

	2019	2018	2017
Performance term	3.0 years	3.0 years	3.0 years
Volatility	18% - 40%	13% - 32%	13% - 31%
Risk-free rate of return	2.48%	2.41%	1.49%
Dividend yield	—%	—%	—%
Weighted-average fair value per share	$192.46	$284.78	$147.25

The following table summarizes the performance stock units ("PSU's") activity for the years ended December 31:

	Number of Shares	Weighted-Average Grant-Date Fair Value	Weighted-Average Remaining Contractual Life	Aggregate Intrinsic Value
			(In years)	(In thousands)
Outstanding — January 1, 2017	54,505	$ 108.51		
Granted	21,444	147.25		
Vested	—			
Canceled	—			
Outstanding — December 31, 2017	75,949	119.45	1.93	$ 16,263
Granted	33,706	238.12		
Vested	—			
Canceled	—			
Outstanding — December 31, 2017	109,655	146.96	1.77	$ 12,423
Granted	34,989	190.83		
Vested	(43,594)	128.54		
Canceled	(1,208)	228.68		
Outstanding — December 31, 2019	99,842	$ 162.34	1.84	$ 14,469

PSU's are included at 100% of target goal. The intrinsic value of the PSU's vested during the year ended December 31, 2019 was $6,830. The total compensation cost related to nonvested awards not yet recorded at December 31, 2019 was $5,833 which is expected to be recognized over a weighted average of 1.8 years. The aggregate fair value of awards vested during the year ended December 31, 2019 was $5,604.

16. EMPLOYEE BENEFIT PLANS

The Company maintains a defined contribution retirement plan offered to all of its U.S. employees, as well as plans at certain foreign and domestic subsidiaries. The Company makes matching contributions to each plan, which amounted to approximately $6,005, $4,261 and $3,363, respectively for years ended December 31, 2019, 2018 and 2017.

The Company has an employee stock purchase plan offered to its U.S. and German employees. The plan allows employees who participate to purchase shares of common stock through payroll deductions at a 15% discount to the lower of the stock price on the first day or the last day of the six-month purchase period. Payroll deductions may not exceed 10% of the employee's compensation and are subject to other limitations. Compensation expense related to the employee stock purchase plan was $2,254, $925 and $967 for the years ended December 31, 2019, 2018 and 2017, respectively. As of December 31, 2019, there were 335,487 shares available for issuance under the employee stock purchase plan.

17. INCOME TAXES

Income before the impact of income taxes for the years ended December 31 consisted of the following:

	2019	2018	2017
U.S.	$ 59,790	$ 146,855	$ 190,480
Foreign	188,586	387,540	361,391
Total	$ 248,376	$ 534,395	$ 551,871

The Company's provision for income taxes for the years ended December 31 consisted of the following:

	2019	2018	2017
Current:			
Federal	$ 7,127	$ 7,274	$ 85,761
State	2,405	2,097	2,387
Foreign	74,072	125,431	93,254
Total current	83,604	134,802	181,402
Deferred:			
Federal	(4,896)	2,497	12,459
State	(1,658)	8,449	649
Foreign	(8,935)	(15,522)	9,773
Total deferred	(15,489)	(4,576)	22,881
Provision for income taxes	$ 68,115	$ 130,226	$ 204,283

A reconciliation of income tax expense at the U.S. federal statutory income tax rate to the recorded tax provision for the years ended December 31, were as follows:

	2019	2018	2017
Tax at statutory rate	$ 52,159	$ 112,223	$ 193,155
Non-U.S. rate differential — net	14,958	26,985	(25,795)
State income taxes — net	2,362	3,367	3,413
Stock-based compensation - tax benefit	(5,114)	(13,298)	(14,015)
Foreign derived intangible income benefit ("FDII")	(4,763)	(7,930)	—
Global intangible low-taxed income taxed in the U.S. ("GILTI")	4,648	5,955	—
Goodwill impairment	10,009	—	—
Effect of 2017 U.S. Tax Cuts and Jobs Act	—	(4,747)	48,126
Withholding tax on intercompany dividend	3,122	—	2,225
Effect of changes in enacted tax rates on deferred tax assets and liabilities	(639)	8,007	1,281
Federal and state tax credits	(12,173)	(11,024)	(9,210)
Change in reserves, including interest and penalties	779	2,290	4,350
Change in valuation allowance	4,515	7,421	(51)
Other — net	(1,748)	977	804
Provision for income taxes	$ 68,115	$ 130,226	$ 204,283

The tax effects of temporary differences that give rise to significant portions of the deferred tax assets and deferred tax liabilities at December 31, were as follows:

	2019	2018
Property, plant and equipment	$ (18,607)	$ (22,443)
Inventory provisions	23,611	12,963
Allowances and accrued liabilities	10,502	(2,599)
Withholding tax on intercompany dividend	(3,597)	(2,225)
Other tax credits	15,001	12,996
Deferred compensation	9,428	17,481
Net operating loss carryforwards	5,748	3,364
Valuation allowance	(14,384)	(7,910)
Net deferred tax assets	$ 27,702	$ 11,627

On December 22, 2017, the U.S. government enacted comprehensive tax legislation commonly referred to as the Tax Cuts and Jobs Act (the "Tax Act"). The Tax Act makes broad and complex changes to the U.S. tax code including, but not limited to, (1) reducing the U.S. federal corporate tax rate from 35% to 21%, (2) requiring a one-time transition tax on certain undistributed earnings of foreign subsidiaries that is payable over eight years, (3) generally eliminating U.S. federal income

taxes on dividends from foreign subsidiaries, (4) providing an incentive benefit for U.S. income from intangibles (Foreign Derived Intangible Income); (5) increasing U.S. taxable income to include all income earned by foreign subsidiaries in excess of ten percent of the fixed assets in those entities (Global Intangible Low-taxed Income) and (6) providing for bonus depreciation that will allow for full expensing of qualified property.

The Securities and Exchange Commission ("SEC") staff issued Staff Accounting Bulletin ("SAB") 118, which provides guidance on accounting for the tax effects of the Tax Act. SAB 118 provides a measurement period that should not extend beyond one year from the Tax Act enactment date for companies to complete the accounting under ASC 740. In accordance with SAB 118, a company must reflect the income tax effects of those aspects of the Tax Act for which the accounting under ASC 740 is complete. To the extent that a company's accounting for certain income tax effects of the Tax Act is incomplete but it is able to determine a reasonable estimate, it must record a provisional estimate in the financial statements. If a company cannot determine a provisional estimate to be included in the financial statements, it should continue to apply ASC 740 on the basis of the provisions of the tax laws that were in effect immediately before the enactment of the Tax Act.

The final calculation for Deemed Repatriation Transition Tax on the 2017 tax return was $43,379. As of December 31, 2017, the Company had recorded a provisional expense for the Transition Tax of $48,126. The decrease of $4,747 was recorded as a reduction in tax expense in the third quarter of 2018. As the Transition Tax is payable over 8 years, $30,263 of this amount is included within other long-term liabilities on the consolidated balance sheets at both December 31, 2019 and 2018. In addition, the Company has calculated a $1,422 reduction in the valuation of net deferred tax assets related to the decrease in the U.S. federal tax rate. As of December 31, 2017, the Company had recorded a provisional decrease of $1,281. The increase of $141 was recorded as an increase to tax expense in the third quarter of 2018. The impact of other provisions in the Tax Act that were effective January 1, 2018, including the tax impact of the FDII and GILTI sections, are included in the effective tax rate calculation for 2019 and 2018.

The Company has recorded $3,597 and $2,225 as a deferred tax liability on December 31, 2019 and 2018, respectively, for certain withholding and dividend taxes related to possible future distributions from its Russian subsidiary to their non-U.S. parent. The Company has paid dividends from its German subsidiary and continues to plan for future dividends to the extent the entity’s cash exceeds its operational and investment needs. Since there is no federal or withholding tax on such distributions, the Company has accrued only a state tax of $130 on a planned dividend of €150,000. With regard to future repatriation of undistributed earnings of other non-U.S. subsidiaries, the Company continues to consider these earnings to be indefinitely reinvested and, accordingly, has not recorded any deferred income taxes for the potential withholding or other taxes that would be assessed on such a repatriation to the U.S. At December 31, 2019 and 2018, the cumulative undistributed earnings in non-U.S. subsidiaries were approximately $1,078,879 and $930,993, respectively.

In determining the Company’s 2019 and 2018 tax provisions under ASC 740, the Company calculated the deferred tax assets and liabilities for each separate tax entity. The Company then considered a number of factors including the positive and negative evidence regarding the realization of our deferred tax assets to determine whether a valuation allowance should be recognized with respect to our deferred tax assets.

As of December 31, 2019 and 2018, the Company had state tax credit carry-forwards of $15,003 and $11,801, respectively. The state tax credit carry-forwards begin expiring in 2020. The Company has determined that it is not more likely than not that some of the state credits will be used before the expiration date and has accrued a valuation allowance of $10,632 and $7,439 as of December 31, 2019 and 2018, respectively.

The Company has tax loss carryforwards in foreign jurisdictions totaling $13,218 and $2,888 as of December 31, 2019 and 2018, respectively. Some of these loss carryforwards start to expire in 2023 and some have an indefinite life but are limited in the amount that can be used in any year. The Company does not believe it is more likely than not that any of the loss carryforwards can be used and has provided a valuation allowance against the tax benefit of the losses in foreign jurisdictions of $3,753 and $474 at December 31, 2019 and 2018, respectively. The Company's acquisition of Menara Networks, Inc. ("Menara") in 2016 included net operating loss carry-forwards of $22,242. As of December 31, 2019 and 2018, the Company had $8,953 and $12,577 of these net operating loss carry-forwards remaining, respectively. No valuation allowance has been provided for these carry-forwards as the Company expects to be able to fully utilize them to offset future income.

The Company provides reserves for potential payments of tax to various tax authorities related to uncertain tax positions and other issues. Reserves recorded are based on a determination of whether and how much of a tax benefit taken by us in our tax filings or positions is "more likely than not" to be realized following resolution of any potential contingencies present related to the tax benefit, assuming that the matter in question will be raised by the tax authorities. The following is a tabular reconciliation of the total amounts of unrecognized tax benefits:

	2019	2018
Balance at January 1	$ 11,206	$ 10,370
Change in prior period positions	(1,776)	(1,067)
Settlement of prior period position	(230)	—
Additions for tax positions in current period	2,000	2,726
Foreign exchange adjustments	$ 216	$ (823)
Balance at December 31	$ 11,416	$ 11,206

Substantially all of the liability for uncertain tax benefits related to various federal, state and foreign income tax matters, would benefit the Company's effective tax rate, if recognized.

Estimated penalties and interest related to the underpayment of income taxes were $543, $631 and $121 for the years ended December 31, 2019, 2018 and 2017, respectively, and are included within the provision for income taxes. Total accrued penalties and interest related to the underpayment of income taxes were $1,672 and $1,419 at December 31, 2019 and 2018, respectively.

The Company's uncertain tax positions are related to tax years that remain subject to examination by the relevant taxing authorities. If these uncertain tax positions were realized, they would benefit the Company’s effective tax rate. The Company is currently under a tax audit in the U.S. for the years 2017 to 2018. Open tax years by major jurisdictions are:

United States	2016 - 2019
Germany	2017 - 2019
Russia	2015 - 2019

18. NET INCOME ATTRIBUTABLE TO IPG PHOTONICS CORPORATION PER SHARE

The following table sets forth the computation of diluted net income attributable to IPG Photonics Corporation per share:

	Year Ended December 31,		
	2019	2018	2017
Net income attributable to IPG Photonics Corporation	$ 180,234	$ 404,027	$ 347,614
Net income attributable to common stockholders	180,234	404,027	347,614
Weighted average shares	53,061	53,522	53,495
Dilutive effect of common stock equivalents	778	1,204	1,204
Diluted weighted average common shares	53,839	54,726	54,699
Basic net income attributable to IPG Photonics Corporation per share	$ 3.40	$ 7.55	$ 6.50
Basic net income attributable to common stockholders	$ 3.40	$ 7.55	$ 6.50
Diluted net income attributable to IPG Photonics Corporation per share	$ 3.35	$ 7.38	$ 6.36
Diluted net income attributable to common stockholders	$ 3.35	$ 7.38	$ 6.36

For the years ended December 31, 2019, 2018 and 2017, respectively, the computation of diluted weighted average common shares excludes common stock equivalents of 670,600 shares, 279,700 shares and 182,900 shares which includes RSU's of 58,700, 60,500 and 11,900, PSU's of 40,900, 14,900 and nil, and non-qualified stock options of 571,000, 204,300, and 171,000, respectively, because the effect would be anti-dilutive.

On February 12, 2019, the Company announced that its board of directors authorized an anti-dilutive stock repurchase program (the "2019 Program"). Under the 2019 Program, IPG is authorized to repurchase shares of common stock in an amount

not to exceed the lesser of (a) the number of shares issued to employees and directors under the Company's various employee and director equity compensation and employee stock purchase plans from January 1, 2019 through December 31, 2020 and (b) $125,000, exclusive of any fees, commissions or other expenses. Share repurchases will be made periodically in open market transactions using the Company's working capital, and are subject to market conditions, legal requirements and other factors. The 2019 Program authorization does not obligate the Company to repurchase any dollar amount or number of its shares, and repurchases may be commenced or suspended from time to time without prior notice.

For the years ended December 31, 2019, 2018 and 2017, respectively, the Company repurchased 301,262 shares, 1,051,825 shares, and 275,495 shares of its common stock with an average price of $135.21, $167.39 and $145.15 per share in the open market. As of December 31, 2019 the remaining amount authorized under the 2019 Program is up to $84,268, but may be less depending upon the equity compensation and employee stock purchase plan dilution during the 2019 Program. The impact on the reduction of weighted average shares for years ended December 31, 2019, 2018 and 2017 was 97,054 shares, 363,936 shares and 160,440 shares, respectively.

19. RELATED-PARTY TRANSACTIONS

The Company's Chief Executive Officer ("CEO") leases the annual right to use 25% of the Company's corporate aircraft under an October 2014 lease, which was superseded by a new lease signed in July 2017 in connection with the purchase of a different aircraft. The 2017 lease expires July 2022. The annual lease rate under the 2017 lease was $925 and future rent payments are adjusted annually. The annual lease rate under the 2014 lease was $651. The CEO paid the Company $924, $925, and $753 in 2019, 2018, and 2017, respectively, under the aircraft leases. There were no amounts due to the Company at December 31, 2019 or at December 31, 2018. The CEO directly pays an unrelated flight management firm for the operating costs of his private use including pilot fees, fuel and other costs.

In 2019, 2018 and 2017, the Company purchased various equipment, parts and services from a company for which one of the Company's independent directors is chairman of its board of directors. The payments for 2019, 2018 and 2017 totaled $51, $947 and $2,296, respectively. There were no amounts due to this company at December 31, 2019 or at December 31, 2018.

20. SELECTED QUARTERLY FINANCIAL DATA (UNAUDITED)

2019	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Net sales	$ 315,047	$ 363,769	$ 329,138	$ 306,627
Gross profit	148,911	180,237	152,858	124,203
Net income (loss) attributable to IPG Photonics Corporation	55,159	72,272	57,253	(4,450)
Net income (loss) per share, basic	1.04	1.36	1.08	(0.08)
Net income (loss) per share, diluted	1.02	1.34	1.07	(0.08)

2018	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Net sales	$ 359,864	$ 413,613	$ 356,346	$ 330,051
Gross profit	203,362	234,975	195,184	166,747
Net income attributable to IPG Photonics Corporation	106,334	121,617	100,517	75,559
Net income per share, basic	1.98	2.27	1.88	1.42
Net income per share, diluted	1.93	2.21	1.84	1.40

Net income attributable to IPG Photonics Corporation as well as the basic and diluted loss per share in the fourth quarter of the year ended December 31, 2019 were impacted by goodwill impairment, impairment of long-lived assets and other restructuring charges discussed in Notes 6 and 7.