PPG INDUSTRIES INC
Form 10-K
February 21, 2019

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549
FORM 10-K
Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934
For the fiscal year ended December 31, 2018
Commission File Number 1-1687

PPG INDUSTRIES, INC.
(Exact name of registrant as specified in its charter)

Pennsylvania	25-0730780
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
One PPG Place, Pittsburgh, Pennsylvania	15272
(Address of principal executive offices)	(Zip code)
Registrant's telephone number, including area code:	412-434-3131

Securities Registered Pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Common Stock – Par Value $1.66 $^2/_3$	New York Stock Exchange
0.000% Notes due 2019	New York Stock Exchange
0.875% Notes due 2022	New York Stock Exchange
0.875% Notes due 2025	New York Stock Exchange
1.400% Notes due 2027	New York Stock Exchange

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 x NO ¨

Indicate by check mark if the Registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. YES ¨ NO x

Indicate by check mark whether the Registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months, and (2) has been subject to such filing requirements for the past 90 days. YES x NO ¨

Indicate by checkmark whether the registrant has submitted electronically every Interactive Date File required to be submitted and posted 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 and post such files). YES x NO ¨

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

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

Large accelerated filer x	Accelerated filer ¨
Non-accelerated filer ¨	Smaller reporting company ¨
(Do not check if a 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 by Rule 12b-2 of the Act). YES o NO x

The aggregate market value of common stock held by non-affiliates as of June 30, 2018, was $25,075 million.

As of January 31, 2019, 235,898,957 shares of the Registrant's common stock, with a par value of 1.66^2/_3$ per share, were outstanding. As of that date, the aggregate market value of common stock held by non-affiliates was $24,842 million.

DOCUMENTS INCORPORATED BY REFERENCE

Document	Incorporated By Reference In Part No.
Portions of PPG Industries, Inc. Proxy Statement for its 2019 Annual Meeting of Shareholders	III

PPG INDUSTRIES, INC.
AND CONSOLIDATED SUBSIDIARIES

As used in this report, the terms "PPG," "Company," "Registrant," "we," "us" and "our" refer to PPG Industries, Inc., and its subsidiaries, taken as a whole, unless the context indicates otherwise.

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Note on Incorporation by Reference
Throughout this report, various information and data are incorporated by reference from the Company's 2018 Annual Report (hereinafter referred to as "the Annual Report"). Any reference in this report to disclosures in the Annual Report shall constitute incorporation by reference only of that specific information and data into this Form 10-K.

Part I

Item 1. Business

PPG Industries, Inc., manufactures and distributes a broad range of paints, coatings and specialty materials. PPG was incorporated in Pennsylvania in 1883. PPG’s vision is to be the world’s leading coatings company by consistently delivering high-quality, innovative and sustainable solutions that customers trust to protect and beautify their products and surroundings. PPG’s business is comprised of two reportable business segments: Performance Coatings and Industrial Coatings.

Performance Coatings and Industrial Coatings

PPG is a major, global supplier of coatings. The Performance Coatings and Industrial Coatings reportable business segments supply coatings and specialty materials to customers in a wide array of end-uses, including industrial equipment and components; packaging material; aircraft and marine equipment; automotive original equipment (“automotive OEM”); automotive refinish; as well as for other industrial and consumer products. PPG also serves commercial and residential new build and maintenance customers by supplying coatings to painting and maintenance contractors and directly to consumers for decoration and maintenance. The coatings industry is highly competitive and consists of several large firms with global presence and many smaller firms serving local or regional markets. PPG competes in its primary markets with the world’s largest coatings companies, most of which have global operations, and many smaller regional coatings companies.

PERFORMANCE COATINGS

Strategic Business Unit	Products	Primary End-uses	Main Distribution Methods	Brands
Automotive Refinish Coatings	Coatings, solvents, adhesives, sundries, software	Automotive and commercial transport/fleet repair and refurbishing, light industrial coatings and specialty coatings for signs	Independent distributors and direct to customers	PPG®, SEM®
Aerospace Coatings	Coatings, sealants, transparencies, transparent armor, adhesives, packaging and chemical management services for the aerospace industry	Commercial, military, regional jet and general aviation aircraft	Direct to customers and company-owned distribution network	PPG®
Protective and Marine Coatings	Coatings and finishes for the protection of metals and structures	Metal fabricators, heavy duty maintenance contractors and manufacturers of ships, bridges and rail cars	Direct to customers, company-owned architectural coatings stores, independent distributors and concessionaires	PPG®
Architectural Coatings Americas and Asia Pacific	Paints, wood stains and purchased sundries	Painting and maintenance contractors and consumers for decoration and maintenance of residential and commercial building structures	Company-owned stores, home centers and other regional or national consumer retail outlets, paint dealers, concessionaires, independent distributors and direct to consumers	PPG®, GLIDDEN®, COMEX®, OLYMPIC®, DULUX® (in Canada), SIKKENS®, PPG PITTSBURGH PAINTS®, MULCO®, FLOOD®, LIQUID NAILS®, SICO®, RENNER®, TAUBMANS®, WHITE KNIGHT®, BRISTOL®, HOMAX® among others
Architectural Coatings Europe, Middle East and Africa (EMEA)				SIGMA®, HISTOR®, SEIGNEURIE®, GUITTET®, PEINTURES GAUTHIER®, RIPOLIN®, JOHNSTONE'S®, LEYLAND®, PRIMALEX®, DEKORAL®, TRILAK®, PROMINENT PAINTS®, GORI®, BONDEX®, and DANKE!® among others

Major Competitive Factors	Product performance, technology, quality, technical and customer service, price, customer productivity, distribution, and brand recognition
Global Competitors	Akzo Nobel N.V., Axalta Coating Systems Ltd., BASF Corporation, Benjamin Moore, Chromology, Hempel A/S, Kansai Paints, the Jotun Group, Masco Corporation, Nippon Paint; RPM International Inc, the Sherwin-Williams Company and Tikkurila Oyj

2018 Strategic Acquisitions	SEM Products, Inc. Refer to Note 3, “Acquisitions and Divestitures” under Item 8 of this Form 10-K for more information.
Average Number of Employees in 2018	27,800
Principal Manufacturing and Distribution Facilities	Amsterdam, Netherlands; Birstall, United Kingdom; Budapest, Hungary; Busan; Korea; Clayton, Australia; Delaware, Ohio; Deurne, Belgium; Huntsville, Ala.; Huron, Ohio; Kunshan, China; Little Rock, Ark.; Mexico City, Mexico; Milan, Italy; Mojave, Calif.; Moreuil, France; Ontario, Canada; Ostrow Wielkopolski, Poland; Shildon, United Kingdom; Sylmar, Calif.; Soborg, Denmark; Stowmarket, United Kingdom; Tepexpan, Mexico; and Wroclaw, Poland.

INDUSTRIAL COATINGS

Strategic Business Unit	Products	Primary End-uses	Main Distribution Methods	Brands
Automotive OEM Coatings	Specifically formulated coatings, adhesives and sealants and metal pretreaments	Automotive original equipment manufacturer (OEM)	Direct to manufacturing companies and various coatings applicators	PPG®
Industrial Coatings	Specifically formulated coatings, adhesives and sealants and metal pretreaments; Services and coatings application	Appliances, agricultural and construction equipment, consumer electronics, automotive parts and accessories, building products (including residential and commercial construction), transportation vehicles and numerous other finished products; On-site coatings services within several customer manufacturing locations as well as at regional service centers.		PPG®
Packaging Coatings	Specifically formulated coatings	Widely used for the protection, performance and decoration of metal cans, closures, plastic tubes, industrial packaging, and promotional and specialty packaging		PPG®
Specialty Coatings and Materials	Amorphous precipitated silicas, TESLIN® substrate, Organic Light Emitting Diode (OLED) materials, optical lens materials and photochromic dyes	SILICA - Tire, battery separator and other end-uses TESLIN - applications such as labels, e-passports, drivers' licenses, breathable membranes, other loyalty cards and identification cards OLED - displays and lighting Lens materials - optical lenses and color-change products		PPG® TESLIN®

Technology / Alliances	PPG's automotive OEM coatings business was the first to introduce breakthrough automotive coating technologies such as cathodic electrocoat, powder clearcoat, compact paint systems and factory-applied spray-in bedliners, and the Company has a continued focus on innovation leadership. PPG has established alliances with Kansai Paints to serve Japanese-based automotive OEM customers in North America and Europe and Asian Paints Ltd. to serve certain aftermarket customers and automotive OEM customers in India.
Major Competitive Factors	Product performance, technology, quality, technical and customer service, price, customer productivity and distribution.
Global Competitors	Akzo Nobel N.V., Axalta Coating Systems Ltd., BASF Corporation, Kansai Paints, Nippon Paint and the Sherwin-Williams Company
2018 Strategic Acquisitions	Refer to Note 3, "Acquisitions and Divestitures" under Item 8 of this Form 10-K for more information.
Average Number of Employees in 2018	15,300
Principal Manufacturing and Distribution Facilities	Barberton, Ohio; Busan, South Korea; Cieszyn, Poland; Cleveland, Ohio; Lake Charles, La.; Oak Creek, Wis.; Quattordio, Italy; San Juan del Rio, Mexico; Sumaré, Brazil; Tianjin, China; and Zhangjiagang, China

Research and Development

($ in millions)	2018	2017	2016
Research and development costs, including depreciation of research facilities [a]	$464	$472	$473
% of annual net sales	3.0 %	3.2 %	3.3 %

[a] Prior year amounts have been recast for the adoption of Accounting Standards Update No. 2017-07, "Improving the Presentation of Net Periodic Pension Cost and Net Periodic Postretirement Benefit Cost." See Note 1 within Item 8 of this Form 10-K for additional information.

Technology innovation has been a hallmark of PPG's success throughout its history. The Company seeks to optimize its investment in research and development to create new products to drive profitable growth. We align our product development with the macro trends in the markets we serve and leverage core technology platforms to develop products for unmet market needs. Our history of successful technology introductions is based on a commitment to an efficient and effective innovation process and disciplined portfolio management. We have obtained government funding for a small portion of the Company's research efforts, and we will continue to pursue government funding where appropriate.

PPG owns and operates several facilities to conduct research and development for new and improved products and processes. In addition to the Company's centralized principal research and development centers (See Item 2. "Properties" of this Form 10-K), operating segments manage their development through centers of excellence. As part of our ongoing efforts to manage our formulations and raw material costs effectively, we operate a global competitive sourcing laboratory in China. Because of the Company's broad array of products and customers, PPG is not materially dependent upon any single technology platform.

Raw Materials and Energy

The effective management of raw materials and energy is important to PPG's continued success. PPG uses a wide variety of complex raw materials that serve as the building blocks of our manufactured products that provide broad ranging, high performance solutions to our customers. The Company's most significant raw materials are epoxy and other resins, titanium dioxide and other pigments, and solvents in the coatings businesses and sand and soda ash for the specialty coatings and materials business. Coatings raw materials include both organic, primarily petroleum-derived, materials and inorganic materials, including titanium dioxide. These raw materials represent PPG's single largest production cost component.

Most of the raw materials and energy used in production are purchased from outside sources, and the Company has made, and plans to continue to make, supply arrangements to meet our planned operating requirements for the future. Supply of critical raw materials and energy is managed by establishing contracts with multiple sources, and identifying alternative materials or technology whenever possible. Our products use both petroleum-derived and bio-based materials as part of a product renewal strategy. While prices for these raw materials typically fluctuate with energy prices and global supply and demand, such fluctuations are impacted by the fact that the manufacture of our raw materials is several steps downstream from crude oil and natural gas.

The Company is continuing its aggressive sourcing initiatives to broaden our supply of high quality raw materials. These initiatives include qualifying multiple and local sources of supply, including suppliers from Asia and other lower cost regions of the world, adding on-site resin production at certain manufacturing locations and a reduction in the amount of titanium dioxide used in our product formulations.

We are subject to existing and evolving standards relating to the registration of chemicals which could potentially impact the availability and viability of some of the raw materials we use in our production processes. Our ongoing, global product stewardship efforts are directed at maintaining our compliance with these standards. PPG has joined a global initiative to eliminate child labor from the mica industry, and the Company is continuing to take steps, including audits of our suppliers, to ensure compliance with PPG's zero-tolerance policy against the use of child labor in their supply chains.

Changes to chemical registration regulations have been proposed or implemented in the EU and many other countries, including China, Canada, the United States (U.S.), Brazil, Mexico and Korea. Because implementation of many of these programs has not been finalized, the financial impact cannot be estimated at this time. We anticipate that the number of chemical registration regulations will continue to increase globally, and we have implemented programs to track and comply with these regulations.

Given the recent volatility in certain energy-based input costs and foreign currencies, the Company is not able to predict with certainty the 2019 full year impact of related changes in raw material pricing versus 2018; however, PPG currently expects overall coatings raw material costs to increase a low-single-digit percentage in the first half of 2019, with impacts varied by region and commodity. Further, given the distribution nature of many of our businesses, logistics and distribution costs are sizable, as are wages and benefits but to a lesser degree. PPG typically experiences fluctuating prices for energy and raw materials driven by various factors, including changes in supplier feedstock costs and inventories, global industry activity levels, foreign currency exchange rates, government regulation, and global supply and demand factors. In aggregate, average

raw material cost inflation rose by a mid-single-digit percentage in 2018 versus 2017 and a comparable amount in 2017 versus 2016, driven by supply shortages, the rise in crude oil and feedstock prices, Chinese environmental regulations, and new tariffs. In addition, freight and logistics costs increased by a low-teen-digit percentage due to higher fuel costs, lack of transportation availability and other reasons.

Backlog

In general, PPG does not manufacture its products against a backlog of orders. Production and inventory levels are geared primarily to projections of future demand and the level of incoming orders.

Global Operations

PPG has a significant investment in non-U.S. operations. This broad geographic footprint serves to lessen the significance of economic impacts occurring in any one region on PPG's total Net sales and Income before income taxes in the consolidated statement of income. As a result of our expansion outside the U.S., we are subject to certain inherent risks, including economic and political conditions in international markets, trade protection measures and fluctuations in foreign currency exchange rates. During 2018, favorable foreign currency translation increased Net sales by approximately $100 million and Income before income taxes by $20 million. Foreign currency translation was favorable in the first half of the year, partly offset by unfavorable foreign currency translation in the second half of the year.

Our net sales in the developed and emerging regions of the world for the years ended December 31st are summarized below:

($ in millions)	2018	2017	2016
Net Sales			
United States, Canada, Western Europe	$10,299	$9,911	$9,773
Latin America, Central and Eastern Europe, Middle East, Africa, Asia Pacific	5,075	4,837	4,497
Total	$15,374	$14,748	$14,270

Refer to Note 20, "Reportable Business Segment Information" under Item 8 of this Form 10-K for geographic information related to PPG's property, plant and equipment, and for additional geographic information pertaining to sales.

Seasonality

PPG's Income from continuing operations has typically been greater in the second and third quarters and Cash from operating activities has been greatest in the fourth quarter due to end-use market seasonality, primarily in PPG's architectural coatings businesses. Demand for PPG's architectural coatings products is typically the strongest in the second and third quarters due to higher home improvement, maintenance and construction activity during the spring and summer months in the U.S., Canada and Europe. The Latin America paint season is the strongest in the fourth quarter. These cyclical activity levels result in the collection of outstanding receivables and lower inventory on hand in the fourth quarter generating higher Cash from operating activities.

Employee Relations

The average number of people employed worldwide by PPG during 2018 was approximately 47,300. The Company has numerous collective bargaining agreements throughout the world. We observe local customs, laws and practices in labor relations when negotiating collective bargaining agreements. There were no significant work stoppages in 2018. While we have experienced occasional work stoppages as a result of the collective bargaining process and may experience some work stoppages in the future, we believe that we will be able to negotiate all labor agreements on satisfactory terms. To date, these work stoppages have not had a significant impact on PPG's results of operations. Overall, the Company believes it has good relationships with its employees.

Environmental Matters

PPG is committed to operating in a sustainable manner and to helping our customers meet their sustainability goals. Our sustainability efforts are led by the Technology and Environment Committee of our Board of Directors and our Sustainability Committee, which is comprised of members of PPG's senior management team. The Sustainability Committee establishes policies, programs, procedures and goals to address sustainability in our business practices, including resource management, climate change, innovation, communications, purchasing, manufacturing and employee wellness.

Our dedication to innovation is intertwined with sustainability. Once again in 2018, we increased the percent of our sales from sustainable products. We are marketing an ever-growing variety of products and services that provide environmental, safety and other benefits to our customers. Our products contribute to lighter, more fuel-efficient vehicles, airplanes and ships, and they help our customers reduce their energy consumption, conserve water and reduce waste. These products include a compact automotive paint process that saves energy and reduces water usage; sustainable, waterborne coatings

formulations; lightweight sealants and coatings for aircraft; coatings that cool surfaces; and solutions for autonomous and battery-powered vehicles.

Public and governmental concerns related to climate change continue to grow, leading to efforts to limit the greenhouse gas (“GHG”) emissions. While PPG has operations in many countries, a substantial portion of PPG’s GHG emissions are generated by locations in the U.S. where considerable legislative and regulatory activity has been taking place. PPG has, and will continue to, annually report our global GHG emissions to the voluntary CDP, formerly the Carbon Disclosure Project.

PPG participates in both the U.S. Department of Energy, BETTER BUILDINGS®, BETTER PLANTS® program, formerly the SAVE ENERGY NOW® Leadership program, and the Environmental Protection Agency ENERGY STAR® Industrial Partnership program, both reinforcing the Company’s voluntary efforts to significantly reduce its industrial energy intensity. These programs include developing and implementing energy management processes and setting energy savings targets while providing a suite of educational, training, and technical resources to help meet those targets. Recognizing the continuing importance of this matter, PPG has a senior management group with a mandate to guide the Company’s progress in this area.

Our commitment to sustainability continues to yield tangible results. In 2018, we again made significant progress reducing our energy intensity, GHG emissions intensity, water usage intensity and waste intensity. More information about PPG’s sustainability values, efforts, goals and data and our community and employee engagement programs can be found in our Sustainability Report and on our sustainability website at http://sustainability.ppg.com and on the CDP’s website at www.cdp.net.

PPG is subject to existing and evolving standards relating to the protection of the environment. In management’s opinion, the Company operates in an environmentally sound manner and is well positioned, relative to environmental matters, within the industries in which it operates. PPG is negotiating with various government agencies concerning 124 current and former manufacturing sites and offsite waste disposal locations, including 22 sites on the National Priority List. While PPG is not generally a major contributor of wastes to these offsite waste disposal locations, each potentially responsible party may face governmental agency assertions of joint and several liability. Generally, however, a final allocation of costs is made based on relative contributions of wastes to the site. There is a wide range of cost estimates for cleanup of these sites, due largely to uncertainties as to the nature and extent of their condition and the methods that may have to be employed for their remediation. The Company has established reserves for onsite and offsite remediation of those sites where it is probable that a liability has been incurred and the amount of loss can be reasonably estimated.

The Company’s experience to date regarding environmental matters leads it to believe that it will have continuing expenditures for compliance with provisions regulating the protection of the environment and for present and future remediation efforts at waste and plant sites. Management anticipates that such expenditures will occur over an extended period of time.

In addition to the $291 million currently reserved for environmental remediation efforts, we may be subject to loss contingencies related to environmental matters estimated to be approximately $100 million to $200 million. These reasonably possible unreserved losses relate to environmental matters at a number of sites, none of which are individually significant. The loss contingencies related to these sites include significant unresolved issues such as the nature and extent of contamination at these sites and the methods that may have to be employed to remediate them.

($ in millions)	2018	2017	2016
Capital expenditures for environmental control projects	$20	$7	$18

It is expected that expenditures for such projects in 2019 will be in the range of $25 million to $35 million. Although future capital expenditures are difficult to estimate accurately because of constantly changing regulatory standards and policies, it can be anticipated that environmental control standards will become increasingly stringent and the cost of compliance will increase.

Management believes that the outcome of these environmental contingencies will not have a material adverse effect on PPG’s financial position or liquidity; however, any such outcome may be material to the results of operations of any particular period in which costs, if any, are recognized. See Note 14, “Commitments and Contingent Liabilities” under Item 8 of this Form 10-K for additional information related to environmental matters and our accrued liability for estimated environmental remediation costs.

Available Information

The Company's website address is www.ppg.com. The Company posts, and shareholders may access without charge, the Company's recent filings and any amendments thereto of its annual reports on Form 10-K, quarterly reports on Form 10-Q and its proxy statements as soon as reasonably practicable after such reports are filed with the Securities and Exchange Commission ("SEC"). The Company also posts all financial press releases, including earnings releases, to its website. All other reports filed or furnished to the SEC, including reports on Form 8-K, are available via direct link on PPG's website to the SEC's website, www.sec.gov. Reference to the Company's, the SEC's or other websites herein does not incorporate by reference any information contained on those websites and such information should not be considered part of this Form 10-K.

Item 1A. Risk Factors

As a global manufacturer of paints, coatings and specialty materials, we operate in a business environment that includes risks. These risks are not unlike the risks we have faced in the recent past nor are they unlike risks faced by our competitors. Each of the risks described in this section could adversely affect our results of operations, financial position and liquidity. While the factors listed here are considered to be the more significant factors, no such list should be considered to be a complete statement of all potential risks and uncertainties. Unlisted factors may present significant additional obstacles which may adversely affect our businesses and our results of operations.

Increases in prices and declines in the availability of raw materials could negatively impact our financial results.

Our financial results are significantly affected by the cost of raw materials. Coatings raw materials include both organic, primarily petroleum-derived, materials and inorganic materials, including titanium dioxide. These raw materials represent PPG's single largest production cost component.

While not our customary practice, we also import raw materials and intermediates, particularly for use at our manufacturing facilities in the emerging regions of the world. In most cases, those imports are priced in the currency of the supplier and, therefore, if that currency strengthens against the currency of our manufacturing facility, our margins may be lower.

Most of our raw materials are purchased from outside sources, and the Company has made, and plans to continue to make, supply arrangements to meet the planned operating requirements for the future. Adequate supply of critical raw materials is managed by establishing contracts, procuring from multiple sources, and identifying alternative materials or technology whenever possible. The Company is continuing its aggressive sourcing initiatives to effectively broaden our supply of high quality raw materials. These initiatives include qualifying multiple and local sources of supply, including suppliers from Asia and other lower cost regions of the world, adding on-site resin production at certain manufacturing locations, and a reduction in the amount of titanium dioxide and other raw materials used in our product formulations. Our products use both petroleum-derived and bio-based materials as part of a product renewal strategy.

An inability to obtain critical raw materials would adversely impact our ability to produce products. Increases in the cost of raw materials may have an adverse effect on our Income from continuing operations or Cash from operating activities in the event we are unable to offset these higher costs in a timely manner.

The pace of economic growth and level of uncertainty could have a negative impact on our results of operations and cash flows.

During 2018, economic conditions improved in all of our major geographical regions while remaining mixed by end-use market. Demand for our products and services depends in part on the general economic conditions affecting the countries and markets in which we do business. Weak economic conditions in certain geographies and changing supply and demand balances in the markets we serve have negatively impacted demand for our products and services in the past and may do so in the future. Recently, global economic uncertainty has increased due to a number of factors, including slowing global growth, global stock and commodity market volatility, disruption in existing trade agreements, the imposition of tariffs and the threat of additional tariffs, the United Kingdom's exit from the European Union, weaker demand in China and increasing interest rates in the United States. PPG provides products and services to a variety of end-use markets in many geographies. This broad end-use market exposure and expanded geographic presence lessens the significance of any individual decrease in activity levels; nonetheless, lower demand levels may result in lower sales, which would result in reduced Income from continuing operations and Cash from operating activities.

We are subject to existing and evolving standards relating to the protection of the environment.
Environmental laws and regulations control, among other things, the discharge of pollutants into the air and water, the handling, use, treatment, storage and clean-up of hazardous and non-hazardous waste, the investigation and remediation of soil and groundwater affected by hazardous substances, and regulate various health and safety matters. The environmental laws and regulations we are subject to impose liability for the costs of, and damages resulting from, cleaning up current sites, past spills, disposals and other releases of hazardous substances. Violations of these laws and regulations can also result

in fines and penalties. Future environmental laws and regulations may require substantial capital expenditures or may require or cause us to modify or curtail our operations, which may have a material adverse impact on our business, financial condition and results of operations.

We are involved in a number of lawsuits and claims, and we may be involved in future lawsuits and claims, in which substantial monetary damages are sought.

PPG is involved in a number of lawsuits and claims, both actual and potential, in which substantial monetary damages are sought. Those lawsuits and claims relate to contract, patent, environmental, product liability, asbestos exposure, antitrust, employment, securities and other matters arising out of the conduct of PPG's current and past business activities. Any such claims, whether with or without merit, could be time consuming, expensive to defend and could divert management's attention and resources. We maintain insurance against some, but not all, of these potential claims, and the levels of insurance we do maintain may not be adequate to fully cover any and all losses. We believe that, in the aggregate, the outcome of all current lawsuits and claims involving PPG, including those described in Note 14, "Commitments and Contingent Liabilities" under Item 8 of this Form 10-K, will not have a material effect on PPG's consolidated financial position or liquidity; however, such outcome may be material to the results of operations of any particular period in which costs, if any, are recognized. Nonetheless, the results of any future litigation or claims are inherently unpredictable, and such outcomes could have a material adverse effect on our results of operations, Cash from operating activities or financial condition.

Fluctuations in foreign currency exchange rates could affect our financial results.

We earn revenues, pay expenses, own assets and incur liabilities in countries using currencies other than the U.S. dollar. Because our consolidated financial statements are presented in U.S. dollars, we must translate revenues and expenses into U.S. dollars at the average exchange rate during each reporting period, as well as assets and liabilities into U.S. dollars at exchange rates in effect at the end of each reporting period. Therefore, increases or decreases in the value of the U.S. dollar against other currencies will affect our Net sales, Net income and the value of balance sheet items denominated in foreign currencies. We may use derivative financial instruments to reduce our net exposure to currency exchange rate fluctuations related to foreign currency transactions. However, fluctuations in foreign currency exchange rates, particularly the strengthening or weakening of the U.S. dollar against major currencies, could adversely or positively affect our financial condition and results of operations expressed in U.S. dollars.

We are subject to a variety of complex U.S. and non-U.S. laws and regulations, which could increase our compliance costs and could adversely affect our results of operations.

We are subject to a wide variety of complex U.S. and non-U.S. laws and regulations, and legal compliance risks, including securities laws, tax laws, environmental laws, employment and pension-related laws, competition laws, U.S. and foreign export and trading laws, and laws governing improper business practices, including bribery. We are affected by new laws and regulations and changes to existing laws and regulations, as well as interpretations by courts and regulators. These laws and regulations effectively expand our compliance obligations and costs.

For example, regulations concerning the composition, use and transport of chemical products continue to evolve. Developments concerning these regulations could potentially impact the availability or viability of some of the raw materials we use in our product formulations and/or our ability to supply certain products to some customers or markets. Import/export regulations also continue to evolve and could result in increased compliance costs, slower product movements or additional complexity in our supply chains.

Further, although we believe that we have appropriate risk management and compliance programs in place, we cannot guarantee that our internal controls and compliance systems will always protect us from improper acts committed by employees, agents, business partners or businesses that we acquire. Any non-compliance or such improper actions or allegations could damage our reputation and subject us to civil or criminal investigations and shareholder lawsuits, could lead to substantial civil and criminal, monetary and non-monetary penalties, and could cause us to incur significant legal and investigatory fees.

Our international operations expose us to additional risks and uncertainties that could affect our financial results.

PPG has a significant investment in global operations. This broad geographic footprint serves to lessen the significance of economic impacts occurring in any one region. Notwithstanding the benefits of geographic diversification, our ability to achieve and maintain profitable growth in international markets is subject to risks related to the differing legal, political, social and regulatory requirements and economic conditions of many countries. As a

result of our operations outside the U.S., we are subject to certain inherent risks, including political and economic uncertainty, inflation rates, exchange rates, trade protection measures, local labor conditions and laws, restrictions on foreign investments and repatriation of earnings, and weak intellectual property protection. Our percentage of sales generated in 2018 by products sold outside the U.S. was approximately 62%.

Changes in the tax regimes and related government policies and regulations in the countries in which we operate could adversely affect our results and our effective tax rate.

As a multinational corporation, we are subject to various taxes in both the U.S. and non-U.S. jurisdictions. Due to economic and political conditions, tax rates in these various jurisdictions may be subject to significant changes. Our future effective income tax rate could be affected by changes in the mix of earnings in countries with differing statutory tax rates, changes in the valuation of deferred tax assets or changes in tax laws or their interpretation. Further, PPG may continue to refine its estimates to incorporate new or better information as it comes available. Recent developments, including the European Commission's investigations on illegal state aid as well as the Organisation for Economic Co-operation and Development project on Base Erosion and Profit Shifting may result in changes to long-standing tax principles, which could adversely affect our effective tax rate or result in higher cash tax liabilities. If our effective income tax rate was to increase, our Cash from operating activities, financial condition and results of operations would be adversely affected.

Although we believe that our tax filing positions are appropriate, the final determination of tax audits or tax disputes may be different from what is reflected in our historical income tax provisions and accruals. If future audits find that additional taxes are due, we may be subject to incremental tax liabilities, possibly including interest and penalties, which could have a material adverse effect on our Cash from operating activities, financial condition and results of operations.

Business disruptions could have a negative impact on our results of operations and financial condition.

Unexpected events, including supply disruptions, temporary plant and/or power outages, work stoppages, natural disasters and severe weather events, computer system disruptions, fires, war or terrorist activities, could increase the cost of doing business or otherwise harm the operations of PPG, our customers and our suppliers. It is not possible for us to predict the occurrence or consequence of any such events. However, such events could reduce our ability to supply products, reduce demand for our products or make it difficult or impossible for us to receive raw materials from suppliers or to deliver products to customers.

Integrating acquired businesses into our existing operations.

Part of the Company's strategy is growth through acquisitions. Over the last decade, we have successfully completed more than 50 acquisitions and we will likely acquire additional businesses and enter into additional joint ventures in the future. Growth through acquisitions and the formation of joint ventures involve risks, including:

- difficulties in assimilating acquired companies and products into our existing business;
- delays in realizing the benefits from the acquired companies or products;
- diversion of our management's time and attention from other business concerns;
- difficulties due to lack of or limited prior experience in any new markets we may enter;
- unforeseen claims and liabilities, including unexpected environmental exposures or product liability;
- unexpected losses of customers or suppliers of the acquired or existing business;
- difficulty in conforming the acquired business' standards, processes, procedures and controls to those of our operations; and
- difficulties in retaining key employees of the acquired businesses.

These risks or other problems encountered in connection with our past or future acquisitions and joint ventures could cause delays in realizing the anticipated benefits of such acquisitions or joint ventures and could adversely affect our results of operations, Cash from operating activities or financial condition.

Our ability to understand our customers' specific preferences and requirements, and to innovate, develop, produce and market products that meet customer demand is critical to our business results.

Our business relies on continued global demand for our brands and products. To achieve business goals, we must develop and sell products that appeal to customers. This is dependent on a number of factors, including our ability to produce products that meet the quality, performance and price expectations of our customers and our ability to develop effective sales, advertising and marketing programs.

We believe the automotive industry will experience significant and continued change in the coming years. Vehicle manufacturers continue to develop new safety features such as collision avoidance technology and self-driving vehicles that may reduce vehicle collisions in the future, potentially lowering demand for our refinish coatings. In addition, through the introduction of new technologies, new business models or new methods of travel, such as

ridesharing, the number of automotive OEM new-builds may decline, potentially reducing demand for our automotive OEM coatings and related automotive parts.

Our future growth will depend on our ability to continue to innovate our existing products and to develop and introduce new products. If we fail to keep pace with product innovation on a competitive basis or to predict market demands for our products, our businesses, financial condition and results of operations could be adversely affected.

The industries in which we operate are highly competitive.

With each of our businesses, an increase in competition may cause us to lose market share, lose a large regional or global customer, or compel us to reduce prices to remain competitive, which could result in reduced margins for our products. Competitive pressures may not only reduce our margins but may also impact our revenues and our growth which could adversely affect our results of operations.

The security of our information technology systems could be compromised, which could adversely affect our ability to operate.

Increased global information technology security requirements, threats and sophisticated and targeted computer crime pose a risk to the security of our systems, networks and the confidentiality, availability and integrity of our data. Despite our efforts to protect sensitive information and confidential and personal data, our facilities and systems may be vulnerable to security breaches. This could lead to negative publicity, theft, modification or destruction of proprietary information or key information, manufacture of defective products, production downtimes and operational disruptions, which could adversely affect our reputation, competitiveness and results of operations.

We have concluded that previously issued financial statements as detailed below should not be relied upon and have restated those previously issued financial statements, which has led to, among other things, shareholder litigation, investigations by the SEC and the U.S. Attorney's office and unanticipated costs for accounting and legal fees, and may result in certain other risks.

As discussed in the Explanatory Note, Note 2, "Restatement of Previously Reported Consolidated Annual Financial Statements" and in Note 19, "Quarterly Financial Information (unaudited)" under Item 8 of the 2017 Form 10-K/A, we have concluded that our previously issued financial statements as of December 31, 2017 and 2016, and for each of the quarterly and year-to-date periods in 2017, and the final quarterly and year-to-date period in 2016, should no longer be relied upon. The determination that the applicable financial statements should no longer be relied upon and that these financial statements would be restated was made following the identification of misstatements. Although the Company has restated these financial statements and the material weakness in the Company's internal control over financial reporting has been remediated, as a result of these misstatements, we have become subject to a number of additional risks and uncertainties, including unanticipated costs for accounting and legal fees in connection with or related to the restatement, the outcome of our shareholder litigation and government investigations, potential loss of investor confidence, and a negative impact on our stock price. Our shareholder litigation and the government investigations could result in substantial defense costs regardless of the outcome of the litigation or investigation. If we do not prevail in any such litigation, we could be required to pay substantial damages or settlement costs.

We are involved in investigations by the SEC and the U.S. Attorney's office which are costly to conduct and may result in substantial financial and other penalties, as well as adverse effects on our business and financial condition.

In connection with the Audit Committee's review of alleged violations of our accounting policies and procedures, we self-reported this matter to the SEC. We are cooperating with the SEC and the U.S. Attorney's office in their investigations of this matter. These investigations are continuing, and we are currently unable to predict their duration, scope or results or whether the SEC or U.S. Attorney will commence any legal action. If we are found to have violated securities laws or other federal statutes, we may be subject to criminal and civil penalties and other remedial measures, including, but not limited to, injunctive relief, disgorgement, civil and criminal fines and penalties, modifications of compliance programs and the retention of a monitor to oversee compliance. The imposition of any of these sanctions or remedial measures could have a material adverse impact on our business, reputation, revenues, results of operations and financial condition.

Item 1B. Unresolved Staff Comments

None.

Item 2. Properties

The Company's corporate headquarters is located in Pittsburgh, Pa. The Company's manufacturing facilities, sales offices, research and development centers and distribution centers are located throughout the world. As of February 21, 2019, the Company operated 128 manufacturing facilities in 39 countries. See Item 1. "Business" of this

Form 10-K for the principal manufacturing and distribution facilities by reportable segment.

The Company has manufacturing facilities in the following geographic areas:

United States and Canada	EMEA	Asia Pacific	Latin America
34 facilities	54 facilities in 24 countries	26 facilities in 9 countries	14 facilities in 4 countries

The Company's principal research and development centers are located in Allison Park, Pa.; Marly, France; Milan, Italy; Monroeville, Pa.; Burbank, Calif.; Tianjin, China; Amsterdam, Netherlands and Tepexpan, Mexico.

The Company's headquarters, certain distribution centers and substantially all company-owned paint stores are located in facilities that are leased while the Company's other facilities are generally owned. Our facilities are considered to be suitable and adequate for the purposes for which they are intended and overall have sufficient capacity to conduct business in the upcoming year.

Item 3. Legal Proceedings

PPG is involved in a number of lawsuits and claims, both actual and potential, including some that it has asserted against others, in which substantial monetary damages are sought. These lawsuits and claims may relate to contract, patent, environmental, product liability, asbestos exposure, antitrust, employment, securities and other matters arising out of the conduct of PPG's current and past business activities. To the extent these lawsuits and claims involve personal injury and property damage, PPG believes it has adequate insurance; however, certain of PPG's insurers are contesting coverage with respect to some of these claims, and other insurers may contest coverage. PPG's lawsuits and claims against others include claims against insurers and other third parties with respect to actual and contingent losses related to environmental, asbestos and other matters.

The Company has self-reported to the SEC information concerning the internal investigation of accounting matters described in the Explanatory Note and in Note 2, "Restatement of Previously Reported Consolidated Annual Financial Statements" under Item 8 of the 2017 Form 10-K/A. The Company continues to cooperate fully with the SEC's ongoing investigation relating to these accounting matters. The Company is also cooperating fully with an investigation into the same accounting matters commenced by the U.S. Attorney's Office for the Western District of Pennsylvania.

On May 20, 2018, a putative securities class action lawsuit was filed in the U.S. District Court for the Central District of California against the Company and certain of its current or former officers. On September 21, 2018, an Amended Class Action Complaint was filed in the action. The Amended Complaint, captioned Trevor Mild v. PPG Industries, Inc., Michael H. McGarry, Vincent J. Morales, and Mark C. Kelly, asserts securities fraud claims under Sections 10(b) and 20(a) of the Securities Exchange Act of 1934 on behalf of putative classes of persons who purchased or otherwise acquired stock of the Company during various time periods between January 19, 2017 and May 10, 2018. The allegations relate to, among other things, allegedly false and misleading statements and/or failures to disclose information about the Company's business, operations and prospects. On December 21, 2018, the Court denied the defendants' motion to dismiss the lawsuit, and on January 4, 2019 the defendants filed answers to the Amended Complaint. This action remains pending. The Company believes this action is without merit and intends to defend itself vigorously.

For many years, PPG has been a defendant in lawsuits involving claims alleging personal injury from exposure to asbestos. For a description of asbestos litigation affecting the Company, see Note 14, "Commitments and Contingent Liabilities" to the accompanying consolidated financial statements under Part I, Item 8 of this Form 10-K.

In the past, the Company and others have been named as defendants in several cases in various jurisdictions claiming damages related to exposure to lead and remediation of lead-based coatings applications. PPG has been dismissed as a defendant from most of these lawsuits and has never been found liable in any of these cases. After having not been named in a new lead-related lawsuit for 15 years, PPG was named as a defendant in two new Pennsylvania state court lawsuits filed by Montgomery County and Lehigh County in the respective counties on October 4, 2018 and October 12, 2018. Both suits seek declaratory relief arising out of alleged public nuisances in the counties associated with the presence of lead paint on various buildings constructed prior to 1980. The Company believes these actions are without merit and intends to defend itself vigorously.

Executive Officers of the Company

Set forth below is information related to the Company's executive officers as of February 21, 2019.

Name	Age	Title
Michael H. McGarry [a]	60	Chairman and Chief Executive Officer since September 2016
Anne M. Foulkes [b]	56	Senior Vice President and General Counsel since September 2018
Vincent J. Morales [c]	53	Senior Vice President and Chief Financial Officer since March 2017
Amy R. Ericson [d]	53	Senior Vice President, Packaging Coatings since July 2018
Timothy M. Knavish [e]	53	Senior Vice President, Architectural Coatings and President PPG EMEA since January 2019
Rebecca B. Liebert [f]	51	Senior Vice President, Automotive Coatings since June 2018
Ramaparasad Vadlamannati [g]	56	Senior Vice President, Protective and Marine Coatings since March 2016

(a) Mr. McGarry served as President and Chief Executive Officer from September 2015 through August 2016, President and Chief Operating Officer from March 2015 through August 2015; Chief Operating Officer from August 2014 through February 2015; Executive Vice President from September 2012 through July 2014; and Senior Vice President, Commodity Chemicals from July 2008 through August 2012.

(b) Ms. Foulkes served as Senior Vice President, General Counsel and Secretary from August 2018 through September 2018, Vice President and Associate General Counsel and Secretary from March 2016 through July 2018 and Assistant General Counsel and Secretary from April 2011 through February 2016.

(c) Mr. Morales served as Vice President, Finance from June 2016 through February 2017. From June 2015 through June 2016, he served as Vice President, Investor Relations and Treasurer and from October 2007 through May 2015 he served as Vice President, Investor Relations.

(d) Ms. Ericson was appointed Senior Vice President, Packaging Coatings in July 2018 when she joined PPG from SUEZ SA. She previously served as President of SUEZ Chemical Monitoring and Solutions from 2017 until 2018, President of General Electric Water Services Company from 2015 to 2017 and President and Chief Executive Officer of Alstom SA's U.S. business from 2013 to 2015.

(e) Mr. Knavish served as Senior Vice President, Industrial Coatings from October 2017 to January 2019, Senior Vice President, Automotive Coatings from March 2016 through September 2017, Vice President, Protective and Marine Coatings from August 2012 through February 2016 and Vice President, Automotive Coatings, Americas from March 2010 through July 2012.

(f) Ms. Liebert was appointed Senior Vice President, Automotive Coatings in June 2018 when she joined PPG from Honeywell International, Inc. She previously served as President and Chief Executive Officer of Honeywell UOP from 2016 to 2018, Senior Vice President and General Manager, Catalyst Adsorbents and Specialties of Honeywell UOP from 2015 to 2016 and Senior Vice President and General Manager, Gas Processing and Hydrogen of Honeywell UOP from 2012 to 2015.

(g) Mr. Vadlamannati served as Vice President, Architectural Coatings, EMEA and Asia/Pacific from August 2014 through February 2016, Vice President, Architectural Coatings, EMEA from February 2012 through July 2014, Vice President, Architectural Coatings, EMEA for Region Western Europe from March 2011 through January 2012 and Vice President, Automotive Refinish, EMEA from September 2010 through February 2011.

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

The information required by Item 5 regarding market information, including PPG's stock exchange listing and quarterly stock market prices, dividends and holders of common stock is included in Exhibit 13.1 filed with this Form 10-K and is incorporated herein by reference. Annual information is also included in the 2018 Financial Overview and Shareholder Information on page 10 of the Annual Report to shareholders.

Issuer Purchases of Equity Securities - Fourth Quarter 2018

Month	Total Number of Shares Purchased	Avg. Price Paid per Share	Total Number of Shares Purchased as Part of Publicly Announced Programs	Max. Number of Shares That May Yet Be Purchased Under the Programs(1)
October 2018				
Repurchase program	2,217,910	$101.80	2,217,910	19,202,867
November 2018				
Repurchase program	—	$—	—	18,458,147
December 2018				
Repurchase program	1,855,100	$98.45	1,855,100	17,953,509
Total quarter ended December 31, 2018				
Repurchase program	4,073,010	$100.28	4,073,010	17,953,509

(1) In December 2017, PPG's board of directors approved a $2.5 billion share repurchase program. The remaining shares yet to be purchased under the program has been calculated using PPG's closing stock price on the last business day of the respective month. This repurchase program has no expiration date.

No shares were withheld in satisfaction of the exercise price and/or tax withholding obligation by holders of employee stock options who exercised options granted under the Company's equity compensation plans in the fourth quarter of 2018.

Item 6. Selected Financial Data

The information required by Item 6 regarding the selected financial data for the five years ended December 31, 2018 is included in Exhibit 13.2 filed with this Form 10-K and is incorporated herein by reference. This information is also reported in the Five-Year Digest on page 104 of the Annual Report to shareholders.

Item 7. Management’s Discussion and Analysis of Financial Condition and Results of Operations
Performance Overview
Net Sales by Region

($ in millions, except percentages)	2018	2017	2016	% Change 2018 vs. 2017	2017 vs. 2016
United States and Canada	$6,485	$6,307	$6,254	2.8%	0.8%
Europe, Middle East and Africa (EMEA)	4,678	4,389	4,164	6.6%	5.4%
Asia Pacific	2,618	2,523	2,431	3.8%	3.8%
Latin America	1,593	1,529	1,421	4.2%	7.6%
Total	$15,374	$14,748	$14,270	4.2%	3.3%

2018 vs. 2017
Net sales increased $626 million due to the following:
Higher selling prices (+2%)
Slightly higher acquisition-related sales, net of dispositions
Slightly higher sales volumes
Slightly favorable foreign currency translation
U.S. and Canada net sales increased a low-single-digit percentage primarily driven by net sales from acquired businesses which added approximately $110 million, primarily from The Crown Group, as well as higher selling prices in most businesses.
Europe, Middle East and Africa (EMEA) net sales increased a mid-single-digit percentage, led by slightly positive sales volumes, higher selling prices in all businesses and favorable foreign currency translation driven by the euro and U.K. pound.
Asia Pacific net sales increased by a mid-single-digit percentage aided by higher selling prices in most businesses and higher sales volumes, slightly offset by weakening industry demand in China later in the year. Sales growth was also supported by a more than 10% increase in India and solid gains in Australia and Southeast Asia. Net sales in this region also benefited from favorable foreign currency translation.
Latin American net sales volumes grew by a mid-single-digit percentage versus the prior year. Sales also benefited from higher selling prices in the region, offset by unfavorable foreign currency translation driven by the Mexican peso.
For specific business results see the Segment Results section within Item 7 of this Form 10-K.
2017 vs. 2016
Net sales increased $478 million due to the following:
Acquisition-related sales (+1%)
Higher sales volumes (+1%)
Slightly favorable foreign currency translation
Slightly higher selling prices
Net sales from acquired businesses added over $200 million of sales in 2017, primarily MetoKote, DEUTEK, Univer and The Crown Group.
U.S. and Canada sales volumes declined slightly year-over-year, with mixed demand by business and end-use segment. Sales volumes in architectural coatings U.S. company-owned stores grew by a mid-single-digit percentage, but were more than offset by sales volumes declines in the independent dealer networks and national retail (DIY) customer accounts in aggregate. Automotive OEM coatings sales volumes declined year-over-year and lagged industry demand levels due to a customer-driven share shift away from PPG that was offset in other regions of the world. These decreases in sales volumes were partially offset by higher sales volumes in specialty coatings and materials, automotive refinish coatings, general industrial coatings, aerospace coatings and packaging coatings.
EMEA sales volumes increased a low-single-digit percentage versus the prior year. Sales volumes in our automotive OEM coatings and aerospace coatings businesses each grew by a mid-single-digit percentage. Specialty coatings and materials sales volumes grew by a double-digit percentage, driven by strong silica demand. Protective coatings volumes also grew year-over-year. These increases in sales volumes were partially offset by lower demand in architectural coatings.

Asia Pacific sales volumes expanded by a mid-single-digit percentage year-over-year led by growth in each business within the Industrial Coatings segment along with sales volume growth in the architectural coatings business. These increases in sales volumes were partially offset by lower demand in marine coatings year-over-year. From a country and sub-region perspective, sales volumes grew in India, China, and Southeast Asia versus the prior year. Korea sales volumes continued to decline year-over-year primarily due to continued weakness in new shipbuilding.

Latin America sales volumes expanded by a mid-single-digit percentage versus the prior year primarily due to above market growth in our automotive OEM coatings and general industrial coatings businesses. The automotive OEM coatings growth was driven by industry production expansion with the opening of new assembly facilities in Mexico. Regional sales volumes were lower in architectural coatings versus the prior year primarily due to lower sales volumes in Brazil and in Mexico due to the impact of the natural disasters during the third quarter.

Cost of sales, exclusive of depreciation and amortization

				% Change	
($ in millions, except percentages)	2018	2017	2016	2018 vs. 2017	2017 vs. 2016
Cost of sales, exclusive of depreciation and amortization	$9,001	$8,209	$7,665	9.6%	7.1%
Cost of sales as a % of net sales	58.5 %	55.7 %	53.7 %	2.8%	2.0%

2018 vs. 2017

Cost of sales, exclusive of depreciation and amortization, increased $792 million due to the following:

- Raw material cost inflation
- Higher sales volumes
- Cost reclassifications associated with the adoption of the new revenue recognition standard. Refer to Note 2, "Revenue Recognition" within Part 2 of this Form 10-K
- Cost of sales attributable to acquired businesses
- Foreign currency translation

Partially offset by:

- Restructuring cost savings

2017 vs. 2016

Cost of sales, exclusive of depreciation and amortization, increased $544 million due to the following:

- Raw material cost inflation
- Higher sales volumes
- Cost of sales attributable to acquired businesses
- Foreign currency translation

Partially offset by:

- Lower manufacturing costs

Selling, general and administrative expenses

				% Change	
($ in millions, except percentages)	2018	2017	2016	2018 vs. 2017	2017 vs. 2016
Selling, general and administrative expenses	$3,573	$3,554	$3,555	0.5%	—%
Selling, general and administrative expenses as a % of net sales	23.2 %	24.1 %	24.9 %	(0.9)%	(0.8)%

2018 vs. 2017

Selling, general and administrative expenses declined as a percent of net sales, but increased $19 million primarily due to:

- Higher sales volumes
- Wage and other cost inflation
- Selling, general and administrative expenses from acquired businesses

Foreign currency translation

Partially offset by:

Cost reclassifications associated with the adoption of the new revenue recognition standard. Refer to Note 2, "Revenue Recognition" within Part 2 of this Form 10-K

Cost management including restructuring cost savings

2017 vs. 2016

Selling, general and administrative expenses decreased $1 million primarily due to:

Lower net periodic pension and other postretirement benefit costs

Lower selling and advertising costs

Restructuring cost savings

Partially offset by:

Wage and other cost inflation

Selling, general and administrative expenses from acquired businesses

Foreign currency translation

Other charges and other income

				% Change	
($ in millions, except percentages)	2018	2017	2016	2018 vs. 2017	2017 vs. 2016
Interest expense, net of Interest income	$95	$85	$99	11.8%	(14.1)%
Business restructuring, net	$66	$—	$191	N/A	(100.0)%
Pension settlement charges	$—	$60	$968	(100.0)%	(93.8)%
Other charges	$122	$74	$242	64.9%	(69.4)%
Other income	($114)	($150)	($127)	(24.0)%	18.1%

Interest expense, net of Interest income

Interest expense, net of Interest income increased $10 million in 2018 versus 2017 primarily due to the issuance of long-term debt in early 2018. Interest expense, net of Interest income decreased $14 million in 2017 versus 2016 due to lower interest rate debt outstanding in 2017.

Business restructuring, net

A pretax restructuring charge of $83 million was recorded in the second quarter of 2018, offset by certain changes in estimates to complete previously recorded programs of $17 million. A pretax charge of $191 million was recorded in 2016. Refer to Note 8, "Business Restructuring" in Item 8 of this Form 10-K for additional information.

Pension settlement charges

During 2017, PPG made lump-sum payments to certain retirees who had participated in PPG's U.S. qualified and non-qualified pension plans totaling approximately $127 million. As the lump-sum payments were in excess of the expected 2017 service and interest costs for the affected plans, PPG remeasured the periodic benefit obligation of these plans in the period payments were made and recorded settlement charges totaling $60 million ($38 million after-tax) during 2017.

During 2016, PPG permanently transferred approximately $1.8 billion of its U.S. and Canadian pension obligations and assets to several highly rated insurance companies. These actions triggered remeasurement and partial settlement of certain of the Company’s defined benefit pension plans. PPG recognized a $968 million pre-tax settlement charge in connection with these transactions. Refer to Note 13, "Employee Benefit Plans" in Item 8 of this Form 10-K for additional information.

Other charges

Other charges in 2018 and 2016 were higher than 2017 primarily due to environmental remediation charges. These charges were principally for environmental remediation at a former chromium manufacturing plant and associated sites in New Jersey. Refer to Note 14, "Commitments and Contingent Liabilities" in Item 8 of this Form 10-K for additional information.

Other income

Other income was lower in 2018 and 2016 than in 2017 primarily due to the gain from the sale of the Mexican Plaka business of $25 million and income from a legal settlement of $18 million in 2017. Refer to Note 3, "Acquisitions and Divestitures" in Item 8 of this Form 10-K for additional information.

Effective tax rate and earnings per diluted share, continuing operations

($ in millions, except percentages)	2018	2017	2016	% Change 2018 vs. 2017	2017 vs. 2016
Income tax expense	$353	$615	$214	(42.6)%	187.4%
Effective tax rate	20.9 %	30.7 %	27.5 %	(9.8)%	3.2%
Adjusted effective tax rate*	22.1 %	24.3 %	24.5 %	(2.2)%	(0.2)%
Earnings per diluted share	$5.40	$5.31	$2.04	1.7%	160.3%
Adjusted earnings per diluted share*	$5.92	$5.86	$5.64	1.0%	3.9%

*See the Regulation G reconciliations - results of operations

The effective tax rate for the year-ended December 31, 2018 was 20.9% and decreased 9.8% from the prior year. In 2017, the tax rate included the tax toll charge for unremitted foreign earnings under the U.S. Tax Cuts and Jobs Act, while in 2018, the tax rate benefited from prior period adjustments, including finalization of the provisional toll charge recorded in 2017. The 2019 effective tax rate from continuing operations is expected to be in the range of 23% to 25%.

As reported, earnings per diluted share from continuing operations for the year ended December 31, 2018 increased year-over-year. Refer to the Regulation G Reconciliations - Results of Operations for additional information. The Company's earnings per diluted share and adjusted earnings per diluted share benefited from the 15.9 million, 7.4 million and 10.7 million shares of stock repurchased in 2018, 2017 and 2016, respectively, in conjunction with the Company's cash deployment objectives.

Regulation G Reconciliations - Results of Operations

PPG Industries believes investors' understanding of the Company's operating performance is enhanced by the disclosure of net income, earnings per diluted share and the effective tax rate adjusted for certain charges. PPG's management considers this information useful in providing insight into the Company's ongoing operating performance because it excludes the impact of items that cannot reasonably be expected to recur on a quarterly basis or that are not attributable to our primary operations. Net income and earnings per diluted share adjusted for these items are not recognized financial measures determined in accordance with U.S. generally accepted accounting principles (GAAP) and should not be considered a substitute for net income or earnings per diluted share or other financial measures as computed in accordance with U.S. GAAP. In addition, adjusted net income, earnings per diluted share and the effective tax rate may not be comparable to similarly titled measures as reported by other companies.

Income before income taxes from continuing operations is reconciled to adjusted income before income taxes, the effective tax rate from continuing operations is reconciled to the adjusted effective tax rate from continuing operations and net income (attributable to PPG) and earnings per share – assuming dilution (attributable to PPG) are reconciled to adjusted net income (attributable to PPG) and adjusted earnings per share – assuming dilution below:

Year-ended December 31, 2018

($ in millions, except percentages and per share amounts)	Income Before Income Taxes	Tax Expense	Effective Tax Rate	Net income from continuing operations (attributable to PPG)	Earnings per diluted share
As reported, continuing operations	$1,693	$353	20.9 %	$1,323	$5.40
Includes:					
Net tax charge related to U.S. Tax Cuts and Jobs Act	—	13	N/A	(13)	(0.05)
Charges related to customer assortment change	18	4	24.3 %	14	0.05
Charges related to environmental remediation and other costs	77	19	24.3 %	58	0.24
Net charge related to business restructuring	66	20	30.3 %	46	0.18
Accelerated depreciation from restructuring actions	9	2	22.2 %	7	0.03

Charge related to a legacy legal settlement	10	2	24.3 %	8	0.03
Charges related to accounting investigation costs	14	3	24.3 %	11	0.05
Charges related to transaction-related costs[1]	6	2	25.5 %	4	0.02
Charge related to brand rationalization	6	2	26.8 %	4	0.02
Gain from the sale of a non-operating asset	(26)	(6)	24.3 %	(20)	(0.08)
Charge related to impairment of a non-manufacturing asset	9	2	24.3 %	7	0.03
Adjusted, continuing operations, excluding certain items	$1,882	$416	22.1 %	$1,449	$5.92

Year-ended December 31, 2017

($ in millions, except percentages and per share amounts)	Income Before Income Taxes	Tax Expense	Effective Tax Rate	Net income from continuing operations (attributable to PPG)	Earnings per diluted share
As reported, continuing operations	$2,005	$615	30.7 %	$1,369	$5.31
Includes:					
Net tax charge related to U.S. Tax Cuts and Jobs Act	—	(134)	N/A	134	0.52
Charges related to transaction-related costs[1]	9	3	37.9 %	6	0.02
Charges related to pension settlements	60	22	37.9 %	38	0.14
Gain from sale of business	(25)	(1)	3.2 %	(24)	(0.09)
Gain from a legacy legal settlement	(18)	(7)	37.9 %	(11)	(0.04)
Gain from sale of a non-operating asset	(13)	(5)	37.9 %	(8)	(0.03)
Charges related to asset write-downs	7	—	— %	7	0.03
Adjusted, continuing operations, excluding certain items	$2,025	$493	24.3 %	$1,511	$5.86

Year-ended December 31, 2016

($ in millions, except percentages and per share amounts)	Income Before Income Taxes	Tax Expense	Effective Tax Rate	Net income from continuing operations (attributable to PPG)	Earnings per diluted share
As reported, continuing operations	$779	$214	27.5 %	$543	$2.04
Includes:					
Charges related to transaction-related costs[1]	8	3	37.6 %	5	0.03
Charge related to pension settlement	968	352	36.4 %	616	2.31
Charge related to business restructuring	191	50	26.2 %	141	0.53
Charge related to environmental remediation	82	31	37.6 %	51	0.20
Net gain from disposals of ownership interests in business affiliates	(46)	(16)	34.8 %	(30)	(0.12)
Net tax effect of asbestos settlement funding	—	(151)	N/A	151	0.57
Charge related to early retirement of debt	8	3	37.6 %	5	0.02
Charges related to asset write-downs	23	7	30.4 %	17	0.06
Adjusted, continuing operations, excluding certain items	$2,013	$493	24.5 %	$1,499	$5.64

(1) Transaction-related costs include advisory, legal, accounting, valuation, and other professional or consulting fees incurred to effect significant acquisitions, as well as similar fees and other costs to effect divestitures not classified as discontinued operations. These costs also include the flow-through cost of sales impact for the step up to fair value of inventory acquired in certain acquisitions.

Performance of Reportable Business Segments

Performance Coatings

($ in millions, except percentages)	2018	2017	2016	$ Change 2018 vs. 2017	$ Change 2017 vs. 2016	% Change 2018 vs. 2017	% Change 2017 vs. 2016
Net sales	$9,087	$8,730	$8,580	$357	$150	4.1%	1.7%
Segment income	$1,300	$1,313	$1,322	($13)	($9)	(1.0)%	(0.7)%

2018 vs. 2017

Performance Coatings net sales increased (4%) due to the following:

- Higher selling prices (+3%)
- Favorable foreign currency translation (+1%)

Higher selling prices across all businesses were achieved, reflecting the value of our products and services and which offset persistent raw material and logistics cost inflation.

Architectural coatings - Americas and Asia-Pacific sales volumes decreased by a low-single-digit percentage versus the prior year. Sales volumes were positive year-over-year in the U.S. and Canada company-owned store network as well as in Mexico, Central America, Australia and Brazil. This growth was more than offset by lower DIY and independent dealer network channel declines, including the unfavorable impact from a customer assortment change in the U.S. architectural DIY channel. In February 2018, PPG announced that Lowe's would discontinue the sale of OLYMPIC® brand paints and stains in its U.S. retail stores, effective mid-2018. During the second quarter 2018, the Company launched its OLYMPIC® stain products at THE HOME DEPOT®'s U.S. retail stores, expanding an existing partnership arrangement. The net impact of these customer assortment changes resulted in net sales being lower by approximately $100 million in 2018.

Architectural coatings - EMEA net sales grew by a mid-single digit percentage. Higher selling prices and acquisition-related sales more than offset modestly lower sales volumes. Sales volumes grew in countries in Northern and Eastern Europe and were lower in Southern Europe.

Automotive refinish coatings organic sales grew by a low-single-digit percentage year-over-year, despite lower demand in the U.S. due to customer inventory destocking and lower industry collision claim activity. Organic sales increased in all other geographic regions as customers continued to adopt PPG's industry leading technologies.

Aerospace coatings sales volumes grew by more than 10 percent versus the prior year, including above-market volume growth in the U.S. and Asia. Strong growth was supported by positive industry demand fundamentals and market outperformance in all major platforms stemming from technology advantaged products.

Protective and marine coatings sales volumes increased by a high-single-digit percentage year-over-year. Protective coatings sales volumes were up a mid-single-digit percentage, driven by growth in China. Marine coatings sales volumes grew by more than 10 percent off a low sales base as ship building activity grew modestly in Asia.

Segment income decreased $13 million year-over-year primarily driven by increasing raw material and logistics costs. These cost increases were partially offset by higher selling prices and additional benefits from the Company's restructuring programs. Favorable foreign currency translation increased segment income by approximately $15 million, primarily related to the strengthening of the euro.

2017 vs. 2016

Performance Coatings net sales increased (2%) due to the following:

- Higher selling prices (+1%)
- Net sales from acquisitions (+1%)
- Modest foreign currency translation

Partially offset by:

- Slightly lower sales volumes

Selling prices increased year-over-year primarily due to selling price initiatives across all businesses to combat accelerating raw material cost inflation.

Architectural coatings - Americas and Asia Pacific sales volumes declined a low-single-digit-percentage versus the prior year. Sales volumes increased by a mid-single-digit percentage in company-owned stores in the U.S. and Canada, including

the unfavorable impact from natural disasters in the third quarter 2017. This increase was more than offset by sales volume declines in the U.S. and Canada independent dealer networks and national retail (DIY) customer accounts, as both distribution channels continued to experience soft demand. Organic sales improved in both the Latin America and Asia Pacific regions.

Architectural coatings - EMEA net sales increased by a high-single-digit percentage year-over-year, primarily due to acquisition-related sales, principally DEUTEK and Univer, which contributed approximately $85 million to net sales. Sales volumes were down year-over-year primarily driven by continued weak demand in France and eastern Europe, as well as our turning away certain business due to low profitability or lack of customer acceptance of selling price increases. Demand growth continued in Northern Europe, where we continued to outperform the market.

Automotive refinish coatings organic sales grew by a low-single-digit percentage year-over-year, led by above-market performance in U.S. and Canada as customers continued to adopt PPG’s industry leading technologies. Organic sales also increased in the Latin American region versus the prior year, reflecting high end-use market demand. In Asia Pacific, net sales increased, largely due to the recent Futian Xinshi acquisition in China.

Aerospace coatings sales volumes grew by a low-single-digit percentage versus the prior year, led by above market performance in Europe and consistent with the overall industry demand.

Protective and marine coatings sales volumes declined by a mid-single-digit percentage year-over-year. Protective coatings sales volumes expanded in most regions, led by Europe, but were more than offset by significant weakness in new shipbuilding activity, primarily in the Asia Pacific region.

Segment income decreased $9 million year-over-year primarily due increasing raw material costs, wage and other cost inflation, and lower sales volumes partially offset by selling price increases, lower overhead and manufacturing costs, including the initial benefits from business restructuring actions.

Looking Ahead

Looking ahead, year-over-year raw material cost inflation is expected in the first half of 2019, primarily due to carry-over inflation. Acquisition related sales are forecast to add a low-single-digit percentage of sales growth primarily from the SEM acquisition and based on current exchange rates, we expect foreign currency translation to have an unfavorable impact on segment sales of approximately $100 million in the first quarter.

Additionally, further selling price increases are expected in 2019 as we continue to offset the cumulative impact of raw material inflation over the past nine quarters. Net sales are expected to be lower in the first half compared to 2018 driven by lower U.S. DIY sales of approximately $110 million due to the customer assortment changes that occurred in 2018. The impact will be larger than the impact realized in the fourth quarter of 2018 due to the seasonality of the U.S. DIY business.

Industrial Coatings

($ in millions, except percentages)	2018	2017	2016	$ Change 2018 vs. 2017	$ Change 2017 vs. 2016	% Change 2018 vs. 2017	% Change 2017 vs. 2016
Net sales	$6,287	$6,018	$5,690	$269	$328	4.5%	5.8%
Segment income	$818	$979	$1,060	($161)	($81)	(16.4)%	(7.6)%

2018 vs. 2017

Industrial Coatings segment net sales increased (5%) due to the following:

- Acquisition-related sales (+1.5%)
- Higher selling prices (+1.5%)
- Higher sales volumes (+1%)

Selling prices increased sequentially throughout the year and were up approximately 1.5 percent year-over-year primarily driven by the general industrial and packaging businesses.

Industrial coatings sales volumes continued to grow led by strong outperformance in coil, heavy-duty equipment and electronics materials. From a geographic perspective, sales volume growth was led by EMEA and Latin America. Acquisition-related sales from The Crown Group added approximately $100 million in sales during the year.

Packaging coatings sales volumes were up a mid-single-digit percentage year-over-year driven by continued customer adoption of PPG's new can coating technologies. From a geographic perspective, sales volumes in the developed regions grew a high-single-digit percentage, offset by a low-single-digit percentage decrease in the Asia Pacific region.

PPG’s automotive OEM coatings sales volumes were slightly lower versus the prior year, consistent with the global automotive industry growth rate. In the second half of the year, automotive OEM production fell sharply in China and new emission standards negatively impacted production in Europe.

Specialty coatings and materials net sales increased by a low-single-digit percentage due to higher selling prices and higher sales volumes in EMEA.

Segment income decreased $161 million year-over-year primarily due to continuing, significant raw material and logistics cost inflation, partially offset by higher selling prices and lower manufacturing costs, including benefits from business restructuring actions. Favorable foreign currency translation added approximately $5 million to segment income.

2017 vs. 2016

Industrial Coatings segment net sales increased (6%) due to the following:

- Higher sales volumes (+4%)
- Acquisition-related sales (+3%)

Partially offset by:

- Lower selling prices (1%)

PPG’s automotive OEM coatings sales volumes increased by a low-single-digit percentage versus the prior year, consistent with the global automotive industry production growth rate, led by China, Mexico, Europe and Brazil. Sales volumes declined in the U.S. and Canada, partially reflecting fewer automotive new builds.

General industrial coatings and specialty coatings and materials sales volumes, in aggregate, grew by a mid-single-digit percentage year-over-year. Sales volumes grew year-over-year in every major region with mixed demand by end-use and geography. This growth was led by Asia Pacific and the U.S., which outpaced regional industrial production demand growth. Sales volumes grew across most segments, including year-over-year increases in electronics materials, heavy duty equipment and organic light emitting diode (OLED) materials. Acquisition-related sales, primarily MetoKote, added approximately $155 million.

Packaging coatings sales volumes grew by a mid-single-digit percentage year-over-year, primarily driven by ongoing industry conversions to PPG’s new can coatings technologies, led by the U.S.

Segment income decreased $81 million year-over-year primarily due to increasing raw material costs, lower selling prices and wage and other cost inflation. These cost increases were partially offset by income from higher sales volumes, lower manufacturing and overhead costs, including the initial benefits from business restructuring actions, and acquisition-related income.

Looking ahead

Looking ahead, we expect that greater volatility in global industrial demand will continue through the first quarter of 2019 with inconsistencies by region. The carryover impact from 2018 cost inflation and significantly unfavorable foreign currency translation will impact first quarter earnings. The Company will continue to prioritize implementing selling price increases and operating margin recovery.

Global automotive OEM industry demand is expected to remain soft in the first quarter for most major regions with greater volatility expected in China. We anticipate that aggregate global general industrial demand growth will continue, but at a more moderate rate than in the first quarter of 2019. In addition, we expect that the Whitford acquisition will close during the latter portion of the first quarter, pending required regulatory approvals, and therefore will not provide meaningful sales or earnings benefit in the quarter. In addition, we expect packaging sales volumes to moderate as the pace of technology conversions slow in 2019.

Review and Outlook

During 2018, economic conditions were generally positive in all of our major geographical regions while remaining mixed by end-uses. PPG’s aggregate organic sales grew approximately 3% versus the prior year. Acquisition-related sales from two acquisitions completed in 2017 and the four completed in 2018 contributed approximately 1% to net sales growth year-over-year, net of dispositions. Foreign currency translation was favorable for the first half of the year then turned unfavorable in the second half of the year. For the full year 2018, foreign currency translation favorably impacted sales by approximately 1%. Raw material inflation was elevated throughout the year and overall rose a mid-single digit percentage driven by supply related factors, including government mandated production curtailments in China to help improve pollution and higher oil prices. In addition, logistics costs were significantly higher in 2018 driven by higher oil prices and shortages in the availability in transportation.

U.S. and Canada

During 2018, the pace of economic activity improved in the U.S. and Canada region versus the prior year, led by stronger GDP growth in the U.S. despite flat automotive industry builds. Demand in the residential and commercial construction markets was modestly higher in 2018 compared to 2017. New home starts advanced approximately 4% in 2018 versus approximately 3% in 2017. Residential remodeling was flat in 2018 versus 2017, while commercial construction was flat compared to a 1% decline in 2017. Market demand for architectural paint continued to shift more to the professional trade painters channel as the continued decline in U.S. unemployment resulted in consumers choosing professional painters rather than completing projects themselves. Demand in U.S. do-it-yourself (DIY) paint stores continued to remain soft throughout the year consistent with 2017. PPG’s architectural coatings performance in the U.S. and Canada was impacted by DIY customer assortment changes that unfavorably impacted sales by approximately $100 million. The automotive refinish coatings business was impacted by lower collision rates and a higher number of automobiles in accidents being totaled rather than repainted offsetting modest growth in miles driven. PPG’s packaging coatings business continued to expand well ahead of the industry driven by continued strong sales growth momentum related to customer adoption of PPG’s new interior can coatings technologies. PPG’s automotive OEM coatings business performance was slightly better than industry demand levels due to modest share gains. The U.S. and Canada region remained PPG’s largest, representing approximately 42% of 2018 sales, although a smaller percentage of total sales than in the prior year.

Europe, Middle East and Africa

European economic activity was mixed in 2018. Industrial production was higher in the first half of the year and moderated as the year progressed. The region was impacted by continuing uncertainty over the United Kingdom’s exit from the European Union. Overall GDP and industrial production were similar to 2017 in the region. Regional demand continued to be mixed by country and end-uses. Demand for PPG’s products in several end-uses drove the regional growth rate, including above market performance in general industrial coatings, packaging coatings and specialty coatings and materials. PPG’s architectural coatings - EMEA business sales volumes decreased year-over-year, driven by soft demand in Southern Europe.

EMEA represented approximately 30% of PPG’s 2018 sales, similar to prior year levels. Regional coatings volumes remain approximately 15% below their pre-recession levels in 2008. The modest volume recovery reflects the slow pace of economic growth in the region. PPG expects modest volume growth over time at attractive incremental margins due to significant cost structure improvements and available capacity to satisfy additional demand. In the

second half of the year, the euro and British pound both depreciated against the U.S. dollar.

Asia Pacific and Latin America

The emerging regions of Asia Pacific and Latin America represented 28% of PPG's 2018 sales in aggregate, similar to the prior year.

Asia remained the largest emerging region, with sales of approximately $2.5 billion, led by China, which continued as PPG's second largest country by revenue. The Performance Coatings segment led sales volume growth in Asia, in part due to strong sales volume growth in protective and marine coatings, aerospace coatings, and automotive refinish coatings. These increases were partially offset by a decline in automotive OEM coatings, particularly in China where industry retail automobile sales fell for the first time in over 25 years.

Overall, demand in Latin America improved year-over-year for the second consecutive year, with continued above market growth in Mexico and Central America. Economic conditions were mixed in South America, and there was heightened currency volatility throughout the entire region. In Mexico, the PPG-Comex business added over 200 new concessionaire locations. The overall region's performance was supported by strong growth in the general industrial and packaging coatings businesses. Foreign currency translation was volatile and finished 4 percent unfavorable compared to 2017, principally the Mexican peso and Brazilian real.

Outlook

Looking ahead to 2019, we expect global market growth to continue, but we expect a downshift in the pace of growth, and it will likely be uneven by region and end-use. We expect most regional growth rates to be modestly lower than 2018, but the Latin America region growth rate to be slightly higher.

We anticipate PPG's U.S. and Canada regional growth will be led by general industrial coatings and aerospace coatings, with flat automotive industry builds. We expect growth in housing and commercial construction to be comparable to 2018.

We expect demand in Europe to grow but at lower levels than 2018. Regional growth is expected to remain mixed by sub-region and country. Favorable end-use trends are expected to continue in general industrial and packaging with flattening demand in automotive OEM coatings as industry growth rates are anticipated to be flat. Demand is expected to stay subdued in the architectural coatings business. We continue to monitor the economic environment in the U.K. as their exit from the European Union progresses and impacts consumer sentiment and coatings demand.

In Asia Pacific, we expect continued industrial production growth in China, Southeast Asia and India. In China, we foresee continued above global average growth with heightened risk as the Chinese economy continues to shift and rely more on domestic consumption. The sharp decline in automotive OEM activity seen in the second half of 2018 is expected to continue in the beginning of 2019. We expect year-over-year demand patterns to become more favorable in the second half of 2019. The recovery in marine coatings demand is expected to continue, albeit off a low base.

In Latin America, we anticipate economic expansion will continue in Mexico, most of Central America and South America.

Significant other factors

In May 2018, PPG initiated an $83 million global restructuring program. The program is largely centered around the change in customer assortment related to the U.S. architectural coatings DIY business. PPG recognized $18 million of savings from this program in 2018.

Significant progress was made on the global restructuring program that was announced in December 2016. This program targeted annual savings of approximately $125 million once fully implemented. The Company achieved approximately $60 million of savings in 2018 bringing the total savings to approximately $110 million to date.

We expect to achieve the full-annualized target of $125 million in 2019. We will continue to aggressively manage the Company's cost structure to ensure alignment with the overall demand environment, and we will make adjustments as required to remain competitive in the marketplace. Restructuring savings from the 2018 and 2016 programs are expected to be between $60 million and $70 million in 2019.

Raw materials are a significant input cost to the process of manufacturing coatings. PPG experiences fluctuating energy and raw material costs driven by various factors, including changes in supplier feedstock costs and inventories, global industry activity levels, foreign currency exchange rates, and global supply and demand factors. In aggregate, average raw material costs were higher by a mid-single-digit percentage in 2018 versus 2017 due to variety of reasons, including supplier force majeure, environmental regulation enforcement, and higher crude oil prices. PPG currently expects overall coatings raw material prices to increase a low-single-digit percentage in the first half of 2019, with impacts varied by region and commodity, marking the tenth and eleventh consecutive quarters of inflation. In addition, logistics costs were inflated throughout the year driven by higher crude oil prices and availability of transportation. Logistics costs are expected to further increase in 2019.

In 2018, we achieved broad selling price improvement, reflecting the Company's efforts to offset higher raw material costs. Further benefits from selling price actions are necessary in 2019 to recover profit contribution margins. The Company will carefully monitor raw material costs during 2019 and assess the need for additional increases to selling prices for increases in these costs.

Pension and postretirement benefit costs, excluding settlements, curtailments and special termination benefits, totaled approximately $30 million in 2018, down approximately $20 million from 2017. In 2019, we expect pension and other postretirement benefit costs will be approximately $30 million, similar to 2018.
PPG contributed $75 million to its U.S. defined benefit pension plans in 2018 and $54 million in 2017. In 2018, the Company made contributions aggregating $24 million to its non-U.S. defined benefit pension plans. In 2019, mandatory contributions to PPG's non-U.S. defined benefit pension plans are expected to be between $20 million and $30 million.
In 2018, favorable foreign currency translation experienced in the first half of the year was mostly offset by unfavorable foreign currency translation experienced in the second half of the year. Based on mid-January 2019 exchange rates, the Company expects year-over-year unfavorable foreign currency translation to decrease 2019 sales by $400 million to $500 million and 2019 income before income taxes by $50 million to $70 million. We expect the foreign currency translation impact to be more prevalent during the first half of 2019 due to prior year foreign exchange rate trends. The foreign currency environment continues to be volatile, and the impact on 2019 net sales and income before income taxes could differ from this estimate. The Company generally purchases raw materials, incurs manufacturing costs and sells finished goods in the same currency, so we typically incur only modest foreign currency transaction related impacts.
The 2019 effective tax rate from continuing operations is expected to be in the range of 23% to 25%. This range represents the Company's best estimate, including updated guidance for the 2017 the U.S. Tax Cuts and Jobs Act.
Over the past five years, the Company used over $5 billion of cash to repurchase approximately 50 million shares of PPG stock, including approximately $1.7 billion in 2018. The Company ended the year with approximately $1.8 billion remaining under its current share repurchase authorization. During 2018, the Company deployed approximately $380 million for acquisitions and $450 million for dividends. PPG increased its per-share dividend in October 2018, marking the 47th annual per share dividend increase and the 119th consecutive year of annual dividend payments.
PPG ended 2018 with approximately $1 billion in cash and short-term investments. The Company expects continued strong cash generation in 2019.

Accounting Standards Adopted in 2018

Note 1, "Summary of Significant Accounting Policies" under Item 8 of this Form 10-K describes the Company's recently adopted accounting pronouncements.

Accounting Standards to be Adopted in Future Years

Note 1, "Summary of Significant Accounting Policies" under Item 8 of this Form 10-K describes accounting pronouncements that have been promulgated prior to December 31, 2018 but are not effective until a future date.

Commitments and Contingent Liabilities, including Environmental Matters

PPG is involved in a number of lawsuits and claims, both actual and potential, including some that it has asserted against others, in which substantial monetary damages are sought. See Item 3. "Legal Proceedings" and Note 14, "Commitments and Contingent Liabilities" under Item 8 of this Form 10-K for a description of certain of these lawsuits. As discussed in Item 3 and Note 14, although the result of any future litigation of such lawsuits and claims is inherently unpredictable, management believes that, in the aggregate, the outcome of all lawsuits and claims involving PPG, including asbestos-related claims, will not have a material effect on PPG's consolidated financial position or liquidity; however, any such outcome may be material to the results of operations of any particular period in which costs, if any, are recognized.
It is PPG's policy to accrue expenses for contingencies when it is probable that a liability has been incurred and the amount of loss can be reasonably estimated. Reserves for environmental contingencies are exclusive of claims against third parties and are generally not discounted. In management's opinion, the Company operates in an environmentally sound manner and the outcome of the Company's environmental contingencies will not have a material effect on PPG's financial position or liquidity; however, any such outcome may be material to the results of operations of any particular period in which costs, if any, are recognized. Management anticipates that the resolution of the Company's environmental contingencies will occur over an extended period of time.
The Company continues to analyze, assess and remediate the environmental issues associated with PPG's former chromium manufacturing plant in Jersey City, N.J. and associated sites ("New Jersey Chrome"). Information will

continue to be generated from the ongoing groundwater remedial investigation activities related to New Jersey Chrome and will be incorporated into a final draft remedial action work plan for groundwater expected to be submitted to the New Jersey Department of Environmental Protection in 2021.
There are multiple, future events yet to occur, including further remedy selection and design, remedy implementation and execution and applicable governmental agency or community organization approvals. Considerable uncertainty exists

regarding the timing of these future events for the New Jersey Chrome sites. Final resolution of these events is expected to occur over the next several years. As these events occur and to the extent that the cost estimates of the environmental remediation remedies change, the existing reserve for this environmental remediation matter will be adjusted.

Liquidity and Capital Resources

During the past three years, PPG has had sufficient financial resources to meet its operating requirements, to fund our capital spending, including acquisitions, share repurchases and pension plans and to pay increasing dividends to shareholders.

Cash and cash equivalents and short-term investments

($ in millions)	2018	2017
Cash and cash equivalents	$902	$1,436
Short-term investments	61	55
Total	$963	$1,491

Cash from operating activities - continuing operations

($ in millions, except percentages)				% Change	
	2018	2017	2016	2018 vs. 2017	2017 vs. 2016
Cash from operating activities	$1,487	$1,551	$1,218	(4.1)%	27.3%

2018 vs. 2017

The $64 million decrease in Cash from operating activities - continuing operations was primarily due to unfavorable changes in working capital and lower income in 2018 partially offset by lower cash taxes.

2017 vs. 2016

The $333 million increase in Cash from operating activities - continuing operations was primarily due to the absence of the prior year funding of the Pittsburgh Corning asbestos trust (the “Trust”), lower defined benefit pension contributions, lower restructuring payments and lower interest payments, partially offset by higher cash taxes paid in 2017 and higher working capital.

Operating working capital

Operating Working Capital is a subset of total working capital and represents (1) receivables from customers, net of allowance for doubtful accounts, (2) inventories, and (3) trade liabilities. See Note 4, “Working Capital Detail” under Item 8 of this Form 10-K for further information related to the components of the Company’s Operating Working Capital. We believe Operating Working Capital represents the key components of working capital under the operating control of our businesses.

A key metric we use to measure our working capital management is Operating Working Capital as a percentage of sales (fourth quarter sales annualized).

($ in millions, except percentages)	2018	2017
Trade Receivables, net	$2,505	$2,559
Inventories, FIFO	1,896	1,833
Trade Creditor’s Liabilities	2,177	2,321
Operating Working Capital	$2,224	$2,071
Operating Working Capital as a % of fourth quarter sales, annualized	15.3 %	14.1 %
Trade Receivables, net as a % of fourth quarter sales, annualized	17.2 %	17.4 %
Days sales outstanding	56	57
Inventories, FIFO as a % of fourth quarter sales, annualized	13.0 %	12.4 %
Inventory turnover	4.8	4.8

Environmental expenditures

($ in millions)	2018	2017	2016
Cash outlays related to environmental remediation activities	$64	$44	$47

We expect cash outlays for environmental remediation activities in 2019 to be between $80 million and $100 million.

Defined benefit pension plan contributions

($ in millions)	2018	2017	2016
U.S. defined benefit pension plans	$75	$54	$134
Non-U.S. defined benefit pension plans	$24	$33	$54

PPG contributed $75 million to its U.S. defined benefit pension plans in 2018. Contributions to PPG's non-U.S. defined benefit pension plans in 2018 were required by local funding requirements. PPG expects to make mandatory contributions to its non-U.S. defined benefit pension plans in the range of $20 million to $30 million in 2019. PPG may make voluntary contributions to its defined benefit pension plans in 2019 and beyond.

Asbestos settlement trust funding

In June 2016, PPG fully funded its portion of the trust that was established by the U.S. Bankruptcy Court for the Western District of Pennsylvania in May 2016. PPG's total cash obligations to fund the Trust totaled $813 million (pre-tax). All payments were applied against a previously established PPG reserve for the total asbestos trust obligation. The Company utilized cash on hand for the payments, and this funding had no impact on PPG's previously stated cash-deployment targets. Refer to Note 14, "Commitments and Contingent Liabilities" under Item 8 of this Form 10-K for additional information.

Cash used for investing activities - continuing operations

($ in millions, except percentages)				% Change	
	2018	2017	2016	2018 vs. 2017	2017 vs. 2016
Cash (used for)/from investing activities	($764)	($63)	$472	1,112.7%	(113.3)%

2018 vs. 2017

The $701 million increase in cash used for investing activities - continuing operations, was primarily due to the absence of the prior year proceeds from the sale of the North American fiber glass business and higher capital expenditures, including business acquisitions.

2017 vs. 2016

The $535 million decrease in cash (used for)/from investing activities - continuing operations, was primarily due to the absence of the prior year proceeds from the sale of the flat glass business, European fiber glass business and two Asian joint ventures, as well as lower capital expenditures, including business acquisitions, partially offset by the current year proceeds from the sale of the North American fiber glass business.

Capital expenditures, including business acquisitions

($ in millions, except percentages)				% Change	
	2018	2017	2016	2018 vs. 2017	2017 vs. 2016
Capital expenditures [1]	$411	$360	$380	14.2%	(5.3)%
Business acquisitions, net of cash acquired [2]	$378	$325	$349	16.3%	(6.9)%
Total capital expenditures, including acquisitions	$789	$685	$729	15.2%	(6.0)%
Capital expenditures, excluding acquisitions, as a % of sales	2.7 %	2.4 %	2.7 %	12.5%	(11.1)%

(1) Includes modernization and productivity improvements, expansion of existing businesses and environmental control projects.

(2) Including cash acquired, business acquisitions totaled $387 million, $332 million, and $362 million in 2018, 2017 and 2016, respectively.

Capital expenditures related to modernization and productivity improvements, expansion of existing businesses and environmental control projects is expected to be in the range of 2.5% to 3.0% of sales during 2019.

A primary focus for the Company in 2019 will continue to be cash deployment focused on shareholder value creation, with a preference for business acquisitions.

Cash proceeds from divestitures

In September 2017, PPG completed the sale of its North American fiber glass business to Nippon Electric Glass Co. and received approximately $540 million in pre-tax cash proceeds.

During 2016, PPG finalized the sale of its flat glass business and several other businesses and business affiliates. The Company received total pre-tax cash proceeds of approximately $1.1 billion from these business divestitures. Refer to

Note 3, “Acquisitions and Divestitures” under Item 8 of this Form 10-K for additional information.

Cash used for financing activities - continuing operations

($ in millions, except percentages)	2018	2017	2016	% Change 2018 vs. 2017	2017 vs. 2016
Cash used for financing activities	($1,205)	($1,954)	($1,210)	(38.3)%	61.5%

2018 vs. 2017

The $749 million decrease in cash used for financing activities - continuing operations, was primarily due to the issuance of long term debt, partially offset by higher net purchases of treasury stock year-over-year.

2017 vs. 2016

The $744 million increase in cash used for financing activities - continuing operations, was primarily due to repayment of long term debt and higher dividends in 2017, partially offset by issuance of long term debt in 2016 and lower net purchases of treasury stock year-over-year.

Share repurchase activity

($ in millions, except number of shares)	2018	2017	2016
Number of shares repurchased (millions)	15.9	7.4	10.7
Cost of shares repurchased	$1,721	$813	$1,050

The Company has approximately $1.8 billion remaining under the current authorization from the Board of Directors, which was approved in December 2017. The current authorized repurchase program has no expiration date.

Dividends paid to shareholders

($ in millions)	2018	2017	2016
Dividends paid to shareholders	$453	$434	$414

PPG has paid uninterrupted annual dividends since 1899, and 2018 marked the 47th consecutive year of increased annual per-share dividend payments to shareholders. The Company raised its per-share quarterly dividend by 7% to $0.48 per share paid in September 2018.

Debt issued and repaid

Debt Issued	Year	$ in millions
$300 million 3.2% Note due 2023 and $700 million 3.75% Notes due 2028	2018	$992
€300 million 0.000% Notes due 2019 and €600 million 0.875% Notes due 2025	2016	987

Debt Repaid	Year	$ in millions
3-year variable rate bank loan due 2017	2017	$587
$125 million 6.65% notes due 2018	2016	133
Two $250 million Term Loan Credit Agreements	2016	500
$250 million 1.9% notes	2016	250

The ratio of total debt, including capital leases, to total debt and equity was 52% at December 31, 2018 up from 43% in 2017.

Credit agreements and lines of credit

In December 2015, PPG entered into a five-year credit agreement (the “Credit Agreement”) with several banks and financial institutions as further discussed in Note 9, “Borrowings and Lines of Credit” under Item 8 of this Form 10-K. The Credit Agreement provides for a $1.8 billion unsecured revolving credit facility. The Credit Agreement will terminate on December 18, 2020. During the years ended December 31, 2018 and 2017, there were no borrowings outstanding.

In addition to the amounts available under the lines of credit, the Company maintains access to the capital markets and may issue debt or equity securities from time to time, which may provide an additional source of liquidity.

See Note 9, “Borrowings and Lines of Credit” under Item 8 of this Form 10-K for information regarding notes entered into and repaid as well as details regarding the use and availability of committed and uncommitted lines of credit, letters of credit, guarantees and debt covenants.

Contractual obligations

We continue to believe that our cash on hand and short term investments, cash from operations and the Company's access to capital markets will continue to be sufficient to fund our operating activities, capital spending, acquisitions, dividend payments, debt service, share repurchases, contributions to pension plans, and PPG's significant contractual obligations. These significant contractual obligations are presented in the following table.

		Obligations Due In:			
($ in millions)	Total	2019	2020-2021	2022-2023	Thereafter
Contractual Obligations					
Long-term debt	$5,000	$644	$624	$981	$2,751
Short-term debt	4	4	—	—	—
Capital lease obligations	12	3	4	2	3
Operating leases	893	207	273	169	244
Interest payments[1]	1,257	130	250	170	707
Pension contributions[2]	30	30	—	—	—
Unconditional purchase commitments[3]	170	77	51	24	18
Other commitments	127	6	13	13	95
Total	$7,493	$1,101	$1,215	$1,359	$3,818

(1) Includes interest on all outstanding debt.

(2) Includes the high end of the range of the expected non-US mandatory pension contributions for 2019 only, as PPG is unable to estimate the pension contributions beyond 2019.

(3) The unconditional purchase commitments are principally take-or-pay obligations related to the purchase of certain materials, including industrial gases and electricity, consistent with customary industry practice.

Other liquidity matters

At December 31, 2018, the total amount of unrecognized tax benefits for uncertain tax positions, including an accrual of related interest and penalties along with positions only impacting the timing of tax benefits, was $182 million. The timing of payments will depend on the progress of examinations with tax authorities. PPG does not expect a significant tax payment related to these obligations within the next year. The Company is unable to make a reasonably reliable estimate as to when any significant cash settlements with taxing authorities may occur.

Off-Balance Sheet Arrangements

The Company's off-balance sheet arrangements include the operating leases and unconditional purchase commitments disclosed in the "Liquidity and Capital Resources" section in the contractual obligations table as well as letters of credit and guarantees as discussed in Note 9, "Borrowings and Lines of Credit" under Item 8 of this Form 10-K.

Critical Accounting Estimates

Management has evaluated the accounting policies used in the preparation of the financial statements and related notes presented under Item 8 of this Form 10-K and believes those policies to be reasonable and appropriate. We believe that the most critical accounting estimates made in the preparation of our financial statements are those related to accounting for contingencies, under which we accrue a loss when it is probable that a liability has been incurred and the amount can be reasonably estimated, and to accounting for pensions, other postretirement benefits, business combinations, goodwill and other identifiable intangible assets with indefinite lives because of the importance of management judgment in making the estimates necessary to apply these policies.

Contingencies

Contingencies, by their nature, relate to uncertainties that require management to exercise judgment both in assessing the likelihood that a liability has been incurred as well as in estimating the amount of potential loss. The most important contingencies impacting our financial statements are those related to environmental remediation, to pending, impending or overtly threatened litigation against the Company and to the resolution of matters related to open tax years. For more information on these matters, see Note 14, "Commitments and Contingent Liabilities" and Note 12, "Income Taxes" under Item 8 of this Form 10-K.

Defined Benefit Pension and Other Postretirement Benefit Plans

Accounting for pensions and other postretirement benefits involves estimating the cost of benefits to be provided well into the future and attributing that cost over the time period each employee works. To accomplish this, we make

extensive use of assumptions about inflation, investment returns, mortality, turnover, medical costs and discount rates. The Company has

established a process by which management reviews and selects these assumptions annually. See Note 13, "Employee Benefit Plans" under Item 8 of this Form 10-K for information on these plans and the assumptions used.

Business Combinations

In accordance with the accounting guidance for business combinations, the Company uses the acquisition method of accounting to allocate costs of acquired businesses to the assets acquired and liabilities assumed based on their estimated fair values at the dates of acquisition. The excess costs of acquired businesses over the fair values of the assets acquired and liabilities assumed were recognized as goodwill. The valuations of the acquired assets and liabilities will impact the determination of future operating results. In addition to using management estimates and negotiated amounts, the Company uses a variety of information sources to determine the estimated fair values of acquired assets and liabilities including: third-party appraisals for the estimated value and lives of identifiable intangible assets and property, plant and equipment; third-party actuaries for the estimated obligations of defined benefit pension plans and similar benefit obligations; and legal counsel or other experts to assess the obligations associated with legal, environmental and other contingent liabilities.

The business and technical judgment of management was used in determining which intangible assets have indefinite lives and in determining the useful lives of finite-lived intangible assets in accordance with the accounting guidance for goodwill and other intangible assets.

Goodwill and Intangible Assets

The Company tests indefinite-lived intangible assets and goodwill for impairment annually by either performing a qualitative evaluation or a quantitative test. The qualitative evaluation is an assessment of factors to determine whether it is more likely than not that the fair values of a reporting unit or asset is less than its carrying amount. Fair values under the quantitative test are estimated using discounted cash flow methodologies that are based on projections of the amounts and timing of future revenues and cash flows. For more information on these matters, see Note 1, "Summary of Significant Accounting Policies" under Item 8 of this Form 10-K.

We believe that the amounts recorded in the financial statements under Item 8 of this Form 10-K related to these contingencies, pensions, other postretirement benefits, business combinations, goodwill and other identifiable intangible assets with indefinite lives are based on the best estimates and judgments of the appropriate PPG management, although actual outcomes could differ from our estimates.

Currency

Comparing exchange rates from December 31, 2017 to December 31, 2018, the U.S. dollar strengthened against all other major currencies associated with countries in which PPG operates, most notably the Australian dollar, British pound, Chinese yuan, euro and South Korean won. As a result, consolidated net assets at December 31, 2018 decreased by approximately $167 million from December 31, 2017. Comparing exchange rates from December 31, 2016 to December 31, 2017, the U.S. dollar was weaker against the currencies in most countries in which PPG operates, most notably the Mexican peso, British pound, Chinese yuan and euro. As a result, consolidated net assets at December 31, 2017 increased by approximately $231 million from December 31, 2016.

Comparing exchange rates during 2018 to those of 2017, in the countries in which PPG operates, there was a favorable impact of approximately $21 million on full year 2018 income before income taxes from the translation of this foreign income into U.S. dollars. Comparing exchange rates during 2017 to those of 2016, in the countries in which PPG operates, there was an unfavorable impact of approximately $7 million on full year 2017 income before income taxes from the translation of this foreign income into U.S. dollars.

Forward-Looking Statements

The Private Securities Litigation Reform Act of 1995 provides a safe harbor for forward-looking statements made by or on behalf of the Company. Management's Discussion and Analysis and other sections of this Annual Report contain forward-looking statements that reflect the Company's current views with respect to future events and financial performance.

You can identify forward-looking statements by the fact that they do not relate strictly to current or historic facts. Forward-looking statements are identified by the use of the words "aim," "believe," "expect," "anticipate," "intend," "estimate, "project," "outlook," "forecast" and other expressions that indicate future events and trends. Any forward-looking statement speaks only as of the date on which such statement is made, and the Company undertakes no obligation to update any forward looking statement, whether as a result of new information, future events or otherwise. You are advised,

however, to consult any further disclosures we make on related subjects in our reports to the Securities and Exchange Commission. Also, note the following cautionary statements.

Many factors could cause actual results to differ materially from the Company’s forward-looking statements. Such factors include global economic conditions, increasing price and product competition by foreign and domestic competitors, fluctuations

in cost and availability of raw materials, the ability to achieve selling price increases, the ability to recover margins, customer inventory levels, our ability to maintain favorable supplier relationships and arrangements, the timing of and the realization of anticipated cost savings from restructuring initiatives, the ability to identify additional cost savings opportunities, difficulties in integrating acquired businesses and achieving expected synergies therefrom, economic and political conditions in the markets we serve, the ability to penetrate existing, developing and emerging foreign and domestic markets, foreign exchange rates and fluctuations in such rates, fluctuations in tax rates, the impact of future legislation, the impact of environmental regulations, unexpected business disruptions, the effectiveness of our internal control over financial reporting, including the identification of additional control deficiencies, further expenditures related to our restatement, the results of governmental actions relating to pending investigations, the results of shareholder actions relating to the restatement of our financial statements and the unpredictability of existing and possible future litigation. However, it is not possible to predict or identify all such factors.

Consequently, while the list of factors presented here and under Item 1A is considered representative, no such list should be considered to be a complete statement of all potential risks and uncertainties. Unlisted factors may present significant additional obstacles to the realization of forward-looking statements.

Consequences of material differences in the results compared with those anticipated in the forward-looking statements could include, among other things, lower sales or income, business disruption, operational problems, financial loss, legal liability to third parties, other factors set forth in Item 1A of this Form 10-K and similar risks, any of which could have a material adverse effect on the Company’s consolidated financial condition, results of operations or liquidity.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk

PPG is exposed to market risks related to changes in foreign currency exchange rates, interest rates, and was exposed to changes in PPG’s stock price. The Company may enter into derivative financial instrument transactions in order to manage or reduce these market risks. A detailed description of these exposures and the Company’s risk management policies are provided in Note 10, “Financial Instruments, Hedging Activities and Fair Value Measurements” under Item 8 of this Form 10-K.

The following disclosures summarize PPG’s exposure to market risks and information regarding the use of and fair value of derivatives employed to manage its exposure to such risks. Quantitative sensitivity analyses have been provided to reflect how reasonably possible, unfavorable changes in market rates can impact PPG’s consolidated results of operations, cash flows and financial position.

Foreign Currency Risk

We conduct operations in many countries around the world. Our results of operations are subject to both currency transaction and currency translation risk. Foreign currency forward contracts outstanding during 2018 and 2017 were generally designated as a hedge of PPG’s exposure to foreign currency transaction risk. As of December 31, 2018 and 2017, the fair value of these contracts was a net asset of $36 million and a net liability of $19 million, respectively.

The potential reduction in PPG’s Income before income taxes resulting from the impact of adverse changes in exchange rates on the fair value of its outstanding foreign currency hedge contracts of 10% for European and Canadian currencies and 20% for Asian and Latin American currencies for the years ended December 31, 2018 and 2017 would have been $291 million and $255 million, respectively.

In February 2018, PPG entered into U.S. dollar to euro cross currency swap contracts with a total notional amount of $575 million outstanding, which had a fair value of a net asset of $35 million as of December 31, 2018. As of December 31, 2017, PPG had U.S. dollar to euro cross currency swap contracts with a total notional amount of $560 million outstanding, which had a fair value of a net asset of $2 million. A 10% increase in the value of the euro to the U.S. dollar would have had an unfavorable effect on the fair value of these swap contracts by reducing the value of these instruments by $57 million and $58 million at December 31, 2018 and December 31, 2017, respectively.

As of December 31, 2018 and 2017, PPG had non-U.S. dollar denominated debt outstanding of $2.6 billion and $2.8 billion, respectively. A weakening of the U.S. dollar by 10% against European currencies and by 20% against Asian and South American currencies would have resulted in unrealized translation losses of $299 million and $314 million as of December 31, 2018 and 2017, respectively.

Interest Rate Risk

The Company manages its interest rate risk by balancing its exposure to fixed and variable rates while attempting to minimize its interest costs. In the first quarter of 2018, PPG entered into interest rate swaps which converted $525 million of fixed rate debt to variable rate debt. The fair value of these contracts was an asset of $8 million as of December 31, 2018. An increase in variable interest rates of 10% would lower the fair value of these swaps and increase interest expense by $10 million over the term of the instrument. A 10% increase in interest rates in the U.S., Canada, Mexico and Europe and a 20% increase in interest rates in Asia and South America would have an insignificant effect on PPG’s variable rate debt obligations and interest

expense for the years ended December 31, 2018 and 2017, respectively. Further, a 10% reduction in interest rates would have increased the present value of the Company’s fixed rate debt by approximately $84 million and $61 million as of December 31, 2018 and 2017, respectively; however, such changes would not have had an effect on PPG’s annual Income before income taxes or cash flows.

Equity Price Risk

In prior years, PPG entered into equity forward arrangements to hedge the Company’s exposure to changes in the fair value of its future obligation to contribute PPG stock to the Trust (see Note 10, “Financial Instruments, Hedging Activities and Fair Value Measurements” and Note 14, “Commitments and Contingent Liabilities” under Item 8 of this Form 10-K). In June 2016, PPG satisfied its funding obligation to the Trust and the equity forward arrangements were settled. At settlement, the aggregated fair value of the equity forward arrangements was an asset of $258 million.

Item 8. Financial Statements and Supplementary Data

Report of Independent Registered Public Accounting Firm

To the Board of Directors and Shareholders of PPG Industries, Inc.

Opinions on the Financial Statements and Internal Control over Financial Reporting

We have audited the accompanying consolidated balance sheets of PPG Industries, Inc. and its subsidiaries (the "Company") as of December 31, 2018 and 2017, and the related consolidated statements of income, comprehensive income, shareholders' equity, and cash flows for each of the three years in the period ended December 31, 2018, including the related notes and schedule of valuation and qualifying accounts for each of the three years in the period ended December 31, 2018 appearing under Item 15(a)(2)(collectively referred to as the "consolidated financial statements"). We also have audited the Company's internal control over financial reporting as of December 31, 2018, based on criteria established in Internal Control - Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

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

Basis for Opinions

The Company's management is responsible for these consolidated financial statements, for maintaining effective internal control over financial reporting, and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management Report on Establishing and Maintaining Adequate Internal Control Over Financial Reporting under Item 8. Our responsibility is to express opinions on the Company's consolidated financial statements and on the Company's internal control over financial reporting based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

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

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

Definition and Limitations of Internal Control over Financial Reporting

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

prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.
Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.
/s/ PricewaterhouseCoopers LLP
Pittsburgh, Pennsylvania
February 21, 2019
We have served as the Company's auditor since 2013.

Management Report

Responsibility for Preparation of the Financial Statements and Establishing and Maintaining Adequate Internal Control Over Financial Reporting

We are responsible for establishing and maintaining adequate internal control over financial reporting as defined in Rules 13a-15(f) and 15d-15(f) under the Securities Exchange Act of 1934, as amended. 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.

We conducted an evaluation of the effectiveness of the Company's internal control over financial reporting as of December 31, 2018. In making this evaluation, we used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in Internal Control - Integrated Framework (2013). Based on this evaluation we have concluded that, as of December 31, 2018, the Company's internal control over financial reporting were effective.

PricewaterhouseCoopers LLP, an independent registered public accounting firm, has issued their report, included on page 46 of this Form 10-K, regarding the Company's internal control over financial reporting.

/s/ Michael H. McGarry	/s/ Vincent J. Morales
Michael H. McGarry	Vincent J. Morales
Chairman and Chief Executive Officer	Senior Vice President and Chief Financial Officer
February 21, 2019	February 21, 2019

Consolidated Statement of Income

($ in millions, except per share amounts)	For the Year 2018	2017	2016
Net sales	$15,374	$14,748	$14,270
Cost of sales, exclusive of depreciation and amortization	9,001	8,209	7,665
Selling, general and administrative	3,573	3,554	3,555
Depreciation	354	331	319
Amortization	143	129	121
Research and development, net	441	451	453
Interest expense	118	105	125
Interest income	(23)	(20)	(26)
Business restructuring, net	66	—	191
Pension settlement charges	—	60	968
Asbestos settlement, net	—	—	5
Other charges	122	74	242
Other income	(114)	(150)	(127)
Income before income taxes	$1,693	$2,005	$779
Income tax expense	353	615	214
Income from continuing operations	$1,340	$1,390	$565
Income from discontinued operations, net of tax	18	225	330
Net income attributable to the controlling and noncontrolling interests	$1,358	$1,615	$895
Less: net income attributable to noncontrolling interests	17	21	22
Net income (attributable to PPG)	$1,341	$1,594	$873
Amounts Attributable to PPG			
Continuing operations	$1,323	$1,369	$543
Discontinued operations	18	225	330
Net income	$1,341	$1,594	$873
Earnings per common share			
Continuing operations	$5.43	$5.34	$2.05
Discontinued operations	0.07	0.88	1.24
Net income (attributable to PPG)	$5.50	$6.22	$3.29
Earnings per common share - assuming dilution			
Continuing operations	$5.40	$5.31	$2.04
Discontinued operations	0.07	0.87	1.23
Net income (attributable to PPG)	$5.47	$6.18	$3.27

Consolidated Statement of Comprehensive Income

($ in millions)	For the Year 2018	2017	2016
Net income attributable to the controlling and noncontrolling interests	$1,358	$1,615	$895
Unrealized foreign currency translation (losses)/gains	(155)	248	(476)
Defined benefit pension and other postretirement benefit adjustments	9	78	808
Unrealized (losses)/gains – derivative financial instruments	(1)	(10)	4
Other comprehensive (loss)/income, net of tax	(147)	316	336
Total comprehensive income	$1,211	$1,931	$1,231
Less: amounts attributable to noncontrolling interests:			
Net income	(17)	(21)	(22)
Unrealized foreign currency translation gains/(losses)	11	(17)	10
Comprehensive income attributable to PPG	$1,205	$1,893	$1,219

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

Consolidated Balance Sheet

	December 31	
($ in millions)	2018	2017
Assets		
Current assets		
Cash and cash equivalents	$902	$1,436
Short-term investments	61	55
Receivables	2,845	2,903
Inventories	1,783	1,730
Other	370	353
Total current assets	$5,961	$6,477
Property, plant and equipment, net	2,805	2,824
Goodwill	4,070	3,942
Identifiable intangible assets, net	1,972	2,045
Deferred income taxes	229	305
Investments	251	268
Other assets	727	677
Total	$16,015	$16,538
Liabilities and Shareholders' Equity		
Current liabilities		
Accounts payable and accrued liabilities	$3,623	$3,781
Restructuring reserves	99	102
Short-term debt and current portion of long-term debt	651	12
Total current liabilities	$4,373	$3,895
Long-term debt	4,365	4,134
Accrued pensions	645	729
Other postretirement benefits	629	699
Deferred income taxes	429	442
Other liabilities	842	967
Total liabilities	$11,283	$10,866
Commitments and contingent liabilities (See Note 14)		
Shareholders' equity		
Common stock	$969	$969
Additional paid-in capital	788	756
Retained earnings	18,131	17,140
Treasury stock, at cost	(12,958)	(11,251)
Accumulated other comprehensive loss	(2,300)	(2,057)
Total PPG shareholders' equity	$4,630	$5,557
Noncontrolling interests	102	115
Total shareholders' equity	$4,732	$5,672
Total	$16,015	$16,538

The accompanying notes to the consolidated financial statements are an integral part of this consolidated statement.

Consolidated Statement of Shareholders' Equity

($ in millions)	Common Stock	Additional Paid-In Capital	Retained Earnings	Treasury Stock	Accumulated Other Comprehensive (Loss)/Income	Total PPG	Non-controlling Interests	Total
January 1, 2016	$969	$635	$15,521	($9,440)	($2,702)	$4,983	$86	$5,069
Net income attributable to the controlling and noncontrolling interests	—	—	873	—	—	873	22	895
Other comprehensive income/(loss), net of tax	—	—	—	—	346	346	(10)	336
Cash dividends	—	—	(414)	—	—	(414)	—	(414)
Purchase of treasury stock	—	—	—	(1,050)	—	(1,050)	—	(1,050)
Issuance of treasury stock	—	37	—	18	—	55	—	55
Stock-based compensation activity	—	35	—	—	—	35	—	35
Dividends paid on subsidiary common stock to noncontrolling interests	—	—	—	—	—	—	(4)	(4)
Reductions in noncontrolling interests	—	—	—	—	—	—	(7)	(7)
December 31, 2016	$969	$707	$15,980	($10,472)	($2,356)	$4,828	$87	$4,915
Net income attributable to the controlling and noncontrolling interests	—	—	1,594	—	—	1,594	21	1,615
Other comprehensive income, net of tax	—	—	—	—	299	299	17	316
Cash dividends	—	—	(434)	—	—	(434)	—	(434)
Purchase of treasury stock	—	—	—	(813)	—	(813)	—	(813)
Issuance of treasury stock	—	49	—	34	—	83	—	83
Dividends paid on subsidiary common stock to noncontrolling interests	—	—	—	—	—	—	(5)	(5)
Reductions in noncontrolling interests	—	—	—	—	—	—	(5)	(5)
December 31, 2017	$969	$756	$17,140	($11,251)	($2,057)	$5,557	$115	$5,672
Net income attributable to the controlling and noncontrolling interests	—	—	1,341	—	—	1,341	17	1,358
Other comprehensive loss, net of tax	—	—	—	—	(136)	(136)	(11)	(147)
Cash dividends	—	—	(453)	—	—	(453)	—	(453)
Purchase of treasury stock	—	—	—	(1,721)	—	(1,721)	—	(1,721)
Issuance of treasury stock	—	28	—	14	—	42	—	42
Stock-based compensation activity	—	4	—	—	—	4	—	4
Dividends paid on subsidiary common stock to noncontrolling interests	—	—	—	—	—	—	(7)	(7)
Reductions in noncontrolling interests	—	—	—	—	—	—	(12)	(12)
Reclassification from other comprehensive income to retained earnings - Adoption of ASU 2018-02	—	—	107	—	(107)	—	—	—
Adjustment to retained earnings - Adoption of ASU 2016-16	—	—	(4)	—	—	(4)	—	(4)
December 31, 2018	$969	$788	$18,131	($12,958)	($2,300)	$4,630	$102	$4,732

The accompanying notes to the consolidated financial statements are an integral part of this consolidated statement.

Consolidated Statement of Cash Flows

($ in millions)	For the Year 2018	2017	2016
Operating activities			
Net income attributable to the controlling and noncontrolling interests	$1,358	$1,615	$895
Less: Income from discontinued operations	18	225	330
Income from continuing operations	$1,340	$1,390	$565
Adjustments to reconcile to cash from operations:			
Depreciation and amortization	497	460	440
Defined benefit pension expense	43	65	85
Pension settlement charge	—	60	968
Business restructuring charge, net	66	—	191
Environmental remediation charges and other costs	77	—	82
Stock-based compensation expense	37	35	45
Gain on sale of land	(26)	—	—
Net gain, from sale of businesses	—	(25)	(39)
Equity affiliate (income)/loss, net of dividends	(1)	(4)	(6)
Deferred income taxes	45	38	171
Contributions to pension plans	(99)	(87)	(188)
Restructuring payments	(66)	(49)	(76)
Funding of asbestos settlement trust	—	—	(813)
Change in certain asset and liability accounts (net of acquisitions):			
Receivables	(69)	(76)	(68)
Inventories	(109)	(116)	56
Other current assets	5	(43)	21
Accounts payable and accrued liabilities	(76)	188	169
Noncurrent assets and liabilities, net	(207)	(170)	(53)
Taxes and interest payable	50	(129)	(268)
Other	(20)	14	(64)
Cash from operating activities - continuing operations	$1,487	$1,551	$1,218
Cash (used for)/from operating activities - discontinued operations	(20)	17	133
Cash from operating activities	$1,467	$1,568	$1,351
Investing activities			
Capital expenditures	($411)	($360)	($380)
Business acquisitions, net of cash balances acquired	(378)	(225)	(349)
Payments for acquisition of equity investment	—	(100)	—
Net proceeds from the sale of businesses	—	593	1,094
Proceeds from sale of land	27	—	—
Proceeds from maturity of short-term investments	—	—	92
Payments for the settlement of cross currency swap contracts	(28)	(34)	(36)
Proceeds from the settlement of cross currency swap contracts	23	37	37
Payments on net investment hedges	—	—	(13)
Other	3	26	27
Cash (used for)/from investing activities - continuing operations	($764)	($63)	$472
Cash used for investing activities - discontinued operations	—	(4)	(36)
Cash (used for)/from investing activities	($764)	($67)	$436
Financing activities			
Net change in borrowings with maturities of three months or less	($1)	($7)	($15)
Net payments on commercial paper and short-term debt	(2)	(93)	(361)

Net proceeds from the issuance of long-term debt (net of discount and issuance costs)	992	—	988
Repayment of long-term debt	(6)	(588)	(379)
Payments related to tax withholding on stock-based compensation awards	(15)	(28)	(26)
Purchase of treasury stock	(1,721)	(813)	(1,050)
Issuance of treasury stock	15	52	31
Dividends paid on PPG common stock	(453)	(434)	(414)
Other	(14)	(43)	16
Cash used for financing activities	($1,205)	($1,954)	($1,210)
Effect of currency exchange rate changes on cash and cash equivalents	(32)	69	(68)
Net (decrease)/increase in cash and cash equivalents	($534)	($384)	$509
Cash and cash equivalents, beginning of year	$1,436	$1,820	$1,311
Cash and cash equivalents, end of year	$902	$1,436	$1,820
Supplemental disclosures of cash flow information:			
Interest paid, net of amount capitalized	$108	$100	$118
Taxes paid, net of refunds	$380	$648	$349

The accompanying notes to the consolidated financial statements are an integral part of this consolidated statement.

Notes to the Consolidated Financial Statements

1. Summary of Significant Accounting Policies

Principles of Consolidation

The accompanying consolidated financial statements include the accounts of PPG Industries, Inc. ("PPG" or the "Company") and all subsidiaries, both U.S. and non-U.S., that it controls. PPG owns more than 50% of the voting stock of most of the subsidiaries that it controls. For those consolidated subsidiaries in which the Company's ownership is less than 100%, the outside shareholders' interests are shown as noncontrolling interests. Investments in companies in which PPG owns 20% to 50% of the voting stock and has the ability to exercise significant influence over operating and financial policies of the investee are accounted for using the equity method of accounting. As a result, PPG's share of income or losses from such equity affiliates is included in the consolidated statement of income and PPG's share of these companies' shareholders' equity is included in Investments on the consolidated balance sheet. Transactions between PPG and its subsidiaries are eliminated in consolidation.

Use of Estimates in the Preparation of Financial Statements

The preparation of financial statements in conformity with U.S. generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the financial statements, as well as the reported amounts of income and expenses during the reporting period. Such estimates also include the fair value of assets acquired and liabilities assumed resulting from the allocation of the purchase price related to business combinations consummated. Actual outcomes could differ from those estimates.

Revenue Recognition

Revenue is recognized as performance obligations with the customer are satisfied, at an amount that is determined to be collectible. For the sale of products, this generally occurs at the point in time when control of the Company's products transfers to the customer based on the agreed upon shipping terms.

Shipping and Handling Costs

Amounts billed to customers for shipping and handling are reported in Net sales in the consolidated statement of income. Shipping and handling costs incurred by the Company for the delivery of goods to customers are included in Cost of sales, exclusive of depreciation and amortization in the consolidated statement of income.

Selling, General and Administrative Costs

Amounts presented in Selling, general and administrative in the consolidated statement of income are comprised of selling, customer service, distribution and advertising costs, as well as the costs of providing corporate-wide functional support in such areas as finance, law, human resources and planning. Distribution costs pertain to the movement and storage of finished goods inventory at company-owned and leased warehouses and other distribution facilities.

Advertising Costs

Advertising costs are expensed as incurred and totaled $280 million, $313 million and $322 million in 2018, 2017 and 2016, respectively.

Research and Development

Research and development costs, which consist primarily of employee related costs, are charged to expense as incurred.

($ in millions)	2018	2017	2016
Research and development – total	$464	$472	$473
Less depreciation on research facilities	23	21	20
Research and development, net	$441	$451	$453

Legal Costs

Legal costs, primarily include costs associated with acquisition and divestiture transactions, general litigation, environmental regulation compliance, patent and trademark protection and other general corporate purposes, are charged to expense as incurred.

Income Taxes

Income taxes are accounted for under the asset and liability method. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to operating losses and tax credit carryforwards as well as differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases. The effect on deferred

tax assets and liabilities of a change in tax rates is recognized in Income tax expense in the consolidated statement of income in the period that includes the enactment date.

A valuation allowance will be provided against deferred tax assets if PPG determines it is more likely than not such assets will not ultimately be realized.

PPG does not recognize a tax benefit unless it concludes that it is more likely than not that the benefit will be sustained on audit by the taxing authority based solely on the technical merits of the associated tax position. If the recognition threshold is met, PPG recognizes a tax benefit measured at the largest amount of the tax benefit that, in PPG's judgment, is greater than 50 percent likely to be realized. PPG records interest and penalties related to uncertain tax positions in Income tax expense in the consolidated statement of income.

Foreign Currency Translation

The functional currency of most significant non-U.S. operations is their local currency. Assets and liabilities of those operations are translated into U.S. dollars using year-end exchange rates; income and expenses are translated using the average exchange rates for the reporting period. Unrealized foreign currency translation gains and losses are deferred in Accumulated other comprehensive loss on the consolidated balance sheet.

Cash Equivalents

Cash equivalents are highly liquid investments (valued at cost, which approximates fair value) acquired with an original maturity of three months or less.

Short-term Investments

Short-term investments are highly liquid, high credit quality investments (valued at cost plus accrued interest) that have stated maturities of greater than three months to less than one year. The purchases and sales of these investments are classified as Investing activities in the consolidated statement of cash flows.

Marketable Equity Securities

The Company's investment in marketable equity securities is recorded at fair market value and reported as Other current assets and Investments on the consolidated balance sheet with changes in fair market value recorded in income.

Inventories

Inventories are stated at the lower of cost or net realizable value. Most U.S. inventories are stated at cost, using the last-in, first-out ("LIFO") method of accounting, which does not exceed net realizable value. All other inventories are stated at cost, using the first-in, first-out ("FIFO") method of accounting, which does not exceed net realizable value. PPG determines cost using either average or standard factory costs, which approximate actual costs, excluding certain fixed costs such as depreciation and property taxes. See Note 4, "Working Capital Detail" for further information concerning the Company's inventory.

Derivative Financial Instruments

The Company recognizes all derivative financial instruments (a "derivative") as either assets or liabilities at fair value on the consolidated balance sheet. The accounting for changes in the fair value of a derivative depends on the use of the instrument.

For derivative instruments that are designated and qualify as cash flow hedges, the unrealized gains or losses on the derivatives are recorded in the consolidated statement of comprehensive income. Amounts in Accumulated other comprehensive loss on the consolidated balance sheet are reclassified into Income before income taxes in the consolidated statement of income in the same period or periods during which the hedged transactions are recorded in Income before income taxes in the consolidated statement of income.

For derivative instruments that are designated and qualify as fair value hedges, the change in the fair value of the derivatives are reported in Income before income taxes in the consolidated statement of income, offsetting the gain or loss recognized for the change in fair value of the asset, liability, or firm commitment that is being hedged.

For derivatives, debt or other financial instruments that are designated and qualify as net investment hedges, the gains or losses associated with the financial instruments are reported as translation gains or losses in Accumulated other comprehensive loss on the consolidated balance sheet. Gains and losses in Accumulated other comprehensive loss related to hedges of the Company's net investments in foreign operations are reclassified out of Accumulated other comprehensive loss and recognized in Income before income taxes in the consolidated statement of income upon a

substantial liquidation, sale or partial sale of such investments or upon impairment of all or a portion of such investments. The cash flow impact of these instruments are classified as Investing activities in the consolidated statement of cash flows.

Notes to the Consolidated Financial Statements

Changes in the fair value of derivative instruments not designated as hedges for hedge accounting purposes are recognized in Income before income taxes in the consolidated statement of income in the period of change.

Property, Plant and Equipment

Property, plant and equipment is recorded at cost. Depreciation is computed on a straight-line method based on the estimated useful lives of related assets. Additional depreciation expense is recorded when facilities or equipment are subject to abnormal economic conditions, restructuring actions or obsolescence.

The cost of significant improvements that add to productive capacity or extend the lives of properties are capitalized. Costs for repairs and maintenance are charged to expense as incurred. When a capitalized asset is retired or otherwise disposed of, the original cost and related accumulated depreciation balance are removed from the accounts and any related gain or loss is recorded in Income before income taxes in the consolidated statement of income. The amortization cost of capitalized leased assets is recorded in Depreciation expense in the consolidated statement of income. Property and other long-lived assets are reviewed for impairment whenever events or circumstances indicate that their carrying amounts may not be recoverable. See Note 5, “Property, Plant and Equipment” for further details.

Goodwill and Identifiable Intangible Assets

Goodwill represents the excess of the cost over the fair value of acquired identifiable tangible and intangible assets less liabilities assumed from acquired businesses. Identifiable intangible assets acquired in business combinations are recorded based upon their fair value at the date of acquisition.

PPG is a multinational manufacturer with 9 operating segments (which the Company refers to as “strategic business units”) that are organized based on the Company’s major products lines. These operating segments are also the Company’s reporting units for purposes of testing goodwill for impairment, which is tested at least annually in connection with PPG’s strategic planning process. The Company tests goodwill for impairment by either performing a qualitative evaluation or a quantitative test. The qualitative evaluation is an assessment of factors, including reporting unit specific operating results as well as industry, market and general economic conditions, to determine whether it is more likely than not that the fair values of a reporting unit is less than its carrying amount, including goodwill. The Company may elect to bypass this qualitative assessment for some or all of its reporting units and perform a quantitative test. The quantitative goodwill impairment test is performed during the fourth quarter by comparing the estimated fair value of the associated reporting unit as of September 30 to its carrying value. Fair value is estimated using discounted cash flow methodologies.

The Company has determined that certain acquired trademarks have indefinite useful lives. The Company tests the carrying value of these trademarks for impairment at least annually, or as needed whenever events and circumstances indicate that their carrying amount may not be recoverable. The annual assessment takes place in the fourth quarter of each year either by completing a qualitative assessment or quantitatively by comparing the estimated fair value of each trademark as of September 30 to its carrying value. Fair value is estimated by using the relief from royalty method (a discounted cash flow methodology). The qualitative assessment includes consideration of factors, including revenue relative to the asset being assessed, the operating results of the related business as well as industry, market and general economic conditions, to determine whether it is more likely than not that the fair value of the asset is less than its carrying amount.

Identifiable intangible assets with finite lives are amortized on a straight-line basis over their estimated useful lives (1 to 30 years) and are reviewed for impairment whenever events or circumstances indicate that their carrying amount may not be recoverable.

Receivables and Allowances

All trade receivables are reported on the consolidated balance sheet at the outstanding principal adjusted for any allowance for credit losses and any charge offs. The Company provides an allowance for doubtful accounts to reduce receivables to their estimated net realizable value when it is probable that a loss will be incurred. Those estimates are based on historical collection experience, current economic and market conditions, a review of the aging of accounts receivable and the assessments of current creditworthiness of customers.

Product warranties

The Company accrues for product warranties at the time the associated products are sold based on historical claims experience. The reserve, pre-tax charges against income and cash outlays for product warranties were not significant

to the consolidated financial statements of the Company for any year presented.

Asset Retirement Obligations

An asset retirement obligation represents a legal obligation associated with the retirement of a tangible long-lived asset that is incurred upon the acquisition, construction, development or normal operation of that long-lived asset. PPG recognizes asset retirement obligations in the period in which they are incurred, if a reasonable estimate of fair value can be made. The

asset retirement obligation is subsequently adjusted for changes in fair value. The associated estimated asset retirement costs are capitalized as part of the carrying amount of the long-lived asset and depreciated over its useful life. PPG's asset retirement obligations are primarily associated with the retirement or closure of certain assets used in PPG's manufacturing process. The accrued asset retirement obligation is recorded in Accounts payable and accrued liabilities and Other liabilities on the consolidated balance sheet, and was $22 million and $19 million as of December 31, 2018 and 2017, respectively.

PPG's only conditional asset retirement obligation relates to the possible future abatement of asbestos contained in certain PPG production facilities. The asbestos in PPG's production facilities arises from the application of normal and customary building practices in the past when the facilities were constructed. This asbestos is encapsulated in place and, as a result, there is no current legal requirement to abate it. Because there is no requirement to abate, the Company does not have any current plans or an intention to abate and therefore the timing, method and cost of future abatement, if any, are not known. The Company has not recorded an asset retirement obligation associated with asbestos abatement, given the uncertainty concerning the timing of future abatement, if any.

Reclassifications

Certain reclassifications of prior years' data have been made to conform to the current year presentation. These reclassifications had no impact on our previously reported Net income, cash flows or shareholders' equity.

Accounting Standards Adopted in 2018

Effective January 1, 2018, PPG adopted Accounting Standard Updates ("ASU") No. 2017-07, "Improving the Presentation of Net Periodic Pension Cost and Net Periodic Postretirement Benefit Cost." This ASU requires the service cost component of these costs to be disaggregated from all other components and to be reported in the same line item or items as other compensation costs. The other components of these costs are required to be presented in the consolidated statement of income separately from the service cost component. This ASU required retrospective adoption for all prior periods presented.

The effect of the retrospective adoption on the consolidated statement of income related to the net periodic pension and other postretirement benefit costs was as follows:

	For the Year Ended December 31, 2017		
($ in millions)	As Previously Reported	Reclassifications	As Revised
Cost of sales, exclusive of depreciation and amortization	$8,207	$2	$8,209
Selling, general and administrative	$3,564	($10)	$3,554
Research and development, net	$453	($2)	$451
Other charges	$64	$10	$74
Income before income taxes	$2,005	$—	$2,005

	For the Year Ended December 31, 2016		
($ in millions)	As Previously Reported	Reclassifications	As Revised
Cost of sales, exclusive of depreciation and amortization	$7,693	($28)	$7,665
Selling, general and administrative	$3,588	($33)	$3,555
Research and development, net	$459	($6)	$453
Other charges	$175	$67	$242
Income before income taxes	$779	$—	$779

In February 2018, the Financial Accounting Standards Board ("FASB") issued ASU No. 2018-02, "Reclassification of Certain Tax Effects from Accumulated Other Comprehensive Income." This ASU allows a reclassification from Accumulated other comprehensive income to Retained earnings for stranded tax effects resulting from the Tax Cuts and Jobs Act. PPG early adopted this standard in the first quarter of 2018 using the specific identification method and

recorded a reclassification from Other comprehensive (loss)/income, net of tax in the consolidated statement of comprehensive income to Retained earnings on the consolidated balance sheet of $107 million.
Effective January 1, 2018, PPG adopted ASU No. 2014-09, "Revenue from Contracts with Customers: Topic 606." See Note 2, "Revenue Recognition" for further details regarding the impact of adoption of this standard.

Notes to the Consolidated Financial Statements

PPG's adoption of the following ASU's in 2018 did not have a material impact on PPG's consolidated financial position, results of operations or cash flows:

Accounting Standard Update	
2018-14	Compensation - Retirement Benefits - Defined Benefit Plans
2017-12	Derivatives and Hedging - Targeted Improvements to Accounting for Hedging Activities
2017-09	Stock Compensation - Scope of Modification Accounting
2016-16	Intra-Entity Transfers of Assets Other Than Inventory
2016-15	Classification of Certain Cash Receipts and Cash Payments
2016-01	Recognition and Measurement of Financial Assets and Liabilities

Accounting Standards to be Adopted in Future Years

In August 2018, the FASB issued ASU No. 2018-15, "Intangibles - Goodwill and Other - Internal-Use Software." This ASU requires capitalization of certain implementation costs incurred in a cloud computing arrangement that is a service contract. The amendments in this ASU are effective for fiscal years beginning after December 15, 2019 and for interim periods therein with early adoption permitted. PPG does not believe this ASU will have a material impact on its consolidated financial position, results of operations or cash flows.

In June 2016, the FASB issued ASU No. 2016-13, "Financial Instruments - Credit Losses." This ASU requires an organization to measure all expected credit losses for financial assets held at the reporting date based on historical experience, current conditions, and reasonable and supportable forecasts. Financial institutions and other organizations will now use forward-looking information to better inform their credit loss estimates. The amendments in this ASU are effective for fiscal years beginning after December 15, 2019 and for interim periods therein. Entities may chose to adopt the new ASU as of its fiscal year beginning after December 15, 2018. PPG does not plan to early adopt this standard. PPG does not believe this ASU will have a material impact on its consolidated financial position, results of operations or cash flows.

In February 2016, the FASB issued ASU No. 2016-02, "Leases." This ASU requires all lessees to recognize on the balance sheet right to use assets and lease liabilities for the rights and obligations created by lease arrangements with terms greater than 12 months. Additionally, in July 2018, the FASB issued ASU No. 2018-11, "Targeted Improvements." This ASU provides an additional transition method to adopt the new leasing standard. Under this new transition method, an entity initially applies the new leasing standard using a cumulative-effect adjustment to the opening balance of retained earnings but will continue to report comparative periods under existing guidance in accordance with ASC 840, Leases. PPG adopted the new standard effective January 1, 2019, using this new transition method and does not expect a material cumulative-effect adjustment to the opening balance of Retained earnings. The Company is nearly complete in assessing the impact the adoption will have on its consolidated financial statements and expects an impact on assets and liabilities on its consolidated balance sheet in the range of $700 million to $750 million. These lease obligations will be classified as debt on the consolidated balance sheet. Due to the corresponding increase in total debt, the Company's total debt to total debt and equity ratio and other financial ratios that include total debt or total capital will be impacted with the adoption of this ASU in the first quarter of 2019.

2. Revenue Recognition

Background

In May 2014, the FASB issued ASU No. 2014-09, "Revenue from Contracts with Customers: Topic 606." This ASU replaces nearly all existing U.S. GAAP guidance on revenue recognition. The standard prescribes a five-step model for recognizing revenue, the application of which may require significant judgment. The new guidance requires PPG to evaluate the transfer of promised goods or services to customers and recognize revenue in an amount that reflects the consideration which the Company expects to be entitled to receive in exchange for those goods and services.

The Company recognizes revenue when control of the promised goods or services is transferred to the customer and in amounts that the Company expects to collect. The timing of revenue recognition takes into consideration the various shipping terms applicable to the Company's sales. For most transactions, control passes in accordance with agreed upon delivery terms. This approach is consistent with the Company's historical revenue recognition methodology.

The Company delivers products to company-owned stores, home centers and other regional or national consumer retail outlets, paint dealers, concessionaires and independent distributors, company-owned distribution networks, and

directly to manufacturing companies and retail customers. Each product delivered to a third party customer is considered to satisfy a performance obligation. Performance obligations generally occur at a point in time and are satisfied when control of the goods passes to the customer. The Company is entitled to collection of the sales price under normal credit terms in the regions in which it operates. Accounts receivable are recognized when there is an unconditional right to consideration. Payment terms vary from customer to customer, depending on creditworthiness, prior payment history and other considerations.

Notes to the Consolidated Financial Statements

The Company also provides services by applying coatings to customers' manufactured parts and assembled products and by providing technical support to certain customers. Performance obligations are satisfied over time as critical milestones are met and as services are provided. PPG is entitled to payment as the services are rendered. For the years ended December 31, 2018 and 2017, service revenue constituted approximately 5% of total revenue.

Net sales by segment and region for the years ended December 31, 2018, 2017 and 2016 were as follows:

	Performance Coatings			Industrial Coatings			Total Net Sales		
($ in millions)	2018	2017	2016	2018	2017	2016	2018	2017	2016
United States and Canada	$4,062	$4,031	$4,055	$2,423	$2,276	$2,199	$6,485	$6,307	$6,254
EMEA	2,936	2,761	2,619	1,742	1,628	1,545	4,678	4,389	4,164
Asia Pacific	1,071	970	959	1,547	1,553	1,472	2,618	2,523	2,431
Latin America	1,018	968	947	575	561	474	1,593	1,529	1,421
Total	$9,087	$8,730	$8,580	$6,287	$6,018	$5,690	$15,374	$14,748	$14,270

The Company adopted the ASU using the modified retrospective approach which required the financial statements to reflect the new standard as of January 1, 2018, and as a result, contracts that ended prior to January 1, 2018 were not included within the Company's assessment. Accordingly, the amounts in the comparative consolidated statements of income and consolidated balance sheet have not been adjusted for the adoption of this standard. The ASU also provided additional clarity that resulted in reclassifications to or from Net sales, Cost of sales, exclusive of depreciation and amortization, Selling, general and administrative and Other income. Certain costs historically reported in Selling, general and administrative costs will now be recorded in Cost of sales, exclusive of depreciation and amortization in the consolidated statement of income, as they represent costs incurred in satisfaction of performance obligations. In addition, the cost of certain customer incentives are now recorded as a reduction of Net sales rather than Cost of sales, exclusive of depreciation and amortization or Selling, general and administrative costs.

The following table summarizes the impact of the adoption of this ASU on the consolidated statement of income for the year ended December 31, 2018:

	Year Ended December 31, 2018		
($ in millions)	Without adoption	Adjustments	As Reported
Net sales	$15,399	($25)	$15,374
Cost of sales, exclusive of depreciation and amortization	$8,925	$76	$9,001
Selling, general and administrative	$3,682	($109)	$3,573
Other income	($122)	$8	($114)
Income before income taxes	$1,693	$—	$1,693

3. Acquisitions and Divestitures

Acquisitions

Announced Acquisitions

In January 2019, PPG announced that it has reached a definitive agreement to acquire automotive coatings manufacturer Hemmelrath. The transaction is expected to close in the first half of 2019.

In December 2018, PPG announced that it has reached a definitive agreement to acquire Whitford Worldwide Company, a global manufacturer that specializes in low-friction and nonstick coatings for industrial applications and consumer products. The transaction is expected to close in the first quarter of 2019.

Completed Acquisitions

SEM Products, Inc.

In the fourth quarter of 2018, PPG completed the acquisition of SEM Products, Inc., a U.S.-based manufacturer of specialized automotive refinish products ("SEM"). SEM, headquartered in Rock Hill, South Carolina, is a leading manufacturer of repair and refinish products used primarily for automotive and other transportation applications. The pro-forma impact on PPG's sales and results of operations, including the pro forma effect of events that are directly attributable to the acquisition, was not significant. The results of this business since the date of acquisition have been reported within the automotive refinish coatings business within the Performance Coatings reportable segment.

Notes to the Consolidated Financial Statements

The Crown Group
On October 2, 2017, PPG acquired The Crown Group (“Crown”), a U.S.-based coatings application services business, which is reported as part of PPG's Industrial Coatings reportable segment. Crown is one of the leading component and product finishers in North America. Crown applies coatings to customers’ manufactured parts and assembled products at 11 U.S. sites. Most of Crown’s facilities, which also provide assembly, warehousing and sequencing services, are located at customer facilities or positioned near customer manufacturing sites. The company serves manufacturers in the automotive, agriculture, construction, heavy truck and alternative energy industries. The pro-forma impact on PPG's sales and results of operations, including the pro forma effect of events that are directly attributable to the acquisition, was not significant. The results of this business since the date of acquisition have been reported within the industrial coatings business within the Industrial Coatings reportable segment.
Taiwan Chlorine Industries
Taiwan Chlorine Industries (“TCI”) was established in 1986 as a joint venture between PPG and China Petrochemical Development Corporation (“CPDC”) to produce chlorine-based products in Taiwan, at which time PPG owned 60 percent of the venture. In conjunction with the 2013 separation of its commodity chemicals business, PPG conveyed to Axiall Corporation ("Axiall") its 60% ownership interest in TCI. Under PPG’s agreement with CPDC, if certain post-closing conditions were not met following the three year anniversary of the separation, CPDC had the option to sell its 40% ownership interest in TCI to Axiall for $100 million. In turn, Axiall had a right to designate PPG as its designee to purchase the 40% ownership interest of CPDC. In April 2016, Axiall announced that CPDC had decided to sell its ownership interest in TCI to Axiall. In June 2016, Axiall formally designated PPG to purchase the 40% ownership interest in TCI. In August 2016, Westlake Chemical Corporation acquired Axiall, which became a wholly-owned subsidiary of Westlake. In April 2017, PPG finalized its purchase of CPDC’s 40% ownership interest in TCI. The difference between the acquisition date fair value and the purchase price of PPG’s 40% ownership interest in TCI has been recorded as a loss in discontinued operations during the year-ended December 31, 2017. PPG’s ownership in TCI is accounted for as an equity method investment and the related equity earnings are reported within Other income in the consolidated statement of income and in Legacy in Note 20, “Reportable Business Segment Information.”
MetoKote Corporation
In July 2016, PPG completed the acquisition of MetoKote Corporation ("MetoKote"), a U.S.-based coatings application services business. MetoKote applies coatings to customers' manufactured parts and assembled products. It operates on-site coatings services within several customer manufacturing locations, as well as at regional service centers, located throughout the U.S., Canada, Mexico, the United Kingdom, Germany, Hungary and the Czech Republic. Customers ship parts to METOKOTE® service centers where they are treated to enhance paint adhesion and painted with electrocoat, powder or liquid coatings technologies. Coated parts are then shipped to the customer’s next stage of assembly. MetoKote coats an average of more than 1.5 million parts per day.
The following table summarizes the estimated fair value of assets acquired and liabilities assumed as reflected in the final purchase price allocation for MetoKote.

($ in millions)			
Current assets		$38	
Property, plant, and equipment	73		
Identifiable intangible assets with finite lives	86		
Goodwill	166		
Deferred income taxes [(a)]	(12		)
Total assets		$351	
Current liabilities	(23		)
	(22		)

Other long-term liabilities	
Total liabilities	($45)
Total purchase price, net of cash acquired	$306

(a) The net deferred income tax liability is included in assets due to the Company's tax jurisdictional netting.

The pro-forma impact on PPG's sales and results of operations, including the pro forma effect of events that are directly attributable to the acquisition, was not significant. While calculating this impact, no cost savings or operating synergies that may result from the acquisition were included. The results of this business since the date of acquisition have been reported within the industrial coatings business within the Industrial Coatings reportable segment.

Notes to the Consolidated Financial Statements

Other Acquisitions

In 2018, 2017, and 2016, the Company completed several smaller business acquisitions. The total consideration paid for these acquisitions, net of cash acquired, debt assumed and other post closing adjustments, was $108 million, $74 million and $43 million, respectively.

In January 2018, PPG acquired ProCoatings, a leading architectural paint and coatings wholesaler located in The Netherlands. ProCoatings, established in 2001, distributes a large portfolio of well-known professional paint brands through its network of 23 multi-brand stores. The company employs nearly 100 people. The results of this business since the date of acquisition have been reported within the architectural coatings Americas and Asia Pacific business within the Performance Coatings reportable segment.

In January 2017, PPG acquired certain assets of automotive refinish coatings company Futian Xinshi (“Futian”), based in the Guangdong province of China. Futian distributes its products in China through a network of more than 200 distributors.

In January 2017, PPG completed the acquisition of DEUTEK S.A., a leading Romanian paint and architectural coatings manufacturer, from the Emerging Europe Accession Fund. DEUTEK, established in 1993, manufactures and markets a large portfolio of well-known professional and consumer paint brands, including OSKAR and Danke!. The company’s products are sold in more than 120 do-it-yourself stores and 3,500 independent retail outlets in Romania.

Divestitures

Glass Segment

In 2017, PPG completed a multi-year strategic shift in the Company's business portfolio, resulting in the exit of all glass operations which consisted of the global fiber glass business, PPG's ownership interest in two Asian fiber glass joint ventures and the flat glass business. Accordingly, the results of operations, including the gains on the divestitures, and cash flows have been recast as discontinued operations for all periods presented. PPG now has two reportable business segments.

The net sales and income from discontinued operations related to the former Glass segment for the three years ended December 31, 2018, 2017, and 2016 were as follows:

($ in millions)	2018	2017	2016
Net sales	$—	$217	$908
Income from operations	$21	$30	$111
Net gains on the divestitures of businesses	—	343	421
Income tax expense	5	140	202
Income from discontinued operations, net of tax	$16	$233	$330

During 2018, PPG released $13 million of previously recorded accruals and contingencies established in conjunction with the divestitures of businesses within the former Glass segment as a result of completed actions, new information and updated estimates. Also during 2018, PPG made a final payment of $20 million to Vitro S.A.B. de C.V related to the transfer of certain pension obligations upon the sale of the former flat glass business.

North American Fiber Glass Business

On September 1, 2017, PPG completed the sale of its North American fiber glass business to Nippon Electric Glass Co. Ltd. (“NEG”). Cash proceeds from the sale were $541 million, resulting in a pre-tax gain of $343 million, net of certain accruals and contingencies established in conjunction with the divestiture.

PPG’s fiber glass operations included manufacturing facilities in Chester, South Carolina, and Lexington and Shelby, North Carolina; and administrative and research-and-development operations in Shelby and in Harmar, Pennsylvania, near Pittsburgh. The business, which employed more than 1,000 people and had net sales of approximately $350 million in 2016, supplies the transportation, energy, infrastructure and consumer markets.

Flat Glass Business

In October 2016, PPG completed the sale of its flat glass manufacturing and glass coatings operations to Vitro S.A.B. de C.V. PPG received approximately $740 million in cash proceeds and recorded a pre-tax gain of $421 million on the sale. Under the terms of the agreement, PPG divested its entire flat glass manufacturing and glass coatings operations, including production sites located in Fresno, California; Salem, Oregon; Carlisle, Pennsylvania; and Wichita Falls, Texas; four distribution/fabrication facilities located across Canada; and a research-and-development center located in

Harmar, Pennsylvania. PPG’s flat glass business included approximately 1,200 employees. The business manufactures glass that is fabricated into products used primarily in commercial and residential construction.

Notes to the Consolidated Financial Statements

European Fiber Glass Business

In October 2016, PPG completed the sale of its European fiber glass business to glass manufacturer NEG. PPG recorded a pre-tax loss of $42 million, consisting predominately of a $46 million pension settlement charge. The European fiber glass business manufactures reinforcement materials for thermoset and thermoplastic composite applications for the transportation, energy, infrastructure and consumer end-uses. Manufacturing facilities in Hoogezand, Netherlands, and Wigan, England, and a research and development facility in Hoogezand were included in the transaction.

PFG Fiber Glass Joint Ventures

In November 2016, PPG sold its 50% ownership interests in its two PFG fiber glass joint ventures to its joint venture partner Nan Ya Plastics Corporation (“Nan Ya”). Nan Ya is affiliated with Taiwan-based Formosa Plastics Group. The PFG fiber glass joint ventures supply electronic yarn fibers used in integrated electronic circuit boards and fiber glass reinforcement products for automotive applications. PPG recorded a net pre-tax gain of $36 million on the sale.

Other Divestitures

Plaka Business

In June 2017, PPG completed the sale of the assets of its Mexico-based Plaka plasterboard and cement-board business to Knauf International GmbH and recorded a $25 million pre-tax gain on the sale. The Company's consolidated balance sheet presents the assets and liabilities of the Plaka business as held for sale as of December 31, 2016.

Pittsburgh Glass Works

In April 2016, PPG sold its minority ownership interest in Pittsburgh Glass Works LLC ("PGW") to LKQ Corporation concurrent with the majority partner’s sale of its ownership interest. PPG recorded a pre-tax gain on the sale of $20 million. PPG accounted for its interest in PGW under the equity method of accounting. PPG’s share of net earnings from PGW are reported in Other income in the consolidated statement of income for all periods presented and have not been reclassified as discontinued operations, as the divestiture of PGW does not represent a strategic shift in PPG’s operations and PGW did not have a major impact on PPG's ongoing results of operations.

4. Working Capital Detail

($ in millions)	2018	2017
Receivables		
Trade - net[1]	$2,505	$2,559
Equity affiliates	4	5
Other - net	336	339
Total	$2,845	$2,903
Inventories[2]		
Finished products	$1,105	$1,083
Work in process	193	177
Raw materials	452	437
Supplies	33	33
Total	$1,783	$1,730
Accounts payable and accrued liabilities		
Trade	$2,177	$2,321
Accrued payroll	424	441
Customer rebates	283	261
Other postretirement and pension benefits	80	78
Income taxes	112	100
Other	547	580
Total	$3,623	$3,781

(1) Allowance for doubtful accounts was $24 million and $25 million as of December 31, 2018 and 2017, respectively.

(2) Inventories valued using the LIFO method of inventory valuation comprised 36% and 34% of total gross inventory values as of December 31, 2018 and 2017, respectively. If the FIFO method of inventory valuation had been used, inventories would have been $113 million and $103 million higher as of December 31, 2018 and 2017,

respectively. During the years ended December 31, 2018 and 2017, certain inventories accounted for on the LIFO method of accounting were reduced, which resulted in the liquidation of certain quantities carried at costs prevailing in prior years. The effect on Income before income taxes was income of $2 million and zero for the years ended December 31, 2018 and 2017, respectively.

Notes to the Consolidated Financial Statements

5. Property, Plant and Equipment

($ in millions)	Useful Lives (years)	2018	2017
Land and land improvements	1-30	$489	$487
Buildings	20-40	1,472	1,488
Machinery and equipment	5-25	3,387	3,432
Other	3-20	989	958
Construction in progress		296	229
Total(1)		$6,633	$6,594
Less: accumulated depreciation		3,828	3,770
Net		$2,805	$2,824

(1) Interest capitalized in 2018, 2017 and 2016 was $4 million, $7 million and $8 million, respectively.

6. Investments

($ in millions)	2018	2017
Investments in equity affiliates	$132	$135
Marketable equity securities (See Note 10)	69	79
Other	50	54
Total	$251	$268

Investments in equity affiliates represent PPG’s ownership interests in entities between 20% and 50% that manufacture and sell coatings and certain chemicals. In 2017, PPG purchased a 40% ownership interest in TCI. Refer to Note 3, “Acquisitions and Divestitures” for additional information.

PPG’s share of undistributed net earnings of equity affiliates was $11 million and $12 million as of December 31, 2018 and December 31, 2017, respectively. Dividends received from equity affiliates were $15 million, $8 million and $7 million in 2018, 2017 and 2016, respectively.

7. Goodwill and Other Identifiable Intangible Assets

Goodwill

($ in millions)	Performance Coatings	Industrial Coatings	Total
January 1, 2017	$2,870	$702	$3,572
Acquisitions, including purchase accounting adjustments	23	89	112
Foreign currency translation	211	47	258
December 31, 2017	$3,104	$838	$3,942
Acquisitions, including purchase accounting adjustments	248	(13)	235
Foreign currency translation	(86)	(21)	(107)
December 31, 2018	$3,266	$804	$4,070

Identifiable Intangible Assets

	December 31, 2018			December 31, 2017		
($ in millions)	Gross Carrying Amount	Accumulated Amortization	Net	Gross Carrying Amount	Accumulated Amortization	Net
Indefinite-Lived Identifiable Intangible Assets						
Trademarks	$1,140	$—	$1,140	$1,158	$—	$1,158
Definite-Lived Identifiable Intangible Assets						
Acquired technology	$648	($515)	$133	$613	($489)	$124
Customer-related	1,396	(798)	598	1,437	(762)	675
Tradenames	190	(96)	94	166	(87)	79
Other	44	(37)	7	44	(35)	9
Total Definite Lived Intangible Assets	$2,278	($1,446)	$832	$2,260	($1,373)	$887
Total Identifiable Intangible Assets	$3,418	($1,446)	$1,972	$3,418	($1,373)	$2,045

Notes to the Consolidated Financial Statements

The Company’s identifiable intangible assets with definite lives are being amortized over their estimated useful lives. Aggregate amortization expense was $143 million, $129 million and $121 million in 2018, 2017 and 2016, respectively.

($ in millions)	2019	2020	2021	2022	2023
Estimated future amortization expense	$125	$100	$95	$85	$80

8. Business Restructuring

The Company records restructuring liabilities that represent charges incurred in connection with consolidations of certain operations, including operations from acquisitions, as well as headcount reduction programs. These charges consist primarily of severance costs and asset write-downs.

2018 Restructuring Program

In April 2018, the Company approved a business restructuring plan which included actions to reduce its global cost structure. The program was in response to the impacts of customer assortment changes in our U.S. architectural coatings business during the first quarter 2018 and sustained, elevated raw material inflation. The program aims to further right-size employee headcount and production capacity in certain businesses based on current product demand, as well as reductions in various global functional and administrative costs.

A pretax restructuring charge of $83 million was recorded in PPG's second quarter 2018 financial results, of which $80 million represented employee severance and other cash costs. The remainder of the charge represents the write-down of certain assets. In addition, other cash costs of approximately $25 million will be incurred, consisting of approximately $10 million of incremental restructuring-related cash costs for certain items that are required to be expensed on an as-incurred basis and approximately $15 million for items which are expected to be capitalized. The Company also expects approximately $20 million of incremental non-cash accelerated depreciation expense for certain assets due to their reduced expected asset life as a result of this program, $9 million of which was recognized in the year ended December 31, 2018. Substantially all actions from this business restructuring plan are expected to be complete by the end of the first quarter of 2020. As of December 31, 2018, approximately 1,000 employees remain to be impacted.

2016 Restructuring Program

In December 2016, a pre-tax restructuring charge of $191 million was recorded. The restructuring actions will result in the net reduction of approximately 2,000 positions, with substantially all actions to be completed by the end of the second quarter of 2019. As of December 31, 2018, approximately 100 employees remain to be impacted.

Other Adjustments

In 2018, adjustments of approximately $49 million were recorded to reduce the remaining restructuring reserves established in 2016 to reflect the current estimate of the costs to complete these actions. Also in 2018, some additional restructuring actions were approved and charges of approximately $32 million were recorded. These amounts are recorded in Business restructuring, net in the consolidated statement of income.

A summary of restructuring charges by reportable business segment is as follows:

Restructuring Charges

($ in millions)	Severance and Other Costs	Asset Write-offs	Total
Performance Coatings	$77	$45	$122
Industrial Coatings	52	14	66
Corporate	7	—	7
Release of prior reserves	(4)	—	(4)
Total 2016 restructuring charge	$132	$59	$191
Performance Coatings	$49	$3	$52
Industrial Coatings	21	—	21
Corporate	10	—	10
Total 2018 restructuring charge	$80	$3	$83

Notes to the Consolidated Financial Statements

The reserve activity for the three years ended December 31, 2018, 2017, and 2016 was as follows:

Restructuring Reserve Activity

($ in millions)	Total Reserve
December 31, 2016	$130
2017 Activity	3
Cash payments	(49)
Foreign currency impact	18
December 31, 2017	$102
Total 2018 restructuring charge	83
Additional actions approved	32
Release of prior reserves and other adjustments [(1)]	(49)
Cash payments	(66)
Foreign currency impact	(4)
Other	12
December 31, 2018	$110

(1) Reductions to remaining restructuring reserves to reflect the current estimate of the costs to complete the actions.

9. Borrowings and Lines of Credit

Long-term Debt Obligations

($ in millions)	Maturity Date	2018	2017
0.00% note (€300)	2019	$343	$358
2.3% notes	2019	299	299
3.6% notes	2020	498	497
9% non-callable debentures[(1)]	2021	133	133
0.875% notes (€600)	2022	685	716
3.2% notes ($300)[(2)]	2023	298	—
0.875% note (€600)	2025	679	710
1.4% notes (€600)	2027	679	711
3.75% notes ($700)[(3)]	2028	694	—
2.5% note (€80)	2029	91	95
7.70% notes	2038	174	174
5.5% notes	2040	247	247
3% note (€120)	2044	131	137
Various other non-U.S. debt[(4)]	Various	39	43
Capital lease obligations	Various	12	15
Impact of derivatives on debt[(1)(5)]	N/A	10	3
Total		$5,012	$4,138
Less payments due within one year	N/A	647	4
Long-term debt		$4,365	$4,134

(1) PPG entered into several interest rate swaps, which were subsequently settled in prior periods. The impact of these settlements are being amortized over the remaining life of the debentures as a reduction to interest expense. The weighted average interest rate for these borrowings was 8.4% for the years ended December 31, 2018 and 2017.

(2) In February 2018, PPG entered into interest rate swaps which converted $150 million of the notes from a fixed interest rate to a floating interest rate based on the three month London Interbank Offered Rate (LIBOR). The impact of the derivative on the notes represents the fair value adjustment of the debt. The average effective interest rate for the portion of the notes impacted by the swaps was 2.7% for the period ended December 31, 2018. Refer to Note 10, “Financial Instruments, Hedging Activities and Fair Value Measurements” for additional information.

(3) In February 2018, PPG entered into interest rate swaps which converted $375 million of the notes from a fixed interest rate to a floating interest rate based on the three month LIBOR. The impact of the derivative on the notes

represents the fair value adjustment of the debt. The average effective interest rate for the portion of the notes impacted by the swaps was 3.2% for the period ended December 31, 2018. Refer to Note 10, "Financial Instruments, Hedging Activities and Fair Value Measurements" for additional information.

(4) Weighted average interest rate of 3.8% and 3.7% as of December 31, 2018 and 2017, respectively.

(5) Fair value adjustment of the 3.2% $300 million notes and 3.75% $700 million notes as a result of fair value hedge accounting treatment related to the outstanding interest rate swaps as of December 31, 2018. Refer to Note 10, "Financial Instruments, Hedging Activities and Fair Value Measurements" for additional information.

Notes to the Consolidated Financial Statements

2018 Activities

In February 2018, PPG completed a public offering of $300 million aggregate principal amount of 3.2% notes due 2023 and $700 million aggregate principal amount of 3.75% notes due 2028. These notes were issued pursuant to PPG's existing shelf registration statement and pursuant to an indenture between the Company and The Bank of New York Mellon Trust Company, N.A., as trustee, as supplemented. The Indenture governing these notes contains covenants that limit the Company's ability to, among other things, incur certain liens securing indebtedness, engage in certain sale-leaseback transactions, and enter into certain consolidations, mergers, conveyances, transfers or leases of all or substantially all the Company's assets. The terms of these notes also require the Company to make an offer to repurchase Notes upon a Change of Control Triggering Event (as defined in the Indenture) at a price equal to 101% of their principal amount plus accrued and unpaid interest. The Company may issue additional debt from time to time pursuant to the Indenture.

The aggregate cash proceeds from the notes, net of discounts and fees, was $992 million. A portion of the notes were converted from a fixed interest rate to a floating interest rate using interest rate swap contracts. For more information, refer to Note 10, "Financial Instruments, Hedging Activities and Fair Value Measurements."

2017 Activities

In November 2017, PPG's €500 million 3-year variable rate bank loan matured and the Company repaid this obligation using $587 million of cash on hand.

2016 Activities

In December 2016, PPG's $125 million 6.65% notes, due 2018, were redeemed using $133 million of cash on hand. Also, the Company prepaid its $250 million Term Loan Credit Agreements, one with the Bank of Tokyo-Mitsubishi UFJ, Ltd. and the other with BNP Paribas, which PPG entered into during May 2016. The Bank of Tokyo-Mitsubishi UFJ, Ltd. Term Loan would have originally terminated and all amounts outstanding would have been payable in March 2017. The BNP Paribas Term Loan would have originally terminated and all amounts outstanding would have been payable in May 2017.

In November 2016, PPG completed a public offering of €300 million 0.000% Notes due 2019 and €600 million 0.875% Notes due 2025. These notes were issued pursuant to PPG's existing shelf registration statement and pursuant to an indenture between the Company and The Bank of New York Mellon Trust Company, N.A., as trustee, as supplemented. The Indenture governing these notes contains covenants that limit the Company's ability to, among other things, incur certain liens securing indebtedness, engage in certain sale-leaseback transactions, and enter into certain consolidations, mergers, conveyances, transfers or leases of all or substantially all the Company's assets. The terms of these notes also require the Company to make an offer to repurchase Notes upon a Change of Control Triggering Event (as defined in the Indenture) at a price equal to 101% of their principal amount plus accrued and unpaid interest. The Company may issue additional debt from time to time pursuant to the Indenture.

The aggregate cash proceeds from the notes, net of discounts and fees, was $987 million. The notes are denominated in euro and have been designated as hedges of net investments in the Company's European operations. For more information, refer to Note 10 "Financial Instruments, Hedging Activities and Fair Value Measurements."

In January 2016, PPG's $250 million 1.9% notes matured, and the Company repaid these obligations using cash on hand.

Credit agreements

In December 2015, PPG entered into a five-year credit agreement (the "Credit Agreement") with several banks and financial institutions. The Credit Agreement provides for a $1.8 billion unsecured revolving credit facility. The Company has the ability to increase the size of the Credit Agreement by up to an additional $500 million, subject to the receipt of lender commitments and other conditions. The Credit Agreement will terminate on December 18, 2020. The Company has the right, subject to certain conditions set forth in the Credit Agreement, to designate certain subsidiaries of the Company as borrowers under the Credit Agreement. In connection with any such designation, the Company is required to guarantee the obligations of any such subsidiaries under the Credit Agreement. There were no amounts outstanding under the Credit Agreement during the years ended December 31, 2018 and 2017. The Credit Agreement also supports the Company's commercial paper borrowings. There were no commercial paper borrowings outstanding as of December 31, 2018 and 2017.

Restrictive Covenants and Cross-Default Provisions

As of December 31, 2018, PPG was in full compliance with the restrictive covenants under its various credit agreements, loan agreements and indentures.

Additionally, the Company's Credit Agreement contains customary cross-default provisions. These provisions provide that a default on a debt service payment of $50 million or more for longer than the grace period provided under another agreement may result in an event of default under this agreement. The Company's 9% non-callable debentures also contain a customary

cross default provision triggered by the Company's default on a debt service payment of $10 million or more. None of the Company's primary debt obligations are secured or guaranteed by the Company's affiliates.

Long-term Debt Maturities

($ in millions)	Maturity per year
2019	$647
2020	497
2021	131
2022	685
2023	298
Thereafter	$2,754

Short-term Debt Obligations

($ in millions)	2018	2017
Various, weighted average 3.4% and 1.9% as of December 31, 2018 and 2017, respectively.	$4	$8

Lease Obligations

Rental expense for operating leases was $289 million, $288 million and $273 million in 2018, 2017 and 2016, respectively. The primary leased assets include paint stores, transportation equipment, warehouses and other distribution facilities, and office space, including the Company's corporate headquarters located in Pittsburgh, Pa. As of January 1, 2019, PPG has adopted ASU 2016-02. See Note 1, "Summary of Significant Accounting Policies" for further information.

Minimum lease commitments for operating leases that have initial or remaining lease terms in excess of one year are as follows:

($ in millions)	As of December 31, 2018
2019	$207
2020	157
2021	116
2022	93
2023	76
Beyond 2023	$244

Lines of Credit, Letters of Credit, Surety Bonds and Guarantees

PPG's non-U.S. operations have uncommitted lines of credit totaling $401 million of which $3 million was used as of December 31, 2018. These uncommitted lines of credit are subject to cancellation at any time and are generally not subject to any commitment fees.

The Company had outstanding letters of credit and surety bonds of $158 million and $163 million as of December 31, 2018 and 2017, respectively. The letters of credit secure the Company's performance to third parties under certain self-insurance programs and other commitments made in the ordinary course of business.

As of December 31, 2018 and 2017, guarantees outstanding were $14 million. The guarantees relate primarily to debt of certain entities in which PPG has an ownership interest and selected customers of certain PPG businesses. A portion of such debt is secured by the assets of the related entities. The carrying value of these guarantees were zero and $1 million at December 31, 2018 and 2017, respectively, and the fair values of these guarantees were $1 million at December 31, 2018 and 2017. The fair value of each guarantee was estimated by comparing the net present value of two hypothetical cash flow streams, one based on PPG's incremental borrowing rate and the other based on the borrower's incremental borrowing rate, as of the effective date of the guarantee. Both streams were discounted at a risk free rate of return. The Company does not believe any loss related to these letters of credit, surety bonds or guarantees is likely.

10. Financial Instruments, Hedging Activities and Fair Value Measurements

Financial instruments include cash and cash equivalents, short-term investments, cash held in escrow, marketable equity securities, accounts receivable, company-owned life insurance, accounts payable, short-term and long-term debt instruments, and derivatives. The fair values of these financial instruments approximated their carrying values at December 31, 2018 and 2017, in the aggregate, except for long-term debt instruments.

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Hedging Activities

The Company has exposure to market risk from changes in foreign currency exchange rates and interest rates, and had exposure to PPG's stock price changes. As a result, financial instruments, including derivatives, have been used to hedge these underlying economic exposures. Certain of these instruments qualify as fair value, cash flow, and net investment hedges upon meeting the requisite criteria, including effectiveness of offsetting hedged or underlying exposures. Changes in the fair value of derivatives that do not qualify for hedge accounting are recognized in Income before income taxes in the period incurred.

PPG's policies do not permit speculative use of derivative financial instruments. PPG enters into derivative financial instruments with high credit quality counterparties and diversifies its positions among such counterparties in order to reduce its exposure to credit losses. The Company did not realize a credit loss on derivatives during the three-year period ended December 31, 2018.

All of PPG's outstanding derivative instruments are subject to accelerated settlement in the event of PPG's failure to meet its debt or payment obligations under the terms of the instruments' contractual provisions. In addition, if the Company would be acquired and its payment obligations under its derivative instruments' contractual arrangements are not assumed by the acquirer, or if PPG would enter into bankruptcy, receivership or reorganization proceedings, its outstanding derivative instruments would also be subject to accelerated settlement.

In 2018 and 2017, there were no derivative instruments de-designated or discontinued as a hedging instrument. There were no gains or losses deferred in Accumulated other comprehensive loss on the consolidated balance sheet that were reclassified to Income before income taxes in the consolidated statement of income during the three-year period ended December 31, 2018 related to hedges of anticipated transactions that were no longer expected to occur.

Fair Value Hedges

Prior to June 2016, PPG entered into renewable equity forward arrangements to hedge the impact to PPG's Income before income taxes for changes in the fair value of 2,777,778 shares of PPG stock that were contributed to the asbestos settlement trust as discussed in Note 14, "Commitments and Contingent Liabilities." These financial instruments were recorded at fair value as assets or liabilities and changes in the fair value of these financial instruments are reflected in Asbestos settlement, net on the consolidated statement of income. The total principal amount paid for these shares was approximately $60 million. During the terms of the equity forward arrangements, PPG paid interest to the counterparty based on the principal amount, and the counterparty paid PPG an amount equal to the dividends paid on the shares, which reduced the transaction price by approximately $10 million, net. The difference between the principal amount and any amounts related to unpaid interest or dividends and the market price for the shares, adjusted for credit risk, represented the fair value of the financial instruments as well as the amount that PPG received when the counterparty chose to settle the financial instruments. In conjunction with the funding of the asbestos settlement trust, the equity forward arrangements were settled. At settlement, in June 2016, the fair value of the equity forward arrangement was an asset of $258 million.

The Company uses interest rate swaps from time to time to manage it's exposure to changing interest rates. When outstanding, the interest rate swaps are typically designated as fair value hedges of certain outstanding debt obligations of the Company and are recorded at fair value.

In February of 2018, PPG entered into interest rate swaps which converted $525 million of fixed rate debt to variable rate debt. The swaps are designated as fair value hedges and are carried at fair value. Changes in the fair value of these swaps and changes in the fair value of the related debt are recorded in Interest expense in the accompanying consolidated statement of income. The fair value of these interest rate swaps was $8 million at December 31, 2018. There were no interest rate swaps outstanding as of December 31, 2017.

Cash Flow Hedges

PPG designates certain foreign currency forward contracts as cash flow hedges of the Company's exposure to variability in exchange rates on intercompany and third party transactions denominated in foreign currencies. Underlying notional amounts related to these foreign currency forward contracts were $50 million and $284 million at December 31, 2018 and 2017, respectively. As of December 31, 2018 and 2017, the fair value of all foreign currency forward contracts designated as cash flow hedges was a liability of $1 million and a net asset of $3 million, respectively.

Net Investment Hedges

PPG uses cross currency swaps, foreign currency euro-denominated debt and forward contracts to hedge a significant portion of its net investment in its European operations, as follows:

In February 2018, PPG entered into U.S. dollar to euro cross currency swap contracts with a total notional amount of $575 million and designated these contracts as hedges of the Company's net investment in its European operations. During the

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term of these contracts, PPG will receive payments in U.S. dollars and make payments in euros to the counterparties. Also in February 2018, the Company settled outstanding U.S. dollar to euro cross currency swap contracts with a total notional amount of $560 million. As of December 31, 2018 and 2017, the fair value of these contracts was an asset of $35 million and $2 million, respectively.

At December 31, 2018 and 2017, PPG had designated €2.3 billion of euro-denominated borrowings as hedges of a portion of its net investment in the Company's European operations. The carrying value of these instruments at December 31, 2018 and 2017 was $2.6 billion and $2.7 billion, respectively.

During 2017 and 2016, PPG used foreign currency forward contracts to hedge a portion of its net investment in its European operations. Changes in the fair value of these derivative instruments were recorded in Accumulated other comprehensive loss on the consolidated balance sheet as gains or losses. There were no such instruments used 2018. The Company paid $3 million to settle a foreign currency forward contract in 2017. There were no foreign currency forward contracts outstanding as of December 31, 2018, 2017,and 2016.

Other Financial Instruments

PPG uses foreign currency forward contracts to manage net transaction exposures that do not qualify for hedge accounting; therefore, the change in the fair value of these instruments is recorded in Other charges in the consolidated statement of income in the period of change. Underlying notional amounts related to these foreign currency forward contracts were $2.5 billion and $2.2 billion at December 31, 2018 and 2017, respectively. As of December 31, 2018 and 2017, the fair values of these contracts were a net asset of $36 million and a liability of $20 million, respectively.

Gains/Losses Deferred in Accumulated other comprehensive loss

As of December 31, 2018 and 2017, the Company had accumulated pre-tax unrealized translation gains in Accumulated other comprehensive loss on the consolidated balance sheet related to the euro-denominated borrowings, foreign currency forward contracts, and the cross currency swaps of $161 million and $16 million, respectively.

The following tables summarize the location and amount of gains (losses) related to derivative and debt financial instruments for the years ended December 31, 2018, 2017 and 2016. All dollar amounts are shown on a pre-tax basis.

($ in millions)	2018 (Loss)/Gain Deferred in AOCL	Gain/(Loss) Recognized	2017 Loss Deferred in AOCL	Gain Recognized	2016 Gain/(Loss) Deferred in AOCL	(Loss)/Gain Recognized	Caption in Consolidated Statement of Income
Fair Value							
Interest rate Swaps		$3		$—		$—	Interest expense
Total Fair Value		$3		$—		$—	
Cash Flow							
Foreign currency forward contracts[1]	($9)	($8)	($7)	$9	$1	($5)	Other charges and Cost of sales
Total Cash Flow	($9)	($8)	($7)	$9	$1	($5)	
Net Investment							
Cross currency swaps	$21	$13	($61)	$—	$25	$—	Interest expense
Foreign denominated debt	124	—	(403)	—	122	—	
Foreign currency forward contracts	—	—	—	—	(14)	—	
Total Net Investment	$145	$13	($464)	$—	$133	$—	
Economic							
Foreign currency forward contracts		$55		$14		$14	Other charges

(1) For the period ended December 31, 2018, the amounts excluded from effectiveness recognized in earnings based on an amortization approach was expense of $4 million.

Fair Value Measurements

The Company follows a fair value measurement hierarchy to measure its assets and liabilities. As of December 31, 2018 and 2017, respectively, the assets and liabilities measured at fair value on a recurring basis were cash equivalents, equity securities and derivatives. In addition, the Company measures its pension plan assets at fair value (see Note 13, “Employee Benefit Plans” for further details). The Company’s financial assets and liabilities are measured using inputs from the following three levels:

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Level 1 inputs are quoted prices in active markets for identical assets and liabilities that the Company has the ability to access at the measurement date. Level 1 inputs are considered to be the most reliable evidence of fair value as they are based on unadjusted quoted market prices from various financial information service providers and securities exchanges.
Level 2 inputs are directly or indirectly observable prices that are not quoted on active exchanges, which include quoted prices for similar assets and liabilities in active markets, quoted prices for identical or similar assets or liabilities in markets that are not active, inputs other than quoted prices that are observable for the asset or liability and inputs that are derived principally from or corroborated by observable market data by correlation or other means. The fair values of the derivative instruments reflect the instruments' contractual terms, including the period to maturity, and uses observable market-based inputs, including forward curves.
Level 3 inputs are unobservable inputs employed for measuring the fair value of assets or liabilities. The Company does not have any recurring financial assets or liabilities that are recorded in its consolidated balance sheets as of December 31, 2018 and 2017 that are classified as Level 3 inputs.
Assets and liabilities reported at fair value on a recurring basis

	December 31, 2018			December 31, 2017		
($ in millions)	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
Assets:						
Other current assets:						
Marketable equity securities	$4	$—	$—	$4	$—	$—
Foreign currency forward contracts[(a)]	—	—	—	—	6	—
Foreign currency forward contracts[(b)]	—	45	—	—	—	—
Cross currency swaps[(c)]	—	—	—	—	2	—
Other assets:						
Cross currency swaps[(c)]	$—	$35	$—	$—	$—	$—
Interest rate swaps[(d)]	—	8	—	—	—	—
Investments:						
Marketable equity securities	$69	$—	$—	$79	$—	$—
Liabilities:						
Accounts payable and accrued liabilities:						
Foreign currency forward contracts[(a)]	$—	$1	$—	$—	$23	$—
Foreign currency forward contracts[(b)]	—	9	—	—	—	—

(a) Cash flow hedges
(b) Derivatives not designated as hedging instruments
(c) Net investment hedges
(d) Fair value hedges

Long-Term Debt

($ in millions)	December 31, 2018[(a)]	December 31, 2017[(b)]
Long-term debt - carrying value	$5,000	$4,123
Long-term debt - fair value	$5,101	$4,341

(a) Excluding capital lease obligations of $12 million and short term borrowings of $4 million as of December 31, 2018.
(b) Excluding capital lease obligations of $15 million and short term borrowings of $8 million as of December 31, 2017.

The fair values of the debt instruments were based on discounted cash flows and interest rates then currently available to the Company for instruments of the same remaining maturities and were measured using level 2 inputs.
Assets and liabilities reported at fair value on a nonrecurring basis
There were no significant adjustments to the fair value of nonmonetary assets or liabilities during the year ended December 31, 2018. In conjunction with the 2016 restructuring actions, certain nonmonetary assets were written down to their fair value. Refer to Note 8, "Business Restructuring" for further details associated with these actions."

Call and put option on noncontrolling interest
PPG owns a majority interest in a coatings business whose financial results are included in PPG’s consolidated financial statements. PPG has recorded the noncontrolling interest in this consolidated affiliate as a liability instead of equity on its

consolidated balance sheets due to call and put option provisions associated with the noncontrolling interest, which have similar terms. This liability was $40 million and $44 million at December 31, 2018 and 2017, respectively.

11. Earnings Per Common Share

($ in millions, except per share amounts)	2018	2017	2016
Earnings per common share (attributable to PPG)			
Income from continuing operations, net of tax	$1,323	$1,369	$543
Income from discontinued operations, net of tax	18	225	330
Net income (attributable to PPG)	$1,341	$1,594	$873
Weighted average common shares outstanding	243.9	256.1	265.6
Effect of dilutive securities:			
Stock options	0.8	0.9	0.8
Other stock compensation plans	0.7	0.8	1.0
Potentially dilutive common shares	1.5	1.7	1.8
Adjusted weighted average common shares outstanding	245.4	257.8	267.4
Earnings per common share (attributable to PPG):			
Income from continuing operations, net of tax	$5.43	$5.34	$2.05
Income from discontinued operations, net of tax	0.07	0.88	1.24
Net income (attributable to PPG)	$5.50	$6.22	$3.29
Earnings per common share - assuming dilution (attributable to PPG)			
Income from continuing operations, net of tax	$5.40	$5.31	$2.04
Income from discontinued operations, net of tax	0.07	0.87	1.23
Net income (attributable to PPG)	$5.47	$6.18	$3.27

There were 1.0 million, 0.6 million, and 0.6 million outstanding stock options excluded in 2018, 2017 and 2016, respectively, from the computation of earnings per diluted common share due to their anti-dilutive effect.

12. Income Taxes

The provision for income taxes by taxing jurisdiction and by significant components consisted of the following:

($ in millions)	2018	2017	2016
Current			
U.S. federal	$7	$179	($251)
U.S. state and local	4	49	(12)
Foreign	297	349	306
Total current income tax expense	$308	$577	$43
Deferred			
U.S. federal	$44	$107	$173
U.S. state and local	7	(16)	(10)
Foreign	(6)	(53)	8
Total deferred income tax expense	$45	$38	$171
Total income tax expense	$353	$615	$214

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A reconciliation of the statutory U.S. corporate federal income tax rate to the Company’s effective tax rate follows:

	2018	2017	2016
U.S. federal income tax rate	21.0 %	35.0 %	35.0 %
Changes in rate due to:			
U.S. tax cost - Tax Cuts & Jobs Act	(2.5)	11.0	—
U.S./foreign tax differential	3.3	(9.3)	(17.7)
U.S. current tax benefit on foreign exchange realization	—	(4.9)	(3.0)
U.S. tax incentives	(1.0)	(2.3)	(3.7)
U.S. tax (benefit) cost on foreign dividends	(0.4)	(1.9)	0.4
U.S. state and local taxes	0.5	1.1	(1.8)
U.S. deferred tax benefit on foreign income	—	(0.6)	(3.1)
Asbestos charge	—	—	19.1
Other	—	2.6	2.3
Effective income tax rate	20.9 %	30.7 %	27.5 %

On December 22, 2017, the U.S. enacted the Tax Cuts and Jobs Act (the “Act”) which, among other things lowered the U.S. corporate statutory income tax rate from 35% to 21%, eliminated certain deductible items and added other deductible items for corporations, imposed a tax on unrepatriated foreign earnings and eliminated U.S. taxes on most future foreign earnings.

In December 2017, as a result of the Act, the Company recorded a provisional net tax charge of $134 million, which included a tax on unrepatriated earnings of $250 million, a charge of approximately $125 million related to the remeasurement of U.S. deferred taxes at the new enacted statutory rate, partially offset by a benefit from the reversal of an existing deferred tax liability on repatriated foreign earnings of approximately $150 million and a benefit resulting from PPG’s decision to accelerate recognition of certain U.S. tax attributes during the fourth quarter.

During 2018, PPG implemented updated regulations for certain aspects of the Act and PPG completed its accounting for the provisional amounts recognized in its consolidated financial statements in 2017. The finalization of the provisional accounting during 2018 resulted in a net tax benefit of $42 million, which consisted of a benefit of $20 million related to unrepatriated foreign earnings, a benefit of $22 million for adjustments to certain deferred taxes, a benefit of $14 million for foreign derived intangible income, partially offset by an expense of $14 million for global intangible low taxed income.

The total tax expense for 2017 includes a deferred tax benefit of $22 million related to the $60 million of pre-tax pension settlement charges discussed in Note 13, “Employee Benefit Plans.” During 2016, the Company recorded a $151 million net tax charge associated with the funding of the Pittsburgh Corning (“PC”) asbestos settlement trust (the “Trust”) described in Note 14, "Commitments and Contingent Liabilities." Further, in conjunction with the funding of the Trust, PPG provided taxes on the earnings of certain foreign subsidiaries and recorded one-time book tax benefits for its contribution of the Company's ownership interest in PC's European subsidiary to the Trust and for a change in the measurement of certain deferred tax liabilities.

Income (Loss) before income taxes of the Company’s U.S. operations for 2018, 2017 and 2016 was $571 million, $713 million and $(210) million, respectively. Income before income taxes of the Company’s foreign operations for 2018, 2017 and 2016 was $1,122 million, $1,292 million and $989 million, respectively.

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Deferred income taxes

Deferred income taxes are provided for the effect of temporary differences that arise because there are certain items treated differently for financial accounting than for income tax reporting purposes. The deferred tax assets and liabilities are determined by applying the enacted tax rate in the year in which the temporary difference is expected to reverse.

($ in millions)	2018	2017
Deferred income tax assets related to		
Employee benefits	$366	$399
Contingent and accrued liabilities	149	164
Operating loss and other carry-forwards	251	221
Inventories	7	6
Property	48	51
Other	82	135
Valuation allowance	(164)	(173)
Total	$739	$803
Deferred income tax liabilities related to		
Property	$310	$314
Intangibles	545	578
Employee benefits	46	11
Derivatives	1	1
Undistributed foreign earnings	5	24
Other	9	20
Total	$916	$948
Deferred income tax liabilities – net	($177)	($145)

Net operating loss and credit carryforwards

($ in millions)	2018	2017	Expiration
Available net operating loss carryforwards:			
Indefinite expiration	$462	$447	NA
Definite expiration	796	247	2019 - 2038
Total	$1,258	$694	NA
Net operating loss carryforwards, tax effected	$192	$210	NA
Income tax credit carryforwards	$61	$9	2019 - 2038

A valuation allowance of $164 million and $173 million has been established for carry-forwards and certain other items at December 31, 2018 and 2017, when the ability to utilize them is not likely.

Undistributed foreign earnings

The Company had $3 billion and $3.4 billion of undistributed earnings of non-U.S. subsidiaries as of December 31, 2018 and 2017, respectively. These amounts relate to approximately 250 subsidiaries in approximately 75 taxable jurisdictions. The Company estimates repatriation of undistributed earnings of non-U.S. subsidiaries as of December 31, 2018 and 2017 would have resulted in a U.S. tax cost of approximately $19 million and $30 million, respectively.

Over the past several years, PPG has established deferred tax liabilities on certain undistributed earnings, namely in connection with divestitures and the funding of the Pittsburgh Corning Asbestos Trust (refer to Note 14, “Commitments and Contingent Liabilities”).

As of December 31, 2018, the Company has not changed its intention to reinvest foreign earnings indefinitely or repatriate when it is tax effective to do so, and as such has not established a liability for foreign withholding taxes or other costs that would be incurred if the earnings were repatriated.

Unrecognized tax benefits

The Company files federal, state and local income tax returns in numerous domestic and foreign jurisdictions. In most tax jurisdictions, returns are subject to examination by the relevant tax authorities for a number of years after the

returns have been filed. The Company is no longer subject to examinations by tax authorities in any major tax jurisdiction for years before 2007. Additionally, the Company is no longer subject to examination by the Internal Revenue Service for U.S. federal income

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tax returns filed for years through 2014. The examinations of the Company's U.S. federal income tax returns for 2015 through 2016 are currently underway.

A reconciliation of the total amounts of unrecognized tax benefits (excluding interest and penalties) as of December 31 follows:

($ in millions)	2018	2017	2016
January 1	$148	$94	$82
Current year tax positions - additions	36	37	25
Prior year tax positions - additions	17	26	8
Prior year tax positions - reductions	(6)	—	(11)
Statute of limitations expirations	(9)	(8)	(8)
Settlements	(15)	(10)	—
Foreign currency translation	(5)	9	(2)
December 31	$166	$148	$94

The Company expects that any reasonably possible change in the amount of unrecognized tax benefits in the next 12 months would not be significant.

The total amount of unrecognized tax benefits that, if recognized, would affect the effective tax rate was $140 million as of December 31, 2018.

Interest and penalties

($ in millions)	2018	2017	2016
Accrued interest and penalties related to unrecognized tax benefits	$16	$15	$9
Loss recognized in income tax expense related to interest and penalties	$2	$4	$1

The Company recognizes accrued interest and penalties related to unrecognized tax benefits in income tax expense.

13. Employee Benefit Plans

Defined Benefit Plans

PPG has defined benefit pension plans that cover certain employees worldwide. The principal defined benefit pension plans are those in the U.S., Canada, the Netherlands and the U.K. These plans in the aggregate represent approximately 92% of the projected benefit obligation at December 31, 2018, of which the U.S. defined benefit pension plans represent the largest component.

U.S. defined benefit plans

As of January 1, 2006, the Company closed the salaried defined benefit plans to new entrants. The defined benefit plan of certain hourly employees was closed to new entrants in 2006 or thereafter. Eligible employees participate in a defined contribution retirement plan. In 2011, the Company approved amendments related to certain U.S. defined benefit plans so that depending upon the affected employee's combined age and years of service to PPG, certain employees stopped or will stop accruing benefits either in 2011 or at the end of 2020. The affected employees will participate in the Company's defined contribution retirement plans from the date their benefits under their respective defined benefit plans are frozen. The Company has amended other defined benefit plans in other countries in a similar way and plans to continue reviewing and potentially changing other PPG defined benefit plans in the future.

Postretirement medical

PPG sponsors welfare benefit plans that provide postretirement medical and life insurance benefits for certain U.S. and Canadian employees and their dependents of which the U.S. welfare benefit plans represent approximately 86% of the projected benefit obligation at December 31, 2018. Salaried and certain hourly employees in the U.S. hired on or after October 1, 2004, or rehired on or after October 1, 2012 are not eligible for postretirement medical benefits.

The U.S. welfare benefit plans include an Employee Group Waiver Plan ("EGWP") for certain Medicare-eligible retirees and their dependents which includes a fully-insured Medicare Part D prescription drug plan. As such, PPG is not eligible to receive the federal subsidy provided under the Medicare Act of 2003 for these retirees and their dependents.

These plans in the U.S. and Canada require retiree contributions based on retiree-selected coverage levels for certain retirees and their dependents and provide for sharing of future benefit cost increases between PPG and participants based on management discretion. The Company has the right to modify, amend or terminate certain of these benefit

plans in the future.

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In 2016, the Company communicated plan design changes to certain Medicare-eligible retiree plan participants. Effective January 1, 2017, the Company-sponsored Medicare-eligible plans were replaced by a Medicare private exchange. By offering retiree health coverage through a private Medicare exchange, PPG is able to provide Medicare-eligible participants with more choice of plans and plan designs, greater flexibility, and different price points for coverage. Beginning January 1, 2017, PPG’s contribution for health care coverage related to Medicare-eligible retirees is in the form of a tax-free account known as a Health Reimbursement Arrangement (HRA). The HRA can be used to pay for health care and prescription drug plan premiums and certain out-of-pocket medical costs; unused funds can be carried over to future years.

The announcement of these plan design changes triggered a remeasurement of PPG’s retiree medical benefit obligation using prevailing interest rates. The plan design change resulted in a $306 million reduction in the Company's postretirement benefit obligation. PPG accounted for the plan design change prospectively, and the plan design change will be amortized to periodic postretirement benefit cost over a 5.6 year period.

The following table sets forth the changes in projected benefit obligations (“PBO”) (as calculated as of December 31), plan assets, the funded status and the amounts recognized on the accompanying consolidated balance sheet for the Company’s defined benefit pension and other postretirement benefit plans:

	Defined Benefit Pension Plans					
	United States		International		Total PPG	
($ in millions)	2018	2017	2018	2017	2018	2017
Projected benefit obligation, January 1	$1,706	$1,692	$1,756	$1,560	$3,462	$3,252
Service cost	17	19	11	14	28	33
Interest cost	57	60	40	38	97	98
Actuarial losses (gains) - net	(129)	124	(117)	61	(246)	185
Benefits paid	(70)	(104)	(55)	(63)	(125)	(167)
Plan transfers	—	—	(8)	—	(8)	—
Foreign currency translation adjustments	—	—	(88)	165	(88)	165
Settlements and curtailments	—	(84)	(24)	(1)	(24)	(85)
Former glass business changes, net	—	—	—	(1)	—	(1)
Other	1	(1)	3	(17)	4	(18)
Projected benefit obligation, December 31	$1,582	$1,706	$1,518	$1,756	$3,100	$3,462
Market value of plan assets, January 1	$1,196	$1,115	$1,687	$1,446	$2,883	$2,561
Actual return on plan assets	(82)	156	(53)	133	(135)	289
Company contributions	75	54	24	33	99	87
Participant contributions	—	—	—	1	—	1
Benefits paid	(49)	(47)	(53)	(62)	(102)	(109)
Plan settlements	—	(82)	(24)	(13)	(24)	(95)
Foreign currency translation adjustments	—	—	(95)	149	(95)	149
Other	—	—	(8)	—	(8)	—
Market value of plan assets, December 31	$1,140	$1,196	$1,478	$1,687	$2,618	$2,883
Funded Status	($442)	($510)	($40)	($69)	($482)	($579)
Amounts recognized in the Consolidated Balance Sheet:						
Other assets (long-term)	—	—	189	173	189	173
Accounts payable and accrued liabilities	(18)	(16)	(8)	(7)	(26)	(23)
Accrued pensions	(424)	(494)	(221)	(235)	(645)	(729)
Net liability recognized	($442)	($510)	($40)	($69)	($482)	($579)

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	Other Postretirement Benefit Plans					
	United States		International		Total PPG	
($ in millions)	2018	2017	2018	2017	2018	2017
Projected benefit obligation, January 1	$641	$692	$112	$100	$753	$792
Service cost	9	10	1	—	10	10
Interest cost	21	21	3	3	24	24
Actuarial losses (gains) - net	(38)	(39)	(9)	12	(47)	(27)
Benefits paid	(45)	(43)	(4)	(5)	(49)	(48)
Foreign currency translation adjustments	—	—	(8)	8	(8)	8
Former glass business changes, net	—	—	—	(8)	—	(8)
Other	(1)	—	(1)	2	(2)	2
Projected benefit obligation, December 31	$587	$641	$94	$112	$681	$753
Amounts recognized in the Consolidated Balance Sheet:						
Accounts payable and accrued liabilities	(48)	(48)	(4)	(6)	(52)	(54)
Other postretirement benefits	(539)	(593)	(90)	(106)	(629)	(699)
Net liability recognized	($587)	($641)	($94)	($112)	($681)	($753)

The PBO is the actuarial present value of benefits attributable to employee service rendered to date, including the effects of estimated future pay increases. The accumulated benefit obligation (“ABO”) is the actuarial present value of benefits attributable to employee service rendered to date, but does not include the effects of estimated future pay increases. The ABO for all defined benefit pension plans as of December 31, 2018 and 2017 was $2,944 million and $3,382 million, respectively.

The following table details the pension plans where the benefit liability exceeds the fair value of the plan assets:

	Pensions	
($ in millions)	2018	2017
Plans with PBO in Excess of Plan Assets:		
Projected benefit obligation	$1,935	$2,544
Fair value of plan assets	$1,269	$1,792
Plans with ABO in Excess of Plan Assets:		
Accumulated benefit obligation	$1,883	$2,434
Fair value of plan assets	$1,269	$1,749

Net actuarial losses and prior service cost/(credit) deferred in accumulated other comprehensive loss

	Pensions		Other Postretirement Benefits	
($ in millions)	2018	2017	2018	2017
Accumulated net actuarial losses	$800	$835	$113	$180
Accumulated prior service cost (credit)	2	—	(178)	(239)
Total	$802	$835	($65)	($59)

The accumulated net actuarial losses for pensions and other postretirement benefits relate primarily to historical declines in the discount rate as well as updated mortality assumptions. The accumulated net actuarial losses exceed 10% of the higher of the market value of plan assets or the PBO at the beginning of the year, therefore, amortization of such excess has been included in net periodic benefit costs for pension and other postretirement benefits in each of the last three years. The amortization period is the average remaining service period of active employees expected to receive benefits unless a plan is mostly inactive in which case the amortization period is the average remaining life expectancy of the plan participants. Accumulated prior service cost (credit) is amortized over the future service periods of those employees who are active at the dates of the plan amendments and who are expected to receive benefits.

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The net decrease in Accumulated other comprehensive loss (pre-tax) in 2018 relating to defined benefit pension and other postretirement benefits is primarily attributable to pension and other postretirement plan design changes, as follows:

($ in millions)	Pensions	Other Postretirement Benefits
Net actuarial loss (gain) arising during the year	$39	($47)
New prior service cost	2	1
Amortization of actuarial loss	(63)	(19)
Amortization of prior service credit	—	60
Foreign currency translation adjustments	(10)	(1)
Impact of settlements and curtailments	(1)	—
Net change	($33)	($6)

The 2018 net actuarial gain related to the Company’s pension and other postretirement benefit plans of $8 million was primarily due to an increase in the weighted average discount rate used to determine the benefit obligation at December 31, 2018, partially offset by asset performance losses on plan assets for the year.

Net periodic benefit cost

Effective January 1, 2018, PPG adopted ASU No. 2017-07, "Improving the Presentation of Net Periodic Pension Cost and Net Periodic Postretirement Benefit Cost." See Note 1, "Summary of Significant Accounting Policies" for more information.

	Pensions			Other Postretirement Benefits		
($ in millions)	2018	2017	2016	2018	2017	2016
Service cost	$28	$33	$48	$10	$10	$15
Interest cost	97	98	142	24	24	31
Expected return on plan assets	(150)	(141)	(213)	—	—	—
Amortization of prior service credit	—	—	(1)	(60)	(59)	(31)
Amortization of actuarial losses	63	75	110	19	12	19
Settlements, curtailments, and special termination benefits	5	60	1,015	—	—	—
Net periodic benefit cost/(income)	$43	$125	$1,101	($7)	($13)	$34

Service cost for net periodic pension and other postretirement benefit costs is included in Cost of sales, exclusive of depreciation and amortization, Selling, general and administrative, and Research and development, net in the accompanying consolidated statements of income. All other components of net periodic benefit cost are now recorded in Other charges, except for pension settlement charges, in the accompanying consolidated statements of income.

Key assumptions

The following weighted average assumptions were used to determine the benefit obligation for the Company’s defined benefit pension and other postretirement plans as of December 31, 2018 and 2017:

	United States		International		Total PPG	
	2018	2017	2018	2017	2018	2017
Discount rate	4.4%	3.7%	2.9%	2.5%	3.7%	3.2%
Rate of compensation increase	1.5%	1.5%	0.9%	1.1%	1.2%	1.3%

The following weighted average assumptions were used to determine the net periodic benefit cost for the Company’s defined benefit pension and other postretirement benefit plans for the three years in the period ended December 31, 2018:

	2018	2017	2016
Discount rate	3.2%	3.6%	3.6%
Expected return on assets	5.4%	5.4%	6.1%

Rate of compensation increase 1.2 % 1.3 % 1.6 %

These assumptions for each plan are reviewed on an annual basis. In determining the expected return on plan asset assumption, the Company evaluates the mix of investments that comprise each plan's assets and external forecasts of future long-term investment returns. The Company compares the expected return on plan assets assumption to actual historic returns to ensure reasonability. For 2018, the return on plan assets assumption for PPG's U.S. defined benefit pension plans was 7.4%. A change in the rate of return of 1 percentage point, with other assumptions held constant, would impact 2018

net periodic pension expense by $12 million. The global expected return on plan assets assumption to be used in determining 2019 net periodic pension expense will be 5.4% (7.4% for the U.S. plans only).
The discount rate used in accounting for pensions and other postretirement benefits is determined by reference to a current yield curve and by considering the timing and amount of projected future benefit payments. In 2016, the Company changed the method it uses to estimate the service and interest cost components of net periodic benefit cost for pension and other postretirement benefit costs for substantially all of its U.S. and foreign plans. Historically, the service and interest cost components were estimated using a single weighted-average discount rate derived from the yield curve used to measure the projected benefit obligation at the beginning of the period. The Company has elected to use a full yield curve approach ("Split-rate" method) in the estimation of these components of benefit cost by applying specific spot rates along the yield curve used in the determination of the benefit obligation to the relevant projected cash flows. The Company made this change to improve the correlation between projected benefit cash flows and the corresponding yield curve spot rates and to provide a more precise measurement of service and interest costs. This change does not affect the measurement of the Company's total benefit obligations. The Company accounted for this change as a change in estimate and, accordingly, began recognizing its effect in fiscal year 2016. A change in the discount rate of 1 percentage point, with all other assumptions held constant, would impact 2019 net periodic benefit expense for our defined benefit pension and other postretirement benefit plans by $19 million and $22 million, respectively.
In 2018, the Company updated mortality tables used to calculate its U.S. defined benefit pension and other postretirement benefit liabilities. The Company considered the available mortality tables released by the Society of Actuaries' Retirement Plans Experience Committee and performed a review of its own mortality history, as well the industry in which the Company operates to assess future improvements in mortality rates based on its U.S. population. The Company chose to value its U.S. defined benefit pension and other postretirement benefit liabilities using a slightly modified assumption of future mortality which better approximates our plan participant population.
The weighted-average healthcare cost trend rate (inflation) used for 2018 was 5.8% declining to a projected 4.5% in the year 2024. For 2019, the assumed weighted-average healthcare cost trend rate used will be 5.6% declining to a projected 4.4% between 2018 and 2039 for medical and prescription drug costs, respectively. These assumptions are reviewed on an annual basis. In selecting rates for current and long-term health care cost assumptions, the Company takes into consideration a number of factors, including the Company's actual health care cost increases, the design of the Company's benefit programs, the demographics of the Company's active and retiree populations and external expectations of future medical cost inflation rates.
Contributions to defined benefit pension plans

($ in millions)	2018	2017	2016
U.S. defined benefit pension plans[(a)]	$75	$54	$134
Non-U.S. defined benefit pension plans[(b)]	$24	$33	$54

(a) During 2016, U.S. contributions totaling $12 million associated with the former glass segment were recast as cash flows from operations - discontinued operations and are excluded from the table above.

(b) During 2016, non-U.S. contributions totaling $4 million associated with the former European fiberglass business were recast as cash flows from operations - discontinued operations and are excluded from the table above.

PPG made voluntary contributions of $75 million to its U.S. defined benefit pension plans in 2018. Contributions made to PPG's non-U.S. defined benefit pension plans in 2018 and 2017 were required by local funding requirements. PPG expects to make mandatory contributions to its non-U.S. plans in the range of $20 million to $30 million in 2019. PPG may make voluntary contributions to its defined benefit pension plans in 2019 and beyond.
Benefit payments
The estimated benefits expected to be paid under the Company's defined benefit pension and other postretirement benefit plans are:

($ in millions)	Pensions	Other Postretirement Benefits
2019	$136	$53

2020	$139	$53
2021	$145	$53
2022	$147	$52
2023	$153	$51
2024 to 2028	$826	$228

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U.S. Qualified Pension

Beginning in 2012, the Company initiated a lump sum payout program that gave certain terminated vested participants in certain U.S. defined benefit pension plans the option to take a one-time lump sum cash payment in lieu of receiving a future monthly annuity. During 2017, PPG paid $87 million in lump sum benefits to terminated vested participants who elected to participate in the program. As the lump-sum payments were in excess of the expected 2017 service and interest costs for the qualified pension plans, PPG remeasured the periodic benefit obligation of the qualified plans and recorded a settlement charge totaling $35 million ($22 million after-tax).

U.S. Non-qualified Pension

In the first quarter 2017, PPG made lump-sum payments to certain retirees who had participated in PPG's U.S. non-qualified pension plan (the "Nonqualified Plan") totaling approximately $40 million. As the lump-sum payments were in excess of the expected 2017 service and interest costs for the Nonqualified Plan, PPG remeasured the periodic benefit obligation of the Nonqualified Plan as of March 1, 2017 and recorded a settlement charge totaling $22 million ($14 million after-tax).

Plan assets

Each PPG sponsored defined benefit pension plan is managed in accordance with the requirements of local laws and regulations governing defined benefit pension plans for the exclusive purpose of providing pension benefits to participants and their beneficiaries. Investment committees comprised of PPG managers have fiduciary responsibility to oversee the management of pension plan assets by third party asset managers. Pension plan assets are held in trust by financial institutions and managed on a day-to-day basis by the asset managers. The asset managers receive a mandate from each investment committee that is aligned with the asset allocation targets established by each investment committee to achieve the plan’s investment strategies. The performance of the asset managers is monitored and evaluated by the investment committees throughout the year.

Pension plan assets are invested to generate investment earnings over an extended time horizon to help fund the cost of benefits promised under the plans while mitigating investment risk. The asset allocation targets established for each pension plan are intended to diversify the investments among a variety of asset categories and among a variety of individual securities within each asset category to mitigate investment risk and provide each plan with sufficient liquidity to fund the payment of pension benefits to retirees.

The following summarizes the weighted average target pension plan asset allocation as of December 31, 2018 and 2017 for all PPG defined benefit plans:

Asset Category	2018	2017
Equity securities	15-45%	15-45%
Debt securities	30-65%	30-65%
Real estate	0-10%	0-10%
Other	20-40%	20-40%

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The fair values of the Company's pension plan assets at December 31, 2018 and 2017, by asset category, are as follows:

($ in millions)	December 31, 2018				December 31, 2017			
	Level 1[1]	Level 2[1]	Level 3[1]	Total	Level 1[1]	Level 2[1]	Level 3[1]	Total
Asset Category								
Equity securities:								
U.S.								
Large cap	$43	$94	$—	$137	$—	$83	$—	$83
Small cap	23	—	—	23	29	—	—	29
Non-U.S.								
Developed and emerging markets[2]	115	103	—	218	115	79	—	194
Debt securities:								
Cash and cash equivalents	3	19	—	22	—	11	—	11
Corporate[3]								
U.S.[4]	—	220	77	297	—	201	86	287
Developed and emerging markets[2]	—	4	—	4	—	43	—	43
Diversified[5]	—	142	—	142	—	124	—	124
Government								
U.S.[4]	68	8	—	76	68	1	—	69
Developed markets	—	6	—	6	—	101	—	101
Other[6]	—	14	359	373	—	14	418	432
Real estate, hedge funds, and other	—	304	359	663	—	185	498	683
Total assets in the fair value hierarchy	$252	$914	$795	$1,961	$212	$842	$1,002	$2,056
Common-collective trusts[7]	—	—	—	657	—	—	—	827
Total Investments	$252	$914	$795	$2,618	$212	$842	$1,002	$2,883

(1) These levels refer to the accounting guidance on fair value measurement described in Note 10, "Financial Instruments, Hedging Activities and Fair Value Measurements."

(2) These amounts represent holdings in investment grade debt or equity securities of issuers in both developed markets and emerging economies.

(3) This category represents investment grade debt securities from a diverse set of industry issuers.

(4) These investments are primarily long duration fixed income securities.

(5) This category represents commingled funds invested in diverse portfolios of debt securities.

(6) This category includes mortgage-backed and asset backed debt securities, municipal bonds and other debt securities including derivatives.

(7) Certain investments that are measured at net asset value per share (or its equivalent) are not required to be classified in the fair value hierarchy.

The change in the fair value of the Company's Level 3 pension assets for the years ended December 31, 2018 and 2017 was as follows:

($ in millions)	Real Estate	Other Debt Securities	Hedge Funds and Other Assets	Total
January 1, 2017	$129	$16	$370	$515
Realized gains	11	45	3	59
Unrealized losses	—	—	5	5
Transfers (out)/in, net	(5)	355	36	386
Foreign currency losses	3	2	32	37
December 31, 2017	$138	$418	$446	$1,002
Realized gains (losses)	9	(29)	10	(10)
Unrealized losses	—	—	(28)	(28)

Transfers (out)/in, net	(6)	(12)	(119)	(137)
Foreign currency loss	(4)	(18)	(10)	(32)
December 31, 2018	$137	$359	$299	$795

Real estate properties are externally appraised at least annually by reputable, independent appraisal firms. Property valuations are also reviewed on a regular basis and are adjusted if there has been a significant change in circumstances related to the property since the last valuation.

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Other debt securities consist of insurance contracts, which are externally valued by insurance companies based on the present value of the expected future cash flows.

Hedge funds consist of a wide range of investments which target a relatively stable investment return. The underlying funds are valued at different frequencies, some monthly and some quarterly, based on the value of the underlying investments. Other assets consist primarily of small investments in private equity funds and senior secured debt obligations of non-investment grade borrowers.

U.S. pension annuity contracts

In June 2016, the Company entered into a Definitive Purchase Agreement by and among the Company, Massachusetts Mutual Life Insurance Company (“MassMutual”) and State Street Bank & Trust Company (“State Street”), as independent fiduciary to the Company’s United States defined benefit pension plans (the “Plans”), and a Definitive Purchase Agreement by and among the Company, Metropolitan Life Insurance Company (“MetLife”) and State Street.

In August 2016, pursuant to the two Definitive Purchase Agreements, the Plans purchased group annuity contracts that irrevocably transferred to the two insurance companies certain pension benefit obligations for approximately 13,200 of the Company’s retirees in the United States who started receiving their monthly retirement benefit payments on or before April 1, 2016. The value of the benefit obligation of each affected former salaried employee’s retirement benefit obligation is irrevocably guaranteed by, and split equally between, MassMutual and MetLife. Pursuant to these Definitive Purchase Agreements, MassMutual serves as the lead administrator. The value of each affected former hourly employee’s retirement benefit obligation is irrevocably guaranteed by MetLife, and MetLife will serve as the administrator. The amount of each affected retiree’s annuity payment is equal to the amount of such individual’s pension benefit. The purchase of group annuity contracts was funded directly by the assets of the Plans. By irrevocably transferring the obligations and assets to MassMutual and MetLife, the Company reduced its overall pension projected benefit obligation by approximately $1.6 billion and recognized a non-cash pension settlement charge of approximately $535 million after-tax ($857 million pre-tax).

Following the transfer of the aforementioned U.S. retiree obligations and assets to third party insurers, PPG contributed $29 million and $146 million to its U.S. plans in 2017 and 2016, respectively. These contributions were funded using cash on hand.

During 2016, in advance of the purchase of group annuity contracts, PPG merged two of its qualified defined benefit pension plans that contained retired plan participants into one surviving plan. In conjunction with the merger and purchase of group annuity contracts, PPG remeasured its qualified pension plan benefit obligations using prevailing discount rates as of July 31, 2016 which averaged 3.6% as compared to a 4.5% discount rate as of December 31, 2015. The remeasurement increased the Company's cumulative pension benefit obligation of its remaining plans by $306 million and increased the Company's full year 2016 qualified defined benefit pension expense by approximately $10 million.

Canadian pension annuity contracts

In 2016, the Company purchased group annuity contracts that transferred pension benefit obligations for certain of the Company’s retirees and terminated vested participants in Canada who started receiving their monthly retirement benefit payments on or before April 1, 2016 to Sun Life Assurance Company of Canada (“Sun Life”) and The Canada Life Assurance Company (“Canada Life”). The amount of each affected retiree’s annuity payment is equal to the amount of such individual’s pension benefit. The purchase of group annuity contracts was funded directly by the assets of the Canadian plans. By transferring the obligations and assets to Sun Life and Canada Life, the Company reduced its overall pension projected benefit obligation by approximately $200 million and recognized a non-cash pension settlement charge of $47 million after-tax ($64 million pre-tax). The Company made voluntary contributions aggregating $7 million to the Canadian plans in 2016 related to the pension annuity contracts. These contributions were funded using cash on hand.

Sale of the flat glass business

In 2016, PPG completed the sale of its flat glass business as discussed in Note 3, “Acquisitions and Divestitures.” PPG transferred to Vitro certain defined benefit pension liabilities resulting in a settlement charge of $11 million which was included in Income from discontinued operations, net of tax. This transaction lowered the projected benefit obligation of PPG’s defined benefit pension plan by approximately $100 million. PPG transferred pension assets of $55 million in

2016 in connection with the sale and transferred an additional $20 million of pension assets in 2018 as a result of finalization of the pension transfer.

Sale of the European fiber glass business

In 2016, PPG completed the sale of its European fiber glass business as discussed in Note 3, “Acquisitions and Divestitures.” PPG transferred to NEG certain defined benefit pension liabilities resulting in a net settlement charge of $46 million. This amount is included in Income from discontinued operations, net of tax in 2016.This transaction lowered the projected benefit

obligation of PPG's defined benefit pension plans by approximately $340 million. In 2016, PPG transferred pension assets of approximately $250 million in connection with the sale.

Retained liabilities and legacy settlement charges

PPG has retained certain liabilities for defined benefit pension and postretirement benefits earned for service up to the date of sale of its former automotive glass and service business for employees who were active as of the divestiture date and for individuals who were retirees of the business as of the divestiture date, totaling $313 million and $369 million at December 31, 2018 and 2017, respectively. PPG recognized expense of $1 million, $2 million, and $20 million related to these obligations in 2018, 2017, and 2016, respectively.

There have been multiple PPG facility closures in Canada. These various plant closures have resulted in partial and full windups, and related settlement charges, of pension plans for various hourly and salary employees employed by these locations. The charges are recorded for the individual plans when a particular windup is approved by the Canadian pension authorities and the Company has made all contributions to the individual plan and has discharged the liability through either lump sum payments to participants or purchasing annuities. The Company may incur additional charges related to this matter in the future.

During 2016, PPG completed the wind-up of two legacy Canadian plans and recorded after-tax wind-up charges totaling $34 million ($47 million pre-tax). Cash contributions made in conjunction with these windups were approximately $1 million.

Other Plans

Defined contribution plans

The Company has defined contribution plans for certain employees in the U.S., China, United Kingdom, Australia, Italy, and other countries. For the years ended December 31, 2018, 2017, and 2016, the Company recognized expense for its defined contribution retirement plans of $63 million, $57 million and $70 million, respectively. The Company's annual cash contributions to its defined contribution retirement plans approximated the expense recognized in each year.

Employee savings plan

PPG's Employee Savings Plan ("Savings Plan") covers substantially all employees in the U.S., Puerto Rico and Canada. The Company makes matching contributions to the Savings Plan, at management's discretion, based upon participants' savings, subject to certain limitations. For most participants not covered by a collective bargaining agreement, Company-matching contributions are established each year at the discretion of the Company and are applied to participant savings up to a maximum of 6% of eligible participant compensation. For those participants whose employment is covered by a collective bargaining agreement, the level of Company-matching contribution, if any, is determined by the relevant collective bargaining agreement. The Company-matching contribution remained at 100% for 2018.

In 2016, the Company terminated its U.S. defined contribution plan and subsequently merged the plan into the Savings Plan. Under the combined plan, eligible employees will continue to receive a contribution equal to between 2% and 5% of annual compensation, based on age and years of service.

Compensation expense and cash contributions related to the Company match of participant contributions to the Savings Plan for 2018, 2017, and 2016 totaled $47 million, $46 million and $48 million, respectively. A portion of the Savings Plan qualifies under the Internal Revenue Code as an Employee Stock Ownership Plan. Accordingly, dividends received on PPG shares held in that portion of the Savings Plan totaling $13 million, $14 million, and $14 million for 2018, 2017, and 2016, respectively, are deductible for U.S. Federal tax purposes.

Deferred compensation plan

The Company has a deferred compensation plan for certain key managers which allows them to defer a portion of their compensation in a phantom PPG stock account or other phantom investment accounts. The amount deferred earns a return based on the investment options selected by the participant. The amount owed to participants is an unfunded and unsecured general obligation of the Company. Upon retirement, death, disability, termination of employment, scheduled payment or unforeseen emergency, the compensation deferred and related accumulated earnings are distributed in accordance with the participant's election in cash or in PPG stock, based on the accounts selected by the participant.

The plan provides participants with investment alternatives and the ability to transfer amounts between the phantom non-PPG stock investment accounts. To mitigate the impact on compensation expense of changes in the market value of the liability, the Company has purchased a portfolio of marketable securities that mirror the phantom non-PPG stock investment accounts selected by the participants, except the money market accounts. These investments are carried by PPG at fair market value, and the changes in market value of these securities are also included in Income before income taxes in the consolidated statement of income. Trading occurs in this portfolio to align the securities held with the participant's phantom non-PPG stock investment accounts, except the money market accounts.

The (benefit) cost of the deferred compensation plan, comprised of dividend equivalents accrued on the phantom PPG stock account, investment income and the change in market value of the liability, was $(1) million, $19 million and $7 million in 2018, 2017 and 2016, respectively. These amounts are included in Selling, general and administrative in the consolidated statements of income. The change in market value of the investment portfolio was (expense) income of $(2) million, $18 million, and $5 million in 2018, 2017 and 2016, respectively, and is also included in Selling, general and administrative in the consolidated statements of income.

The Company's obligations under this plan, which are included in Accounts payable and accrued liabilities and Other liabilities on the consolidated balance sheet, totaled $110 million and $121 million as of December 31, 2018 and 2017, respectively, and the investments in marketable securities, which are included in Investments and Other current assets on the accompanying consolidated balance sheet, were $73 million and $83 million as of December 31, 2018 and 2017, respectively.

14. Commitments and Contingent Liabilities

PPG is involved in a number of lawsuits and claims, both actual and potential, including some that it has asserted against others, in which substantial monetary damages are sought. These lawsuits and claims may relate to contract, patent, environmental, product liability, antitrust, employment and other matters arising out of the conduct of PPG's current and past business activities. To the extent that these lawsuits and claims involve personal injury and property damage, PPG believes it has adequate insurance; however, certain of PPG's insurers are contesting coverage with respect to some of these claims, and other insurers, as they had prior to the asbestos settlement described below, may contest coverage with respect to some of the asbestos claims if the settlement is not implemented. PPG's lawsuits and claims against others include claims against insurers and other third parties with respect to actual and contingent losses related to environmental, asbestos and other matters.

The results of any current or future litigation and claims are inherently unpredictable. However, management believes that, in the aggregate, the outcome of all lawsuits and claims involving PPG will not have a material effect on PPG's consolidated financial position or liquidity; however, such outcome may be material to the results of operations of any particular period in which costs, if any, are recognized.

Asbestos matters

Prior to 2000, the Company had been named as a defendant in numerous claims alleging bodily injury from (i) exposure to asbestos-containing products allegedly manufactured, sold or distributed by the Company, its subsidiaries, or for which they are otherwise alleged to be liable; (ii) exposure to asbestos allegedly present at a facility owned or leased by the Company; or (iii) exposure to asbestos-containing products of Pittsburgh Corning Corporation ("PC") for which the Company was alleged to be liable under a variety of legal theories (the Company and Corning Incorporated were each 50% shareholders in PC).

Pittsburgh Corning Corporation asbestos bankruptcy settlement

In 2000, PC filed for Chapter 11 in the U.S. Bankruptcy Court for the Western District of Pennsylvania in an effort to permanently and comprehensively resolve all of its pending and future asbestos-related liability claims. At the time of the bankruptcy filing, the Company had been named as one of many defendants in approximately 114,000 open claims. The Bankruptcy Court subsequently entered a series of orders preliminarily enjoining the prosecution of asbestos litigation against PPG until after the effective date of a confirmed PC plan of reorganization. During the pendency of this preliminary injunction staying asbestos litigation against PPG, PPG and certain of its historical liability insurers negotiated a settlement with representatives of present and future asbestos claimants. That settlement was incorporated into a PC plan of reorganization that was confirmed by the Bankruptcy Court on May 24, 2013 and ultimately became effective on April 27, 2016. With the effectiveness of the plan, the preliminary injunction staying the prosecution of asbestos litigation against PPG expired by its own terms on May 27, 2016. In accordance with the settlement, the Bankruptcy Court issued a permanent channeling injunction under Section 524(g) of the Bankruptcy Code that prohibits present and future claimants from asserting claims against PPG that arise, in whole or in part, out of exposure to asbestos or asbestos-containing products manufactured, sold and/or distributed by PC or asbestos on or emanating from any PC premises. The channeling injunction, by its terms, also prohibits codefendants in cases that are subject to the channeling injunction from asserting claims against PPG for contribution, indemnification or other recovery. The channeling injunction also precludes the prosecution of claims against PPG arising from alleged

exposure to asbestos or asbestos-containing products to the extent that a claimant is alleging or seeking to impose liability, directly or indirectly, for the conduct of, claims against, or demands on PC by reason of PPG's: (i) ownership of a financial interest in PC; (ii) involvement in the management of PC, or service as an officer, director or employee of PC or a related party; (iii) provision of insurance to PC or a related party; or (iv) involvement in a financial transaction affecting the financial condition of PC or a related party. The foregoing PC related claims are referred to as "PC Relationship Claims."

The channeling injunction channels the Company's liability for PC Relationship Claims to a trust funded in part by PPG and its participating insurers for the benefit of current and future PC asbestos claimants (the "Trust"). The Trust is the sole recourse for holders of PC Relationship Claims. PPG and its affiliates have no further liability or responsibility for, and will be permanently

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protected from, pending and future PC Relationship Claims. The channeling injunction does not extend to present and future claims against PPG that arise out of alleged exposure to asbestos or asbestos-containing products historically manufactured, sold and/or distributed by PPG or its subsidiaries or for which they are alleged to be liable that are not PC Relationship Claims, and does not extend to claims against PPG alleging personal injury allegedly caused by asbestos on premises presently or formerly owned, leased or occupied by PPG. These claims are referred to as non-PC Relationship Claims.

In accordance with the PC plan of reorganization, PPG's equity interest in PC was canceled. PPG satisfied its funding obligations to the Trust on June 9, 2016, when it conveyed to the Trust the stock it owned in Pittsburgh Corning Europe and 2,777,778 shares of PPG’s common stock and made a cash payment to the Trust in the amount of $764 million. PPG’s historical insurance carriers participating in the PC plan of reorganization are required to make cash payments to the Trust of approximately $1.7 billion, subject to a right of prepayment at a 5.5% discount rate.

On October 13, 2016, the Bankruptcy Court issued an order entering a final decree and closing the Chapter 11 case. That order provided that the Bankruptcy Court retained jurisdiction to enforce any order issued in the case and any agreements approved by the court, enforce the terms and conditions or the modified third amended Plan, and consider any requests to reopen the case.

The following table outlines the impact on PPG's financial statements for the year-ended December 31, 2016, including the change in fair value of the PPG stock contributed to the Trust, the equity forward instrument and the increase in the net present value of the payments made to the trust.

	Consolidated Balance Sheet			
	Asbestos Settlement Liability		Equity Forward (Asset) Liability	Pre-tax Charge
($ in millions)	Current	Long-term		
Balance as of and Activity for the year ended December 31, 2015	$796	$252	($223)	$12
Change in fair value:				
PPG stock	34	—	—	34
Equity forward instrument	—	—	(35)	(35)
Accretion of asbestos liability	—	6	—	6
Settlement of equity forward instrument with counterparty [(a)]	—	—	(49)	—
Contribution of PCE shares and relinquishment of PC investment	(15)	—	—	—
Contribution of 2,777,778 shares of PPG stock to the PC Trust	(308)	—	308	—
Contribution of cash to the PC Trust [(a)]	(506)	(258)	—	—
Reclassification	(1)	—	(1)	—
Balance as of and Activity for the year ended December 31, 2016	$—	$—	$—	$5

(a) Cash outflows related to the asbestos settlement funding totaled $813 million in 2016.

Non-PC relationship asbestos claims

At the time PC filed for bankruptcy, PPG had been named as one of many defendants in one or more of the categories of asbestos-related claims identified above. Over the course of the 16 years during which the PC bankruptcy proceedings, and corresponding preliminary injunction staying the prosecution of asbestos-related claims against PPG, were pending, certain plaintiffs alleging premises claims filed motions seeking to lift the stay with respect to more than 1,000 individually-identified premises claims. The Bankruptcy Court granted motions to lift the stay in respect to certain of these premises claims and directed PPG to engage in a process to address any additional premises claims that were the subject of pending or anticipated lift-stay motions. As a result of the overall process as directed by the Bankruptcy Court involving more than 1,000 premises claims between 2006 and May 27, 2016, hundreds of these claims were withdrawn or dismissed without payment and approximately 650 premises claims were dismissed upon agreements by PPG and its insurers to resolve such claims in exchange for monetary payments.

With respect to the remaining claims not identified above and still reportable within the inventory of 114,000 asbestos-related claims at the time PC filed for bankruptcy, the Company considers such claims to fall within one or more of the following categories: (1) claims that have been closed or dismissed as a result of processes undertaken

during the bankruptcy; (2) claims that may have been previously filed on the dockets of state and federal courts in various jurisdictions, but are inactive as to the Company; and (3) claims that are subject, in whole or in part, to the channeling injunction and thus will be resolved, in whole or in part, in accordance with the Trust procedures established under the PC bankruptcy reorganization plan. As a result of the foregoing, the Company does not consider these three categories of claims to be open or active litigation against it, although the Company cannot now determine whether, or the extent to which, any of these claims may in the future be reinstituted, reinstated, or revived such that they may become open and active asbestos-related claims against it.

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Current open and active claims post-Pittsburgh Corning bankruptcy

The Company is aware of approximately 460 open and active asbestos-related claims pending against the Company and certain of its subsidiaries. These claims consist primarily of non-PC Relationship Claims and claims against a subsidiary of PPG. The Company is defending the remaining open and active claims vigorously.

Since April 1, 2013, a subsidiary of PPG has been implicated in claims alleging death or injury caused by asbestos-containing products manufactured, distributed or sold by a North American architectural coatings business or its predecessors which was acquired by PPG. All such claims have been either served upon or tendered to the seller for defense and indemnity pursuant to obligations undertaken by the seller in connection with the Company's purchase of the North American architectural coatings business. The seller has accepted the defense of these claims subject to the terms of various agreements between the Company and the seller. The seller's defense and indemnity obligations in connection with newly filed claims ceased with respect to claims filed after April 1, 2018.

PPG has established reserves totaling approximately $180 million for asbestos-related claims that would not be channeled to the Trust which, based on presently available information, we believe will be sufficient to encompass all of PPG's current and potential future asbestos liabilities. These reserves include a $162 million reserve established in 2009 in connection with an amendment to the PC plan of reorganization. These reserves, which are included within Other liabilities on the accompanying consolidated balance sheets, represent PPG's best estimate of its liability for these claims. PPG does not have sufficient current claim information or settlement history on which to base a better estimate of this liability in light of the fact that the Bankruptcy Court's injunction staying most asbestos claims against the Company was in effect from April 2000 through May 2016. PPG will monitor the activity associated with its remaining asbestos claims and evaluate, on a periodic basis, its estimated liability for such claims, its insurance assets then available, and all underlying assumptions to determine whether any adjustment to the reserves for these claims is required.

The amount reserved for asbestos-related claims by its nature is subject to many uncertainties that may change over time, including (i) the ultimate number of claims filed; (ii) the amounts required to resolve both currently known and future unknown claims; (iii) the amount of insurance, if any, available to cover such claims; (iv) the unpredictable aspects of the litigation process, including a changing trial docket and the jurisdictions in which trials are scheduled; (v) the outcome of any trials, including potential judgments or jury verdicts; (vi) the lack of specific information in many cases concerning exposure for which PPG is allegedly responsible, and the claimants' alleged diseases resulting from such exposure; and (vii) potential changes in applicable federal and/or state tort liability law. All of these factors may have a material effect upon future asbestos-related liability estimates. As a potential offset to any future asbestos financial exposure, under the PC plan of reorganization PPG retained, for its own account, the right to pursue insurance coverage from certain of its historical insurers that did not participate in the PC plan of reorganization. While the ultimate outcome of PPG's asbestos litigation cannot be predicted with certainty, PPG believes that any financial exposure resulting from its asbestos-related claims will not have a material adverse effect on PPG's consolidated financial position, liquidity or results of operations.

Environmental matters

It is PPG's policy to accrue expenses for environmental contingencies when it is probable that a liability has been incurred and the amount of loss can be reasonably estimated. Reserves for environmental contingencies are exclusive of claims against third parties and are generally not discounted. In management's opinion, the Company operates in an environmentally sound manner and the outcome of the Company's environmental contingencies will not have a material effect on PPG's financial position or liquidity; however, any such outcome may be material to the results of operations of any particular period in which costs, if any, are recognized. Management anticipates that the resolution of the Company's environmental contingencies will occur over an extended period of time.

As of December 31, 2018 and 2017, PPG had reserves for environmental contingencies associated with PPG's former chromium manufacturing plant in Jersey City, N.J. ("New Jersey Chrome") and for other environmental contingencies, including National Priority List sites and legacy glass and chemical manufacturing sites. These reserves are reported as Accounts payable and accrued liabilities and Other liabilities in the accompanying consolidated balance sheet.

Environmental Reserves

($ in millions)	2018	2017

New Jersey Chrome	$151	$136
Glass and chemical	90	71
Other	50	51
Total	$291	$258
Current Portion	$105	$73

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Pre-tax charges against income for environmental remediation costs are included in "Other charges" in the accompanying consolidated statement of income. The pre-tax charges and cash outlays related to such environmental remediation in 2018,
2017 and 2016, were as follows:

($ in millions)	2018	2017	2016
New Jersey Chrome	$62	$4	$60
Other	16	6	34
Total	$78	$10	$94
Cash outlays for environmental spending	$64	$44	$47

The Company continues to analyze, assess and remediate the environmental issues associated with New Jersey Chrome as further discussed below. During the past three years, charges for estimated environmental remediation costs were significantly higher than PPG's historical range. Excluding the charges related to New Jersey Chrome, pre-tax charges against income for environmental remediation have ranged between approximately $5 million and $35 million per year for the past 10 years.
Management expects cash outlays for environmental remediation costs to range from $80 million to $100 million in 2019 and $20 million to $50 million annually from 2020 through 2023.
It is possible that technological, regulatory and enforcement developments, the results of environmental studies and other factors could alter the Company's expectations with respect to future charges against income and future cash outlays. Specifically, the level of expected future remediation costs and cash outlays is highly dependent upon activity related to New Jersey Chrome as discussed below.
Remediation: New Jersey Chrome
In June 2009, PPG entered into a settlement agreement with the New Jersey Department of Environmental Protection ("NJDEP") and Jersey City, New Jersey (which had asserted claims against PPG for lost tax revenue) which was in the form of a Judicial Consent Order (the "JCO"). Under the JCO, PPG accepted sole responsibility for the remediation activities at its former chromium manufacturing location in Jersey City and 19 additional sites. The principal contaminant of concern is hexavalent chromium. The JCO also provided for the appointment of a court-approved Site Administrator who is responsible for establishing a master schedule for the remediation of the 20 PPG sites which existed at that time. One site was subsequently removed from the JCO process during 2014 and will be remediated separately at a future date. A total of 19 sites remain subject to the JCO process.
The most significant assumptions underlying the estimate of remediation costs for all New Jersey Chrome sites are those related to the extent and concentration of chromium impacts in the soil, as these determine the quantity of soil that must be treated in place, the quantity that will have to be excavated and transported for offsite disposal, and the nature of disposal required. In 2018 and 2016, PPG completed updated assessments of costs incurred to date versus current progress and the potential cost impacts of the most recent information, including the extent of impacted soils, percentage of hazardous versus non-hazardous soils, daily soil excavation rates, and engineering, administrative and other associated costs. Based on these assessments, the reserve has been adjusted accordingly as noted in the table above. Principal factors affecting costs included refinements in the estimate of the mix of hazardous to non-hazardous soils to be excavated, an overall increase in soil volumes to be excavated, enhanced water management requirements, decreased daily soil excavation rates due to site conditions, initial estimates for remedial actions related to groundwater, and increased oversight and management costs. The reserve adjustments for the estimated costs to remediate all New Jersey Chrome sites are exclusive of any third party indemnification, as the recovery of any such amounts is uncertain.
Groundwater remediation at the former Garfield Avenue chromium-manufacturing site and five adjacent sites is expected to occur over several years after NJDEP's approval of the work plan. Ongoing groundwater monitoring will be utilized to develop a final groundwater remedial action work plan which is currently expected to be submitted to NJDEP in 2021.
PPG's financial reserve for remediation of all New Jersey Chrome sites is $151 million at December 31, 2018. The major cost components of this liability continue to be related to excavation, transportation and disposal of impacted soil, as well as construction services. These components each account for approximately 22%, 19% and 28% of the

accrued amount, respectively.

There are multiple, future events yet to occur, including further remedy selection and design, remedy implementation and execution and applicable governmental agency or community organization approvals. Considerable uncertainty exists regarding the timing of these future events for the New Jersey Chrome sites. Final resolution of these events is expected to occur over the next several years. As these events occur and to the extent that the cost estimates of the environmental remediation remedies change, the existing reserve for this environmental remediation matter will be adjusted.

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Remediation: other sites

Among other sites at which PPG is managing environmental liabilities, remedial actions are occurring at a legacy chemical manufacturing site in Barberton, Ohio, where PPG has completed a Facility Investigation and Corrective Measure Study under USEPA's Resource Conservation and Recovery Act ("RCRA") Corrective Action Program. PPG has also been addressing the impacts from a legacy plate glass manufacturing site in Kokomo, Indiana under the Voluntary Remediation Program of the Indiana Department of Environmental Management. PPG is currently performing additional investigation activities at this location.

With respect to certain other waste sites, the financial condition of other potentially responsible parties also contributes to the uncertainty of estimating PPG's final costs. Although contributors of waste to sites involving other potentially responsible parties may face governmental agency assertions of joint and several liability, in general, final allocations of costs are made based on the relative contributions of wastes to such sites. PPG is generally not a major contributor to such sites.

Remediation: reasonably possible matters

In addition to the amounts currently reserved for environmental remediation, the Company may be subject to loss contingencies related to environmental matters estimated to be as much as $100 million to $200 million. Such unreserved losses are reasonably possible but are not currently considered to be probable of occurrence. These reasonably possible unreserved losses relate to environmental matters at a number of sites, none of which are individually significant. The loss contingencies related to these sites include significant unresolved issues such as the nature and extent of contamination at these sites and the methods that may have to be employed to remediate them. The impact of evolving programs, such as natural resource damage claims, industrial site re-use initiatives and domestic and international remediation programs, also adds to the present uncertainties with regard to the ultimate resolution of this unreserved exposure to future loss. The Company's assessment of the potential impact of these environmental contingencies is subject to considerable uncertainty due to the complex, ongoing and evolving process of investigation and remediation, if necessary, of such environmental contingencies, and the potential for technological and regulatory developments.

15. Shareholders' Equity

A class of 10 million shares of preferred stock, without par value, is authorized but unissued. Common stock has a par value of $1.66 $^{2}/_{3}$ per share; 1.2 billion shares are authorized.

	Common Stock	Treasury Stock	Shares Outstanding
January 1, 2016	581,146,136	(314,270,127)	266,876,009
Purchases	—	(10,725,869)	(10,725,869)
Issuances	—	1,180,020	1,180,020
December 31, 2016	581,146,136	(323,815,976)	257,330,160
Purchases	—	(7,427,557)	(7,427,557)
Issuances	—	1,271,796	1,271,796
December 31, 2017	581,146,136	(329,971,737)	251,174,399
Purchases	—	(15,877,364)	(15,877,364)
Issuances	—	564,399	564,399
December 31, 2018	581,146,136	(345,284,702)	235,861,434

Per share cash dividends paid were $1.86 in 2018, $1.70 in 2017 and $1.56 in 2016.

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16. Accumulated Other Comprehensive Loss

($ in millions)	Unrealized Foreign Currency Translation Adjustments	Pension and Other Postretirement Benefit Adjustments, net of tax (c)	Unrealized Gain (Loss) on Derivatives, net of tax (d)	Accumulated Other Comprehensive Loss
January 1, 2016	($1,332)	($1,379)	$9	($2,702)
Current year deferrals to AOCI (a)	(299)	—	—	(299)
Current year deferrals to AOCI, tax effected (b)	(167)	29	3	(135)
Reclassifications from AOCI to net income	—	779	1	780
Period change	($466)	$808	$4	$346
December 31, 2016	($1,798)	($571)	$13	($2,356)
Current year deferrals to AOCI (a)	542	—	—	542
Current year deferrals to AOCI, tax effected (b)	(311)	20	(4)	(295)
Reclassifications from AOCI to net income	—	58	(6)	52
Period change	$231	$78	($10)	$299
December 31, 2017	($1,567)	($493)	$3	($2,057)
Current year deferrals to AOCI (a)	(292)	—	—	(292)
Current year deferrals to AOCI, tax effected (b)	148	(12)	(7)	129
Reclassifications from AOCI to net income	—	21	6	27
Period change	($144)	$9	($1)	($136)
Reclassification from AOCI to Retained earnings - Adoption of ASU 2018-02	(23)	(84)	—	(107)
December 31, 2018	($1,734)	($568)	$2	($2,300)

(a) Except for income taxes of $9 million related to foreign currency impacts of certain unasserted earnings, unrealized foreign currency translation adjustments related to translation of foreign denominated balance sheets are not presented net of tax given that no deferred U.S. income taxes have been provided on undistributed earnings of non-U.S. subsidiaries because they are deemed to be reinvested for an indefinite period of time.

(b) The tax benefit (cost) related to unrealized foreign currency translation adjustments on tax inter-branch transactions and net investment hedges for the years ended December 31, 2018, 2017 and 2016 was $4 million, $141 million and $(34) million, respectively.

(c) The tax cost related to the adjustment for pension and other postretirement benefits for the years ended December 31, 2018, 2017 and 2016 was $(34) million, $(33) million and $(403) million, respectively. Reclassifications from AOCI are included in the computation of net periodic benefit costs (See Note 13, "Employee Benefit Plans"). The cumulative tax benefit related to the adjustment for pension and other postretirement benefits at December 31, 2018 and 2017 was $209 million and $243 million, respectively.

(d) The tax cost related to the change in the unrealized loss on derivatives for the year ended December 31, 2018 was $2 million. The tax cost related to the change in the unrealized gain on derivatives for the years ended December 31, 2017 and 2016 was $5 million and $2 million, respectively. Reclassifications from AOCI are included in the gain or loss recognized on cash flow hedges (See Note 10 "Financial Instruments, Hedging Activities and Fair Value Measurements").

17. Other Income

($ in millions)	2018	2017	2016
Gain on sale of assets[1]	$33	$28	$6
Royalty income	10	11	12
Share of net earnings of equity affiliates (See Note 6)	16	12	8
Gain on disposals of ownership interests in business affiliates	—	25	46
Income from a legal settlement	—	18	—

Other	55	56	55
Total	$114	$150	$127

(1) Includes a $26 million gain on the sale of land near a facility of the Company's former commodity chemicals business in 2018.

18. Stock-Based Compensation

The Company's stock-based compensation includes stock options, restricted stock units ("RSUs") and grants of contingent shares that are earned based on achieving targeted levels of total shareholder return. All current grants of stock options, RSUs and contingent shares are made under the PPG Industries, Inc. Amended and Restated Omnibus Incentive Plan ("PPG Amended Omnibus Plan"), which was amended and restated effective April 21, 2016. Shares available for future grants under the PPG Amended Omnibus Plan were 7.8 million as of December 31, 2018.

Notes to the Consolidated Financial Statements

($ in millions)	2018	2017	2016
Total stock-based compensation	$37	$35	$45
Income tax benefit recognized	$8	$12	$17

Stock Options

PPG has outstanding stock option awards that have been granted under the PPG Amended Omnibus Plan. Under the PPG Amended Omnibus Plan, certain employees of the Company have been granted options to purchase shares of common stock at prices equal to the fair market value of the shares on the date the options were granted. The options are generally exercisable 36 months after being granted and have a maximum term of 10 years. Upon exercise of a stock option, shares of Company stock are issued from treasury stock.

The fair value of stock options issued to employees is measured on the date of grant and is recognized as expense, net of estimated forfeitures, over the requisite service period. PPG estimates the fair value of stock options using the Black-Scholes option pricing model. The risk-free interest rate is determined by using the U.S. Treasury yield curve at the date of the grant and using a maturity equal to the expected life of the option. The expected life of options is calculated using the average of the vesting term and the maximum term, as prescribed by accounting guidance on the use of the simplified method for determining the expected term of an employee share option. The expected dividend yield and volatility are based on historical stock prices and dividend amounts over past time periods equal in length to the expected life of the options. PPG applies an estimated forfeiture rate that is calculated based on historical activity.

The following weighted average assumptions were used to calculate the fair values of stock option grants in each year:

	2018	2017	2016
Weighted average exercise price	$115.98	$101.53	$95.29
Risk free interest rate	2.9 %	2.4 %	1.6 %
Expected life of option in years	6.5	6.5	6.5
Expected dividend yield	1.7 %	1.8 %	2.1 %
Expected volatility	21.0 %	22.0 %	22.8 %

The weighted average fair value of options granted was $25.27 per share, $21.15 per share and $17.94 per share for the years ended December 31, 2018, 2017, and 2016, respectively.

Stock Options Outstanding and Exercisable	Number of Shares	Weighted Average Exercise Price	Weighted Average Remaining Contractual Life (in years)	Intrinsic Value (in millions)
Outstanding, January 1, 2018	3,575,625	$83.34	6.4	$120
Granted	533,105	$115.98		
Exercised	(288,760)	$50.82		
Forfeited/Expired	(58,970)	$106.32		
Outstanding, December 31, 2018	3,761,000	$90.10	6.1	$61
Vested or expected to vest, December 31, 2018	3,724,235	$89.89	6.1	$61
Exercisable, December 31, 2018	1,924,079	$77.79	4.3	$56

At December 31, 2018, unrecognized compensation cost related to outstanding stock options that have not yet vested totaled $7 million. This cost is expected to be recognized as expense over a weighted average period of 1.5 years.

The following table presents stock option activity for the years ended December 31, 2018, 2017 and 2016:

($ in millions)	2018	2017	2016
Total intrinsic value of stock options exercised	$19	$40	$34
Cash received from stock option exercises	$15	$52	$32
Income tax benefit from the exercise of stock options	$4	$15	$12
Total fair value of stock options vested	$10	$13	$16

Notes to the Consolidated Financial Statements

Restricted Stock Units ("RSUs")

Long-term incentive value is delivered to selected key management employees by granting RSUs, which have either time or performance-based vesting features. The fair value of an RSU is equal to the market value of a share of PPG stock on the date of grant. Time-based RSUs vest over the three-year period following the date of grant, unless forfeited, and will be paid out in the form of stock, cash or a combination of both at the Company's discretion at the end of the three year vesting period. Performance-based RSUs vest based on achieving specific annual performance targets for earnings per share growth and cash flow return on capital over the three calendar year-end periods following the date of grant. Unless forfeited, the performance-based RSUs will be paid out in the form of stock, cash or a combination of both at the Company's discretion at the end of the three-year performance period if PPG meets the performance targets. The amount paid for performance-based awards may range from 0% to 180% of the original grant, based upon the frequency with which the annual earnings per share growth and cash flow return on capital performance targets are met over the three calendar year periods comprising the vesting period. PPG has assumed that performance-based RSUs granted in 2016, 2017 and 2018 will vest at the 100% level. As of December 31, 2018, three of the six possible performance targets had been met for the 2016 grant, two of the four possible performance targets had been met for the 2017 grant, and one of two possible performance targets had been met for the 2018 grant.

RSU Activity	Number of Shares	Weighted Average Fair Value	Intrinsic Value (in millions)
Outstanding, January 1, 2018	615,607	$101.73	$63
Granted	252,885	$112.98	
Released from restrictions	(194,329)	$99.80	
Forfeited	(42,432)	$106.15	
Outstanding, December 31, 2018	631,731	$102.80	$65
Vested or expected to vest, December 31, 2018	616,894	$102.67	$63

There was $17 million of total unrecognized compensation cost related to unvested RSUs outstanding as of December 31, 2018. This cost is expected to be recognized as expense over a weighted average period of 1.8 years.

Contingent Share Grants

The Company also provides grants of contingent shares to selected key executives that may be earned based on PPG total shareholder return ("TSR") over the three-year period following the date of grant. Contingent share grants (referred to as "TSR awards") are made annually and are paid out at the end of each three-year period based on the Company's performance. Performance is measured by determining the percentile rank of the total shareholder return of PPG common stock in relation to the total shareholder return of the S&P 500 for the three-year period following the date of grant. This comparison group represents the entire S&P 500 Index as it existed at the beginning of the performance period, excluding any companies that have been removed from the index because they ceased to be publicly traded. The payment of awards following the three-year award period will be based on performance achieved in accordance with the scale set forth in the plan agreement and may range from 0% to 220% of the initial grant. A payout of 100% is earned if the target performance is achieved. Contingent share awards for the 2016-2018, 2017-2019, and 2018-2020 periods earn dividend equivalents for the award period, which will be paid to participants or credited to the participants' deferred compensation plan accounts with the award payout at the end of the period based on the actual number of contingent shares that are earned. Any payments made at the end of the award period may be in the form of stock, cash or a combination of both. The TSR awards qualify as liability awards, and compensation expense is recognized over the three-year award period based on the fair value of the awards (giving consideration to the Company's percentile rank of total shareholder return) remeasured in each reporting period until settlement of the awards.

As of December 31, 2018, there was $5 million of total unrecognized compensation cost related to outstanding TSR awards based on the current estimate of fair value. This cost is expected to be recognized as expense over a weighted average period of 1.8 years.

Notes to the Consolidated Financial Statements

19. Quarterly Financial Information (unaudited)

($ in millions, except per share amounts)	2018 Quarter Ended March 31	June 30	September 30	December 31	Full Year 2018[1]
Net sales	$3,781	$4,131	$3,817	$3,645	$15,374
Cost of sales[2]	2,181	2,379	2,253	2,188	9,001
Net income attributable to PPG					
Continuing operations	$328	$371	$368	$256	$1,323
Discontinued operations	6	—	10	2	18
Net income	$334	$371	$378	$258	$1,341
Earnings per common share					
Continuing operations	$1.32	$1.51	$1.52	$1.07	$5.43
Discontinued operations	0.02	—	0.04	0.01	0.07
Earnings per common share	$1.34	$1.51	$1.56	$1.08	$5.50
Earnings per common share - assuming dilution					
Continuing operations	$1.31	$1.51	$1.51	$1.07	$5.40
Discontinued operations	0.02	—	0.04	0.01	0.07
Earnings per common share – assuming dilution	$1.33	$1.51	$1.55	$1.08	$5.47

($ in millions except per share amounts)	2017 Quarter Ended March 31	June 30	September 30	December 31	Full Year 2017[1]
Net sales	$3,486	$3,804	$3,776	$3,682	$14,748
Cost of sales[2]	1,902	2,083	2,104	2,120	8,209
Net income attributable to PPG					
Continuing operations	$331	$497	$393	$148	$1,369
Discontinued operations	6	(1)	217	3	225
Net income	$337	$496	$610	$151	$1,594
Earnings per common share					
Continuing operations	$1.29	$1.93	$1.53	$0.59	$5.34
Discontinued operations	0.02	—	0.85	0.01	0.88
Earnings per common share	$1.31	$1.93	$2.38	$0.60	$6.22
Earnings per common share - assuming dilution					
Continuing operations	$1.28	$1.92	$1.52	$0.58	$5.31
Discontinued operations	0.02	—	0.84	0.01	0.87
Earnings per common share – assuming dilution	$1.30	$1.92	$2.36	$0.59	$6.18

(1) Full year earnings-per-share was calculated using the full year weighted average shares outstanding. As such, the sum of the quarters may not equal the total earnings-per-share for the year.

(2) Exclusive of depreciation and amortization.

20. Reportable Business Segment Information

Segment Organization and Products

PPG is a multinational manufacturer with 9 operating segments (which the Company refers to as “strategic business units”) that are organized based on the Company’s major products lines. The Company’s reportable business segments include the following two segments: Performance Coatings and Industrial Coatings. The operating segments have been aggregated based on economic similarities, the nature of their products, production processes, end-use markets and methods of distribution.

The Performance Coatings reportable segment is comprised of the automotive refinish coatings, aerospace coatings, architectural coatings – Americas and Asia-Pacific, architectural coatings - EMEA, and protective and marine coatings operating segments. This reportable segment primarily supplies a variety of protective and decorative coatings,

sealants and finishes along with paint strippers, stains and related chemicals, as well as transparencies and transparent armor.

The Industrial Coatings reportable segment is comprised of the automotive original equipment manufacturer ("OEM") coatings, industrial coatings, packaging coatings, and the specialty coatings and materials operating segments. This reportable segment primarily supplies a variety of protective and decorative coatings and finishes along with adhesives, sealants, metal pretreatment products, optical monomers and coatings, precipitated silicas and other specialty materials.

Notes to the Consolidated Financial Statements

Production facilities and sales for Performance Coatings and Industrial Coatings are global. PPG's reportable segments continue to pursue opportunities to further develop their global reach, including efforts in Asia, Eastern Europe and Latin America. Each of the reportable segments in which PPG is engaged is highly competitive. The diversification of our product lines and the worldwide sales tend to minimize the impact on PPG's Net sales and Income before income taxes in the consolidated statement of income of changes in demand in a particular industry or in a particular geographic area.

The accounting policies of the operating segments are the same as those described in the summary of significant accounting policies (See Note 1, "Summary of Significant Accounting Policies"). The Company allocates resources to operating segments and evaluates the performance of operating segments based upon segment income, which is income before interest expense – net, income taxes, and noncontrolling interests and excludes certain charges which are considered to be unusual or non-recurring. The Company also evaluates performance of operating segments based on working capital reduction, margin growth, and sales volume growth. Legacy items include current costs related to former operations of the Company, including certain environmental remediation, pension and other postretirement benefit costs, and certain charges for legal and other matters which are considered to be unusual or non-recurring. These legacy costs are excluded from the segment income that is used to evaluate the performance of the operating segments.

Corporate unallocated costs include the costs of corporate staff functions not directly associated with the operating segments, the cost of corporate legal cases, net of related insurance recoveries and the cost of certain insurance and stock-based compensation programs. Net periodic pension expense is allocated to the operating segments and the portion of net periodic pension expense related to the corporate staff functions is included in the Corporate unallocated costs.

Product movement between Performance Coatings and Industrial Coatings is limited, is accounted for as an inventory transfer, and is recorded at cost plus a mark-up, the impact of which is not significant to the segment income of the reportable segments.

($ in millions)	2018	2017	2016
Net sales to external customers[1]			
Performance Coatings	$9,087	$8,730	$8,580
Industrial Coatings	6,287	6,018	5,690
Total Net sales	$15,374	$14,748	$14,270
Segment income			
Performance Coatings	$1,300	$1,313	$1,322
Industrial Coatings	818	979	1,060
Total Segment income	$2,118	$2,292	$2,382
Corporate / Non-Segment Items[1]			
Legacy items[2]	$5	($2)	($17)
Environmental remediation charges and other costs	(77)	—	(82)
Business restructuring, net	(66)	—	(191)
Accelerated depreciation related to restructuring actions	(9)	—	—
Impairment of a non-manufacturing asset	(9)	—	—
Accounting investigation costs	(14)	—	—
Legacy legal settlements	(10)	—	—
Costs related to customer assortment change	(18)	—	—
Transaction-related costs[3]	(6)	(9)	(8)
Gain from sale of a non-operating asset	26	13	—
Brand rationalization charge	(6)	—	—
Gain from a legal settlement	—	18	—
Asset write-downs	—	(7)	(23)
Pension settlement charges	—	(60)	(968)
Gains on disposals of ownership interests in business affiliates	—	25	46

Interest expense, net of interest income	(95)	(85)	(99)
Corporate unallocated[1]	(146)	(180)	(261)
Total Income before income taxes	$1,693	$2,005	$779

Notes to the Consolidated Financial Statements

($ in millions)	2018	2017	2016
Depreciation and amortization			
Performance Coatings	$274	$272	$272
Industrial Coatings	181	164	143
Corporate / Non-Segment Items(1)	42	24	25
Total	$497	$460	$440
Share of net earnings of equity affiliates			
Performance Coatings	$1	$2	$5
Industrial Coatings	—	—	1
Corporate / Non-Segment Items(1)	15	10	2
Total	$16	$12	$8
Segment assets(4)			
Performance Coatings	$9,846	$9,763	$9,168
Industrial Coatings	4,441	4,563	3,972
Corporate / Non-Segment Items(1)	1,728	2,212	2,631
Total	$16,015	$16,538	$15,771
Investment in equity affiliates			
Performance Coatings	$33	$32	$30
Industrial Coatings	13	13	13
Corporate / Non-Segment Items(1)	86	89	3
Total	$132	$134	$46
Expenditures for property (including business acquisitions)			
Performance Coatings	$545	$224	$187
Industrial Coatings	157	328	510
Corporate / Non-Segment Items(1)	87	133	32
Total	$789	$685	$729

($ in millions)	2018	2017	2016
Geographic Information			
Net sales(5)			
United States and Canada	$6,485	$6,307	$6,254
Europe, Middle East and Africa ("EMEA")	4,678	4,389	4,164
Asia Pacific	2,618	2,523	2,431
Latin America	1,593	1,529	1,421
Total	$15,374	$14,748	$14,270
Segment income			
United States and Canada	$1,022	$1,135	$1,176
EMEA	549	560	235
Asia Pacific	306	361	589
Latin America	241	236	382
Total	$2,118	$2,292	$2,382
Property—net			
United States and Canada	$1,254	$1,224	$1,184
EMEA	777	826	726
Asia Pacific	482	493	447
Latin America	292	281	251
Total	$2,805	$2,824	$2,608

(1) Corporate intersegment net sales represent intersegment net sales eliminations. Corporate unallocated costs include the costs of corporate staff functions not directly associated with the operating segments, certain legal and insurance costs and stock-based compensation expense.

(2) Legacy items include current costs related to former operations of the Company, including pension and other postretirement benefit costs, legal costs and certain charges which are considered to be non-recurring. Legacy items also include equity earnings from PPG's investment in TCI. Refer to Note 3, "Acquisitions and Divestitures".

(3) Transaction-related costs include advisory, legal, accounting, valuation, and other professional or consulting fees incurred to effect significant acquisitions, as well as similar fees and other costs to effect divestitures not classified as discontinued operations. These costs also include the flow-through cost of sales for the step up to fair value of inventory acquired in acquisitions.

(4) Segment assets are the total assets used in the operation of each segment. Corporate assets are principally cash and cash equivalents, cash held in escrow, short term investments and deferred tax assets. Non-segment items also includes the assets of businesses which have been reclassified as discontinued operations in the consolidated statement of income. Refer to Note 3, “Acquisitions and Divestitures”.

(5) Net sales to external customers are attributed to geographic regions based upon the location of the operating unit shipping the product.

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

None.

Item 9A. Controls and Procedures

(a) Evaluation of disclosure controls and procedures.

Based on their evaluation as of the end of the period covered by this Form 10-K, the Company's principal executive officer and principal financial officer have concluded that the Company's disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934 (the "Exchange Act")) are effective to ensure that information required to be disclosed by the Company in reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in Securities and Exchange Commission rules and forms and to ensure that information required to be disclosed by the Company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the Company's management, including its principal executive and principal financial officers, as appropriate, to allow timely decisions regarding required disclosure.

(b) Changes in internal control over financial reporting.

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

(c) Management report on internal control over financial reporting.

See Management Report on page 47 for management's annual report on internal control over financial reporting. See Report of Independent Registered Public Accounting Firm on page 46 for PricewaterhouseCoopers LLP's audit report on the Company's internal control over financial reporting.

(d) Remediation of Material Weakness.

In connection with the investigation described in the Explanatory Note within the 2017 Form 10-K/A, the Company identified and implemented actions to improve the effectiveness of its internal control over financial reporting and disclosure controls and procedures, including enhancing the Company's resources and training with respect to financial reporting and disclosure responsibilities. Management reviewed and will continue to review such actions with the Audit Committee. The steps taken to remediate the Company's material weakness included the following:

- The Company terminated the employment of the former Vice President and Controller.
- Two employees who acted under the direction of the former Vice President and Controller were re-assigned to different positions within the Company where they do not have a Financial Reporting Oversight Role or a role in the design or operation of internal control over financial reporting, disclosure controls or accounting policy.
- The Company appointed its former Director of Corporate Audit Services and former Assistant Controller, Financial Reporting as Acting Controller and, on July 19, 2018 appointed him the Company's permanent Vice President and Controller.
- The Company's Chairman and Chief Executive Officer has emphasized to all employees, and to the Company's finance employees specifically, the importance of acting ethically and adhering to the Company's Global Code of Ethics.

The Company is committed to maintaining a strong internal control environment and to ensuring that a proper, consistent tone is communicated throughout the organization. In addition to the steps set forth above, the Company has also taken other remedial measures as described below:

- The Company re-emphasized (1) its commitment to ethical standards, (2) the requirements of the Company's Code of Ethics, (3) reporting obligations and (4) non-retaliation policy for complaints;
- The Company enhanced its corporate finance department by adding personnel with responsibility for areas identified in the investigation and enhanced segregation of duties in the finance department;
- The Company enhanced policies and procedures relating to the preparation, approval and entry of journal entries;
- The Company enhanced its process to evaluate and adjust certain significant expense accruals;
- The Company enhanced its policies and procedures relating to inventory standard cost revaluations;

- The Company enhanced its policies and procedures concerning accounting entries related to discontinued operations;
- The Company now requires additional annual/onboarding education for finance staff;
- The Company will conduct additional periodic risk assessments and targeted internal audit reviews; and
- The Company separated the financial forecasting process from financial accounting.

As discussed in Management's Report on page 47, management has determined that, as of December 31, 2018, the remedial measures described above have been satisfactorily implemented and that the Company has had sufficient time to test the design and operating effectiveness of such remedial measures. As such, the material weakness identified in the Company's internal control over financial reporting has been remediated.

Item 9B. Other Information

None.

Part III

Item 10. Directors, Executive Officers and Corporate Governance

The information about the Company's directors required by Item 10 and not otherwise set forth below is contained under the caption "Proposal 1: Election of Directors" in PPG's definitive Proxy Statement for the 2019 Annual Meeting of Shareholders (the "Proxy Statement") which the Company anticipates filing with the Securities and Exchange Commission, pursuant to Regulation 14A, not later than 120 days after the end of the Company's fiscal year, and is incorporated herein by reference.

The executive officers of the Company are elected by the Board of Directors. The information required by this item concerning the Company's executive officers is incorporated by reference herein from Part I of this report under the caption "Executive Officers of the Company."

Information regarding the Company's Audit Committee is included in the Proxy Statement under the caption "Corporate Governance – Audit Committee" and is incorporated herein by reference.

Information regarding the Company's codes of ethics is included in the Proxy Statement under the caption "Corporate Governance – Codes of Ethics" and is incorporated herein by reference.

Information about compliance with Section 16(a) of the Exchange Act is included in the Proxy Statement under the caption "Beneficial Ownership – Section 16(a) Beneficial Ownership Reporting Compliance" and is incorporated herein by reference.

Item 11. Executive Compensation

The information required by Item 11 is contained in the Proxy Statement under the captions "Compensation of Directors," "Compensation Discussion and Analysis," "Compensation of Executive Officers," "Potential Payments upon Termination or Change in Control," "Corporate Governance – Compensation Committee Interlocks and Insider Participation," and "Corporate Governance – Officers-Directors Compensation Committee Report to Shareholders" and is incorporated herein by reference.

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

The information required by Item 12 is contained in the Proxy Statement under the captions "Beneficial Ownership" and "Equity Compensation Plan Information" and is incorporated herein by reference.

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

The information required by Item 13 is contained in the Proxy Statement under the captions "Corporate Governance – Director Independence," "Corporate Governance – Review and Approval or Ratification of Transactions with Related Persons" and "Corporate Governance – Certain Relationships and Related Transactions" and is incorporated herein by reference.

Item 14. Principal Accounting Fees and Services

The information required by Item 14 is contained in the Proxy Statement under the caption "Independent Registered Public Accounting Firm" and is incorporated herein by reference.

Part IV

Item 15. Exhibits, Financial Statement Schedules

(a)(1) Consolidated Financial Statements and Reports of Independent Registered Public Accounting Firm (see Part II, Item 8 of this Form 10-K).

The following information is filed as part of this Form 10-K:

	Page
Report of Independent Registered Public Accounting Firm	46
Management Report	47
Consolidated Statement of Income for the Years Ended December 31, 2018, 2017 and 2016	48
Consolidated Statement of Comprehensive Income for the Years Ended December 31, 2018, 2017 and 2016	48
Consolidated Balance Sheet as of December 31, 2018 and 2017	49
Consolidated Statement of Shareholders' Equity for the Years Ended December 31, 2018, 2017 and 2016	50
Consolidated Statement of Cash Flows for the Years Ended December 31, 2018, 2017 and 2016	51
Notes to the Consolidated Financial Statements	52

(a)(2) Consolidated Financial Statement Schedule for the years ended December 31, 2018, 2017 and 2016.

The following Consolidated Financial Statement Schedule should be read in conjunction with the previously referenced financial statements:

Schedule II – Valuation and Qualifying Accounts

Allowance for Doubtful Accounts for the Years Ended December 31, 2018, 2017, and 2016

($ in millions)	Balance at Beginning of Year	Charged to Costs and Expenses	Deductions(1)	Balance at End of Year
2018	$25	$18	($19)	$24
2017	$36	$15	($26)	$25
2016	$43	$22	($29)	$36

(1) Notes and accounts receivable written off as uncollectible, net of recoveries, amounts attributable to divestitures and changes attributable to foreign currency translation.

All other schedules are omitted because they are not applicable.

(a)(3) Exhibits. The following exhibits are filed as a part of, or incorporated by reference into, this Form 10-K.
Index to Exhibits

3	Statement with Respect to Shares Eliminating the Series A Junior Participating Preferred Stock, was filed as Exhibit 3.1 to the Registrant's Quarterly Report on Form 10-Q for the period ended September 30, 2014.
3.1	Restated Articles of Incorporation of PPG Industries, Inc., was filed as Exhibit 3.2 to the Registrant's Quarterly Report on Form 10-Q for the period ended September 30, 2014.
3.2	Articles of Amendment to the Restated Articles of Incorporation of PPG Industries, Inc. effective June 12, 2015, was filed as Exhibit 3.1 to the Registrant's Current Report on Form 8-K filed on June 18, 2015.
3.3	Amended and Restated Bylaws of PPG Industries, Inc., as amended on December 10, 2015, was filed as Exhibit 3.1 to the Registrant's Current Report on Form 8-K filed on December 15, 2015.
4	Indenture, dated as of Aug. 1, 1982, was filed as Exhibit 4.1 to the Registrant's Registration Statement on Form S-3 (No. 333-44397) dated January 16, 1998.
4.1	First Supplemental Indenture, dated as of April 1, 1986, was filed as Exhibit 4.2 to the Registrant's Registration Statement on Form S-3 (No. 333-44397) dated January 16, 1998.
4.2	Second Supplemental Indenture, dated as of October 1, 1989, was filed as Exhibit 4.3 to the Registrant's Registration Statement on Form S-3 (No. 333-44397) dated January 16, 1998.
4.3	Third Supplemental Indenture, dated as of November 1, 1995, was filed as Exhibit 4.4 to the Registrant's Registration Statement on Form S-3 (No. 333-44397) dated January 16, 1998.
4.5	Indenture, dated as of March 18, 2008, was filed as Exhibit 4.1 to the Registrant's Current Report on Form 8-K filed on March 18, 2008.
4.6	Supplemental Indenture, dated as of March 18, 2008, was filed as Exhibit 4.2 to the Registrant's Current Report on Form 8-K filed on March 18, 2008.
4.7	Second Supplemental Indenture, dated as of November 12, 2010, was filed as Exhibit 4.3 to the Registrant's Current Report on Form 8-K filed on November 12, 2010.
4.8	Third Supplemental Indenture, dated as of August 3, 2012, was filed as Exhibit 4.4 to the Registrant's Current Report on Form 8-K filed on August 3, 2012.
4.9	Fourth Supplemental Indenture, dated as of November 12, 2014, between PPG Industries, Inc. and The Bank of New York Mellon Trust Company, was filed as Exhibit 4.2 to the Registrant's Current Report on Form 8-K filed on November 12, 2014.
4.10	Fifth Supplemental Indenture, dated as of March 13, 2015, between PPG Industries, Inc. and The Bank of New York Mellon Trust Company, N.A., as trustee, was filed as Exhibit 4.3 to the Registrant's Current Report on Form 8-K filed on March 13, 2015.
4.11	Sixth Supplemental Indenture, dated as of November 3, 2016, between PPG Industries, Inc. and The Bank of New York Mellon Trust Company, N.A., as trustee, was filed as Exhibit 4.3 to the Registrant's Current Report on Form 8-K filed on November 3, 2016.
*10	PPG Industries, Inc. Nonqualified Retirement Plan, as amended and restated September 24, 2008, was filed as Exhibit 10 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2011.
*10.1	Form of Change in Control Employment Agreement entered into with executives prior to January 1, 2008, as amended, was filed as Exhibit 10.2 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2007.
*10.2	Form of Change in Control Employment Agreement entered into with executives on or after January 1, 2008 through December 31, 2009, was filed as Exhibit 10.24 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2007.
*10.3	Form of Change in Control Employment Agreement entered into with executives on or after January 1, 2010, was filed as Exhibit 10.3 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2009.
*10.4	Form of Change in Control Employment Agreement entered into with executives on or after June 30, 2012 was filed as Exhibit 10.4 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2012.
*10.5	Form of Change in Control Employment Agreement entered into with executives on or after January 1, 2014, was filed as Exhibit 10.2 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31,

	2014.
*10.6	PPG Industries, Inc. Deferred Compensation Plan for Directors related to compensation deferred prior to January 1, 2005, was filed as Exhibit 10.3 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 1997.

*10.7	PPG Industries, Inc. Deferred Compensation Plan for Directors related to compensation deferred on or after January 1, 2005, as amended February 15, 2006, was filed as Exhibit 10.4 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31, 2006.
*10.8	PPG Industries, Inc. Deferred Compensation Plan related to compensation deferred prior to January 1, 2005, as amended effective July 14, 2004, was filed as Exhibit 10.1 to the Registrant's Quarterly Report on Form 10-Q for the period ended June 30, 2004.
*10.9	PPG Industries, Inc. Deferred Compensation Plan related to compensation deferred on or after January 1, 2005, as amended and restated September 24, 2008, was filed as Exhibit 10.6 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2008.
*10.10	PPG Industries, Inc. Deferred Compensation Plan related to compensation deferred on or prior to January 1, 2005, as amended and restated effective January 1, 2011, was filed as Exhibit 10.3 to the Registrant's Quarterly Report on Form 10-Q for the period ended June 30, 2012.
*10.11	PPG Industries, Inc. Deferred Compensation Plan related to compensation deferred on or after to January 1, 2005, as amended and restated effective January 1, 2011, was filed as Exhibit 10.4 to the Registrant's Quarterly Report on Form 10-Q for the period ended June 30, 2012.
*10.12	PPG Industries, Inc. Executive Officers' Long Term Incentive Plan was filed as Exhibit 10.1 to the Registrant's Current Report on Form 8-K dated February 15, 2005.
*10.13	PPG Industries, Inc. Amended and Restated Omnibus Incentive Plan, was filed as Annex A to the Registrant's Definitive Proxy Statement for its 2011 Annual Meeting of Shareholders filed on March 10, 2011.
*10.14	PPG Industries, Inc. Amended and Restated Omnibus Incentive Plan, was filed as Annex B to the Registrant's Definitive Proxy Statement for its 2016 Annual Meeting of Shareholders filed on March 10, 2016.
*10.15	Form of Time-Vested Restricted Stock Unit Award Agreement for Directors, was filed as Exhibit 10 to the Registrant's Quarterly Report on Form 10-Q for the period ended June 30, 2014.
*10.16	Form of Non-Qualified Stock Option Award Agreement, was filed as Exhibit 10.14 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2008.
*10.17	Form of Non-Qualified Stock Option Award Agreement, was filed as Exhibit 10.3 to the Registrant's Quarterly Report on Form 10-Q for the period ended September 30, 2009.
*10.18	Form of Non-Qualified Stock Option Award Agreement, was filed as Exhibit 10.4 to the Registrant's Quarterly Report on Form 10-Q for the period ended June 30, 2011.
*10.19	Form of Non-Qualified Stock Option Award Agreement, was filed as Exhibit 10.2 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31, 2013.
*10.20	Form of TSR Share Award Agreement, was filed as Exhibit 10.6 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31, 2013.
*10.21	Form of Performance-Based Restricted Stock Unit Award Agreement, was filed as Exhibit 10.4 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31, 2013.
*10.22	Form of Performance-Based Restricted Stock Unit Award Agreement for Key Employees, was filed as Exhibit 10.3 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31, 2013.
*10.23	Form of Time-Vested Restricted Stock Unit Award Agreement, was filed as Exhibit 10.5 to the Registrant's Quarterly Report on Form 10-Q for the period ended March 31, 2013.
10.24	Term Loan Agreement, dated November 20, 2014, between PPG Industries, Inc. and Sumitomo Mitsui Banking Corporation, as Administrative Agent and as Initial Lender was filed as Exhibit 10.39 to the Registrant's Annual Report on Form 10-K for the period ended December 31, 2014.
10.25	Five-Year Credit Agreement dated as of December 18, 2015 among PPG Industries, Inc.; the several banks and financial institutions party thereto; JPMorgan Chase Bank, N.A., as administrative agent; The Bank of Tokyo-Mitsubishi UFJ, Ltd., BNP Paribas, Citibank, N.A. and PNC Bank, National Association, as co-syndication agents; and J.P. Morgan Securities LLC, The Bank of Tokyo-Mitsubishi UFJ, Ltd., BNP Paribas Securities Corp., Citigroup Global Markets Inc., and PNC Capital Markets LLC, as co-lead arrangers and co-bookrunners, was filed as Exhibit 10.1 to the Registrant's Current Report on Form 8-K filed on December 22, 2015.
*10.26	

	Employment arrangement with Jean-Marie Greindl, was filed as Exhibit 10.1 to the Registrant’s Quarterly Report on Form 10-Q for the quarter ended March 31, 2016.
*10.27	Letter Agreement with Rebecca Liebert was filed as Exhibit 10.1 to the Registrant’s Quarterly Report on Form 10-Q for the quarter ended September 30, 2018.
*10.28	Letter Agreement with Amy R. Ericson was filed as Exhibit 10.2 to the Registrant’s Quarterly Report on Form 10-Q for the quarter ended September 30, 2018.

†* 10.29	PPG Industries, Inc. Incentive Compensation Plan for Key Employees, as amended and restated on January 1, 2019.
†* 10.30	PPG Industries, Inc. Management Award Plan, as amended and restated on January 1, 2019.
† 13.1	Market Information, Dividends and Holders of Common Stock.
† 13.2	Selected Financial Data for the Five Years Ended December 31, 2018.
† 21	Subsidiaries of the Registrant.
† 23	Consent of PricewaterhouseCoopers LLP.
† 24	Powers of Attorney.
† 31.1	Certification of Principal Executive Officer Pursuant to Rule 13a-14(a) or 15d-14(a) of the Exchange Act, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.
† 31.2	Certification of Principal Financial Officer Pursuant to Rule 13a-14(a) or 15d-14(a) of the Exchange Act, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.
†† 32.1	Certification of Chief Executive Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.
†† 32.2	Certification of Chief Financial Officer Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.
** 101.INS	XBRL Instance Document
** 101.SCH	XBRL Taxonomy Extension Schema Document
** 101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document
** 101.DEF	XBRL Taxonomy Extension Definition Linkbase Document
** 101.LAB	XBRL Taxonomy Extension Label Linkbase Document
** 101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document

† Filed herewith.

†† Furnished herewith.

* Management contracts, compensatory plans or arrangements required to be filed as an exhibit hereto pursuant to Item 601 of Regulation S-K.

** Attached as Exhibit 101 to this report are the following documents formatted in XBRL (Extensible Business Reporting Language) as of and for the year ended December 31, 2018: (i) the Consolidated Statement of Income, (ii) the Consolidated Balance Sheet, (iii) the Consolidated Statement of Shareholders' Equity, (iv) the Consolidated Statement of Comprehensive Income (Loss), (v) the Consolidated Statement of Cash Flows, (vi) Notes to Consolidated Financial Statements and (vii) Financial Schedule of Valuation and Qualifying Accounts.

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 21, 2019.

PPG INDUSTRIES, INC.
(Registrant)

By /s/ Vincent J. Morales
Vincent J. Morales
Senior Vice President and Chief Financial Officer (Principal Financial Officer and Duly Authorized Officer)

/s/ William E. Schaupp
William E. Schaupp
Vice President and Controller (Principal Accounting Officer and Duly Authorized Officer)

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed by the following persons on behalf of the Registrant and in the capacities indicated on February 21, 2019.

Signature	Capacity
/s/ Michael H. McGarry	Director, Chairman and Chief Executive Officer
Michael H. McGarry	
/s/ Vincent J. Morales	Senior Vice President and Chief Financial Officer (Principal Financial Officer and Duly Authorized Officer)
Vincent J. Morales	
/s/ William E. Schaupp	Vice President and Controller (Principal Accounting Officer and Duly Authorized Officer)
William E. Schaupp	

S. F. Angel	Director	
J. G. Berges	Director	
J. V. Faraci	Director	
H. Grant	Director	
V. F. Haynes	Director	By /s/ Vincent J. Morales
M. L. Healey	Director	Vincent J. Morales, Attorney-in-Fact
G. R. Heminger	Director	
M. J. Hooper	Director	
M. W. Lamach	Director	
M. H. Richenhagen	Director	