

GRACE

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Focus on Value Delivered

2019 ANNUAL REPORT

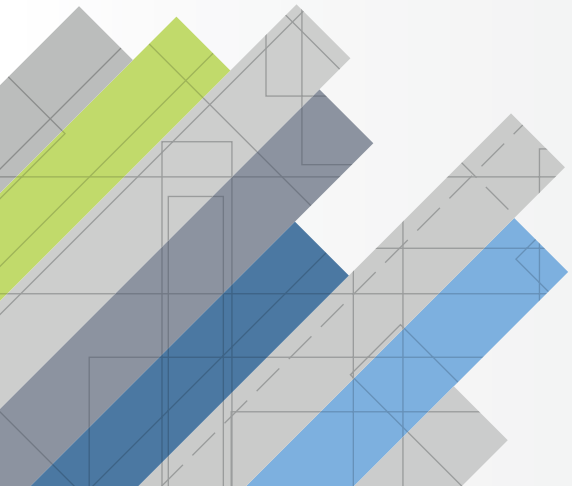


Executing Our Growth Strategy

In 2019, we continued to execute our profitable growth strategy built on the strength of long-term demand for our technically differentiated, specialized products that help our customers achieve their sustainability objectives and meet the rising demands of the world's growing middle class.

Through customer-driven innovation, strategic acquisitions, flexible worldwide manufacturing, and the talent of our people, we maintain strong strategic positions and unmatched customer relationships with many of the world's best companies. Over 80 percent of our sales were in segments where we are #1 or #2.

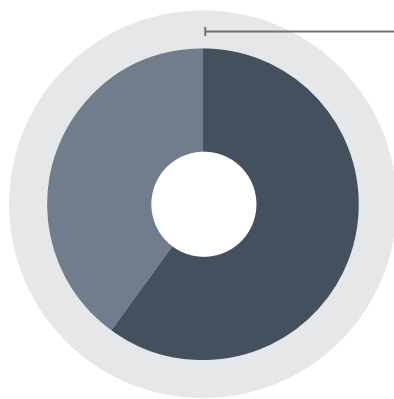
We are investing in our businesses to accelerate our growth and extend our competitive advantages. The Grace Value Model is our guide for prioritizing investments and focusing the efforts of our 4,000 global employees. Together, we are making significant progress with our commercial excellence and operating excellence priorities, including safety and the Grace Manufacturing System. Customer-driven innovation and commercial excellence remain at the core of our unrelenting commitment to delivering value and building trust with our customers worldwide.



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Refining Technologies



- 60% Fluid Catalytic Cracking (FCC)
- 40% Hydroprocessing

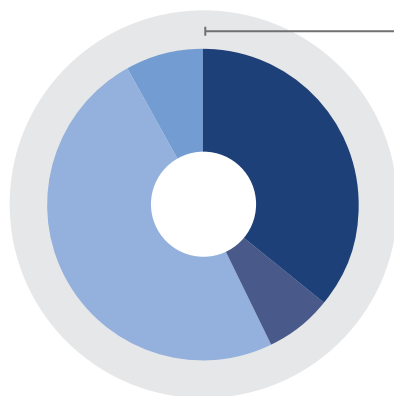
2019 SALES (FCC and ART)

\$1,318.9 Million

Up 2.3%



Specialty Catalysts



- 36% Polypropylene Catalysts
- 7% Polypropylene Process Technology Licensing
- 49% Polyethylene Catalysts
- 8% Chemical Catalysts

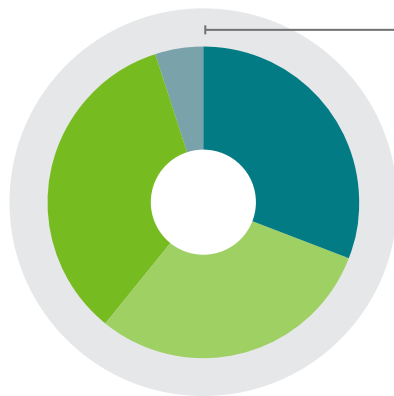
2019 SALES

\$705.3 Million

Up 6.6%



Materials Technologies



- 31% Consumer/Pharma
- 30% Coatings
- 34% Chemical Process
- 5% Other

2019 SALES

\$461.4 Million

Down 1.5%





Refining Technologies Adds Technology and Capacity

Our Fluid Catalytic Cracking (FCC) catalyst customers—world-class refiners delivering fuels and petrochemical feedstocks—continue to value Grace innovation as they seek to maximize their profitability, meet their sustainability objectives, and adjust their product mix to meet the demands of today and tomorrow. Our 2019 acquisition of RIVE® Molecular Highway® zeolite technology offers many of our customers a highly advanced technology to improve the conversion of crude oil to petrochemical feedstocks to meet growing demand and improve their profitability.

Our ART® Hydroprocessing catalysts technologies, provided through our joint venture with Chevron, remain in high demand as regulations around the world continue the move to cleaner-burning fuels. For example, shippers worldwide are selecting fuels formulated to meet the U.N. International Maritime Organization's stricter environmental standards for marine fuel. Part of our response to this rapidly growing demand is the anticipated opening in 2020 of a world-scale, state-of-the-art hydroprocessing catalysts manufacturing facility in our Lake Charles, LA complex.



Specialty Catalysts Delivers Value from a Position of Leadership

Grace's strong strategic positions are no more evident than in our worldwide polyolefin catalysts and process technology licensing business. After investing \$1.2 billion in accretive, synergistic acquisitions over the past six years, including five new plants on three continents, Grace offers our world-class customers the broadest and most technically advanced portfolio of polyolefin catalysts technologies that enable them to produce high-value resins in demand by their customers.

Grace signed six UNIPOL® Polypropylene Process Technology licenses in 2019, seeding relationships with multi-year lifespans and the opportunity to deliver millions of dollars in value to our customers in improved profits and differentiated products.



Materials Technologies Adds Capacity in Europe and Malaysia

A global leader in specialty silica, Grace will begin operation of a new colloidal silica plant in 2020 at our European flagship manufacturing and R&D center in Worms, Germany. This investment will significantly increase capacity for our renowned LUDOX® colloidal silica technologies and enable us to meet customers' increasing technical requirements as we help them develop entirely new products and market segments. Cited in over 25,000 patents, Grace's LUDOX® colloidal silica is one of the most versatile and functional silica-based technologies available for high-performance applications. A second silica manufacturing plant in Kuantan, Malaysia soon will add vital capacity and flexibility to our global manufacturing network. This investment supports our growing business in Asia by increasing our capacity and lowering our cost to serve customers in the region.

Growth Highlights

In millions¹

SALES GROWTH



ADJUSTED EBIT GROWTH



ADJUSTED EPS GROWTH



CONTINUING INVESTMENT IN CAPACITY AND OPERATING EXCELLENCE



GROWING SUSTAINABILITY PORTFOLIO²



RETURNING CASH TO SHAREHOLDERS THROUGH SHARE REPURCHASE AND DIVIDENDS



¹ For a discussion of non-GAAP financial measures and reconciliations to GAAP financial measures, see Analysis of Operations in Management's Discussion and Analysis of Financial Condition and Results of Operations in Grace's 2019 Annual Report on Form 10-K.

² Includes revenues aligned to SASB Chemicals Sustainability Accounting Standards definition of products designed for use-phase resource efficiency, including improving energy efficiency, eliminating/lowering emissions, reducing raw materials consumption, increasing product longevity, and/or reducing water consumption.

³ Figures include unconsolidated ART joint venture.

A LETTER FROM THE

President and Chief Executive Officer

Hudson La Force



Hudson La Force
President and Chief Executive Officer

DEAR FELLOW SHAREHOLDERS:

Our team delivered solid results in a challenging year. We grew sales, Adjusted EBIT, Adjusted EPS, and cash flow. We returned \$102 million to shareholders and reduced our net leverage ratio to within our target range following our most recent acquisitions. And we improved pricing and expanded gross margins by 80 basis points. This financial performance is a strong indication of our team's ability to execute in a challenging environment.

Just as important, we made significant progress executing our profitable growth strategy established two years ago. The strategy has four key elements:

- Invest to accelerate growth and extend our competitive advantages.
- Invest in great people to strengthen our high-performance culture.
- Execute the Grace Value Model to drive operating excellence.
- Acquire to build our technology and manufacturing capabilities for our customers.

BUILDING ON OUR STRENGTHS

Over many years, we have built strong strategic positions and clear competitive advantages in polyolefin catalysts and licensing, refining catalysts, and specialty silica gels.

We're number one in each of these market segments, yet we don't take that position for granted. We have a clear strategy to accelerate our growth and extend our competitive advantages in each of our businesses.

Sustainability has become much more important to our customers, our shareholders, and to us. For decades we have helped our customers achieve their product performance and manufacturing process goals. During this time, helping customers solve their problems became a core part of our

value model. Today, customers are asking us to help them achieve their sustainability objectives as well, and a significant portion of our sales come from products specifically intended to do so.

Our products and technical services help our customers improve the efficiency of their processes and products; reduce energy, water, and raw material use; cut harmful emissions; and reduce waste. They help our customers make products that meet the toughest environmental standards and address rising consumer and regulatory expectations for sustainability, human health, and safety.

In 2019, approximately \$1.1 billion, or 44 percent of our sales including the ART joint venture, were of products that directly contributed to our customers' sustainability objectives. This is an increase of about 10 percent over 2018. In the more distant future, our technologies will enable chemical recycling and circularity, and we can imagine a scenario where our sustainability growth driver accelerates faster than any other.

INVESTING TO GROW OUR BUSINESSES

Over the last two years, we've made significant progress executing our growth strategy, with a focus on three key levers:

1. Our growth capacity investments are the most significant financially. We are investing in three major capacity additions for our polyolefin catalysts, hydroprocessing catalysts, and colloidal silica businesses. These investments and other growth investments are well-supported by customer demand with over 90 percent of the capital spending linked to specific customers, contracts, or licenses. The payback on these investments will begin in 2020 and accelerate in 2021.

2. Second is customer-driven innovation and commercial excellence. We've increased our R&D spending by 15 percent since 2017 to accelerate new product development and satisfy strong demand for our technically-differentiated, specialized products. We've also invested \$6 million and over fifty thousand employee hours to upgrade our commercial capabilities, including a global Salesforce® implementation, intensive value selling and negotiations training, and much more rigorous segment marketing including account planning and key account management. These investments are starting to pay off in better customer retention, higher win rates, increased customer share of wallet, and improved profitability.
3. Third, we've invested over \$20 million in the Grace Manufacturing System (GMS) and other operating excellence initiatives to increase throughput and reliability, reduce manufacturing and delivery costs, and improve our customer experience. In 2019, the first GMS investments contributed 75 basis points to our margins, 50 percent higher than our original benefit expectations. These benefits will continue in the years to come.



GRACE VALUE MODEL

As I've highlighted, we are seeing the initial payback of these investments already and that payback will accelerate in 2020 and 2021 as new capacity delivers more high-quality, technically-differentiated products and our integrated supply chain improvements mature.

VALUE DELIVERED

Our growth and investment are focused on one goal: delivering value to our customers, investors, and employees. The Grace Value Model defines how we achieve this through nine key elements, including customer-driven innovation, commercial excellence, operating excellence, and disciplined capital allocation. The most important elements of our model are great talent and high-performance culture, the most enduring sources of our competitive advantage.

I want to recognize Grace's 4,000 global employees. Their unique, diverse talents, their commitment to our customers and our investors, their drive for results, and their daily example of our values and leadership behaviors are what make Grace a leader in our industry and a great place to work.

THANK YOU

On behalf of the Grace Board and our employees, thank you for your confidence in Grace and our strategy for the future. Our strategy is built on the talent, technology, and trust at the core of our business and customer relationships. It is aligned with the enduring demand drivers in the markets we serve. And it is made possible by the capital you have entrusted to us.

When I step back and consider the investments we are making, the strong customer demand for our high-value technologies, the sustainability benefits we deliver to our customers, and the strength of our growth drivers, I am confident in our ability to deliver value to you.

Hudson La Force
President and Chief Executive Officer



A Growing Sustainability-Driven Portfolio

Sustainability has become dramatically more important to our customers, our investors, our employees, and to many other stakeholders.

Our own safety and environmental goals are simply stated: no one hurt, nothing out of place, and no harm from our products. Yet our focus on sustainability extends far beyond the walls of our manufacturing plants. We are making a strong contribution to our customers' sustainability objectives.

For decades, our technologies and technical services have been helping our customers achieve their product performance and manufacturing process goals. In fact, helping customers solve their problems is a core part of the Grace Value Model.

Today, more and more customers are asking us to help them achieve their sustainability objectives as well, and a significant portion of our sales comes from products specifically engineered to do just that. Our products and technical services help our customers improve process efficiency and reduce raw

material requirements and emissions. Our technologies also help our customers reformulate products to comply with new, rising regulatory standards and customer health and wellness expectations.

Last year we noted that sales from our products that directly contribute to our customers' sustainability objectives totaled \$1 billion, or 38 percent of sales, including our ART joint venture. In 2019, that total increased approximately 10 percent to \$1.1 billion, or 44 percent of sales. We fully expect this total will continue to grow. In fact, over 65 percent of our current R&D activity is focused on new products for our sustainability portfolio and our top three growth capital investments are dedicated to these products.

We focus on sustainability through operating excellence, continually tracking progress toward our goals of no one hurt, nothing out of place, and no harm from our products. The discipline of continually improving the efficiency and performance of our manufacturing and integrated supply chain is deeply embedded in our culture and annual operating plans.

PRODUCTS TO MEET SUSTAINABILITY OBJECTIVES



- 44% of 2019 sales were of products that help our customers meet their sustainability objectives
- 65% of our R&D work is focused on products to help our customers meet their sustainability objectives

2019 REVENUE¹ FROM SUSTAINABILITY-DRIVEN PRODUCTS

\$1.1 Billion

Up 10%

¹ Includes revenues aligned to SASB Chemicals Sustainability Accounting Standards definition of products designed for use-phase resource efficiency, including improving energy efficiency, eliminating/lowering emissions, reducing raw materials consumption, increasing product longevity, and/or reducing water consumption. Figure includes unconsolidated ART joint venture.



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Focus on Value Delivered

2019 FORM 10-K

**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, 2019

or

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

For the transition period from _____ to _____

Commission file number 1-13953

W. R. GRACE & CO.

(Exact name of registrant as specified in its charter)

Delaware

65-0773649

(State or other jurisdiction of incorporation or organization)

(I.R.S. Employer Identification No.)

7500 Grace Drive, Columbia, Maryland 21044-4098

(Address of principal executive offices) (Zip Code)

(410) 531-4000

(Registrant's telephone number, including area code)

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

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, \$0.01 par value per share	GRA	New York Stock Exchange

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

None

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

Yes ☒ No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the

Act. Yes ☐ No ☒

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

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

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

Large accelerated filer

☒

Accelerated filer

☐

Non-accelerated filer

☐

Smaller reporting company

☐

Emerging growth company

☐

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

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

The aggregate market value of W. R. Grace & Co. voting and non-voting common equity held by non-affiliates as of June 30, 2019 (the last business day of the registrant's most recently completed second fiscal quarter) was \$4,323,527,569.

Indicate by check mark whether the registrant has filed all documents and reports required to be filed by Sections 12, 13 or 15(d) of the Securities Exchange Act of 1934 subsequent to the distribution of securities under a plan confirmed by a court. Yes ☒ No ☐

At January 31, 2020, 66,720,858 shares of W. R. Grace & Co. Common Stock, \$.01 par value per share, were outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the definitive Proxy Statement to be delivered to our shareholders in connection with the Annual Meeting of Shareholders to be held on May 12, 2020, are incorporated by reference into Part III.

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Notes on references that we use in this Report. Unless the context indicates otherwise, the terms "Grace," the "Company," "we," "us," or "our" mean (i) W. R. Grace & Co. itself, or (ii) W. R. Grace & Co. and/or one or more of its consolidated subsidiaries and affiliates and, in certain cases, their respective predecessors. Unless otherwise indicated, the contents of websites that we mention are not incorporated by reference or otherwise made a part of this Report.

We refer to the Financial Accounting Standards Board as the "FASB." The FASB issues, among other things, Accounting Standards Codifications (which we refer to as "ASC") and Accounting Standards Updates (which we refer to as "ASU"). We refer to the U.S. Internal Revenue Services as the "IRS."

Trademarks and other intellectual property that we discuss in this Report. GRACE®, the GRACE® logo (and any other use of the term "Grace" as a tradename) as well as the other trademarks, service marks, or trade names used in this Report are trademarks, service marks, or trade names of Grace or its operating units, except as otherwise indicated. UNIPOL® and UNIPOL UNIPPAC® are trademarks of The Dow Chemical Company or an affiliated company of Dow. Grace and/or its affiliates are licensed to use the UNIPOL® and UNIPOL UNIPPAC® trademarks in the area of polypropylene. ART® and ADVANCED REFINING TECHNOLOGIES® are trademarks, registered in the United States and/or other countries, of Advanced Refining Technologies LLC. RESPONSIBLE CARE® is a trademark of the American Chemistry Council.

PART I

Item 1. BUSINESS

BUSINESS OVERVIEW

W. R. Grace & Co., through its subsidiaries, is engaged in the production and sale of specialty chemicals and specialty materials on a global basis through two reportable business segments: Grace Catalysts Technologies (“Catalysts Technologies”), which includes catalysts and related products and technologies used in petrochemical, refining, and other chemical manufacturing applications; and Grace Materials Technologies (“Materials Technologies”), which includes specialty materials, including silica-based and silica-alumina-based materials, used in consumer/pharma, coatings, and chemical process applications.

Historical Perspective

Grace is the successor to a company that began in 1854 and originally became a public company in 1953. We entered the specialty chemicals and specialty materials industries in 1954, the year in which we acquired the Davison Chemical Company. W. R. Grace & Co. is a Delaware corporation.

W. R. Grace & Co. conducts all of its business through a single wholly-owned subsidiary, W. R. Grace & Co.–Conn. (“Grace–Conn.”), a Connecticut corporation formed in 1899. Grace–Conn. owns all of the assets, properties and rights of W. R. Grace & Co. on a consolidated basis, either directly or through subsidiaries.

Recent Developments

Acquisitions

We discuss our approach to Mergers and Acquisitions below, under “Profitable Growth Strategy.” In line with that strategy, in recent years we have completed the following transactions:

We completed the acquisition of the business and assets of Rive Technology, Inc. (“Rive”) on June 17, 2019, for \$22.8 million. The business is included in the Refining Technologies operating segment of our Catalysts Technologies reportable segment. The acquisition included Rive’s MOLECULAR HIGHWAY[®] zeolite technology for catalytic processes, which allows us to offer a broader spectrum of products for converting crude oil to petrochemical feedstocks.

On April 3, 2018, we acquired the assets of the polyolefin catalysts business of Albemarle Corporation for \$418.0 million, net of cash acquired and including customary post-closing adjustments. The acquisition included production plants in Baton Rouge, Louisiana and Yeosu, South Korea; research and development and pilot plant capabilities; and an extensive portfolio of intellectual property. The business is included in the Specialty Catalysts operating segment of our Catalysts Technologies reportable segment. The acquisition was complementary to our existing Specialty Catalysts business and has strengthened our commercial relationships, catalysts technology portfolio, and manufacturing network.

On June 30, 2016, we completed the acquisition of the assets of the BASF Polyolefin Catalysts business for a purchase price of \$250.6 million. The acquisition included technologies, patents, trademarks, and production plants in Pasadena, Texas, and Tarragona, Spain. The acquisition added the following technologies to our catalysts portfolio: (1) LYNX[®] high-activity polyethylene (“PE”) catalyst technologies used commercially in slurry processes for the production of high-density PE resins such as bimodal film and pipe; and (2) LYNX[®] polypropylene (“PP”) catalyst technologies used commercially in all major PP process technologies including slurry, bulk loop, stirred gas, fluid gas, and stirred bulk. The acquisition also provided us with significant additional flexibility and capacity for our global polyolefin catalysts manufacturing network. These products became part of the Specialty Catalyst operating segment of our Catalysts Technologies reportable segment.

We completed the acquisition of the assets of the Polypropylene Licensing and Catalysts business of The Dow Chemical Company on December 2, 2013, for a cash purchase price of \$510.4 million (which included post-closing adjustments). The acquisition included UNIPOL[®] Polypropylene Process Technology as well as CONSISTA[®] and SHAC[®] catalysts. The technology and products complemented our polyolefin catalyst businesses as part of the Specialty Catalysts operating segment of our Catalysts Technologies reportable segment. The acquisition also included our production plant in Norco, Louisiana.

Other Notable Developments

In 2016, we exited certain peripheral Materials Technologies product lines, as those product lines no longer fit into our strategic growth plans. We sold certain of these assets to unaffiliated buyers for aggregate proceeds of \$12.9 million.

In 2016, Grace completed a separation transaction with respect to GCP Applied Technologies Inc., then a wholly-owned subsidiary of Grace (“GCP”), which included Grace’s former Construction Products operating segment and the packaging technologies business of its Materials Technologies operating segment (the “Separation”). The Separation was effected by means of a pro rata distribution to the Company’s stockholders of all of the outstanding shares of GCP common stock. As a result of the transaction, GCP became an independent public company.

On February 3, 2014, Grace concluded a voluntary reorganization under Chapter 11 of the United States Bankruptcy Code in the United States Bankruptcy Court for the District of Delaware, when the joint plan of reorganization (the “Joint Plan”) filed by Grace and certain other parties became effective.

Global Scope

We operate our business on a global scale with approximately 72% of our 2019 consolidated sales outside the United States. We operate and/or sell to customers in over 60 countries and in over 30 currencies. We manage our operating segments on a global basis, to serve global markets. Currency fluctuations affect our reported results of operations, cash flows, and financial position.

Profitable Growth Strategy

We create value for customers and investors by profitably growing our specialty chemicals and specialty materials businesses and achieving high levels of efficiency and cash flow. To meet these objectives, we:

- Invest to accelerate growth and extend our competitive advantages;
- Invest in great people to strengthen our high-performance culture;
- Execute the Grace Value Model to drive operating excellence; and
- Acquire to build our technology and manufacturing capabilities for our customers.

Our businesses are well-positioned to grow through our customer-driven innovation, commercial and operating excellence and thoughtful, disciplined merger and acquisition approach. Our businesses are interconnected through shared materials science and our highly-integrated global manufacturing and supply chain operations.

Our organic growth drivers include: global demand for plastics and petrochemical feedstocks; global demand for cleaner fuels and heavy oil upgrading; rising living standards and growing middle class incomes; stricter environmental standards; and increased focus on health and wellness.

The Grace Value Model (“GVM”)

In 2018, we introduced investors to the Grace Value Model, our framework for creating and delivering value to customers, investors and employees. At the company level, we create value through our focused portfolio, strong strategic position, and disciplined capital allocation. At the business level, we create value through customer-driven innovation, commercial excellence, and operating excellence. Linking and enabling all of these elements are great talent, high-performance culture, and integrated business management processes. Our ability to rigorously execute the Grace Value Model is a principal source of our competitive advantage in the global marketplace and our financial performance. The Grace Value Model is illustrated as follows:



Talent and Culture

Our great talent and high-performance culture are the most important sources of our competitive advantage and long-term ability to deliver value to customers and investors. We have invested heavily in our global talent and talent management system, which includes aligned goal setting, ongoing feedback and coaching, effective performance reviews, and a continuous cycle of professional development. In 2019, we refreshed more than 10% of our global workforce, including upgrading talent where needed and adding key leadership roles throughout the organization.

Our high-performance culture is based on our commitment to performance and our five Grace Leadership Behaviors: Deliver Results; Think Critically; Be Authentic; Communicate; and Engage and Include. We expect our colleagues to model these behaviors and our values in their daily business conduct. We aspire to continually strengthen our talent and culture by welcoming and valuing the unique backgrounds, cultures, experiences, perspectives, and contributions of our employees around the globe as a core element of executing our profitable growth strategy and achieving our value creation goals.

Our Approach to Mergers & Acquisitions (“M&A”)

Our approach to M&A prioritizes strategic fit, synergies and returns. We seek investments that improve our technology, research and development and/or commercial capabilities; enhance and/or leverage our manufacturing capabilities; and include attractive growth and profitability opportunities. Our recent acquisitions have been very synergistic, with strong growth and returns driven by significant cost and capital synergies. We establish minimum return requirements for every investment, based on specific risk-adjusted hurdle rates, and expect all acquisitions to be accretive to earnings per share (“EPS”).

Our Reportable Business Segments

GRACE CATALYSTS TECHNOLOGIES

Catalysts Technologies uses our significant catalysts knowledge and applications expertise to design and manufacture products to create significant value for our customers. Our customers include major oil refiners as well as plastics and chemicals manufacturers. We believe that our technological expertise and broad technology platform provide a competitive advantage, allowing us to quickly design products that help our customers create value in their operations and their end markets.

The following table sets forth Catalysts Technologies sales of similar products as a percentage of Grace total revenue.

(In millions)	Year Ended December 31,					
	2019		2018		2017	
	Sales	% of Grace Revenue	Sales	% of Grace Revenue	Sales	% of Grace Revenue
Refining catalysts	\$ 791.4	40.4%	\$ 802.0	41.5%	\$ 758.1	44.2%
Polyolefin and chemical catalysts	705.3	36.0%	661.5	34.2%	518.4	30.2%
Total	\$ 1,496.7	76.4%	\$ 1,463.5	75.7%	\$ 1,276.5	74.4%

A description of our Catalysts Technologies products and services and their applications follows:

Products and Services	Overview/Use	Key Brands
<i>Refining Technologies</i>		
FCC Catalysts	Crack the hydrocarbon chains in distilled crude oil to produce transportation fuels, such as gasoline and diesel fuels, and feeds for production of petrochemicals	MIDAS® • IMPACT® • NEKTOR™ • GENESIS® • ACHIEVE® • FUSION™ • VIP-R™ • RIVE TECHNOLOGY® • MOLECULAR HIGHWAY®
FCC Additives	Used to reduce sulfur in gasoline, maximize propylene production from refinery FCC units, and reduce emissions of sulfur oxides, nitrogen oxides, and carbon monoxide from refinery FCC units	D-PRISM® • GSR® • SURCA® • ZAVANTI™ • OLEFINSULTRA® • DESOX® • DENOX® • CP®
Hydroprocessing Catalysts (HPC)	Marketed through the ART joint venture with Chevron (discussed below), these catalysts are used in process reactors to upgrade heavy oils into lighter, more useful products, enabling less expensive feedstock usage in the petroleum refining process and to produce products that meet more stringent environmental regulations; our catalysts and solutions allow our customers to improve their profitability in the production of cleaner petroleum-based fuels to meet regulatory and fuel quality standards	ICR® • GR® • SmART Catalyst System® • APART® • LS™ Catalyst Platform • HSLS® Catalyst Platform • HCRC™ Catalyst Platform
<i>Polyolefin and Chemical Catalysts (also referred to as Specialty Catalysts)</i>		
Polyethylene Catalysts/ Polypropylene Catalysts/ Catalyst Supports	Used in the production of polyethylene (PE) and polypropylene (PP) thermoplastic resins, which can be customized to enhance the performance of a wide range of industrial and consumer end-use applications including high pressure pipe, geomembranes, food packaging, automotive parts, medical devices, and textiles; non-phthalate catalysts allow our customers to produce phthalate-free PP products; includes catalysts that allow for the lightweighting of automobiles by replacing steel parts with PP while meeting demanding performance standards of automakers	PE Brands - MAGNAPORE® • SYLOPOL® • LYNX® PP Brands - CONSISTA® • SHAC® • LYNX® • POLYTRAK® • HYAMPP®
Gas-Phase Polypropylene Process Technology Licensing	Provides licensees with a proven, cost-effective, flexible, and reliable capability to manufacture polypropylene products having a wide spectrum of performance attributes enabling customers to manufacture products for a broad array of end-use applications	UNIPOL® PP Process Technology • UNIPOL UNIPPAC® Process Control Software
Chemical Catalysts	Used in a variety of petrochemical chain conversions and fine chemical production	RANEY® • DAVICAT®

Refining Technologies

FCC Catalysts and Additives

We are a global leader in developing and manufacturing fluid catalytic cracking, or FCC, catalysts and additives that are designed to enable petroleum refiners to increase profits by improving product yields, value and quality. Our FCC products also enable refiners to reduce emissions from their FCC units and reduce sulfur content in the transportation fuels they produce. Oil refining is a highly specialized discipline, and FCC catalysts must be tailored to meet local variations in crude oil feedstocks and a refinery's desired product mix. We work regularly with our customers to identify the most appropriate catalyst and additive formulations for their changing needs.

FCC units are designed to produce a broad spectrum of refined product yields, including gasoline, middle distillates, and liquefied petroleum gas, or LPG. Traditionally, many FCC operators have focused on maximizing yields of transportation fuels. However, as demand for petrochemicals increases, a growing segment of refiners have transitioned their FCC operations with the primary objective of maximizing yields of petrochemical feedstocks, such as propylene. We maintain multiple industry leading technologies, including ZAVANTI™ and VIP-R™, that allow our customers to capture unique value from petrochemical feedstock driven operations.

Many countries and regions, including the U.S., European Union, Japan, Russia, India and China have imposed regulatory limitations on the sulfur content of gasoline and diesel fuel. We have developed a portfolio of products designed to assist refiners in meeting their gasoline sulfur-reduction targets, including our D-PRISM[®] and GSR[®] additives and our SURCA[®] catalyst family.

Also, many U.S. petroleum refiners have entered into consent decrees with the U.S. Environmental Protection Agency (the “EPA”) under which the refiners have agreed to reduce emissions of nitrogen oxides and sulfur oxides. The European Union has also imposed requirements on refineries with respect to nitrogen oxides and sulfur oxides emissions. Our additives are designed to assist refineries in meeting their obligations to reduce these pollutants. Our Super DESOX[®] additive reduces sulfur oxides emissions from commercial FCC units. Our DENOX[®] additives are designed to achieve reductions in nitrogen oxides emissions comparable to those obtained from capital intensive alternatives available to a refinery, while our non-platinum-based combustion promoter CP[®] P is designed to enable refiners to control carbon monoxide emissions without increasing nitrogen oxides.

Hydroprocessing Catalysts

We market most of our hydroprocessing catalysts through our Advanced Refining Technologies LLC (“ART”) joint venture with Chevron Products Company (“Chevron”). We hold a 50% economic interest in ART, which is not consolidated in our financial statements so ART’s sales are excluded from our sales. We established ART to combine our technology with that of Chevron and to develop, market, and sell hydroprocessing catalysts to customers in the petroleum refining industry worldwide.

We are a leading supplier of hydroprocessing catalysts designed for processing high resid content feedstocks. We offer products for fixed-bed resid hydrotreating, on-stream catalyst replacement, and ebullating-bed resid hydrocracking processes.

We also offer a full line of catalysts, customized for individual refiners, used in distillate hydrotreating to produce ultra-low sulfur content gasoline and diesel fuel, including our SmART CATALYST SYSTEM[®] and APART[®] Catalyst Systems. As discussed above, regulatory limitations on the sulfur content of gasoline and diesel fuel are becoming more common. These products are designed to help refiners to reduce the sulfur content of their products.

We have rights to sell hydrocracking and lubes hydroprocessing catalysts to licensees of Chevron Lummus Global (“CLG”) and other petroleum refiners for unit refills. These rights allow us to streamline hydroprocessing catalyst supply and improve technical service for refining customers by establishing ART as their single point of contact for all their hydroprocessing catalyst needs.

Polyolefin and Chemical Catalysts (also referred to as Specialty Catalysts)

Polyolefin Catalysts and Catalyst Supports

We are a leading provider of catalyst systems and catalyst supports to the polyolefins industry for a variety of polyethylene and polypropylene process technologies.

We use a combination of proprietary catalyst and support technology and technology licensed from third parties to provide unique catalyst-based solutions to our customers and to provide a broad technology portfolio for enhancing collaboration opportunities with technology leaders.

Polypropylene Process Technology

Also, we are a leading licensor of gas-phase polypropylene process technology to polypropylene manufacturers. Our UNIPOL[®] polypropylene technology is designed to have fewer moving parts and require less equipment than other competing technologies, which reduces operating costs. This technology provides our licensees with a flexible and reliable capability to manufacture products for a broad array of end-use applications. The polypropylene process licensing industry is technology-intensive, and licensors must adapt the technology and the related licenses to meet individual customer needs.

Chemical Catalysts

Our chemical catalysts include hydrogenation and dehydrogenation catalyst products. These catalysts can be customized for use in a variety of petrochemical chain conversions as well as fine chemical production.

Manufacturing, Marketing and Raw Materials

Our Catalysts Technologies products are manufactured by a network of globally coordinated plants. Our integrated supply chain organization is responsible for the effective utilization of our manufacturing capabilities. For a discussion of our manufacturing plants for Catalysts Technologies, see Item 2, “Properties,” below.

We use a global organization of technical professionals, including a direct sales force, with extensive experience in refining processes, catalyst development, and catalyst applications to market our refining catalysts and additives. These professionals work to tailor our technology to the needs of each specific customer. We generally negotiate prices for our refining catalysts because our formulations are specific to the needs of each customer and each customer receives individual attention and technical service. We sell a significant portion of our hydroprocessing catalysts through multiple-year supply agreements with our geographically diverse customer base.

We use a global organization of direct sales professionals to market our polyolefin catalysts, polypropylene process technology, and chemical catalysts, that seeks to maintain close working relationships with our customers. Our global direct sales force is complemented by a network of distributors and agents in Asia Pacific and, to a lesser extent, the Americas and Middle East. These relationships enable us to cooperate with major polymer and chemical producers to develop catalyst technologies that complement their process or application developments. We have geographically distributed our sales and technical service professionals to make them responsive to the needs of our geographically diverse customers. We typically operate under long-term contracts with our customers.

The principal raw materials for Catalysts Technologies products include molybdenum oxide, specialty inorganics, caustic soda, alumina and derivatives, sodium silicate, nickel, rare earths, and tungsten salt. Multiple suppliers are generally available for each of these materials; however, some of our raw materials may be provided by single sources of supply. We seek to mitigate the risk of using single source suppliers by identifying and qualifying alternative suppliers or, for unique materials, by using alternative formulations from other suppliers. In some instances, we produce our own raw materials and intermediates.

Prices for many of our raw materials, including metals, and energy can be volatile. In response to increases in raw materials and energy costs, we generally take actions to mitigate the effects of higher costs including developing alternative formulations for our products, increasing productivity, hedging purchases of certain raw materials, and increasing prices.

As in many chemical businesses, we consume significant quantities of natural gas in the production of Catalysts Technologies products. World events and other economic factors cause volatility in the price of natural gas. Increases or decreases in the cost of natural gas and raw materials can have a significant impact on our operating margins. We have implemented a risk management program under which we hedge natural gas in a way that is designed to mitigate the effects of price volatility.

Seasonality

Seasonality does not have a significant overall effect on our Catalysts Technologies reportable segment. However, under traditional patterns, sales of FCC catalysts have tended to be lower in the first calendar quarter due to maintenance outages taken prior to the shift in production by refineries from home heating oil for the winter season to gasoline production for the summer season. FCC catalysts and ebullating-bed hydroprocessing catalysts are consumed at a relatively steady rate and are replaced regularly. Fixed-bed hydroprocessing catalysts are consumed over a period of years and are replaced in bulk in an irregular pattern. Since our customers periodically shut down their refining processes to replace fixed-bed hydroprocessing catalysts in bulk, our hydroprocessing catalyst sales to any customer can vary substantially over the course of a year and between years based on that customer's catalyst replacement schedule.

Backlog of Orders; Working Capital

While at any given time there may be some backlog of orders, this backlog is not material in respect to our total annual sales for Catalysts Technologies, nor are the changes, from time to time, significant. Our working capital consists of inventory, accounts receivable, accounts payable, and deferred revenue. We closely manage these working capital accounts. We value inventory balances under the first-in, first-out (“FIFO”) method. Inventories have turned regularly, but balances typically increase during the first half of the year before declining

as a result of increased sales in the second half. Accounts receivable and accounts payable are also affected by this business cycle, typically requiring us to have greater working capital needs during the second and third quarters.

Competition

Competition in FCC catalysts and additives and hydroprocessing catalysts is based on value delivered to refiners, which is based on differentiated technology, catalyst performance, technical and customer service, and price. Our principal global FCC catalyst competitors are Albemarle, BASF, and SINOPEC. Our principal global competitors in FCC additives are Johnson Matthey, Albemarle, and BASF. Our principal global competitors in hydroprocessing catalysts are Shell Catalysts (formerly Criterion), Albemarle, Haldor Topsoe, UOP, and Axens. We also have multiple regional competitors.

Competition in the polyolefin catalyst, catalyst supports, and polypropylene process licensing industry is technology-intensive. Our competition in this industry includes Univation, LyondellBasell, PQ, and Lummus Novolen Technology. Most competitors sell their products and/or license their technology worldwide.

GRACE MATERIALS TECHNOLOGIES

Materials Technologies uses our significant specialty silica, zeolite and fine chemical knowledge and applications expertise to design and manufacture products to create significant value for our customers. Our customers include consumer products manufacturers, pharmaceutical companies, coatings manufacturers, emission control system manufacturers, petrochemical and natural gas processors, and plastics manufacturers. We believe that our technological expertise and broad technology platform provide a competitive advantage, allowing us to tailor our products to specific customer requirements and help them create value in their operations and end markets.

The following table sets forth Materials Technologies sales of similar products as a percentage of Grace total revenue.

(In millions)	Year Ended December 31,					
	2019		2018		2017	
	Sales	% of Grace Revenue	Sales	% of Grace Revenue	Sales	% of Grace Revenue
Consumer/Pharma	\$ 144.6	7.4%	\$ 132.6	6.9%	\$ 123.3	7.2%
Coatings	139.8	7.1%	155.4	8.1%	142.2	8.3%
Chemical process	156.1	8.0%	157.3	8.1%	153.5	8.9%
Other	20.9	1.1%	23.3	1.2%	21.0	1.2%
Total	\$ 461.4	23.6%	\$ 468.6	24.3%	\$ 440.0	25.6%

A description of our Materials Technologies products and services and their applications follows:

Products and Services	Overview/Use	Key Brands
Consumer/Pharma	<i>Specialized materials used as additives and intermediates for pharmaceuticals, nutraceuticals, beer, toothpaste, food, and cosmetic segments, including:</i>	
	Toothpaste abrasives and thickening agents	SYLODENT® • SYLOBLANC® • SIDENT®
	Free-flow agents, anticaking agents, heating agents, tableting aids, cosmetic additives and flavor carriers	PERKASIL® • SYLOID® • SYLOSIV® • ZEOFLO® • ZEOFOAM™
	Edible oil refining agents, stabilizers and clarification aids for beer, juices and other beverages; for beer stabilization, our products allow our customers to reduce their environmental footprint using water more efficiently and reducing waste sent to solid landfills	TRISYL® • DARACLAR®
	Pharmaceutical excipients and drug delivery	SYLOID® FP • SYLOID® XDP • SILSOL®
	Fine chemical intermediates and regulatory starting materials	
Coatings	Chromatography purification media	DAVISIL® • VYDAC®
	<i>Functional additives for wood and architectural coatings that provide surface effects and corrosion protection for metal substrates, including:</i>	
	Matting agents, anticorrosion pigments, TiO2 extenders and moisture scavengers for paints and lacquers; our products allow our customers to reformulate their anti-corrosive coating products to eliminate heavy metals	SYLOID® • SHIELDEX® • SYLOSIV® • SYLOWHITE™
	Additives for matte, semi-glossy and glossy ink receptive coatings on high performance ink jet papers, photo paper, and commercial wide-format print media	SYLOJET® • DURAFILL® • LUDOX®
	Paper retention aids, functional fillers, paper frictionizers	DURAFILL® • LUDOX®
Chemical Process	Defoamers	ZEOFLO® • ZEOFOAM™
	<i>Functional materials for use in plastics, rubber, tire, metal casting, and adsorbent products for petrochemical and natural gas applications, including:</i>	
	Reinforcing agents for rubber and tires	PERKASIL®
	Inorganic binders and surface smoothening aids for precision investment casting and refractory applications; also enable our customers to produce automotive catalytic converters for automakers to meet emissions control regulations	LUDOX®
	Static adsorbents for dual pane windows and refrigerant applications, moisture scavengers, and package desiccants	PHONOSORB® • SYLOSIV® • CRYOSIV® • PROTEKSORB®
	Chemical metal polishing aids and formulations for chemical mechanical planarization/electronics applications	POLIEDGE®
	Antiblocking additives for plastic films to prevent adhesion of layers in manufacturing	SYLOBLOC®
	Process adsorbents used in petrochemical and natural gas processes for such applications as ethylene-cracked-gas-drying, natural gas drying and sulfur removal	SYLOBEAD®

Silica-based Products

We globally manufacture functional additives and process aids, such as silica gel, colloidal silica, zeolitic adsorbents, precipitated silica and silica-aluminas, for a wide variety of applications and end-use industries. We also custom manufacture fine chemical intermediates and regulatory starting materials used primarily in the pharmaceutical and nutritional supplements industries.

Our materials are integrated into our customers' manufacturing processes and when combined with our technical support, can increase the efficiency and performance of their operations and their products. By working closely with our customers, we seek to help them respond quickly to changing consumer demands. In addition, we focus on developing and manufacturing products that differentiate our customers' products and help them meet evolving regulatory and environmental requirements. For example, our coatings additives are designed to be used in more sustainable water-based and VOC-compliant coatings. Our pharmaceutical excipients help improve bioavailability, extend shelf-life, and/or make drug manufacturing more efficient. Our dental silicas are engineered to provide high cleaning with gentle abrasivity. Our beer stabilization silicas offer greater productivity to breweries while reducing solid waste and water usage. Our custom manufacturing of advanced intermediates supports pharmaceutical drug development processes, enabling commercialization of life-saving therapies.

Manufacturing, Marketing and Raw Materials

Our Materials Technologies products are manufactured by a network of globally integrated plants that are positioned to service our customers. Our integrated supply chain organization is responsible for the effective utilization of our manufacturing capabilities. Our global footprint allows us to partner effectively with both multinational and regional companies requiring multiple manufacturing facilities complemented by regional technical expertise in local languages. For a discussion of our manufacturing plants for Materials Technologies, see Item 2, "Properties," below.

We use country-based direct sales forces and further support our customers with application-specific technical customer service teams to market our Materials Technologies products. Our sales force seeks to develop long-term relationships with our customers and focuses on consultative sales, technical support, and key account growth programs. To ensure full geographic coverage, our direct sales organization is further supplemented by a network of distributors.

The principal raw materials for Materials Technologies products include sodium silicate, zeolite, sand, soda ash, sulfuric acid, and caustic soda. Multiple suppliers are generally available for each of these materials; however, some of our raw materials may be provided by single sources of supply. We seek to mitigate the risk of using single source suppliers by identifying and qualifying alternative suppliers or, for unique materials, by using alternative formulations from other suppliers. In some instances, we produce our own raw materials and intermediates.

Prices for some of our raw materials and energy can be volatile. In response to increases in input costs, we generally take actions intended to mitigate the effects of higher costs including developing alternative formulations for our products, increasing productivity, and increasing prices.

As in many chemical businesses, we consume significant quantities of natural gas in the production of Materials Technologies products. World events and other economic factors can cause volatility in the price of natural gas. Increases or decreases in the cost of natural gas and raw materials can have a significant impact on our operating margins. We have implemented a risk management program under which we hedge natural gas in a way that is designed to mitigate the effects of price volatility.

Seasonality

Seasonality does not have a significant overall effect on our Materials Technologies reportable segment. Seasonal and weather-related factors are mitigated by the global scope of our business.

Backlog of Orders; Working Capital

While at any given time there may be some backlog of orders, this backlog is not material in respect to our total annual sales for Materials Technologies, nor are the changes, from time to time, significant. Our working capital consists of inventory, accounts receivable and accounts payable. We closely manage these working capital accounts. We value inventory balances under the FIFO method. Inventories have turned regularly.

Competition

There are many manufacturers of engineered materials that market their products on a global basis including Evonik, PQ, and UOP. Competition is generally based on product performance, technical service, quality and reliability, price, and other differentiated product features to address the needs of customers, end-users, and brand owners. Our products compete on the basis of distinct technology, product quality, and customer support.

Competition for these products is highly fragmented, with a large number of companies that sell their products on a global or regional basis.

INTELLECTUAL PROPERTY; RESEARCH ACTIVITIES

Competition in the specialty chemicals and specialty materials industry is often based on technological superiority and innovation. Our ability to maintain our margins and effectively compete with other suppliers depends on our ability to introduce new products based on innovative technology, as well as our ability to obtain patent or other intellectual property protection. Our research and development programs emphasize development of new products and processes, improvement of existing products and processes, and application of existing products and processes to new industries and uses. We conduct most of our research activity in North America and Europe.

We file patents in order to protect our investments in innovation arising from research and product development in all our businesses, and as a result, numerous patents and patent applications protect our products, formulations, manufacturing processes, equipment, and improvements. For example, we selectively file and obtain patents in our Refining Technologies business, as well as in our chemical catalysts product line in our Specialty Catalysts business, for strategic new products or for significant business opportunities. We routinely file and obtain patents in a number of countries around the world that are significant to our polyolefin catalysts product line in our Specialty Catalysts business.

In our Materials Technologies business, we focus our research on the development and use of specialty materials products and formulations for diverse applications. We file patents and trademarks in various countries to protect our unique products, processes and expertise in strategic areas of our business, and to cover key product innovations in adjacent market segments.

We also benefit from the use of trade secret information, including know-how and other proprietary information relating to many of our products and processing technologies in all of our businesses.

While we seek legal protection for our innovations, there can be no assurance, however, that our patents, patent applications and precautions to protect trade secrets and know-how will provide sufficient protection for our intellectual property. In addition, other companies may independently develop technology that could replicate, and thus diminish the advantage provided by, our trade secrets. Other companies may also develop alternative technology or design-arounds that could circumvent our patents or may acquire patent rights applicable to our business which might interpose a limitation on expansion of our business in the future.

ENVIRONMENT, HEALTH AND SAFETY (or “EHS”) MATTERS

We are subject, along with other manufacturers of specialty chemicals, to stringent regulations under numerous regional, national, provincial, state and local environment, health and safety laws and regulations relating to the manufacture, storage, handling, disposal and stewardship of chemicals and other materials. Environmental laws require that certain responsible parties, as defined in the relevant statute, fund remediation actions regardless of legality of original disposal or ownership of a disposal site. We are involved in various response actions to address the presence of chemical substances as required by applicable laws.

We have expended substantial funds to comply with environmental laws and regulations and expect to continue to do so in the future. The following table sets forth our expenditures in the past three years, and our estimated expenditures in 2020 and 2021, for (i) the operation and maintenance of manufacturing facilities and the disposal of wastes; (ii) capital expenditures for environmental control facilities; and (iii) site remediation:

(In millions)	Operation of Facilities and Waste Disposal	Capital Expenditures	Site Remediation
2017	\$ 51	\$ 7	\$ 20
2018	56	8	18
2019	54	7	14
2020(1)	60	26	23
2021(1)	61	17	22

(1) Amounts are based on environmental response matters for which sufficient information is available to estimate costs. We do not have sufficient information to estimate all of our possible future environmental response costs. As we receive new information, our estimate of such costs may change materially.

Additional information about our environmental remediation activities is provided in this Report in Item 8 “Financial Statements and Supplementary Data” under Note 10, “Commitments and Contingent Liabilities,” to the Consolidated Financial Statements, which information is incorporated herein by reference.

Environment, Health and Safety Programs

We continuously seek to improve our environmental, health and safety performance. To the extent applicable, we extend the basic elements of the American Chemistry Council’s RESPONSIBLE CARE® program to all our locations worldwide, embracing specific performance objectives in the key areas of management systems, product stewardship, employee health and safety, community awareness and emergency response, distribution, process safety and pollution prevention.

Sustainability

Overview

We succeed when we deliver value to our customers, and that success is increasingly based on how we help them meet their sustainability goals. Many of our products and technical services improve the efficiency of our customers’ products and processes, reduce energy or water use, cut harmful emissions, conserve material inputs, and/or reduce waste. Several of our technologies enable our customers to make products that meet the toughest environmental standards or to reformulate products to address rising consumer and regulatory expectations for sustainability, human health, and safety. As a leading manufacturer of process catalysts, we have become an active participant in the circular economy, with an increasing business in arranging for the recycling or reprocessing of spent catalysts. As part of our commitment to Responsible Care®, we systematically track safety and environmental performance through a comprehensive, global EHS management system covering the environmental, health, safety (including process safety and product safety) and security aspects of our operations, and track progress through pertinent metrics. In 2019, we began reporting to the Carbon Disclosure Project.

Product Portfolio

As part of a strategic review of our product portfolio, in 2019 we identified the products that directly contribute to our customers’ sustainability objectives, including:

- Products designed for use-phase efficiency — defined by the Sustainability Accounting Standards Board (SASB) as products that “through their use—can be shown to improve energy efficiency, eliminate or lower greenhouse gas (GHG) emissions, reduce raw materials consumption, increase product longevity, and/or reduce water consumption,” either through:
 - Improved products — by increasing the efficiency of a product during its use phase, or
 - Improved processes — by increasing the efficiency of the manufacturing processes used to make products, and
- Stricter Environmental Standards — products that directly enable customers to meet environmental regulatory/legal requirements applicable to their products or manufacturing processes.
- Reduced Consumption/Sustainable — products that enable customers to reformulate their products to avoid or reduce to de minimis levels substances of concern to their customers.

Together, the products in our portfolio, including those of our ART joint venture, that address these sustainability endpoints accounted for approximately \$1.1 billion, or 44% of our total revenue in 2019, an increase of approximately 10% over 2018.

EcoVadis Ranking

For 2019, Grace earned a Gold Rating from EcoVadis, placing the Company in the top 6% of ranked suppliers in our industry for Corporate Social Responsibility. EcoVadis is a leading third-party entity that evaluates suppliers on a complex scale of sustainability and environmental, social, and governance (or “ESG”) factors.

Further Information

Shareholders and other interested persons can visit our website for additional sustainability information at www.grace.com/sustainability/en-us. That further information is not incorporated herein by reference and is not a part of this Annual Report on Form 10-K.

Security

We have implemented the RESPONSIBLE CARE® Security Code through a company-wide security program focused on the security of our people, processes, and systems. We have reviewed existing security (including cybersecurity) vulnerability and taken actions to enhance security systems where deemed necessary. In addition, we are complying with the Department of Homeland Security’s Chemical Facility Anti-Terrorism Standards, including identifying facilities subject to the standards, conducting security vulnerability assessments and developing and executing site security plans, as necessary.

EMPLOYEE RELATIONS

As of December 31, 2019, we employed approximately 4,000 persons, of whom approximately 2,200 were employed in the United States and approximately 1,000 were employed in Germany. Of our total employees, approximately 2,500 were salaried and 1,500 were hourly.

Approximately 700 of our manufacturing employees at 5 manufacturing sites in the United States are represented by unions. We have operated without a labor work stoppage for more than 20 years. Outside the United States, we have works councils and unions serving approximately 1,300 employees, the majority of whom are located at our European sites.

OTHER INFORMATION, WEBSITE, AND AVAILABILITY OF REPORTS AND OTHER DOCUMENTS

Our principal executive offices are located at: W. R. Grace & Co., 7500 Grace Drive, Columbia, Maryland 21044. We maintain a website at www.grace.com. Our telephone number at our principal executive offices is +1 410.531.4000.

Our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, and amendments to those reports, filed or furnished pursuant to Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended, are available, free of charge, on our website as soon as reasonably practicable after such reports are electronically filed with, or furnished to, the Securities and Exchange Commission, or SEC. These reports may be accessed through our website’s investor information page at <http://investor.grace.com/>. These reports as well as our proxy and information statements may also be accessed through the SEC’s website at www.sec.gov.

In addition, the charters for the Audit, Compensation, Nominating and Governance, and Corporate Responsibility Committees of our Board of Directors, our corporate governance principles and code of ethics are available, free of charge, on our website at www.grace.com/en-us/corporate-leadership/pages/governance.aspx. Printed copies of the charters, governance principles and code of ethics may be obtained free of charge by contacting Grace Shareholder Services at +1 410.531.4167.

The information on our website is not, and shall not be deemed to be, a part of this report or incorporated into any other filings we make with the SEC.

Our Principal Executive Officer and Principal Financial Officer have submitted certifications to the SEC pursuant to the Sarbanes Oxley Act of 2002 as exhibits to this Report.

Important information can be found throughout this Form 10-K and shareholders and potential investors are encouraged in particular to review Item 1A, "Risk Factors."

EXECUTIVE OFFICERS

See "Information about our Executive Officers" following Part I, Item 4 of this Report for information about our Executive Officers.

Item 1A. RISK FACTORS

This Report contains, and our other public communications may contain, forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. All statements other than statements of historical fact, including statements regarding expected: financial positions; results of operations; cash flows; financing plans; business strategy; operating plans; capital and other expenditures; environmental expenditures; competitive positions; growth opportunities for existing products; benefits from new technology and cost reduction initiatives, plans and objectives; and markets for securities, are forward looking. Such statements generally include the words "believes," "plans," "intends," "targets," "will," "expects," "suggests," "anticipates," "outlook," "continues" or similar expressions. For these statements, we claim the protection of the safe harbor for forward-looking statements contained in Section 27A of the Securities Act and Section 21E of the Exchange Act. We are subject to risks and uncertainties that could cause our actual results to differ materially from our projections or that could cause other forward-looking statements to prove incorrect. Factors that could cause actual events to differ materially from those contained in the forward-looking statements include those factors set forth below and elsewhere in this Annual Report on Form 10-K. Our reported results should not be considered as an indication of our future performance. Readers are cautioned not to place undue reliance on our projections and forward-looking statements, which speak only as of the date those projections and statements are made. We undertake no obligation to publicly release any revisions to the projections and forward-looking statements contained in this document, or to update them to reflect events or circumstances occurring after the date of this document. In addition to general economic, business and market conditions, we are subject to other risks and uncertainties, including, without limitation, the following:

For reference, we have divided the various significant risks to our business, financial condition, and results of operations into the following three categories: (i) key business risks; (ii) risks related to legacy matters; and (iii) risks related to financial matters, as set forth below.

Key Business Risks

The global scope of our operations subjects us to the risks of doing business in foreign countries, which could adversely affect our business, financial condition and results of operations.

We operate our business on a global scale with approximately 72% of our 2019 consolidated sales outside the United States. We operate and/or sell to customers in over 60 countries and in over 30 currencies. We currently have many production facilities, research and development facilities, and administrative and sales offices located outside North America, including facilities and offices located in EMEA (Europe Middle East Africa), Asia Pacific and Latin America. We expect non-U.S. sales to continue to represent a substantial majority of our revenue. Accordingly, our business is subject to risks related to the differing legal, political, social and regulatory requirements and economic conditions of many jurisdictions. Risks inherent in non-U.S. operations include the following:

- commercial agreements may be more difficult to enforce and receivables more difficult to collect;
- intellectual property rights may be more difficult to enforce;
- increased shipping costs, disruptions in shipping or reduced availability of freight transportation;
- difficulty transferring our profits or capital from foreign operations to other countries where such funds could be more profitably deployed;
- unexpected adverse changes in export duties, quotas and tariffs, and difficulties in obtaining export licenses;
- additional withholding and other taxes or restrictions on foreign trade or investment, including import, currency exchange and capital controls, charges and limitations;
- foreign governments may nationalize private enterprises;
- political or economic repercussions on a domestic, country-specific or global level from terrorist activities and the response to such activities;

- unexpected adverse changes in foreign laws or regulatory requirements;
- increased cash taxes in the event of a change in tax laws, regulations or interpretations in one or more foreign jurisdictions, could adversely affect our business, financial condition, results of operations, or liquidity; and
- geopolitical risk, where unexpected changes in global, regional, or local political or social conditions could adversely affect our foreign operations.

Our success as a global business will depend, in part, upon our ability to succeed in differing legal, regulatory, economic, social and political conditions by developing, implementing and maintaining policies and strategies that are effective in each location where we do business.

In addition to the risks and uncertainties that we discussed above, recent world events have increased the risks posed by international trade disputes, tariffs, and sanctions. We procure a wide spectrum of commodities globally to support our production. For materials sourced from nations that could be impacted by trade disputes, tariffs or sanctions, we could potentially face increased costs, supply disruptions and/or costs associated with securing alternative materials. Additionally, such disputes, tariffs, and sanctions could potentially lead to a reduction in our sales of products, technology, and services. We view geopolitical risk along with other potential supply chain and sales risks, and work actively to diversify and mitigate these potential impacts; however, such events could adversely affect our business, financial condition and results of operations.

As we operate worldwide in a competitive environment, global economic and financial market conditions may adversely affect our business, financial condition and results of operations.

We compete by selling value-added products, technologies and services. Increased levels and numbers of competitors, globally or regionally, could negatively impact our results of operations. Economic conditions around the world can have a direct impact on our revenues. A global or regional economic downturn or market uncertainty could reduce the demand for our products, technologies and services, which could negatively impact our results of operations. Since many of our customers are refiners, our fluid catalytic cracking (FCC) catalyst business is highly dependent on the economics of the petroleum refining industry. Demand for our FCC products is affected by refinery throughput, the type and quality of refinery feedstocks, and the demand for transportation fuels and other refinery products, such as propylene. Also, disruptions in the financial markets could have an adverse effect on our ability to finance our operations and growth plans, and could negatively impact our suppliers and customers in similar manners.

We are exposed to currency exchange rate changes that impact our profitability.

We are exposed to currency exchange rate risk through our U.S. and non-U.S. operations. Changes in currency exchange rates may materially affect our operating results. For example, changes in currency exchange rates may affect the relative prices at which we and our competitors sell products in the same region and the cost of materials used in our operations. A substantial portion of our net sales and assets are denominated in currencies other than the U.S. dollar, particularly the euro. When the U.S. dollar strengthens against other currencies, at a constant level of business, our reported sales, earnings, assets and liabilities are reduced because the non-U.S. currencies translate into fewer U.S. dollars.

We incur a currency transaction risk whenever one of our operating subsidiaries enters into either a purchase or a sales transaction using a currency different from the operating subsidiary's functional currency. Given the volatility of exchange rates, we may not be able to manage our currency transaction risks effectively, or volatility in currency exchange rates may expose our financial condition or results of operations to a significant additional risk.

Prices for certain raw materials and energy are volatile and can have a significant effect on our manufacturing and supply chain strategies as we seek to maximize our profitability. If we are unable to successfully adjust our strategies in response to volatile raw materials and energy prices, such volatility could have a negative effect on our earnings in future periods.

We use metals, natural gas, petroleum-based materials, and other materials in the manufacture of our products. We consume substantial amounts of energy in our manufacturing processes. Prices for these materials and energy are volatile and can have a significant effect on our pricing, sales, manufacturing and supply chain strategies as we seek to maximize our profitability. Our ability to adjust strategies successfully in response to volatile raw material and energy prices is a significant factor in maintaining or improving our profitability. If we are

unable to successfully adjust our strategies in response to volatile prices, such volatility could have a negative effect on our sales and earnings in future periods.

A substantial portion of our raw materials are commodities whose prices fluctuate as market supply and demand fundamentals change.

We attempt to manage exposure to price volatility of major commodities through:

- long-term supply contracts;
- contracts with customers that permit adjustments for changes in prices of commodity-based materials and energy;
- forward buying programs that layer in our expected requirements systematically over time; and
- limited use of financial instruments.

Although we regularly assess our exposure to raw material price volatility, we cannot always predict the prospects of volatility and we cannot always cover the risk in a cost effective manner.

We have a policy of maintaining, when available, multiple sources of supply for raw materials. However, certain of our raw materials may be provided by single sources of supply. We may not be able to obtain sufficient raw materials due to unforeseen developments that would cause an interruption in supply. Even if we have multiple sources of supply for raw materials, these sources may not make up for the loss of a major supplier.

If we are not able to continue our technological innovation and successful introduction of new products, our customers may turn to other suppliers to meet their requirements.

The specialty chemicals and specialty materials industries and the end-use markets into which we sell our products experience ongoing technological change and product improvements. A key element of our business strategy is to invest in research and development activities with the goal of introducing new high-performance, technically-differentiated products. We may not be successful in developing new technology and products that effectively compete with products introduced by our competitors, and our customers may not accept, or may have lower demand for, our new products. If we fail to keep pace with evolving technological innovations or fail to improve our products in response to our customers' needs, then our business, financial condition and results of operations could be adversely affected as a result of reduced sales of our products.

We may be subject to claims of infringement of the intellectual property rights of others, which could hurt our business.

From time to time, we face infringement claims from our competitors or others alleging that our processes or products infringe on their proprietary technologies. Any claims that our products or processes infringe the intellectual property rights of others, regardless of the merit or resolution of the claims, could cause us to incur significant costs in responding to, defending and resolving the claims, and may divert the efforts and attention of our management and technical personnel from our business. If we are found to be infringing on the proprietary technology of others, we may be liable for damages, and we may be required to change our processes, redesign our products, pay others to use the technology, or stop using the technology or producing the infringing product. Even if we ultimately prevail, the existence of the lawsuit could prompt our customers to switch to products that are not the subject of infringement suits.

Some of our employees are unionized, represented by works councils or employed subject to local laws that are less favorable to employers than the laws in the United States.

As of December 31, 2019, we had approximately 4,000 global employees. Approximately 700 of our approximately 2,200 U.S. employees are unionized at 5 manufacturing sites, and approximately 1,300 of our employees outside the U.S. are represented by works councils and unions. In addition, a large number of our employees are employed in countries in which employment laws provide greater bargaining or other rights to employees than the laws in the United States. Such employment rights require us to work collaboratively with the legal representatives of the employees to effect any changes to labor arrangements. For example, most of our employees in Europe are represented by works councils that have co-determination rights on any changes in conditions of employment, including certain salaries and benefits and staff changes, and may impede efforts to restructure our workforce. A strike, work stoppage or slowdown by our employees or significant dispute with our

employees, whether or not related to these negotiations, could result in a significant disruption of our operations or higher ongoing labor costs.

We intend to pursue acquisitions, joint ventures and other transactions that complement or expand our businesses. We may not be able to complete proposed transactions and even if completed, the transactions may involve a number of risks that may materially and adversely affect our business, financial condition and results of operations.

We intend to continue to pursue opportunities to buy other businesses or technologies that could complement, enhance or expand our current businesses or product lines or that might otherwise offer us growth opportunities. We may have difficulty identifying appropriate opportunities or, if we do identify opportunities, we may not be successful in completing transactions for a number of reasons. Any transactions that we are able to identify and complete may involve a number of risks, including:

- the diversion of management's attention from our existing businesses to integrate the operations and personnel of the acquired or combined business or joint venture;
- possible adverse effects on our operating results during the integration process;
- failure of the acquired business to achieve expected financial, operational, and other objectives;
- possible assumption of unexpected liabilities; and
- inability to obtain indemnification from other parties to transactions.

In addition, we may not be able to successfully or profitably integrate, operate, maintain and manage any newly acquired operations or their employees. We may not be able to maintain uniform standards, controls, procedures and policies, which may lead to operational inefficiencies.

We spend large amounts of money for environmental compliance in connection with our current and former operations, and may continue to do so.

As a manufacturer of specialty chemicals and specialty materials, we are subject to stringent regulations under numerous U.S. federal, state, local and foreign environmental, health and safety laws and regulations relating to the generation, storage, handling, discharge, disposition and stewardship of chemicals and other materials. We have expended substantial funds to comply with such laws and regulations and have established a policy to minimize our emissions to the environment. Nevertheless, legislative, regulatory and economic uncertainties (including existing and potential laws and regulations pertaining to climate change) make it difficult for us to project future spending for these purposes, and if there is an acceleration in new regulatory requirements, we may be required to expend substantial additional funds to remain in compliance, which may be material.

We work with dangerous materials that can injure our employees, damage our facilities, disrupt our operations, and contaminate the environment.

Some of our operations involve the handling of hazardous materials that may pose the risk of fire, explosion, or the release of hazardous substances. Such events could result from natural disasters, operational failures or terrorist attacks, and might cause injury or loss of life to our employees and others, environmental contamination, and property damage. These events might cause a temporary shutdown of an affected plant, or portion thereof, and we could be subject to penalties or claims as a result of any of these events. A disruption of our operations caused by these or other events could have a material adverse effect on our results of operations.

We are subject to business continuity risks that may adversely affect our business, financial condition and results of operations.

We are subject to significant risks from both natural disasters and accidents such as fires, storms, and floods; public health concerns, including pandemics and quarantines; and disruptive events, such as war, insurrection, and terrorist actions; and other force majeure events. These types of occurrences can negatively affect our manufacturing, supply chain, logistics, information technology, and communications functions. Similarly, they can strike major suppliers and customers, thus restricting or delaying our supply of raw materials or energy as well as reducing or deferring demand for our products and services. In the event of a major disruption, we may not be able to replace this business in a timely manner or at similar margins. Also, we have centralized certain administrative functions, primarily in North America, Europe and Asia, to improve efficiency and reduce costs. To

the extent that these central locations are disrupted or disabled, key business processes, such as invoicing, payments and general management operations, could be interrupted.

We insure against many of these risks by carrying property, general, liability, and other coverages with highly rated global insurers. Given the current insurance market as well as our recent claims experience, we may experience increased costs to purchase insurance coverage going forward. Our ability to obtain certain coverage, including contingent time element business interruption insurance, for losses related to our suppliers or customers may be limited or more costly in the future.

A failure of our information technology infrastructure could adversely impact our business and operations.

We rely upon the capacity, reliability and security of our IT infrastructure and our ability to expand and continually update this infrastructure in response to the changing needs of our business. If we experience a problem with the functioning of an important IT system, the resulting disruptions could have an adverse effect on our business. Our IT systems affect virtually every aspect of our business, including supply chain, manufacturing, logistics, finance and communications. We and certain of our third-party vendors receive and store personal information in connection with our human resources operations and other aspects of our business. Any IT system failure, natural disaster, accident, or intentional breach could result in disruptions to our operations.

Our ability to operate our businesses and our financial condition could be significantly undermined by cybersecurity breaches.

Despite our implementation of security measures, our information technology (“IT”) systems are subject to cyberattack and other similar disruptions. Breaches by hackers, the introduction of computer viruses, ransomware, and other cybersecurity incidents affecting our IT systems could result in disruptions to our operations. Also, such incidents could include theft of our trade secrets and other intellectual property, as well as confidential customer, employee and business information, which could be used by unauthorized parties and publicly disclosed. This could negatively affect our relationships with customers and our ability to compete effectively, and could ultimately harm our reputation, business, financial condition and results of operations. In addition, we may be required to incur significant costs to protect against damage caused by cybersecurity breaches in the future.

Risks Related to Legacy Matters

We are subject to liabilities for Legacy Matters, which include (i) product, (ii) environmental, and (iii) other liabilities, relating to past activities of Grace.

In addition to the legacy product and legacy environmental liabilities discussed below in these Risk Factors, we are subject to other liabilities relating to past activities of Grace. On April 3, 2019, the Montana Department of Natural Resources and Conservation issued a five-year operating permit for a dam at the Libby mine site. We constructed the dam in 1971 to prevent vermiculite ore tailings from moving into nearby creeks and rivers. The permit requires us to complete construction of a new spillway before the permit is further renewed in five years. We contracted a third-party engineering and consulting firm to develop a range of cost estimates for the project. Based on this work, we recorded pre-tax charges of \$68.0 million in 2019 for the estimated costs of the project. These costs are preliminary and may vary significantly as the project progresses. Based on the consultants’ estimates, we believe it is reasonably possible that the ultimate costs of this project could range between \$50 million and \$100 million.

We are subject to environmental clean-up costs, fines, penalties and damage claims that have been and continue to be costly.

In the U.S., we are subject to lawsuits and regulatory actions, in connection with current and former operations (including some divested businesses and off-site disposal facilities), that seek clean-up or other remedies. We are also subject to similar risks outside of the U.S.

We operated a vermiculite mine in Libby, Montana, until 1990. Some of the vermiculite ore that was mined at the Libby mine contained naturally occurring asbestos. We are engaged with the U.S. Environmental Protection Agency (or the “EPA”) and other federal, state and local governmental agencies in a remedial investigation and feasibility study (or the “RI/FS”) of the Libby mine and the surrounding area, known as Operable Unit 3 (or “OU3”).

The RI/FS will determine the specific areas within OU3 requiring remediation and will identify possible remedial action alternatives. Possible remedial actions within OU3 are wide-ranging, from institutional controls such as land use restrictions, to more active measures involving soil removal, containment projects, or other protective measures. As part of the RI/FS process, we contracted an engineering and consulting firm to develop a range of possible remedial alternatives and associated cost estimates for OU3. Based on this work, we recorded a pre-tax charge of \$70.0 million in the 2018 third quarter for the estimated costs of remediation of OU3. We believe that this amount should provide for a protective remedy meeting the statutory requirements of the Comprehensive Environmental Response, Compensation, and Liability Act.

The estimated costs of remediation are preliminary and consist of several components, each of which may vary significantly as the remedial alternatives are further developed and analyzed by the regulatory bodies providing oversight. It is reasonably possible that the ultimate costs of remediation could range between \$30 million and \$170 million. The ultimate remedy will be determined by the EPA after the RI/FS is finalized. Such remedy will be set forth in a Record of Decision (or "ROD") that is currently expected to be issued by the EPA no earlier than 2021. Costs associated with the more active remedial alternatives would be expected to be incurred over a decade or more. We will reevaluate our estimated liability as remedial alternatives evolve based on further work by the engineering and consulting firm and discussions with the EPA as the RI/FS process moves toward a ROD. Technical memoranda expected prior to the issuance of the ROD may provide insight into the likely remedial alternatives ultimately selected, allowing Grace to update its cost of remediation estimate. Depending on the remedial alternatives that the EPA selects in the ROD, the total cost of remediating OU3 may exceed our current estimate by material amounts.

The EPA is also investigating or remediating formerly owned or operated sites that processed Libby vermiculite into finished products. We have cooperated with the EPA on these investigation and remediation activities. We have recorded a liability for remaining expected EPA response and oversight costs, and for potential future site remediation, where a review has indicated that liability is probable and the cost is estimable. The EPA may commence additional investigations in the future at other sites that processed Libby vermiculite. Liability for unaccrued additional investigation and remediation costs is probable but not yet estimable, and could be material.

We have recorded liabilities for all environmental matters for which a loss is considered to be probable and sufficient information is available to reasonably estimate the loss. We also face legacy environmental liability for response costs at sites not related to our former vermiculite mining and processing activities. This liability relates to our former businesses or operations, including our share of liability at off-site disposal facilities. Our estimated liability is based upon regulatory requirements and environmental conditions at each site. As we receive new information, our estimated liability may increase materially.

We may be required to make one or more contingent deferred payments to the trust for asbestos property damage claims, which we refer to as the "PD Trust," in respect of claims related to our former Zonolite attic insulation ("ZAI") product ("ZAI PD Claims"); we may also be obligated to make additional payments to the PD Trust in respect of "Other PD Claims" (those being asbestos property damage claims other than ZAI PD Claims); and our obligations to make payments to the PD Trust in respect of Other PD Claims is not capped.

Grace emerged from bankruptcy effective February 3, 2014 (the "Effective Date"). Under the Joint Plan, the PD Trust was established and funded under Section 524(g) of the Bankruptcy Code. The order of the Bankruptcy Court confirming the Joint Plan contains a channeling injunction, which provides that all pending and future asbestos-related property damage claims and demands (or "PD Claims") can only be brought against the PD Trust. The PD Trust contains two accounts. One of these accounts is the "ZAI PD Account," which is funded in respect of claims related to ZAI. The other account is the "PD Account," which is funded solely in respect of Other PD Claims.

Under the Joint Plan, all pending and future asbestos-related personal injury claims are channeled for resolution to a personal injury trust (the "PI Trust"). We have satisfied all of our financial obligations to the PI Trust. We have contingent financial obligations remaining to the PD Trust. With respect to ZAI PD Claims, the PD Trust was funded with \$49.4 million (net of \$15 million of attorneys' fees) to pay claims and expenses. We are also obligated to make up to 10 contingent deferred payments of \$8 million per year to the PD Trust during the 20-year period beginning on the fifth anniversary of the Effective Date, with each such payment due only if the assets of the PD Trust fall below \$10 million during the preceding year. As of December 31, 2019, the PD Trust has paid out

approximately \$29 million in ZAI PD Claims and expenses, leaving a balance of approximately \$23 million, including the benefit of realized investment gains.

Due to the limited claims history, the unique nature of this product, and the uncertainty of future claims patterns, an actuarial analysis was completed to estimate the range of possible future payments. The analysis was conducted by a third-party actuarial firm directed by us and using historical claims data provided by the ZAI trustee. Certain key assumptions employed in the analysis were (1) projections of the future number of filed claims, assuming a percentage increase in claims during earlier years and annual decreases in later years; (2) application of historical percentages of claims closed with indemnity payment compared to total closed claims, applied on a regional basis; and (3) application of the average claim payout, which reflects the average indemnity cost per claim closing with payment. As a result of the analysis and taking into account the relative uncertainty of future claims activity, we determined that contingent funding obligations beyond the next five years are not reasonably estimable. We estimate that the reasonable range of payments over the next five years is expected to be between \$16 million and \$24 million and project that the first payment could be due in 2022. In the 2019 fourth quarter, we recorded a reserve in the amount of \$24 million related to probable future obligations to fund the PD Trust for ZAI PD Claims. Our maximum financial obligation over the next 19 years is \$80 million, and no single year's obligation can exceed \$8 million.

With respect to Other PD Claims, claims unresolved as of the Effective Date are to be litigated in the bankruptcy court and any future claims are to be litigated in a federal district court, in each case pursuant to procedures approved by the bankruptcy court. To the extent any such Other PD Claims are determined to be allowed claims, they are to be paid in cash by the PD Trust. We are obligated to make a payment to the PD Trust every six months in the amount of any Other PD Claims allowed during the preceding six months plus interest (if applicable) and the amount of PD Trust expenses for the preceding six months (the "PD Obligation"). We have not paid any Other PD Claims since emergence. Annual expenses have been approximately \$0.2 million per year. The aggregate amount to be paid under the PD Obligation is not capped, and we may be obligated to make additional payments to the PD Trust in respect of the PD Obligation. We have accrued for those unresolved Other PD Claims that we believe are probable and estimable. We have not accrued for other unresolved or unasserted Other PD Claims as we do not believe that payment is probable.

All payments to the PD Trust required after the Effective Date are secured by the Company's obligation to issue 77,372,257 shares of Company common stock to the PD Trust in the event of default, subject to customary anti-dilution provisions.

Risks Related to Financial Matters

Our indebtedness may materially affect our business, including our ability to fulfill our obligations, react to changes in our business and incur additional debt to fund future needs.

We have a substantial amount of debt. As of December 31, 2019, we had \$1,042.3 million of unsecured indebtedness outstanding and \$938.1 million of secured indebtedness outstanding. Our indebtedness may have material effects on our business, including to:

- require us to dedicate a substantial portion of our cash flow to principal and interest payments, thereby reducing funds available for working capital, capital expenditures, acquisitions, research and development, distributions to shareholders (which fall within the discretion of our Board of Directors taking into account financial, liquidity and other considerations), share repurchase programs and other purposes;
- restrict us from making strategic acquisitions or taking advantage of favorable business opportunities;
- limit our flexibility in planning for, or reacting to, changes in our business and the industries in which we operate;
- increase our vulnerability to adverse economic, credit and industry conditions, including recessions;
- make it more difficult for us to satisfy our other obligations;
- place us at a competitive disadvantage compared to our competitors that have relatively less debt; and
- limit our ability to borrow additional funds, or to dispose of assets to raise funds, if needed, for working capital, capital expenditures, acquisitions, research and development and other purposes.

If we incur additional debt, the risks related to our indebtedness may intensify.

Restrictions imposed by agreements governing our indebtedness may limit our ability to operate our business, finance our future operations or capital needs, or engage in other business activities. If we fail to comply with certain restrictions under these agreements, our debt could be accelerated, and we may not have sufficient cash to pay our accelerated debt.

The agreements governing our indebtedness contain various covenants that limit, among other things, our ability, and the ability of certain of our subsidiaries, to:

- incur certain liens;
- enter into sale and leaseback transactions; and
- consolidate, merge or sell all or substantially all of our assets or the assets of our guarantors.

As a result of these covenants, we will be limited in the manner in which we can conduct our business, and may be unable to engage in favorable business activities or finance future operations or capital needs. Accordingly, these restrictions may limit our flexibility to operate our business. A failure to comply with the restrictions contained in these agreements, including maintaining the financial ratios required by our credit facilities, could lead to an event of default which could result in an acceleration of our indebtedness. We cannot guarantee that our future operating results will be sufficient to enable us to comply with the covenants contained in the agreements governing our indebtedness or to remedy any such default. In addition, in the event of an acceleration, we may not have or be able to obtain sufficient funds to make any accelerated payments. Additionally, in the event of a change in control, we will be required to offer to purchase our senior unsecured notes at a price equal to 101% of the aggregate principal amount outstanding plus accrued and unpaid interest.

Our indebtedness exposes us to interest expense increases if interest rates increase.

As of December 31, 2019, approximately \$293.5 million of our borrowings were at variable interest rates and expose us to interest rate risk, excluding \$592.5 million hedged by cross-currency swaps effective in November 2018, and \$100.0 million hedged by interest rate swaps effective in April 2018. If interest rates increase, our debt service obligations on the variable rate indebtedness would increase even though the amount borrowed would remain the same, and our net income would decrease. An increase of 100 basis points in the interest rates payable on our variable rate indebtedness would increase our annual estimated debt-service requirements by \$2.9 million, assuming our consolidated variable interest rate indebtedness outstanding as of December 31, 2019, remains the same.

The uncertainty regarding the potential phase-out of LIBOR may negatively impact our operating results.

We currently have term loan borrowings, a revolving credit facility and financial derivatives that rely on the London Interbank Offered Rate (“LIBOR”) as a benchmark rate. LIBOR is expected to be phased out as a benchmark rate by the end of 2021, when private sector banks are no longer required to report the information used to set the rate. Without this data, LIBOR may no longer be published, or the lack of quality and quantity of data may cause the rate to no longer be representative of the market. No consensus exists as to what rate or rates will become accepted alternatives to LIBOR at this time, although the U.S. Federal Reserve, in connection with the Alternative Reference Rates Committee, a steering committee composed of large U.S. financial institutions, is considering replacing U.S. dollar LIBOR with the Secured Overnight Financing Rate (“SOFR”). SOFR is a more generic measure than LIBOR and considers the cost of borrowing cash overnight, collateralized by U.S. Treasury securities.

Given the inherent differences between LIBOR and SOFR, or any other alternative benchmark rate that may be established, there are uncertainties regarding a transition from LIBOR. These uncertainties include, but are not limited to, the need to amend all contracts with LIBOR as the referenced rate and the impact on our cost of variable rate debt, including the use of certain financial derivatives. We will also need to consider new contracts and determine if they should reference an alternative benchmark rate and/or include suggested fallback language, as published by the Alternative Reference Rates Committee. The consequences of these developments with respect to LIBOR cannot be entirely predicted and span multiple future periods; however, they could result in a change in the cost of our variable rate debt or derivative financial instruments, which may be detrimental to our financial position or operating results.

We have unfunded and underfunded pension plan liabilities. We will require future operating cash flow to fund these liabilities. We have no assurance that we will generate sufficient cash to satisfy these obligations.

We maintain U.S. and non-U.S. defined benefit pension plans covering current and former employees who meet or met age and service requirements. Our net pension liability and cost is materially affected by the discount rate used to measure pension obligations, the longevity and actuarial profile of our workforce, the level of plan assets available to fund those obligations and the actual and expected long-term rate of return on plan assets. Significant changes in investment performance or a change in the portfolio mix of invested assets can result in corresponding increases and decreases in the valuation of plan assets or in a change in the expected rate of return on plan assets. Assets available to fund the pension benefit obligation of the U.S. advance-funded pension plans at December 31, 2019, were approximately \$956 million, or approximately 93% of the measured pension projected benefit obligation on a U.S. GAAP basis. In addition, any changes in the discount rate, as well as actual returns on plan assets, could result in a significant increase or decrease in the valuation of pension obligations, affecting the reported funded status of our pension plans as well as the net periodic pension cost in the following years. Similarly, changes in the expected return on plan assets can result in significant changes in the net periodic pension cost in the following years.

Our ability to use tax credits and / or net operating losses to reduce future tax payments may be limited if there is a change in ownership of Grace or if Grace does not generate sufficient taxable income or foreign source income for U.S. tax purposes. Our ability to use these attributes is also subject to time limitations. Changes in tax laws and regulations may reduce their value and availability.

Our ability to utilize tax attributes including tax credits, future tax deductions, and net operating losses (“NOLs”), is dependent on our ability to generate sufficient taxable income and foreign source income for U.S. tax purposes. Under U.S. income tax law, federal tax credits may be carried forward for 10 years, and research and development tax credits may be carried forward for 20 years. State NOL carryforwards are generally available for deduction against future taxable income for up to 20 years, subject to state-specific regulations. Also, our ability to realize the benefits of these tax credits and/or NOLs and their value may be adversely affected by changes in tax laws and regulations. In addition, our ability to utilize U.S. federal tax credits as well as state NOLs may be limited in the event of future changes in the ownership of outstanding Company common stock.

Item 1B. UNRESOLVED STAFF COMMENTS

None.

Item 2. PROPERTIES

We operate manufacturing plants and other facilities (including offices, warehouses, labs and other service facilities) throughout the world. Some of these plants and facilities are shared by our reportable segments. We consider our operating properties generally to be in good operating condition and suitable for their current use. We believe that the productive capacity of our plants and other facilities, supplemented by tolling arrangements, is generally adequate for current operations. The table below summarizes our manufacturing plants by reportable segment and region as of December 31, 2019:

	Number of Facilities(1)				
	North America	Europe Middle East Africa (EMEA)	Asia Pacific	Latin America	Total
Catalysts Technologies	10	3	2	—	15
Owned	8	1	2	—	11
Leased	2	2	—	—	4
Materials Technologies	4	2	1	1	8
Owned	3	1	1	—	5
Leased	1	1	—	1	3

(1) Shared facilities are counted in both reportable segments. The total number of facilities included in the above table, without regard to sharing between reportable segments, is 20, of which we own 13 and lease 7.

Generally, we own the machinery and equipment at our manufacturing plants. We also own the land on which most of our largest manufacturing plants are situated; however, certain manufacturing plants are located on leased land, normally long-term. We own our Corporate Headquarters in Columbia, Maryland. We also lease and operate a shared services facility in Manila, Philippines.

The table below sets forth our manufacturing plants by reportable segment.

Catalysts Technologies	Materials Technologies
Aiken, South Carolina	Dueren, Germany*
Baton Rouge, Louisiana*	East Chicago, Indiana*
Chattanooga, Tennessee	Hesperia, California
Chicago, Illinois	Kuantan, Malaysia
Lake Charles, Louisiana	Sorocaba, Brazil*
Norco, Louisiana*	
Pasadena, Texas	
Qingdao, China**	
Stenungsund, Sweden*	Shared
Tarragona, Spain*	Albany, Oregon
Valleyfield, Quebec, Canada	Curtis Bay, Maryland
Yeosu, South Korea	Worms, Germany

* Denotes leased site.

** Facility was idled in 2019.

Our three largest manufacturing sites are: Worms, in Germany; and Curtis Bay, Maryland, and Lake Charles, Louisiana, in the United States. The unanticipated loss of any of our manufacturing, headquarters, or shared services facilities could have a material adverse effect upon our business, financial condition or results of operations.

For information on our properties and equipment by region and country, see disclosure set forth in Item 8 (Financial Statements and Supplementary Data) under Note 18 (Segment Information) to our Consolidated Financial Statements, which disclosure is incorporated herein by reference.

Item 3. LEGAL PROCEEDINGS

CHAPTER 11 PROCEEDINGS AND ASBESTOS CLAIMS

Disclosures provided in this Report in Item 1 (Business) and Item 8 (Financial Statements and Supplementary Data) under Note 10 (Commitments and Contingent Liabilities, under the caption “Legacy Liabilities”) to the Consolidated Financial Statements, are incorporated herein by reference.

ENVIRONMENTAL INVESTIGATIONS AND CLAIMS

Disclosures provided in this Report in Item 1 (Business) under the caption “Environment, Health and Safety Matters” and Item 8 (Financial Statements and Supplementary Data) under Note 10 (Commitments and Contingent Liabilities, under the caption “Legacy Environmental Liabilities”) to the Consolidated Financial Statements, are incorporated herein by reference.

Item 4. MINE SAFETY DISCLOSURES

Information concerning mine safety violations or other regulatory matters required by Section 1503(a) of the Dodd-Frank Wall Street Reform and Consumer Protection Act and Item 104 of Regulation S-K (17 CFR 229.104) is included in Exhibit 95 to this Report.

INFORMATION ABOUT OUR EXECUTIVE OFFICERS

Pursuant to General Instruction G(3) of Form 10-K, the following list of executive officers of Grace as of February 15, 2020, is included as an unnumbered Item in Part I of this report in lieu of being included in the Grace Proxy Statement relating to the Annual Meeting of Shareholders to be held on May 12, 2020. Our executive officers are elected annually.

Name and Age	Office	First Elected
Hudson La Force (55)	President and Chief Executive Officer Director	November 8, 2018 November 2, 2017
William C. Dockman (60)	Senior Vice President and Chief Financial Officer	May 8, 2019
Elizabeth C. Brown (56)	Senior Vice President and Chief Human Resources Officer	January 21, 2015
Keith N. Cole (61)	Senior Vice President, Government Relations and Environment, Health and Safety	February 10, 2014
Mark A. Shelnitz (61)	Senior Vice President, General Counsel and Secretary	April 27, 2005

Mr. La Force, Ms. Brown, Mr. Cole, and Mr. Shelnitz have been actively engaged in Grace's business as executive officers for the past five years. Mr. La Force is Grace's Principal Executive Officer.

Mr. Dockman joined Grace in 1999. From 2012 until he became an executive officer, Mr. Dockman was Grace's Vice President—Finance, Controller and Chief Accounting Officer. Mr. Dockman is Grace's Principal Financial Officer and its Principal Accounting Officer.

PART II

Item 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED SHAREHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

Except as provided below, the disclosure required by this Item appears in this Report in: Item 6 (Selected Financial Data) opposite the caption "Other Statistics—Common shareholders of record"; Item 8 (Financial Statements and Supplementary Information) in Note 14 (Shareholders' Equity) and Note 21 (Quarterly Financial Information (Unaudited)) opposite the caption "Dividends declared per share" to the Consolidated Financial Statements; and Item 12 (Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters), and such disclosure is incorporated herein by reference.

COMPANY COMMON STOCK

The principal market for Company common stock is the New York Stock Exchange, under the symbol GRA.

DIVIDENDS ON COMPANY COMMON STOCK

On February 4, 2020, we announced that the Board of Directors had approved an increase to the annual cash dividend rate, from \$1.08 to \$1.20 per share of Company common stock. We expect to continue growing our dividend as part of our disciplined capital allocation strategy.

Although our credit agreement and indentures (as described in Item 8 (Financial Statements and Supplementary Data) under Note 5 (Debt) to the Consolidated Financial Statements and filed as an exhibit to this Report) contain certain restrictions on the payment of dividends on, and redemptions of, equity interests and other restricted payments, we believe that such restrictions do not currently materially limit our ability to pay dividends. Any determination to pay cash dividends in the future may be affected by business and market conditions, our views on potential future capital requirements, the restrictions noted above, covenants contained in any agreements we may enter into in the future and changes in federal income tax law.

SHARE REPURCHASES

On February 5, 2015, we announced that the Board of Directors authorized a share repurchase program of up to \$500 million, which we completed on July 10, 2017. On February 8, 2017, we announced that the Board of Directors authorized an additional share repurchase program of up to \$250 million. Repurchases under the programs may be made through one or more open market transactions at prevailing market prices; unsolicited or solicited privately negotiated transactions; accelerated share repurchase programs; or through any combination of the foregoing, or in such other manner as determined by management. The timing of the repurchases and the actual amount repurchased will depend on a variety of factors, including the market price of the Company's shares, strategic priorities for the deployment of capital, and general market and economic conditions.

The following table presents information regarding the status of repurchases of Company common stock by or on behalf of Grace or any "affiliated purchaser" of Grace.

	Total number of shares purchased (#)	Average price paid per share (\$/share)	Total number of shares purchased as part of publicly announced plans or programs (#)	Approximate dollar value of shares that may yet be purchased under the plans or programs (\$ in millions)
10/1/2019 - 10/31/2019	—	—	—	109.1
11/1/2019 - 11/30/2019	—	—	—	109.1
12/1/2019 - 12/31/2019	1,434	69.59	1,434	109.0
Total	1,434	69.59	1,434	

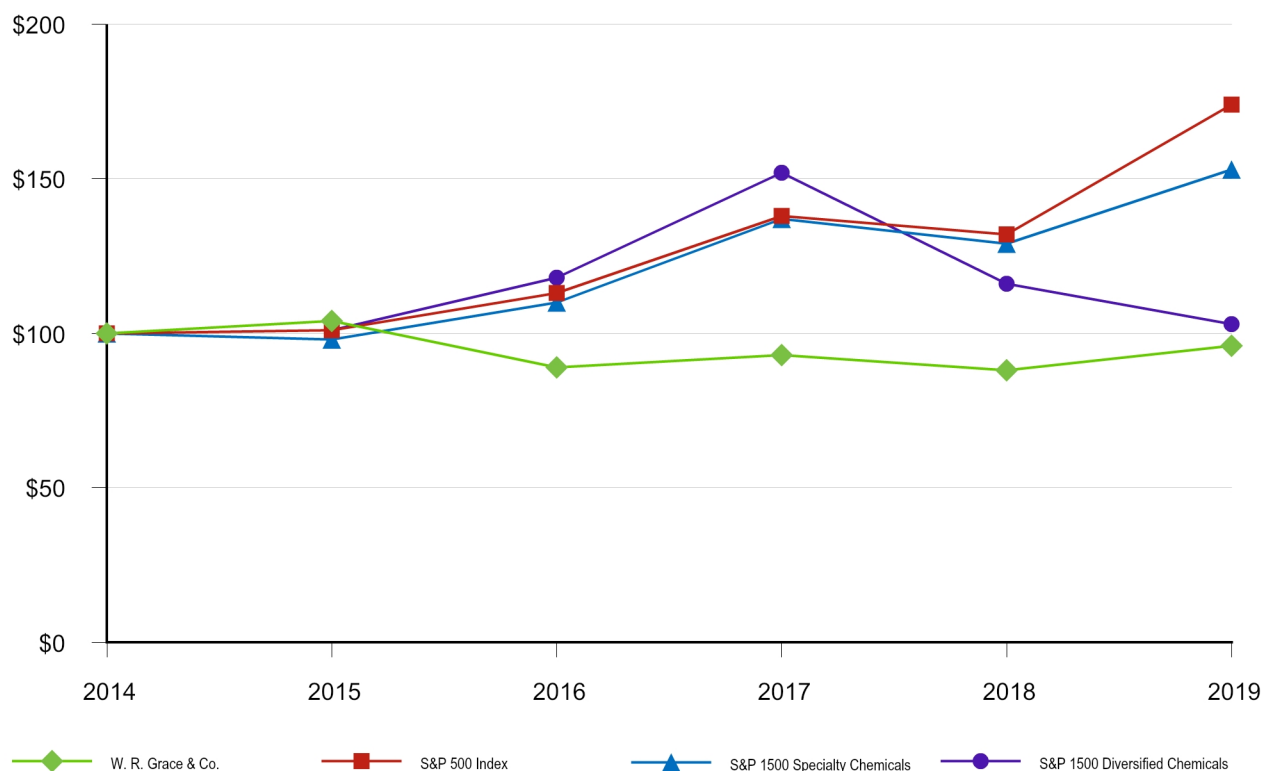
STOCK PERFORMANCE GRAPH

The following information in Item 5 is not deemed to be "soliciting material" or to be "filed" with the SEC or subject to Regulation 14A or 14C under the Securities Exchange Act of 1934, as amended (the "Exchange Act") or to the liabilities of Section 18 of the Exchange Act, and will not be deemed to be incorporated by reference into

any filing under the Securities Act of 1933, as amended, or the Exchange Act, except to the extent Grace specifically incorporates it by reference into such a filing.

The line graph and table below compare the cumulative total shareholder return on Company common stock with the cumulative total return of companies on the Standard & Poor's ("S&P") 500 Stock Index, the S&P Composite 1500 Specialty Chemicals Index and S&P 1500 Diversified Chemicals Index. This graph and table assume the investment of \$100 in Company common stock on December 31, 2014. Cash dividends paid in 2016 through 2019 are assumed reinvested for the graph and table below.

Comparison of 5-Year Cumulative Total Return as of December 31, 2019
Assumes Initial Investment of \$100 on December 31, 2014



	2014	2015	2016	2017	2018	2019
W. R. Grace & Co.(1)	\$ 100	\$ 104	\$ 89	\$ 93	\$ 88	\$ 96
S&P 500 Index	100	101	113	138	132	174
S&P 1500 Specialty Chemicals	100	98	110	137	129	153
S&P 1500 Diversified Chemicals	100	101	118	152	116	103

(1) W. R. Grace & Co. stock value at December 31, 2014, reflects the adjusted post-Separation market value.

Item 6. SELECTED FINANCIAL DATA

(In millions, except per share amounts and shareholders)	2019	2018	2017	2016	2015
Statement of Operations					
Net sales	\$ 1,958.1	\$ 1,932.1	\$ 1,716.5	\$ 1,598.6	\$ 1,628.2
Income (loss) from continuing operations(1)(2)	126.7	166.8	10.4	107.0	123.9
Financial Position					
Total assets	3,932.6	3,565.3	2,907.0	2,911.8	3,645.7
Debt payable after one year	1,957.3	1,961.0	1,523.8	1,507.6	2,111.5
Shareholders' equity	402.2	337.0	263.3	372.4	212.5
Data Per Common Share					
Income (loss) from continuing operations—basic	\$ 1.89	\$ 2.49	\$ 0.16	\$ 1.53	\$ 1.72
Income (loss) from continuing operations—diluted	1.89	2.49	0.16	1.52	1.71
Dividends declared	1.08	0.96	0.84	0.51	—
Other Statistics					
Common shareholders of record	3,749	4,369	4,646	4,895	5,142

- (1) Adjustments related to our legacy liabilities, Chapter 11, and pension mark-to-market accounting are included in and affect the period-to-period comparability of “income (loss) from continuing operations” and the related data per common share. See Note 18 to the Consolidated Financial Statements for a detail of these items.
- (2) For 2017, “Income (loss) from continuing operations” includes a charge of \$143.0 million related to the estimated impacts of the U.S. Tax Cuts and Jobs Act of 2017.

Item 7. MANAGEMENT’S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

See “Analysis of Operations” for a discussion of our non-GAAP performance measures. Our references to “advanced economies” and “emerging regions” refer to classifications established by the International Monetary Fund.

Results of Operations

2019 Performance Summary

Following is a summary of our financial performance for the year ended December 31, 2019, compared with the prior year.

- Net sales increased 1.3% to \$1,958.1 million.
- Net income attributable to Grace shareholders decreased to \$126.3 million.
- Adjusted EBIT¹ increased 3.6% to \$473.2 million.
- Diluted earnings per share from continuing operations decreased to \$1.89 per diluted share.
- Adjusted EPS¹ increased 5.8% to \$4.38 per diluted share.

¹ Non-GAAP performance measures further discussed below.

Summary Description of Business

We are engaged in specialty chemicals and specialty materials businesses on a worldwide basis through our two reportable segments, Grace Catalysts Technologies and Grace Materials Technologies. See Item 1 (Business—Business Overview) of this Report for a summary description of our business.

Analysis of Operations

We have set forth in the table below our key operating statistics with percentage changes for the years ended December 31, 2019, 2018, and 2017. Please refer to this Analysis of Operations when reviewing this Management's Discussion and Analysis of Financial Condition and Results of Operations. In the table we present financial information in accordance with U.S. GAAP, as well as the non-GAAP financial information described below. We believe that the non-GAAP financial information provides useful supplemental information about the performance of our businesses, improves period-to-period comparability and provides clarity on the information our management uses to evaluate the performance of our businesses. In the table, we have provided reconciliations of these non-GAAP financial measures to the most directly comparable financial measure calculated and presented in accordance with U.S. GAAP. The non-GAAP financial measures should not be considered as a substitute for financial measures calculated in accordance with U.S. GAAP, and the financial results calculated in accordance with U.S. GAAP and reconciliations from those results should be evaluated carefully.

We define Adjusted EBIT (a non-GAAP financial measure) to be net income attributable to W. R. Grace & Co. shareholders adjusted for interest income and expense; income taxes; costs related to legacy matters; restructuring and repositioning expenses and asset impairments; pension costs other than service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits; gains and losses on sales and exits of businesses, product lines, and certain other investments; third-party acquisition-related costs and the amortization of acquired inventory fair value adjustment; and certain other items that are not representative of underlying trends.

We define Adjusted EBITDA (a non-GAAP financial measure) to be Adjusted EBIT adjusted for depreciation and amortization.

We define Adjusted EBIT Return On Invested Capital (a non-GAAP financial measure) to be Adjusted EBIT (on a trailing four quarters basis) divided by Adjusted Invested Capital, which is defined as equity adjusted for debt; underfunded and unfunded defined benefit pension plans; liabilities related to legacy matters; cash, cash equivalents, and restricted cash; net income tax assets; and certain other assets and liabilities. We have modified the presentation of this financial measure to reconcile to return on equity.

We define Adjusted Gross Margin (a non-GAAP financial measure) to be gross margin adjusted for pension-related costs included in cost of goods sold, the amortization of acquired inventory fair value adjustment, and write-offs of inventory related to exits of businesses and product lines.

We define Adjusted Earnings Per Share (EPS) (a non-GAAP financial measure) to be diluted EPS adjusted for costs related to legacy matters; restructuring and repositioning expenses and asset impairments; pension costs other than service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits; gains and losses on sales and exits of businesses, product lines and certain other investments; third-party acquisition-related costs and the amortization of acquired inventory fair value adjustment; certain other items that are not representative of underlying trends; certain discrete tax items; and income tax expense related to historical tax attributes.

We define Net Sales, constant currency (a non-GAAP financial measure) to be the period-over-period change in net sales calculated using the foreign currency exchange rates that were in effect during the previous comparable period.

"Legacy matters" include legacy (i) product, (ii) environmental, and (iii) other liabilities, relating to past activities of Grace.

We use Adjusted EBIT as a performance measure in significant business decisions and in determining certain incentive compensation. We use Adjusted EBIT as a performance measure because it provides improved period-to-period comparability for decision making and compensation purposes, and because it better measures the ongoing earnings results of our strategic and operating decisions by excluding the earnings effects of our legacy matters; restructuring and repositioning activities; certain acquisition-related items; and certain other items that are not representative of underlying trends.

We use Adjusted EBITDA, Adjusted EBIT Return On Invested Capital, Adjusted Gross Margin, and Adjusted EPS as performance measures and may use these measures in determining certain incentive compensation. We

use Adjusted EBIT Return On Invested Capital in making operating and investment decisions and in balancing the growth and profitability of our operations.

We use Net Sales, constant currency as a performance measure to compare current period financial performance to historical financial performance by excluding the impact of foreign currency exchange rate fluctuations that are not representative of underlying business trends and are largely outside of our control.

Adjusted EBIT, Adjusted EBITDA, Adjusted EBIT Return On Invested Capital, Adjusted Gross Margin, Adjusted EPS, and Net Sales, constant currency are non-GAAP financial measures; do not purport to represent income measures as defined under U.S. GAAP; and should not be used as alternatives to such measures as an indicator of our performance. These measures are provided to investors and others to improve the period-to-period comparability and peer-to-peer comparability of our financial results, and to ensure that investors understand the information we use to evaluate the performance of our businesses. They distinguish the operating results of Grace's current business base from the costs of Grace's legacy matters; restructuring and repositioning activities; and certain other items. These measures may have material limitations due to the exclusion or inclusion of amounts that are included or excluded, respectively, in the most directly comparable measures calculated and presented in accordance with U.S. GAAP, and thus investors and others should review carefully our financial results calculated in accordance with U.S. GAAP.

Adjusted EBIT has material limitations as an operating performance measure because it excludes costs related to legacy matters, and may exclude income and expenses from restructuring, repositioning, and other activities, which historically have been material components of our net income. Adjusted EBITDA also has material limitations as an operating performance measure because it excludes the impact of depreciation and amortization expense. Our business is substantially dependent on the successful deployment of capital, and depreciation and amortization expense is a necessary element of our costs. We compensate for the limitations of these measurements by using these indicators together with net income as measured under U.S. GAAP to present a complete analysis of our results of operations. Adjusted EBIT and Adjusted EBITDA should be evaluated together with net income and net income attributable to Grace shareholders, measured under U.S. GAAP, for a complete understanding of our results of operations.

Analysis of Operations (In millions, except per share amounts)	2019	2018	% Change	2017	% Change
Net sales:					
Catalysts Technologies	\$ 1,496.7	\$ 1,463.5	2.3 %	\$ 1,276.5	14.6 %
Materials Technologies	461.4	468.6	(1.5)%	440.0	6.5 %
Total Grace net sales	\$ 1,958.1	\$ 1,932.1	1.3 %	\$ 1,716.5	12.6 %
Net sales by region:					
North America	\$ 597.8	\$ 581.7	2.8 %	\$ 486.0	19.7 %
Europe Middle East Africa	791.6	752.2	5.2 %	667.7	12.7 %
Asia Pacific	475.4	481.5	(1.3)%	459.8	4.7 %
Latin America	93.3	116.7	(20.1)%	103.0	13.3 %
Total net sales by region	\$ 1,958.1	\$ 1,932.1	1.3 %	\$ 1,716.5	12.6 %
Performance measures:					
Adjusted EBIT(A):					
Catalysts Technologies segment operating income	\$ 466.5	\$ 440.5	5.9 %	\$ 395.4	11.4 %
Materials Technologies segment operating income	97.8	105.6	(7.4)%	100.6	5.0 %
Corporate costs	(72.7)	(73.5)	1.1 %	(69.0)	(6.5)%
Certain pension costs(B)(C)	(18.4)	(15.9)	(15.7)%	(13.0)	(22.3)%
Adjusted EBIT	473.2	456.7	3.6 %	414.0	10.3 %
Costs related to legacy matters	(103.5)	(82.3)		(33.1)	
Pension MTM adjustment and other related costs, net(B)(C)	(85.9)	15.2		(51.1)	
Restructuring and repositioning expenses	(13.7)	(46.4)		(26.7)	
Benefit plan adjustment	(5.0)	—		—	
Write-off of MTO inventory(D)	(3.6)	—		—	
Third-party acquisition-related costs	(3.6)	(7.3)		(2.9)	
Amortization of acquired inventory fair value adjustment	—	(6.9)		—	
Loss on early extinguishment of debt	—	(4.8)		—	
Accounts receivable reserve—Venezuela	—	—		(10.0)	
Interest expense, net	(74.8)	(78.5)	4.7 %	(78.5)	— %
(Provision for) benefit from income taxes	(56.8)	(78.1)	27.3 %	(200.5)	61.0 %
Net income (loss) attributable to W. R. Grace & Co. shareholders	\$ 126.3	\$ 167.6	(24.6)%	\$ 11.2	NM
Diluted EPS	\$ 1.89	\$ 2.49	(24.1)%	\$ 0.16	NM
Adjusted EPS	\$ 4.38	\$ 4.14	5.8 %	\$ 3.40	21.8 %

Analysis of Operations (In millions)	2019	2018	% Change	2017	% Change
Adjusted performance measures:					
Gross Margin:					
Catalysts Technologies	42.8 %	41.7 %	1.1 pts	40.8 %	0.9 pts
Materials Technologies	36.5 %	37.8 %	(1.3) pts	37.9 %	(0.1) pts
Adjusted Gross Margin	41.4 %	40.7 %	0.7 pts	40.1 %	0.6 pts
Pension costs in cost of goods sold	(0.7)%	(0.7)%	0.0 pts	(0.7)%	0.0 pts
Write-off of MTO inventory(D)	(0.2)%	— %	NM	— %	0.0 pts
Amortization of acquired inventory fair value adjustment	— %	(0.3)%	NM	— %	(0.3) pts
Total Grace	40.5 %	39.7 %	0.8 pts	39.4 %	0.3 pts
Adjusted EBIT:					
Catalysts Technologies	\$ 466.5	\$ 440.5	5.9 %	\$ 395.4	11.4 %
Materials Technologies	97.8	105.6	(7.4)%	100.6	5.0 %
Corporate, pension, and other	(91.1)	(89.4)	(1.9)%	(82.0)	(9.0)%
Total Grace	473.2	456.7	3.6 %	414.0	10.3 %
Depreciation and amortization:					
Catalysts Technologies	\$ 81.9	\$ 81.7	0.2 %	\$ 87.1	(6.2)%
Materials Technologies	14.2	15.5	(8.4)%	19.6	(20.9)%
Corporate	4.2	3.6	16.7 %	4.8	(25.0)%
Total Grace	100.3	100.8	(0.5)%	111.5	(9.6)%
Adjusted EBITDA:					
Catalysts Technologies	\$ 548.4	\$ 522.2	5.0 %	\$ 482.5	8.2 %
Materials Technologies	112.0	121.1	(7.5)%	120.2	0.7 %
Corporate, pension, and other	(86.9)	(85.8)	(1.3)%	(77.2)	(11.1)%
Total Grace	573.5	557.5	2.9 %	525.5	6.1 %
Adjusted EBIT margin:					
Catalysts Technologies	31.2 %	30.1 %	1.1 pts	31.0 %	(0.9) pts
Materials Technologies	21.2 %	22.5 %	(1.3) pts	22.9 %	(0.4) pts
Total Grace	24.2 %	23.6 %	0.6 pts	24.1 %	(0.5) pts
Adjusted EBITDA margin:					
Catalysts Technologies	36.6 %	35.7 %	0.9 pts	37.8 %	(2.1) pts
Materials Technologies	24.3 %	25.8 %	(1.5) pts	27.3 %	(1.5) pts
Total Grace	29.3 %	28.9 %	0.4 pts	30.6 %	(1.7) pts

Analysis of Operations (In millions)	2019	2018	2017
Calculation of Adjusted EBIT Return On Invested Capital (trailing four quarters):			
Adjusted EBIT	\$ 473.2	\$ 456.7	\$ 414.0
Net Income	126.3	167.6	11.2
Total equity	402.2	337.0	263.3
Reconciliation to Adjusted Invested Capital:			
Debt	1,980.4	1,983.3	1,543.9
Underfunded and unfunded defined benefit pension plans	519.8	433.1	502.4
Liabilities related to legacy matters	206.7	126.9	70.6
Cash, cash equivalents, and restricted cash	(282.9)	(201.0)	(163.5)
Net income tax assets	(501.6)	(517.3)	(543.1)
Other items	19.7	21.6	22.1
Adjusted Invested Capital	\$ 2,344.3	\$ 2,183.6	\$ 1,695.7
GAAP Return on Equity	31.4%	49.7%	4.3%
Adjusted EBIT ROIC	20.2%	20.9%	24.4%

Amounts may not add due to rounding.

NM—Not Meaningful

- (A) Grace's segment operating income includes only Grace's share of income of consolidated and unconsolidated joint ventures.
- (B) Certain pension costs include only ongoing costs recognized quarterly, which include service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits. Catalysts Technologies and Materials Technologies segment operating income and corporate costs do not include any amounts for pension expense. Other pension-related costs including annual mark-to-market (MTM) adjustments and actuarial gains and losses are excluded from Adjusted EBIT. These amounts are not used by management to evaluate the performance of Grace's businesses and significantly affect the peer-to-peer and period-to-period comparability of our financial results. Mark-to-market adjustments and actuarial gains and losses relate primarily to changes in financial market values and actuarial assumptions and are not directly related to the operation of Grace's businesses.
- (C) "Defined benefit pension expense" as measured under U.S. GAAP includes actuarial gains and losses and actual returns on assets. Adjusted EBIT includes expected returns on assets but excludes both actuarial gains and losses and actual returns on assets. The table below presents expected and actual returns on plan assets for U.S. and non-U.S. plans for the years ended December 31, 2019, 2018, and 2017.

(In millions)	2019		2018		2017	
	U.S. Plans	Non-U.S. Plans	U.S. Plans	Non-U.S. Plans	U.S. Plans	Non-U.S. Plans
Actual return on plan assets	\$ 154.6	\$ 4.1	\$ (41.9)	\$ (1.7)	\$ 112.7	\$ 1.6
Actual return on plan assets	18.90%	20.00%	(3.51)%	(8.01)%	11.20%	8.62%
Expected return on plan assets	\$ 48.2	\$ 0.9	\$ 57.2	\$ 1.0	\$ 57.5	\$ 0.9
Expected return on plan assets	5.75%	4.43%	5.25 %	4.69 %	5.50%	4.69%

- (D) In June 2019, we idled our methanol-to-olefins ("MTO") manufacturing facility in China.

Grace Overview

Following is an overview of our financial performance for the years ended December 31, 2019, 2018, and 2017.

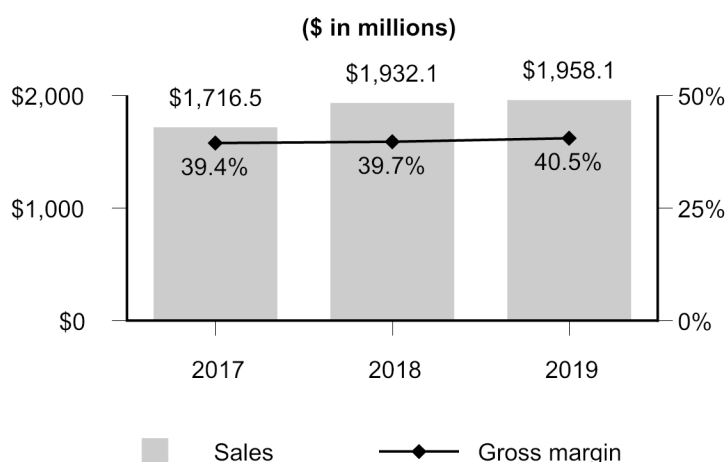
Discrete Items Impacting 2019

Four discrete items (the “Discrete Items”) impacted 2019 full-year results:

- *Refining Technologies*: an FCC catalysts customer’s bankruptcy following a fire resulting in the closure of its refinery;
- *Specialty Catalysts*: a customer-specific inventory correction in the second half of 2019;
- *Specialty Catalysts*: customer-specific temporary reductions in operating rates and catalyst usage due to reduced feedstock supply following an attack in the Middle East; and
- *Materials Technologies*: an equipment failure in one of our silicas manufacturing lines (operations fully restored by mid-July).

These Discrete Items reduced 2019 full-year net sales by approximately \$36 million. These Discrete Items also reduced pretax income and Adjusted EBIT by approximately \$36 million. The earnings effect includes lost margin on lower sales, the costs of adjusting our manufacturing operations in response to lower demand, costs incurred to serve customers and minimize any impact to their operations, and costs related to the FCC catalysts customer bankruptcy. These effects were partially mitigated by an approximately \$12 million benefit from cost-reduction activities in response to these events and \$8 million of business interruption proceeds from the FCC catalyst customer event, resulting in a net reduction to pretax income of approximately \$16 million.

Net Sales and Gross Margin



Sales for 2019 increased 1.3% overall compared with the prior year, up 3.0% on constant currency. The increase was driven by improved pricing in both segments and all regions. Higher sales volumes in Catalysts Technologies were driven by Specialty Catalysts growth in EMEA and Asia Pacific and the 2018 second quarter polyolefin catalysts acquisition, partially offset by the Discrete Items. Sales volumes in Materials Technologies were up driven by growth in the Americas, partially offset by a decline in Asia Pacific and EMEA.

Gross margin increased 80 basis points to 40.5% from 39.7% for the prior year. Adjusted Gross Margin increased 70 basis points to 41.4% from 40.7% for the prior year. Improved pricing, higher sales volumes, favorable mix, and lower depreciation were partially offset by higher manufacturing costs, including a 20 basis point impact related to higher raw materials and energy costs.

Sales for 2018 increased 12.6% overall compared with the prior year, up 11.4% on constant currency. Higher sales volumes in Catalysts Technologies were driven by the polyolefin catalysts acquisition and growth across all regions except Asia. Sales volumes in Materials Technologies were up driven by growth in Europe, North America, and Latin America.

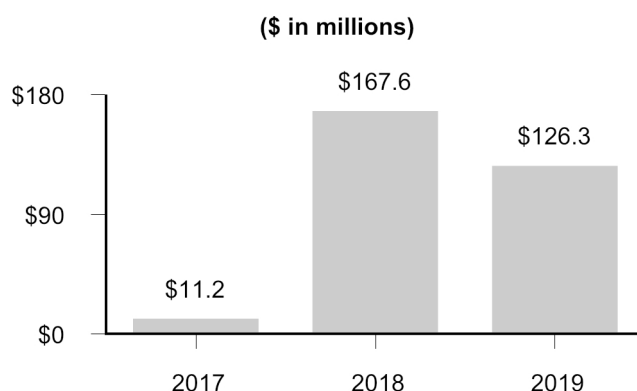
Gross margin increased 30 basis points to 39.7% from 39.4% for the prior year. Adjusted Gross Margin increased 60 basis points to 40.7% from 40.1% for the prior year. The increases were primarily due to lower depreciation expense, improved pricing, higher sales volumes, and favorable product and regional mix, partially offset by higher manufacturing costs including a 170 basis point impact related to higher raw materials and energy costs.

The following tables identify the year-over-year increase or decrease in sales attributable to changes in sales volume and/or mix, product price, and the impact of currency translation.

Net Sales Variance Analysis	2019 as a Percentage Increase (Decrease) from 2018			
	Volume	Price	Currency Translation	Total
Catalysts Technologies	0.9 %	2.5%	(1.1)%	2.3 %
Materials Technologies	0.3 %	1.9%	(3.7)%	(1.5)%
Net sales	0.6 %	2.4%	(1.7)%	1.3 %
By Region:				
North America	0.2 %	2.6%	— %	2.8 %
Europe Middle East Africa	6.0 %	3.0%	(3.8)%	5.2 %
Asia Pacific	(1.8)%	0.7%	(0.2)%	(1.3)%
Latin America	(20.7)%	4.4%	(3.8)%	(20.1)%

Net Sales Variance Analysis	2018 as a Percentage Increase (Decrease) from 2017			
	Volume	Price	Currency Translation	Total
Catalysts Technologies	12.1%	1.6 %	0.9 %	14.6%
Materials Technologies	3.1%	1.6 %	1.8 %	6.5%
Net sales	9.8%	1.6 %	1.2 %	12.6%
By Region:				
North America	17.6%	2.1 %	— %	19.7%
Europe Middle East Africa	6.8%	2.7 %	3.2 %	12.7%
Asia Pacific	4.0%	0.4 %	0.3 %	4.7%
Latin America	19.0%	(2.2)%	(3.5)%	13.3%

Grace Net Income



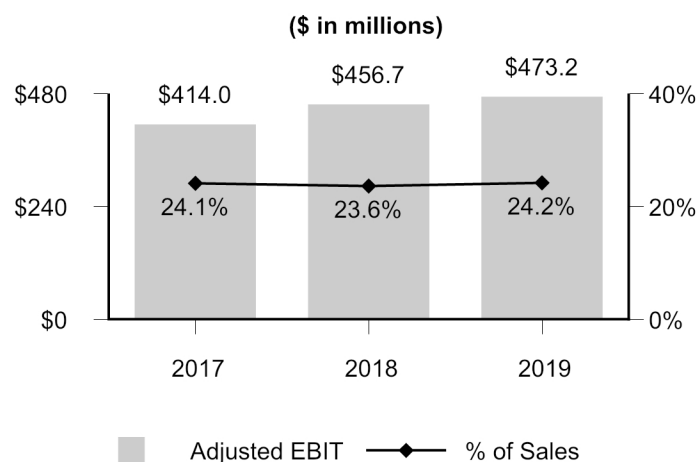
Net income attributable to Grace was \$126.3 million for 2019 compared with \$167.6 million for the prior year. The decrease was primarily due to a loss recorded for the annual pension mark-to-market adjustment and higher costs related to legacy matters, including charges of \$68.0 million for the estimated costs of construction of a new dam spillway at our former vermiculite mine site and \$24.0 million related to probable future payments with

respect to our former ZAI product (see Note 10 to the Consolidated Financial Statements), partially offset by lower restructuring and repositioning expenses, higher operating income from our Catalysts Technologies segment, and a lower provision for income taxes.

Net income attributable to Grace was \$167.6 million for 2018 compared with \$11.2 million for the prior year. The increase was primarily due to the \$143.0 million provisional tax charge for the estimated impacts of the U.S. Tax Cuts and Jobs Act of 2017 (the “TCJA”), which was recorded in 2017. This was partially offset by higher restructuring and repositioning expenses and a higher provision for environmental remediation in 2018, which was primarily due to the \$70.0 million charge for the estimated costs of future remediation-related activities at the Libby, Montana, mine site and surrounding area (see Note 10 to the Consolidated Financial Statements).

In 2018, we completed a study to evaluate the useful lives of our operating machinery and equipment, including a review of historical asset retirement data as well as review and analysis of relevant industry practices. As a result of this study, effective January 1, 2018, we revised the accounting useful lives of certain machinery and equipment, which was determined to be a change in accounting estimate and was applied prospectively. As a result of this change in accounting estimate, depreciation expense with respect to such machinery and equipment was reduced by \$23.5 million, resulting in an increase to net income of \$18.0 million or \$0.27 per diluted share for the year ended December 31, 2018. Estimated useful lives for operating machinery and equipment, which previously ranged from 3 to 10 years, now range from 5 to 25 years.

Adjusted EBIT



Adjusted EBIT was \$473.2 million for 2019, an increase of 3.6% compared with the prior year primarily due to higher sales and gross profit including the 2019 first quarter benefit of the polyolefin catalysts acquisition, partially offset by the net impact of the Discrete Items, lower income from our ART joint venture, and unfavorable currency transaction effects.

Adjusted EBIT was \$456.7 million for 2018, an increase of 10.3% compared with the prior year primarily due to higher gross profit including the effect of the polyolefin catalysts acquisition, higher income from our ART joint venture, and favorable currency translation, partially offset by business interruption insurance recoveries in the prior year that did not repeat in 2018 and higher operating expenses.

Adjusted EPS

The following table reconciles our Diluted EPS (GAAP) to our Adjusted EPS (non-GAAP):

(In millions, except per share amounts)	2019			
	Pre-Tax	Tax Effect	After-Tax	Per Share
Diluted Earnings Per Share				\$ 1.89
Costs related to legacy matters	\$ 103.5	\$ 25.2	\$ 78.3	1.17
Pension MTM adjustment and other related costs, net	85.9	24.0	61.9	0.93
Restructuring and repositioning expenses	13.7	3.0	10.7	0.16
Benefit plan adjustment	5.0	1.1	3.9	0.06
Write-off of MTO inventory	3.6	—	3.6	0.05
Third-party acquisition-related costs	3.6	0.9	2.7	0.04
Income tax expense related to historical tax attributes(1)		(8.6)	8.6	0.13
Discrete tax items, including adjustments to uncertain tax positions		3.6	(3.6)	(0.05)
Adjusted EPS				\$ 4.38

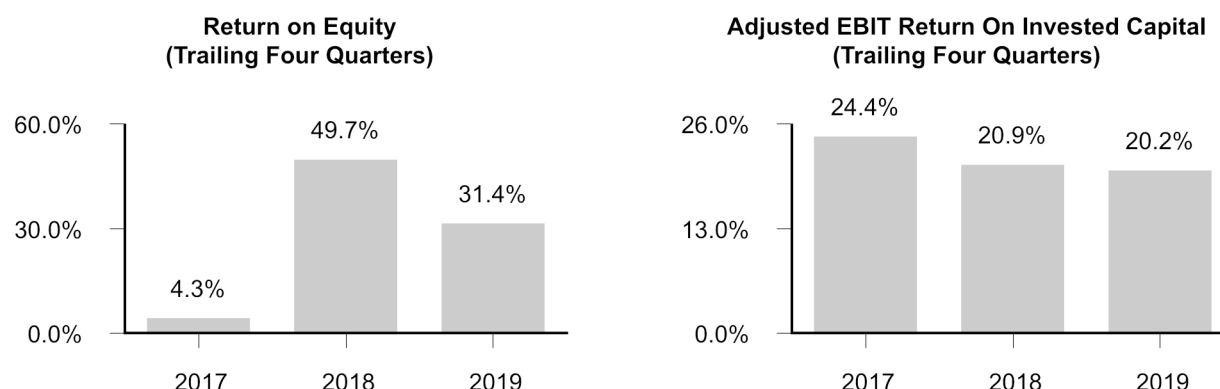
- (1) Our historical tax attribute carryforwards (net operating losses and tax credits) unfavorably affected our tax expense with respect to certain provisions of the TCJA. To normalize the effective tax rate, an adjustment was made to eliminate the tax expense impact associated with the historical tax attributes.

(In millions, except per share amounts)	2018			
	Pre-Tax	Tax Effect	After-Tax	Per Share
Diluted Earnings Per Share				\$ 2.49
Costs related to legacy matters	\$ 82.3	\$ 17.7	\$ 64.6	0.96
Restructuring and repositioning expenses	46.4	10.0	36.4	0.54
Pension MTM adjustment and other related costs, net	(15.2)	(3.4)	(11.8)	(0.18)
Third-party acquisition-related costs	7.3	1.6	5.7	0.08
Amortization of acquired inventory fair value adjustment	6.9	1.5	5.4	0.08
Loss on early extinguishment of debt	4.8	1.0	3.8	0.06
Income tax expense related to historical tax attributes(1)		(25.6)	25.6	0.38
Provisional charge related to the U.S. Tax Cuts and Jobs Act of 2017		17.1	(17.1)	(0.25)
Discrete tax items, including adjustments to uncertain tax positions		1.4	(1.4)	(0.02)
Adjusted EPS				\$ 4.14

- (1) Our historical tax attribute carryforwards (net operating losses and tax credits) unfavorably affected our tax expense with respect to certain provisions of the TCJA. To normalize the effective tax rate, an adjustment was made to eliminate the tax expense impact associated with the historical tax attributes.

(In millions, except per share amounts)	2017			
	Pre-Tax	Tax Effect	After-Tax	Per Share
Diluted Earnings Per Share				\$ 0.16
Pension MTM adjustment and other related costs, net	\$ 51.1	\$ 17.4	\$ 33.7	0.49
Costs related to legacy matters	33.1	12.3	20.8	0.30
Restructuring and repositioning expenses	26.7	8.9	17.8	0.26
Accounts receivable reserve—Venezuela	10.0	3.5	6.5	0.10
Third-party acquisition-related costs	2.9	1.1	1.8	0.03
Provisional charge related to the U.S. Tax Cuts and Jobs Act of 2017		(143.0)	143.0	2.10
Discrete tax items, including adjustments to uncertain tax positions		2.7	(2.7)	(0.04)
Adjusted EPS				\$ 3.40

Return on Equity and Adjusted EBIT Return On Invested Capital



Return on equity for 2019 was 31.4% on a trailing four quarters basis, compared with 49.7% and 4.3% for 2018 and 2017, respectively, on the same basis. Net income for 2019 reflects a charge related to mark-to-market pension accounting, compared with income related to mark-to-market pension accounting in 2018. Net income for 2017 includes charges related to the TCJA and mark-to-market pension accounting.

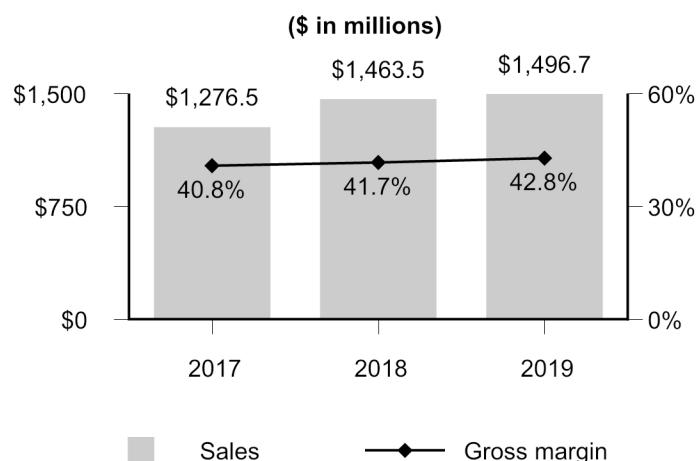
Adjusted EBIT Return On Invested Capital for 2019 was 20.2% on a trailing four quarters basis, compared with 20.9% and 24.4% for 2018 and 2017, respectively, on the same basis. The decline from 2018 is primarily due to increased growth capital investments that have not yet been placed into service. These assets are expected to be placed in service beginning in 2020 and will support volume growth over the next few years. The decline from 2017 is primarily due to the polyolefin catalysts acquisition, which was completed on April 3, 2018, and increased invested capital at that date.

We manage our businesses with the objective of maximizing sales, earnings and cash flow over time. Doing so requires that we successfully balance our growth, profitability and working capital and other investments to support sustainable, long-term financial performance. We use Adjusted EBIT Return On Invested Capital as a performance measure in evaluating operating results, in making operating and investment decisions, and in balancing the growth and profitability of our businesses.

Segment Overview—Grace Catalysts Technologies

Following is an overview of the financial performance of Catalysts Technologies for the years ended December 31, 2019, 2018, and 2017.

Net Sales—Grace Catalysts Technologies



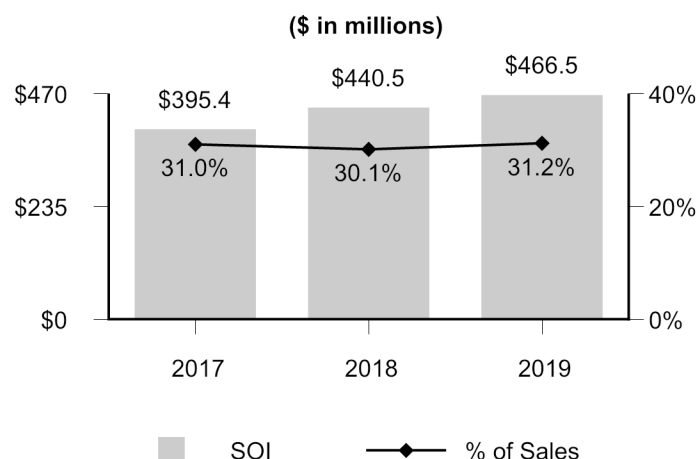
Sales were up 2.3% in 2019, or up 3.4% on constant currency, compared with the prior year. The increase on a constant currency basis was due to improved pricing in all regions and higher sales volumes, partially offset by lower sales volumes from the Discrete Items. The improved pricing in both Refining Technologies and Specialty Catalysts was driven by our focused value-selling efforts. For the trailing 12 months ending December 31, 2019, FCC pricing was up over 200 basis points. Higher sales volumes in Catalysts Technologies were driven by Specialty Catalysts growth in EMEA and Asia Pacific and the 2018 second quarter polyolefin catalysts acquisition, partially offset by lower volumes from the Discrete Items. We are actively working to replace the lost sales volume from the FCC catalysts customer refinery closure, but do not expect to commercialize that volume before late 2020 or 2021. In 2019, we announced 6 new UNIPOL[®] polypropylene process technology licenses totaling approximately 2,500 kilotons of annual resin capacity, which will continue to drive long-term catalysts and donor sales. Unfavorable currency translation affected both product groups as the U.S. dollar strengthened, primarily against the euro, compared with the prior-year period.

Gross profit was \$641.3 million for 2019, an increase of 5.1% compared with the prior year. Gross margin was 42.8% compared with 41.7% for the prior year. The increases were primarily due to improved pricing, favorable mix, higher sales volumes, and lower depreciation, partially offset by higher manufacturing costs including a 10 basis point impact related to higher raw materials and energy costs and the Discrete Items.

Sales were up 14.6% in 2018, or up 13.7% on constant currency, compared with the prior year. The increase on a constant currency basis was due to higher sales volumes and improved pricing. Higher sales were driven by the 2018 polyolefin catalysts acquisition and growth across all regions except Asia, driven by higher demand from new and existing customers and higher licensing revenues. Favorable currency translation affected both product groups as the U.S. dollar weakened against multiple currencies, especially the euro, compared with the prior year.

Gross profit was \$610.0 million for 2018, an increase of 17.0% compared with the prior year. Gross margin was 41.7% compared with 40.8% for the prior year. The increases were primarily due to lower depreciation expense, higher sales volumes, improved pricing, and favorable product and regional mix, partially offset by higher manufacturing costs including a 180 basis point impact related to higher raw materials and energy costs.

Segment Operating Income (SOI) and Margin—Grace Catalysts Technologies



Segment operating income was \$466.5 million for 2019, an increase of 5.9% compared with the prior year, primarily due to higher sales and gross profit, and business interruption insurance recoveries, partially offset by lower income from our ART joint venture, higher operating expenses including from the polyolefin catalysts acquisition, unfavorable effects of currency exchange rates, and higher amortization. The ART joint venture contributed \$27.8 million to operating income, a decrease of \$4.0 million from the prior-year period primarily due to an increase in expenses charged to the joint venture by the partners. Segment operating margin for 2019 increased to 31.2%, an improvement of 110 basis points compared with the prior year.

In June 2019, a Catalysts Technologies customer experienced a fire resulting in its refinery closure and subsequent bankruptcy. Lost earnings from this Discrete Item in 2019 were approximately \$14 million. We recognized a benefit of and received \$8.0 million in payments from our third-party insurer during the 2019 fourth quarter under our business interruption insurance policy for a portion of profits lost in the third and fourth quarters of 2019 as a result of the closure. We expect to receive additional insurance recoveries related to this event in 2020. The policy has a \$25.0 million limit for this event.

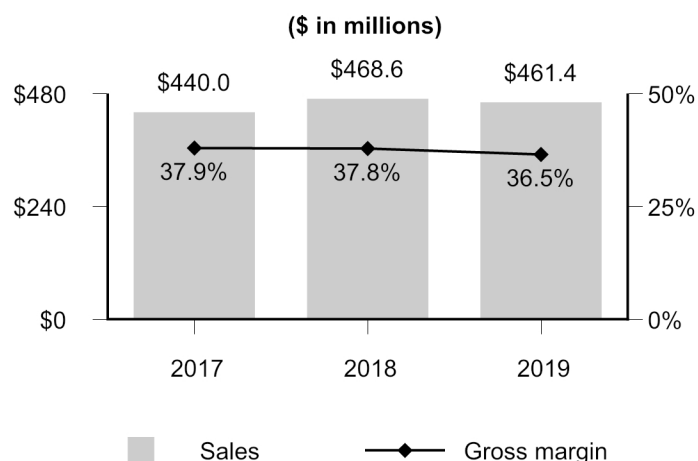
Segment operating income was \$440.5 million for 2018, an increase of 11.4% compared with the prior year, primarily due to higher gross profit, higher income from our ART joint venture, and favorable currency translation. The increase was partially offset by the absence of business interruption insurance recoveries that were included in the prior year and higher operating expenses. The ART joint venture contributed \$31.8 million to operating income, an increase of \$5.9 million from the prior-year period. Segment operating margin for 2018 decreased to 30.1%, a decline of 90 basis points compared with the prior year, primarily due to the absence of business interruption insurance recoveries.

In January 2017, a Catalysts Technologies customer experienced a fire resulting in an extended outage. We recognized a benefit of and received \$25.0 million in payments from our third-party insurer during 2017 under our business interruption insurance policy for a portion of profits lost as a result of the outage. The policy had a \$25.0 million limit for this event.

Segment Overview—Grace Materials Technologies

Following is an overview of the financial performance of Materials Technologies for the years ended December 31, 2019, 2018, and 2017.

Net Sales—Grace Materials Technologies



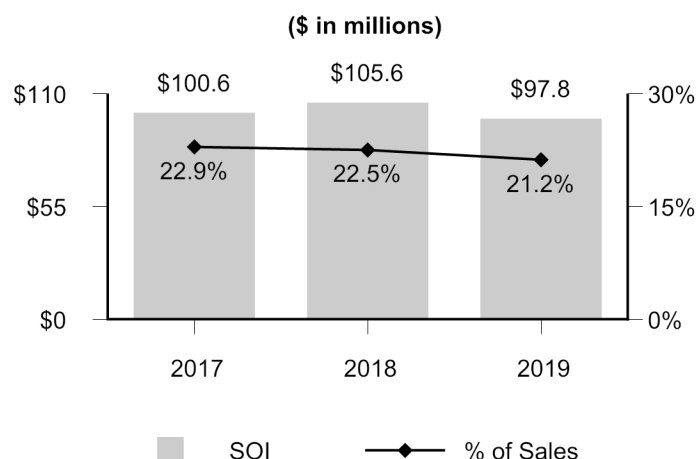
Sales were down 1.5% in 2019, or up 2.2% on constant currency, compared with the prior year. The increase on a constant currency basis was due to improved pricing and higher sales volumes, partially offset by lower sales volumes from one of the Discrete Items. Pricing improved across all regions, driven by EMEA and the Americas. The increase in sales volumes was primarily driven by higher consumer/pharma sales in all regions, partially offset by lower coatings sales in Asia, EMEA, and North America. The pricing improvement and increased sales volumes were more than offset by unfavorable currency translation as the U.S. dollar strengthened, primarily against the euro, compared with the prior-year period. Our Materials Technologies business segment is particularly sensitive to changes in the euro.

Gross profit was \$168.6 million for 2019, a decrease of 4.7% compared with the prior year. Gross margin was 36.5% compared with 37.8% for the prior year. The decrease in gross margin was primarily due to higher manufacturing costs including costs directly related to one of the Discrete Items and 50 basis points related to higher raw materials and energy costs, partially offset by improved pricing and lower depreciation expense.

Sales were up 6.5% in 2018, or up 4.7% on constant currency, compared with the prior year. The increase on a constant currency basis was due to higher sales volumes and improved pricing. The increase in sales volumes was primarily driven by higher consumer/pharma and coatings sales in Europe, higher chemical process and coatings sales in North America, and higher sales across all product groups in Latin America. The remainder of the increase was driven by improved pricing across all regions and favorable currency translation as the U.S. dollar weakened against multiple currencies, especially the euro, compared with the prior year.

Gross profit was \$177.0 million for 2018, an increase of 6.1% compared with the prior year, primarily due to higher sales volumes and favorable product and regional mix, partially offset by higher manufacturing costs. Gross margin was 37.8% compared with 37.9% for the prior year. The decrease in gross margin was primarily due to higher manufacturing costs including a 120 basis point impact related to higher raw materials and energy costs, partially offset by favorable product and regional mix, improved pricing, and lower depreciation expense.

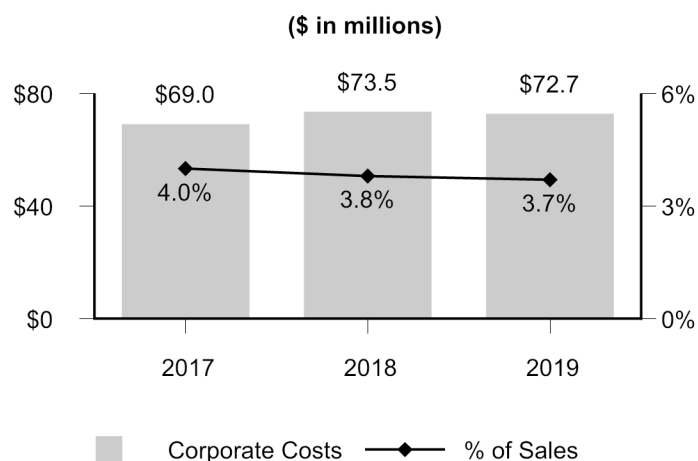
Segment Operating Income (SOI) and Margin—Grace Materials Technologies



Segment operating income was \$97.8 million for 2019, a decrease of 7.4% compared with the prior year, primarily due to lower gross profit and higher operating expenses, including the effects of one of the Discrete Items. Segment operating margin for 2019 decreased to 21.2%, a decline of 130 basis points compared with the prior year.

Segment operating income was \$105.6 million for 2018, an increase of 5.0% compared with the prior year, primarily due to higher gross profit, partially offset by higher operating expenses. Segment operating margin for 2018 decreased to 22.5%, a decline of 40 basis points compared with the prior year.

Corporate Overview



Corporate costs include functional and other costs such as professional fees, incentive compensation, and insurance premiums. Corporate costs for 2019 decreased 1.1% compared with the prior year, primarily due to lower accruals for incentive compensation, partially offset by higher employee-related costs.

Corporate costs for 2018 increased 6.5% compared with the prior year, primarily due to higher incentive compensation expense.

Restructuring and Repositioning Expenses

During 2019, we incurred \$2.6 million of restructuring expenses primarily related to severance costs pertaining to the idling of our methanol-to-olefins (“MTO”) manufacturing facility in China, which were substantially paid in 2019. Restructuring expenses of \$14.0 million in 2018 primarily related to the closure of two smaller

manufacturing plants, the activities from which have been moved to larger, more cost-effective plants as part of our strategy to capture synergies from our recent catalysts acquisitions. Restructuring expenses of \$11.5 million in 2017 primarily related to workforce reduction programs in Grace's manufacturing, supply chain, finance and IT functions. Substantially all costs related to the restructuring programs are expected to be paid by December 31, 2021, but could be paid earlier subject to negotiations around certain plant exit costs.

Repositioning expenses for the years ended December 31, 2019, 2018, and 2017 were \$11.1 million, \$32.4 million, and \$15.2 million respectively. Expenses incurred in 2019 and 2018 related to a multi-year program to transform manufacturing and business processes to extend our competitive advantages and improve our cost position. Expenses in 2018 also included \$11.7 million of severance and stock compensation costs related to employee separations, and write-offs of \$8.5 million of previously capitalized plant engineering costs as a result of terminating an expansion project no longer necessary due to the polyolefin catalysts acquisition (see Note 20). Expenses incurred in 2017 primarily related to third-party costs associated with productivity and transformation initiatives, as well as costs related to the Separation. Excluding asset write-offs and stock compensation costs, substantially all of these costs have been or are expected to be settled in cash.

The following table presents the major components of restructuring and repositioning expenses for the years ended December 31, 2019, 2018, and 2017.

(In millions)	Year Ended December 31,		
	2019	2018	2017
Third-party costs of manufacturing and business transformation programs	\$ 7.4	\$ 13.7	\$ 8.2
Employee severance and accelerated stock compensation	5.8	12.3	13.5
Costs related to plant closures	—	13.4	0.6
Write-off of engineering costs	—	8.5	—
Costs related to the Separation	—	0.2	0.9
Other	0.5	(1.7)	3.5
Total restructuring and repositioning expenses	\$ 13.7	\$ 46.4	\$ 26.7

Defined Benefit Pension Expense

Defined benefit pension expense includes costs under U.S. and non-U.S. defined benefit pension plans that provide benefits to business segment and corporate employees, as well as retirees and former employees of divested businesses where we retained these obligations.

Under mark-to-market accounting, our pension costs consist of two elements: (1) "certain pension costs"—ongoing costs recognized quarterly, which include service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits; and (2) "pension mark-to-market adjustment and other related costs, net"—mark-to-market gains and losses recognized annually in the fourth quarter, or at an interim period should a significant event occur, resulting from changes in actuarial assumptions, such as discount rates and the difference between actual and expected returns on plan assets.

Certain pension costs were \$18.4 million, \$15.9 million and \$13.0 million for 2019, 2018 and 2017, respectively. The increase from 2017 to 2018 was primarily due to a decrease in discount rates. The increase from 2018 to 2019 was primarily due to a decrease in expected return on assets, partially offset by a decrease in service cost and interest cost due to an increase in discount rates.

Pension mark-to-market adjustment and other related costs, net were \$85.9 million, \$(15.2) million and \$51.1 million for 2019, 2018 and 2017, respectively. These costs are reported in "other (income) expense, net" in our Consolidated Financial Statements. The 2019 mark-to-market pension expense of \$85.9 million was primarily due to the decrease in discount rates used to value the projected benefit obligations of our plans from year-end 2018 to year-end 2019, partially offset by higher than expected return on assets. The 2018 mark-to-market pension income of \$15.2 million was primarily due to the increase in discount rates used to value the projected benefit obligations of our plans from year-end 2017 to year-end 2018, partially offset by lower than expected return on assets. The 2017 mark-to-market pension expense of \$51.1 million was primarily due to the decrease in discount rates used to value the projected benefit obligations of our plans from year-end 2016 to year-end 2017, partially offset by higher than expected return on assets in the U.S.

Interest and Financing Expenses

Net interest and financing expenses were \$74.8 million for 2019, a 4.7% decrease compared with 2018 primarily due to higher capitalized interest in 2019 related primarily to the growth capital investments. Interest and financing expenses were \$78.5 million for 2018, flat compared with 2017.

Income Taxes

Income tax expense (benefit) for 2019, 2018 and 2017 was \$56.8 million, \$78.1 million and \$200.5 million, respectively, on income before income taxes of \$183.5 million, \$244.9 million and \$210.9 million in 2019, 2018 and 2017, respectively.

Our 2019 effective tax rate of 31.0% was higher than the 21% U.S. statutory rate. The higher rate was primarily caused by U.S. taxes on foreign earnings and an increase to the valuation allowance on deferred tax assets in U.S. state and foreign jurisdictions, partially offset by U.S. federal research and development tax credits and the release of certain U.S. liabilities for unrecognized tax benefits. Due to the utilization of our U.S. federal NOLs, our 2019 effective tax rate reflects a benefit associated with the GILTI deduction, which was not available in the prior year.

Our 2018 effective tax rate of 31.9% also was higher than the 21% U.S. statutory rate. The higher rate was primarily caused by recognition of the GILTI tax that could not be offset with a corresponding GILTI deduction due to our utilization of federal NOLs in 2018. The geographic mix of income also contributed to the higher rate since the statutory rates in effect for our foreign subsidiaries exceed the 21% U.S. statutory rate.

Our 2017 effective tax rate includes \$143.0 million in charges related to the TCJA. The effective tax rate without the impact of the TCJA would have been 27.3%, lower than the 35% U.S. statutory rate, primarily due to the geographic mix of income and U.S. federal research and development tax credits.

See Note 7 to the Consolidated Financial Statements for additional information regarding income taxes.

Financial Condition, Liquidity, and Capital Resources

Following is an analysis of our financial condition, liquidity and capital resources at December 31, 2019.

Our principal uses of cash are generally capital investments and acquisitions; working capital investments; compensation paid to employees, including contributions to our defined benefit pension plans and defined contribution plans; the repayment of debt and interest payments thereon; and the return of cash to shareholders through the repurchase of shares and the payment of dividends.

On February 8, 2017, we announced that the Board of Directors had authorized a share repurchase program of up to \$250 million. During the first half of 2019 we repurchased 409,769 shares of Company common stock for \$29.8 million. During the second half of 2019, we did not repurchase Company common stock under this program as we prioritized de-leveraging at this time with a focus on lowering our leverage ratio. As of December 31, 2019, \$109.1 million remained under the current authorization.

We paid cash dividends of \$72.6 million during 2019. On February 7, 2019, we announced that our Board of Directors had approved an increase in the annual dividend rate, from \$0.96 to \$1.08 per share of Company common stock, effective with the dividend paid March 21, 2019. On February 4, 2020, we announced that our Board of Directors had approved a further increase to \$1.20 per share of Company common stock, effective with the dividend to be paid March 17, 2020.

We believe that the cash we expect to generate during 2020 and thereafter, together with other available liquidity and capital resources, are sufficient to finance our operations, growth strategy, share repurchase program and expected dividend payments, and to meet our debt and pension obligations.

On April 3, 2018, we entered into the Credit Agreement, which provides for secured credit facilities, consisting of:

- (a) a \$950 million term loan due in 2025, with interest at LIBOR +175 basis points, and
- (b) a \$400 million revolving credit facility due in 2023, with interest at LIBOR +175 basis points.

We used the proceeds from the term loan to repay in full the outstanding borrowings of \$507.0 million under our 2014 credit agreement, to fund the 2018 polyolefin catalysts acquisition for \$418.0 million, and to make a voluntary \$50.0 million accelerated contribution to our U.S. qualified pension plans. See Note 5 to the Consolidated Financial Statements for additional information related to the Credit Agreement.

Cash Resources and Available Credit Facilities

At December 31, 2019, we had available liquidity of \$700.0 million, consisting of \$282.5 million in cash and cash equivalents (\$189.1 million in the U.S.), \$378.5 million available under our revolving credit facility, and \$39.0 million of available liquidity under various non-U.S. credit facilities. The \$400 million revolving credit facility includes a \$100 million sublimit for letters of credit.

Our non-U.S. credit facilities are extended to various subsidiaries that use them primarily to issue bank guarantees supporting trade activity and to provide working capital during occasional cash shortfalls. We generally renew these credit facilities as they expire.

The following table summarizes our non-U.S. credit facilities as of December 31, 2019:

(In millions)	Maximum Borrowing Amount	Available Liquidity	Expiration Date
China	\$ 11.9	\$ 9.5	April 3, 2023
Singapore	18.0	9.1	April 3, 2023
Other countries	21.3	20.4	April 3, 2023, as well as open-ended
Total	\$ 51.2	\$ 39.0	

Analysis of Cash Flows

The following table summarizes our cash flows for the years ended December 31, 2019, 2018, and 2017:

(In millions)	Year Ended December 31,		
	2019	2018	2017
Net cash provided by (used for) operating activities from continuing operations	\$ 392.1	\$ 342.0	\$ 319.2
Net cash provided by (used for) investing activities from continuing operations	(210.1)	(618.5)	(129.2)
Net cash provided by (used for) financing activities from continuing operations	(99.4)	316.5	(134.8)
Effect of currency exchange rate changes on cash and cash equivalents	(0.7)	(2.5)	7.7
Net increase (decrease) in cash and cash equivalents	81.9	37.5	62.9
Cash and cash equivalents, beginning of period	201.0	163.5	100.6
Cash and cash equivalents, end of period	\$ 282.9	\$ 201.0	\$ 163.5

Net cash provided by operating activities in 2019 was \$392.1 million compared with \$342.0 million in the prior year. The year-over-year change in cash flow is primarily due to higher gross profit in 2019 and the \$50.0 million accelerated contribution to the U.S. defined benefit pension plans in 2018, partially offset by lower advance payments from customers compared with 2018.

Net cash provided by operating activities in 2018 was \$342.0 million compared with \$319.2 million in the prior year. The year-over-year change in cash flow was primarily due to higher income from continuing operations and the timing of advance payments from customers in 2018, and a 2017 payment of \$30.0 million to satisfy a deferred payment obligation to the asbestos property damage trust required under the joint plan of reorganization, partially offset by a \$50.0 million accelerated contribution to the U.S. defined benefit pension plans, higher net cash paid for income taxes, and the prior-year dividend received from ART that did not repeat in 2018.

Net cash used for investing activities in 2019 was \$210.1 million compared with \$618.5 million in 2018 and \$129.2 million in 2017. Net cash used for investing activities primarily includes the net cash paid for capital expenditures and businesses acquired. In 2018, we completed the purchase of the polyolefin catalysts business of Albemarle Corporation for \$418.0 million. Our capital expenditures include investments in new capacity, improved productivity, information technology, and maintenance of our manufacturing and office facilities. We

expect our capital expenditures in 2020 to be approximately \$195 million and have entered into commitments related to a portion of those expenditures. We expect to fund our capital expenditures from net cash provided by operating activities.

Net cash used for financing activities in 2019 was \$99.4 million compared with cash provided of \$316.5 million in 2018 and cash used of \$134.8 million in 2017. Cash paid for repurchases of common stock in 2019 was \$29.8 million, compared with \$80.0 million in 2018 and \$65.0 million in 2017. We paid cash dividends of \$72.6 million in 2019, compared with \$64.6 million in 2018 and \$57.3 million in 2017. In 2018, we entered into the Credit Agreement and used a portion of the proceeds to repay in full the borrowings outstanding under our 2014 credit agreement.

Debt and Other Contractual Obligations

Total debt outstanding at December 31, 2019, was \$1,980.4 million. Set forth below are our contractual obligations as of December 31, 2019:

(In millions)	Payments Due by Period				
	Total	1 Year or Less	2-3 Years	4-5 Years	More Than 5 Years
Debt	\$ 1,980.4	\$ 23.1	\$ 735.1	\$ 330.5	\$ 891.7
Expected interest payments on debt(1)	343.3	93.2	139.3	101.6	9.2
Operating lease obligations	47.1	11.1	13.6	5.7	16.7
Operating commitments(2)	176.8	143.9	31.0	1.9	—
Pension funding requirements per ERISA(3)	5.5	0.5	1.1	3.9	—
Funding requirements for non-U.S. retirement plans(4)	48.3	9.1	19.0	20.2	—
Total Contractual Obligations	\$ 2,601.4	\$ 280.9	\$ 939.1	\$ 463.8	\$ 917.6

- (1) Amounts are based on current interest rates as of December 31, 2019, for principal debt outstanding as of December 31, 2019. Actual interest payments may vary based on any interest rate swaps in effect.
- (2) Amounts do not include open purchase commitments, which are routine in nature and normally settle within 90 days, or obligations to employees under annual or long-term incentive programs.
- (3) Based on the U.S. qualified pension plans' status as of December 31, 2019, minimum funding requirements under ERISA have been estimated for the next five years. Amounts in subsequent years or additional payments have not yet been determined.
- (4) Based on the non-U.S. retirement plans' status as of December 31, 2019, funding requirements have been estimated for the next five years. Amounts in subsequent years have not yet been determined.

See Note 10 to the Consolidated Financial Statements for a discussion of Financial Assurances.

Employee Benefit Plans

See Note 8 to the Consolidated Financial Statements for further discussion of Pension Plans and Other Retirement Plans.

Defined Contribution Retirement Plan

We sponsor a defined contribution retirement plan for our employees in the United States. This plan is qualified under section 401(k) of the U.S. tax code. Currently, we contribute an amount equal to 100% of employee contributions, up to 6% of an individual employee's salary or wages. Our costs related to this benefit plan were \$13.9 million, \$12.6 million and \$11.5 million for the years ended December 31, 2019, 2018 and 2017, respectively.

U.S. salaried employees and certain U.S. hourly employees hired on or after January 1, 2017, and employees in Germany hired on or after January 1, 2016, participate in enhanced defined contribution plans instead of defined benefit pension plans. For the U.S. plan, we contribute 4% of an individual employee's salary or wages. For the German plan, contributions vary based on the individual employee's contributions and other factors. Our cost related to these enhanced defined contribution plans established in the United States and

Germany was \$3.7 million, \$1.9 million, and \$0.8 million for the years ended December 31, 2019, 2018, and 2017, respectively. We expect these amounts to increase in the future as more employees enroll in these plans.

Defined Benefit Pension Plans

We sponsor defined benefit pension plans for our employees in the U.S., Canada, Germany, and a number of other countries, and fund government-sponsored programs in other countries where we operate. Certain of our defined benefit pension plans are advance-funded and others are pay-as-you-go. The advance-funded plans are administered by trustees who receive direction related to the management of plan assets and arrange to have obligations paid when due. Our most significant advance-funded plans cover current and former salaried employees in the U.S. and employees covered by collective bargaining agreements at certain of our U.S. facilities. Our U.S. advance-funded plans are qualified under the U.S. tax code.

The following table presents the funded status of our underfunded and unfunded pension plans:

(In millions)	Fully-Funded Pension Plans(1)		Underfunded Pension Plans(1)		Unfunded Pension Plans(2)	
	2019	2018	2019	2018	2019	2018
Projected benefit obligation	\$ 35.6	\$ 32.4	\$ 1,022.8	\$ 920.3	\$ 448.5	\$ 380.0
Fair value of plan assets	44.1	38.1	936.7	852.5	—	—
Funded status (PBO basis)	\$ 8.5	\$ 5.7	\$ (86.1)	\$ (67.8)	\$ (448.5)	\$ (380.0)

(1) Plans intended to be advance-funded.

(2) Plans intended to be pay-as-you-go.

We have both fully-funded and underfunded pension plans. Our fully-funded plans have assets in excess of projected benefit obligation ("PBO") of \$8.5 million at December 31, 2019. Underfunded plans include a group of advance-funded plans that are underfunded on a PBO basis by a total of \$86.1 million as of December 31, 2019. Additionally, we have several plans that are funded on a pay-as-you-go basis, and therefore, the entire PBO for these plans of \$448.5 million at December 31, 2019, is unfunded. The net funded status of all of these plans was \$526.1 million as of December 31, 2019, and is presented in the Consolidated Balance Sheets as follows: \$8.5 million in "other assets," \$14.8 million in "other current liabilities," \$434.6 million in "unfunded defined benefit pension plans," and \$85.2 million in "underfunded defined benefit pension plans."

At the December 31, 2019, measurement date for the U.S. advance-funded plans, the PBO was \$1,029.4 million as measured under U.S. GAAP. The PBO is measured as the present value (using a 3.13% weighted average discount rate as of December 31, 2019) of vested and non-vested benefits earned from employee service to date, based upon current services and estimated future pay increases for active employees. Of the participants in the U.S. advance-funded plans, approximately 79% are retired or former employees or employees of our former businesses, which shortens the duration of the PBO. Assets available to fund the PBO for the U.S. advance-funded plans at December 31, 2019, were \$955.6 million, or \$73.8 million less than the measured obligation.

The following table presents the components of cash contributions for the advance-funded and pay-as-you-go plans:

(In millions)	2019	2018	2017
U.S. advance-funded plans	\$ 0.1	\$ 50.0	\$ 2.1
U.S. pay-as-you-go plans	6.6	6.9	7.5
Non-U.S. advance-funded plans	1.5	1.9	1.1
Non-U.S. pay-as-you-go plans	7.6	7.7	7.1
Total Cash Contributions	\$ 15.8	\$ 66.5	\$ 17.8

We intend to fund non-U.S. pension plans based upon applicable legal requirements and actuarial and trustee recommendations. We contributed \$9.1 million related to these plans in 2019.

Other Contingencies

See Note 10 to the Consolidated Financial Statements for a discussion of our other contingent matters.

Inflation

We recognize that inflationary pressures may have an adverse effect on us through higher asset replacement costs and higher raw materials and other operating costs. We try to minimize these impacts by developing alternative formulations, increasing productivity, hedging purchases of certain raw materials, and increasing prices.

Critical Accounting Estimates

The preparation of financial statements in conformity with U.S. GAAP requires that we make estimates and assumptions affecting the assets and liabilities reported at the date of the Consolidated Financial Statements, and the revenues and expenses reported for the periods presented. We believe that our accounting estimates are appropriate and the related balances are reasonable; however, actual amounts could differ from the original estimates, requiring adjustments in future periods. Changes in estimates are recorded in the period in which the change is identified. Our accounting policies are described in Note 1 to the Consolidated Financial Statements. Critical accounting estimates are described in this section.

An accounting estimate is considered critical if the estimate requires management to make assumptions and judgments about matters that were highly uncertain at the time the estimate was made, if different estimates reasonably could have been used, or if changes in the estimate are reasonably likely to occur from period to period that could have a material impact on our financial condition or results of operations. As part of our quarterly disclosure controls and procedures, management has discussed the development, selection and disclosure of the critical accounting estimates with the Audit Committee of the Board of Directors.

Contingent Liabilities

We have recorded a liability for the resolution of contingencies related to asbestos property damage, environmental remediation, and litigation. We record a liability if we have determined that a loss is probable and we are able to reasonably estimate the amount of the loss or have another reasonable basis for recording a liability. We have determined that each of the contingencies discussed below involves an accounting judgment that is material to our Consolidated Financial Statements.

Legacy Product Liabilities

We emerged from an asbestos-related Chapter 11 bankruptcy on February 3, 2014, as discussed in Note 10 to the Consolidated Financial Statements. Under the plan of reorganization, all pending and future asbestos-related claims are channeled for resolution to either the PI Trust or the PD Trust. The trusts are the sole recourse for holders of asbestos-related claims. The channeling injunctions issued by the bankruptcy court prohibit holders of asbestos-related claims from asserting such claims directly against us.

We have satisfied all of our financial obligations to the PI Trust. We have contingent financial obligations remaining to the PD Trust. With respect to ZAI PD Claims, the PD Trust was funded with \$49.4 million (net of \$15 million of attorneys' fees) to pay claims and expenses. We are also obligated to make up to 10 contingent deferred payments of \$8 million per year to the PD Trust during the 20-year period beginning on the fifth anniversary of the Effective Date, with each such payment due only if the assets of the PD Trust in respect of ZAI PD Claims fall below \$10 million during the preceding year. As of December 31, 2019, the PD Trust has paid out approximately \$29 million in ZAI PD Claims and expenses, leaving a balance of approximately \$23 million, including the benefit of realized investment gains.

Due to the limited claims history, the unique nature of this product, and the uncertainty of future claims patterns, an actuarial analysis was completed to estimate the range of possible future payments. The analysis was conducted by a third-party actuarial firm directed by us and using historical claims data provided by the ZAI trustee. Certain key assumptions employed in the analysis were (1) projections of the future number of filed claims, assuming a percentage increase in claims during earlier years and annual decreases in later years; (2) application of historical percentages of claims closed with indemnity payment compared to total closed claims, applied on a regional basis; and (3) application of the average claim payout, which reflects the average indemnity cost per claim closing with payment. As a result of the analysis and taking into account the relative uncertainty of

future claims activity, we determined that contingent funding obligations beyond the next five years are not reasonably estimable. We estimate that the reasonable range of payments over the next five years is expected to be between \$16 million and \$24 million and project that the first payment could be due in 2022. In the 2019 fourth quarter, we recorded a reserve in the amount of \$24.0 million related to probable future obligations to fund the PD Trust for ZAI PD Claims. Our maximum financial obligation over the next 19 years is \$80.0 million, and no single year's obligation can exceed \$8.0 million.

With respect to Other PD Claims, claims unresolved as of the Effective Date are to be litigated in the bankruptcy court and any future claims are to be litigated in a federal district court, in each case pursuant to procedures approved by the bankruptcy court. To the extent any such Other PD Claims are determined to be allowed claims, they are to be paid in cash by the PD Trust. We are obligated to make a payment to the PD Trust every six months in the amount of any Other PD Claims allowed during the preceding six months plus interest (if applicable) and the amount of PD Trust expenses for the preceding six months. We have not paid any Other PD Claims since emergence. Annual expenses have been approximately \$0.2 million per year. The aggregate amount to be paid under the PD Obligation is not capped, and we may be obligated to make additional payments to the PD Trust in respect of the PD Obligation. We have accrued for those unresolved Other PD Claims that we believe are probable and estimable. We have not accrued for other unresolved or unasserted Other PD Claims as we do not believe that payment is probable.

All payments to the PD Trust required after the Effective Date are secured by our obligation to issue 77,372,257 shares of Company common stock to the PD Trust in the event of default, subject to customary anti-dilution provisions.

Environmental Remediation

We are obligated under applicable law to remediate certain properties related to our business or former businesses. At some sites we outsource all or a portion of the remediation to third parties, and at others we perform the required remediation ourselves. Our environmental remediation obligation has a significant impact on our Consolidated Financial Statements. See disclosure in this Report in Item 1 (Business—Environment, Health and Safety Matters) and in Note 10 to the Consolidated Financial Statements for a discussion of our environmental remediation liabilities.

At sites where third parties conduct remediation, we estimate our obligations from information available to us from these third parties and other consultants, including actual costs incurred, expected future costs and time to completion. At sites where we conduct remediation, we work with regulatory authorities to define compliance requirements and then estimate the cost required to meet those requirements with information available to us. We base our estimates on our historical knowledge and engineering assessments specific to conditions at each site, and we update our estimates as necessary.

Our estimates can fluctuate significantly due to the extended duration of some remediation projects. The accuracy of our estimates is dependent on the validity of assumptions regarding regulatory approaches and such matters as labor rates, indirect costs and capital costs, which are each difficult to forecast over extended periods. Future changes in estimates, if required, may lead to material adjustments to our Consolidated Financial Statements, and the ultimate resolution of these obligations could have a material impact on our liquidity and capital resources.

We purchased a vermiculite mine in Libby, Montana, in 1963 and operated it until 1990. Vermiculite concentrate from the Libby mine was used in the manufacture of attic insulation and other products. Some of the vermiculite ore contained naturally occurring asbestos. We are engaged with the EPA and other federal, state and local governmental agencies in a remedial investigation and feasibility study of the Libby mine and the surrounding area, known as OU3. The RI/FS will determine the specific areas within OU3 requiring remediation and will identify possible remedial action alternatives. Possible remedial actions within OU3 are wide-ranging, from institutional controls such as land use restrictions, to more active measures involving soil removal, containment projects, or other protective measures.

As part of the RI/FS process, we contracted an engineering and consulting firm to develop a range of possible remedial alternatives and associated cost estimates for OU3. Based on this work, we recorded a pre-tax charge of \$70.0 million in the 2018 third quarter for the estimated costs of remediation of OU3. We believe that

this amount should provide for a protective remedy meeting the statutory requirements of the Comprehensive Environmental Response, Compensation, and Liability Act.

The estimated costs of remediation are preliminary and consist of several components, each of which may vary significantly as the remedial alternatives are further developed. It is reasonably possible that the ultimate costs of remediation could range between \$30 million and \$170 million. We are working closely with the EPA, and the ultimate remedy will be determined by the EPA after the RI/FS is finalized. Such remedy will be set forth in a ROD that is currently expected to be issued by the EPA no earlier than 2021. Costs associated with the more active remedial alternatives would be expected to be incurred over a decade or more. We will reevaluate our estimated liability as remedial alternatives evolve based on further work by the engineering and consulting firm and discussions with the EPA as the RI/FS process moves toward a ROD. Technical memoranda expected prior to the issuance of the ROD may provide insight into the likely remedial alternatives ultimately selected, allowing us to update our cost of remediation estimate. Depending on the remedial alternatives that the EPA selects in the ROD, the total cost of remediating OU3 may exceed our current estimate by material amounts.

We have cooperated with the EPA in investigating and remediating a number of formerly owned or operated sites that processed Libby vermiculite into finished products. We have recorded a liability for remaining expected EPA response and oversight costs, and for potential future site remediation, where a review has indicated that liability is probable and the cost is estimable. The EPA may commence additional investigations in the future at other sites that processed Libby vermiculite. Liability for unaccrued additional investigation and remediation costs is probable but not yet estimable, and could be material.

Other Legacy Liabilities

On April 3, 2019, the Montana Department of Natural Resources and Conservation issued a five-year operating permit for a dam at the Libby mine site. We constructed the dam in 1971 to prevent vermiculite ore tailings from moving into nearby creeks and rivers. The permit requires us to complete construction of a new spillway before the permit is further renewed in five years. We contracted a third-party engineering and consulting firm to develop a range of cost estimates for the project. Based on this work we recorded pre-tax charges of \$68.0 million in 2019 for the estimated costs of the project. These costs are preliminary and may vary significantly as the project progresses. Based on the consultants' estimates, we believe it is reasonably possible that the ultimate costs of this project could range between \$50 million and \$100 million. Construction of the new spillway is expected to take three to four years.

Litigation

We are subject to legal proceedings and claims arising out of the normal course of business. To estimate the cost to resolve our legal obligations, we review the facts of each matter to determine the merits of the case and the corresponding probability of a loss. If we determine that a loss is probable, we determine if there is sufficient information to make a reasonable estimate of the loss amount. Our estimates regarding the outcome of our legal proceedings and claims involve substantial uncertainties that could cause our actual losses to differ materially from our estimates. In estimating the likely outcome of a legal proceeding, we consider the nature of the specific claim (or unasserted claim), our experience with similar claims, the jurisdiction in which the proceeding is filed, court rulings, the status of any settlement negotiations, the likelihood of resolution through settlement or alternative dispute resolution, the proceeding's current status and other relevant information and events. We adjust our recorded liability for litigation contingencies as necessary to reflect our current evaluation of these and other factors.

Goodwill and Intangible Assets

We account for business combinations under the acquisition method of accounting, which requires us to allocate the purchase price to the tangible and identifiable intangible assets and liabilities acquired based on their estimated fair values at the acquisition date in accordance with ASC 805 "Business Combinations." The excess of the purchase price over the fair values of these identifiable assets and liabilities is recorded to goodwill. The assessment of fair value requires management to make significant estimates, including future expected revenues, earnings, and cash flows; expected useful lives; and attrition and discount rates. The allocation of the purchase price may be adjusted during the measurement period, which may not exceed one year after the acquisition date.

We review our finite-lived tangible and intangible assets for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be fully recoverable. We have no indefinite-lived intangible assets. There were no impairment charges recorded in any of the periods presented.

We review our goodwill for impairment on an annual basis at October 31 and whenever events or changes in circumstances indicate that the carrying amount may not be fully recoverable. We have identified our operating segments as reporting units for goodwill impairment testing. Our Catalysts Technologies reportable segment has two reporting units for goodwill impairment testing, which are our Refining Technologies and Specialty Catalysts operating segments. Our Materials Technologies operating segment represents a single reporting unit for goodwill impairment testing.

We performed a qualitative analysis as of October 31, 2019, and concluded that the estimated fair value of all of our reporting units substantially exceeded their carrying values.

Pension Expenses and Liabilities

We sponsor defined benefit pension plans for our employees in the United States and a number of other countries, including Canada and Germany, and fund government-sponsored programs in other countries where we operate. See Note 8 to the Consolidated Financial Statements for a detailed discussion of our pension plans.

In order to estimate our pension expenses and liabilities we evaluate the range of possible assumptions to be used in the calculation of pension expenses and liabilities. We select the assumptions that we believe to be most indicative of factors such as participant demographics, past experiences and market indices, and provide the assumptions to independent actuaries. These assumptions are updated annually and primarily include factors such as discount rates, expected return on plan assets, mortality rates, retirement rates, and rate of compensation increase. The independent actuaries review our assumptions for reasonableness, and use the assumptions to calculate our estimated liability and future pension expense. We review the actuarial reports for reasonableness and adjust our expenses, assets and liabilities to reflect the amounts calculated in the actuarial reports.

Our method of accounting for actuarial gains and losses relating to its global defined benefit pension plans is referred to as “mark-to-market accounting.” Under mark-to-market accounting, our pension costs consist of two elements: (1) ongoing costs recognized quarterly, which include service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits; and (2) mark-to-market gains and losses recognized annually in the fourth quarter resulting from changes in actuarial assumptions, such as discount rates and the difference between actual and expected returns on plan assets. Should a significant event occur, our pension obligation and plan assets are remeasured at an interim period, and the gains or losses on remeasurement are recognized in that period.

The two key assumptions used in determining our ongoing quarterly pension expense (excluding the effects of the annual mark-to-market adjustment) are the discount rate and expected return on plan assets. Our most significant pension assets and pension liabilities relate to U.S. pension plans.

The assumed discount rate for pension plans reflects the market rates for high-quality corporate bonds currently available and is subject to change based on changes in overall market interest rates. For the U.S. pension plans, the assumed weighted average discount rate was selected in consultation with our independent actuaries, based on a yield curve constructed from a portfolio of high-quality bonds for which the timing and amount of cash outflows approximate the estimated payouts of the plan.

We selected the expected return on plan assets for the U.S. qualified pension plans for 2019 in consultation with our independent actuaries, using an expected return model. The model determines the weighted average return for an investment portfolio based on the target asset allocation and expected future returns for each asset class, which were developed using a building block approach based on observable inflation, available interest rate information, current market characteristics, and historical results.

The following table reflects the sensitivity of 2020 pre-tax expense (excluding the effects of the annual mark-to-market adjustment) and our year-end PBO to a change in the discount rate and expected rate of return on plan assets assumptions for the U.S. pension plans:

Change in Assumption (In millions)	Effect on 2020 Pre-Tax Pension Expense	Effect on December 31, 2019 PBO
25 basis point decrease in discount rate	\$ (1)	\$ 35
25 basis point increase in discount rate	1	(33)
25 basis point decrease in expected return on plan assets	2	—
25 basis point increase in expected return on plan assets	(2)	—

Income Taxes

Our effective tax rate is primarily determined based on our pre-tax income and the statutory income tax rates in the jurisdictions in which we operate. The effective tax rate also reflects the tax impacts of items treated differently for tax purposes than for financial reporting purposes. Some of these differences are permanent, such as expenses that are not deductible in our tax returns, and some differences are temporary, reversing over time, such as depreciation expense. These temporary differences create deferred income tax assets and liabilities. Deferred income tax assets are also recorded for NOL and federal tax credit carryforwards.

Deferred income tax assets and liabilities are recognized by applying enacted tax rates to temporary differences that exist as of the balance sheet date. We reduce the carrying amounts of deferred tax assets by a valuation allowance if, based on the available evidence, it is more likely than not that such assets will not be realized. The need to establish valuation allowances for deferred tax assets is assessed quarterly. In assessing the requirement for, and amount of, a valuation allowance in accordance with the more likely than not standard, we give appropriate consideration to all positive and negative evidence related to the realization of the deferred tax assets. This assessment considers, among other matters, the nature, frequency and severity of current and cumulative losses, forecasts of future profitability and foreign source income ("FSI"), the duration of statutory carryforward periods, and our experience with operating loss and tax credit carryforward expirations. A history of cumulative losses is a significant piece of negative evidence used in our assessment. If a history of cumulative losses is incurred for a tax jurisdiction, forecasts of future profitability are not used as positive evidence related to the realization of the deferred tax assets in the assessment.

Our net deferred income tax assets (see Note 7 to the Consolidated Financial Statements) as of December 31, 2019, include deferred U.S. federal income tax assets representing federal tax credit carryforwards of \$294.7 million and federal NOL carryforwards of \$1.2 million, state NOL deferred income tax assets of \$51.3 million, and foreign NOL deferred tax assets of \$9.6 million. We have established valuation allowances in the amount of \$24.1 million, consisting of \$10.1 million for state NOL carryforwards, \$13.8 million for foreign deferred tax assets, primarily foreign operating loss carryforwards, and \$0.2 million for federal NOL carryforwards.

The federal tax credit carryforwards arose primarily as a result of the payment of intercompany dividends from our foreign affiliates, from the mandatory repatriation under the TCJA, and from research and development credits. The state NOLs arose primarily as a result of the amounts paid as a result of our bankruptcy proceedings.

In order to fully utilize our U.S. federal tax credits before they expire from 2021 to 2039, we will need to generate income of approximately \$1.4 billion. We will need to generate approximately \$2.5 billion for state income tax purposes during the respective realization periods (ranging from 2020 to 2036) in order to fully realize the state NOLs.

Inherent in determining our effective tax rate are judgments regarding business plans and expectations about future operations. These judgments include the amount and geographic mix of future taxable income, the amount of FSI, limitations on the usage of NOL carryforwards, the impact of ongoing or potential tax audits, and other future tax consequences.

Our ability to utilize deferred tax assets may be impacted by certain future events, such as changes in tax legislation or insufficient future taxable income or FSI prior to expiration of certain deferred tax assets.

We recognize the tax benefits of an uncertain tax position if those benefits are more likely than not to be sustained based on existing tax law. Additionally, we establish a reserve for tax positions that are more likely than not to be sustained based on existing tax law, if the ultimate benefit to be sustained upon examination by the relevant taxing authorities is uncertain. Unrecognized tax benefits are subsequently recognized at the time the

more likely than not recognition threshold is met, the tax matter is effectively settled or the statute of limitations for the relevant taxing authority to examine and challenge the tax position has expired, whichever is earlier.

Recent Accounting Pronouncements

See Note 1 to the Consolidated Financial Statements for a discussion of recent accounting pronouncements and their effect on us.

Item 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Our global operations, raw materials and energy requirements, and debt obligations expose us to various market risks. We use derivative financial instruments to mitigate certain of these risks. The following is a discussion of our primary market risk exposures, how those exposures are managed, and certain quantitative data pertaining to our market risk-sensitive instruments.

Currency Exchange Rate Risk

We operate and/or sell to customers in over 60 countries and in over 30 currencies; therefore, our results of operations are exposed to changes in currency exchange rates. We seek to minimize exposure to these changes by matching revenue streams with expenditures in the same currencies, but it is not always possible to do so. Further, where revenue streams exceed expenditures in a given currency, we seek opportunities to invoice our customers in U.S. dollars or peg the revenue stream to the U.S. dollar at the time of the sale. From time to time, we use financial instruments such as currency forward contracts, swaps, options, or combinations of them to reduce the risk of certain specific transactions. However, we do not have a policy of hedging all exposures, because management does not believe that such a level of hedging would be cost-effective. Significant uses of derivatives to mitigate the effects of changes in currency exchange rates are as follows.

In May 2016, Grace entered into a fixed-to-fixed cross-currency swap maturing in October 2021 to hedge its net investment in non-U.S. subsidiaries. On every April 1 and October 1, Grace will swap interest payments. Grace will pay euro fixed at the annual rate of 3.426% on €170.0 million and receive U.S. dollars fixed at the annual rate of 5.125% on \$190.3 million. The agreement requires an exchange of the notional amounts at maturity. The following tables provide information about the cross-currency swap at December 31, 2019, specifically, the aggregate future cash flows for each of the next two years and the fair value. The fair value represents the value of the derivative contract, and is included in “other current assets” and “other liabilities” in the Consolidated Balance Sheets.

(In millions)	2020	2021
Payable—interest and principal in euro	€ 5.8	€ 174.4
Receivable—interest and principal in U.S. dollars	\$ 9.8	\$ 197.6

(In millions)	December 31, 2019
Current asset	\$ 3.1
Noncurrent liability	(4.0)
Net fair value	\$ (0.9)

In April 2018, in connection with the Credit Agreement (see Note 5), Grace entered into new cross-currency swaps beginning on April 3, 2018, and maturing on March 31, 2023, to synthetically convert \$600.0 million of U.S. dollar-denominated floating rate debt into €490.1 million of euro-denominated debt fixed at 2.0231%. These cross-currency swaps were de-designated and terminated on November 5, 2018, and replaced with new, at-market cross-currency swaps beginning on November 5, 2018, and maturing on March 31, 2023, to synthetically convert \$600.0 million of U.S. dollar-denominated floating rate debt into €525.9 million of euro-denominated debt fixed at 1.785%. The agreements require partial exchanges of the notional amounts each quarter and the remaining amounts at maturity. The following tables provide information about the cross-currency swaps at December 31, 2019, specifically, the aggregate future cash flows for each of the next four years and the fair value. The fair value represents the value of the derivative contracts, and is included in “other current assets” and “other liabilities” in the Consolidated Balance Sheets.

(In millions)	2020	2021	2022	2023
Payable—interest and principal in euro	€ 14.6	€ 14.5	€ 14.4	€ 505.9
Receivable—interest and principal in U.S. dollars	\$ 28.2	\$ 27.9	\$ 27.6	\$ 579.9

(In millions)	December 31, 2019
Current asset	\$ 10.2
Noncurrent liability	(6.8)
Net fair value	<u>\$ 3.4</u>

There were no significant currency forward exchange agreements outstanding at December 31, 2019.

Interest Rate Risk

As of December 31, 2019, approximately \$293.5 million of our borrowings were at variable interest rates and expose us to interest rate risk, excluding \$592.5 million hedged by cross-currency swaps effective in November 2018, and \$100.0 million hedged by interest rate swaps effective in April 2018. As a result, we have been and will continue to be subject to the fluctuations in interest rates in respect of our floating-rate debt. A 100 basis point increase in the interest rates payable on our variable rate debt outstanding as of December 31, 2019, would increase our annual interest expense by \$2.9 million.

In connection with the Credit Agreement (see Note 5), Grace entered into new interest rate swaps beginning on April 3, 2018, and maturing on March 31, 2023, fixing the LIBOR component of the interest on \$100.0 million of term debt at 2.775%. While we have and may continue to enter into agreements intending to limit our exposure to higher interest rates, any such agreements may not offer complete protection from this risk.

See Item 8 (Financial Statements and Supplementary Data) under Note 6 (Fair Value Measurements and Risk) to the Consolidated Financial Statements for additional disclosure around market risk, which disclosure is incorporated herein by reference.

Item 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA**TABLE OF CONTENTS**

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The Financial Statement Schedule should be read in conjunction with the Consolidated Financial Statements and Notes thereto. Financial Statement Schedules not included have been omitted because they are not applicable or the required information is shown in the Consolidated Financial Statements or Notes thereto. Financial statements of less than majority-owned persons and other persons accounted for by the equity method have been omitted as provided in Rule 3-09 of the United States Securities and Exchange Commission's (the "SEC") Regulation S-X.

Management's Report on Internal Control Over Financial Reporting

Responsibility For Financial Information—We are responsible for the preparation, accuracy, integrity and objectivity of the Consolidated Financial Statements and the other financial information included in this report. Such information has been prepared in conformity with accounting principles generally accepted in the United States of America and accordingly, includes certain amounts that represent management's best estimates and judgments. Actual amounts could differ from those estimates.

Responsibility For Internal Controls—We and our management are also responsible for establishing and maintaining adequate internal controls over financial reporting. These internal controls consist of policies and procedures that are designed to assess and monitor the effectiveness of the control environment including risk identification, governance structure, delegations of authority, information flow, communications and control activities. A chartered Disclosure Committee oversees Grace's public financial reporting process and key managers are required to confirm their compliance with Grace's policies and internal controls quarterly. While no system of internal controls can ensure elimination of all errors and irregularities, Grace's internal controls, which are reviewed and modified in response to changing conditions, have been designed to provide reasonable assurance that assets are safeguarded, policies and procedures are followed, transactions are properly executed and reported, and appropriate disclosures are made. The concept of reasonable assurance is based on the recognition that there are limitations in all systems of internal control and that the costs of such systems should be balanced with their benefits. The Audit Committee of the Board of Directors, which is composed solely of independent directors, meets regularly with Grace's senior financial management, internal auditors and independent registered public accounting firm to review audit plans and results, as well as the actions taken by management in discharging its responsibilities for accounting, financial reporting and internal controls. The Audit Committee is responsible for the selection and compensation of the independent registered public accounting firm. Grace's financial management, internal auditors and independent registered public accounting firm have direct and confidential access to the Audit Committee at all times.

Report On Internal Control Over Financial Reporting—We and our management have evaluated Grace's internal control over financial reporting as of December 31, 2019. This evaluation was based on criteria for effective internal control over financial reporting set forth in *Internal Control—Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission. Based on this evaluation, we and our management have concluded that Grace's internal control over financial reporting is effective as of December 31, 2019. Grace's independent registered public accounting firm that audited our financial statements included in Item 8 has also audited the effectiveness of Grace's internal control over financial reporting as of December 31, 2019, as stated in their report, which appears on the following page.

Report On Disclosure Controls And Procedures—As of December 31, 2019, we and our management carried out an evaluation of the effectiveness of the design and operation of Grace's disclosure controls and procedures pursuant to Rule 13a-15 under the Securities Exchange Act of 1934, as amended (the "Exchange Act"). Based upon that evaluation, we concluded that Grace's disclosure controls and procedures are effective in ensuring that information required to be disclosed in Grace's periodic filings and submissions under the Exchange Act is accumulated and communicated to us and our management to allow timely decisions regarding required disclosures, and such information is recorded, processed, summarized and reported within the time periods specified in the Securities and Exchange Commission's rules and forms.

/s/ HUDSON LA FORCE

Hudson La Force
President and Chief Executive Officer
(Principal Executive Officer)

/s/ WILLIAM C. DOCKMAN

William C. Dockman
Senior Vice President and Chief Financial Officer
(Principal Financial Officer and Principal Accounting Officer)

Date: February 27, 2020

Report of Independent Registered Public Accounting Firm

To the Board of Directors and Shareholders of W. R. Grace & Co.

Opinions on the Financial Statements and Internal Control over Financial Reporting

We have audited the accompanying consolidated balance sheets of W. R. Grace & Co. and its subsidiaries (the "Company") as of December 31, 2019 and 2018, and the related consolidated statements of operations, of comprehensive income (loss), of equity and of cash flows for each of the three years in the period ended December 31, 2019, including the related notes and financial statement schedule listed in the accompanying index for each of the three years in the period ended December 31, 2019 (collectively referred to as the "consolidated financial statements"). We also have audited the Company's internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control - Integrated Framework* (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission (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, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019 in conformity with accounting principles generally accepted in the United States of America. Also in our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on criteria established in *Internal Control - Integrated Framework* (2013) issued by the COSO.

Change in Accounting Principle

As discussed in Note 1 to the consolidated financial statements, the Company changed the manner in which it accounts for leases in 2019.

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 Report on Internal Control Over Financial Reporting. 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.

Critical Audit Matters

The critical audit matters communicated below are matters arising from the current period audit of the consolidated financial statements that were communicated or required to be communicated to the audit committee and that (i) relate to accounts or disclosures that are material to the consolidated financial statements and (ii) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matters below, providing a separate opinion on the critical audit matters or on the accounts or disclosures to which they relate.

Environmental Liability for the Libby Mine and Surrounding Area

As described in Note 10 to the consolidated financial statements, the Company is engaged with the U.S. Environmental Protection Agency (the "EPA") and other federal, state and local governmental agencies in a remedial investigation and feasibility study ("RI/FS") of the Libby mine and the surrounding area, known as Operable Unit 3 ("OU3"). The RI/FS will determine the specific areas within OU3 requiring remediation and will identify possible remedial action alternatives. Possible remedial actions within OU3 are wide-ranging, from institutional controls such as land use restrictions, to more active measures involving soil removal, containment projects, or other protective measures. As part of the RI/FS process, management contracted an engineering and consulting firm to develop a range of possible remedial alternatives and associated cost estimates for OU3. The estimated costs of remediation are preliminary and consist of several components, each of which may vary significantly as the remedial alternatives are further developed. It is reasonably possible that the ultimate costs of remediation could range between \$30 million and \$170 million. The ultimate remedy will be determined by the EPA after the RI/FS is finalized. Such remedy will be set forth in a Record of Decision ("ROD") that is currently expected to be issued by the EPA no earlier than 2021. Depending on the remedial alternatives that the EPA selects in the ROD, the total cost of remediating OU3 may exceed management's current estimate by material amounts. The Company's estimated liability for response costs that are currently estimable for OU3 and vermiculite processing sites outside of Libby at December 31, 2019 totaled \$76.0 million.

The principal considerations for our determination that performing procedures relating to the environmental liability for the Libby mine and surrounding area is a critical audit matter are (i) there was significant judgment by management when developing the environmental liability for the Libby mine and the surrounding area, which in turn led to a high degree of auditor judgment and subjectivity in performing procedures and evaluating audit evidence related to management's estimated remedial alternatives and the related estimated costs of such remedial alternatives, and (ii) the audit effort involved the use of professionals with specialized skill and knowledge to assist in performing these procedures and evaluating the audit evidence.

Addressing the matter involved performing procedures and evaluating audit evidence in connection with forming our overall opinion on the consolidated financial statements. These procedures included testing the effectiveness of controls relating to management's estimates of the environmental liability for the Libby mine and surrounding area, including controls over the on-going monitoring of information that may impact the remedial alternatives or the associated costs. These procedures also included, among others, assessing the completeness, accuracy and relevance of the underlying data used by management, and evaluating the remedial alternatives and associated

costs selected by management. Professionals with specialized skill and knowledge were used to assist in evaluating the remedial alternatives selected by management and in evaluating the associated costs.

Legacy Product Liabilities for the Zonolite Attic Insulation Property Damage Claims

As described in Note 10 to the consolidated financial statements, the Company has contingent financial obligations remaining to the property damage trust (the PD Trust) related to pending and future asbestos-related claims. With respect to property damage claims related to the Company's former Zonolite attic insulation product (ZAI PD Claims), the Company is obligated to make up to 10 contingent deferred payments of \$8 million per year to the PD Trust during the 20-year period beginning on the fifth anniversary of February 3, 2014, the effective date of emergence from Chapter 11 bankruptcy, with each such payment due only if the assets of the PD Trust in respect of ZAI PD Claims fall below \$10 million during the preceding year. As of December 31, 2019, the PD Trust has paid out approximately \$29 million in ZAI PD Claims and expenses, leaving a balance of approximately \$23 million, including the benefit of realized investment gains. Due to the limited claims history, the unique nature of this product, and the uncertainty of future claims patterns, an actuarial analysis was completed to estimate the range of possible future payments. As a result of the analysis and taking into account the relative uncertainty of future claims activity, management determined that contingent funding obligations beyond the next five years are not reasonably estimable. Management estimates that the reasonable range of payments over the next five years is expected to be between \$16 million and \$24 million and projects that the first payment could be due in 2022. In the 2019 fourth quarter, management recorded a reserve in the amount of \$24.0 million related to probable future obligations to fund the PD Trust for ZAI PD Claims.

The principal considerations for our determination that performing procedures relating to the legacy product liabilities for the ZAI PD Claims is a critical audit matter are (i) there was significant judgment by management when developing the estimate for the amount and timing of future claims payments from the PD Trust, which in turn led to a high degree of auditor judgment, subjectivity and effort in performing procedures and evaluating audit evidence related to management's estimated liability and (ii) the audit effort involved the use of professionals with specialized skill and knowledge to assist in performing these procedures and evaluating the audit evidence.

Addressing the matter involved performing procedures and evaluating audit evidence in connection with forming our overall opinion on the consolidated financial statements. These procedures included testing the effectiveness of controls relating to management's estimate of the legacy product liability for the ZAI PD Claims. These procedures also included, among others, assessing the completeness, accuracy and relevance of the underlying data used in the actuarial analysis. Professionals with specialized skill and knowledge were used to assist in evaluating management's actuarial analysis used to estimate the liability, including the assumption relating to future claims patterns and the determination that contingent funding obligations past the next five years are not reasonably estimable.

/s/ PricewaterhouseCoopers LLP
Baltimore, Maryland
February 27, 2020

We have served as the Company's auditor since 1906.

Consent of Independent Registered Public Accounting Firm

We hereby consent to the incorporation by reference in the Registration Statements on Form S-8 (Nos. 333-224767, 333-194171) of W. R. Grace & Co. of our report dated February 27, 2020 relating to the financial statements and financial statement schedule and the effectiveness of internal control over financial reporting, which appears in this Form 10-K.

/s/ PricewaterhouseCoopers LLP
Baltimore, Maryland
February 27, 2020

W. R. Grace & Co. and Subsidiaries
Consolidated Statements of Operations

(In millions, except per share amounts)	Year Ended December 31,		
	2019	2018	2017
Net sales	\$ 1,958.1	\$ 1,932.1	\$ 1,716.5
Cost of goods sold	1,164.4	1,165.4	1,040.4
Gross profit	793.7	766.7	676.1
Selling, general and administrative expenses	299.0	300.4	268.4
Research and development expenses	64.5	62.7	56.3
Costs related to legacy matters	103.5	82.3	33.1
Restructuring and repositioning expenses	13.7	46.4	26.7
Equity in earnings of unconsolidated affiliate	(27.8)	(31.8)	(25.9)
Interest expense and related financing costs	76.7	80.2	79.5
Other (income) expense, net	80.6	(18.4)	27.1
Total costs and expenses	610.2	521.8	465.2
Income (loss) before income taxes	183.5	244.9	210.9
(Provision for) benefit from income taxes	(56.8)	(78.1)	(200.5)
Net income (loss)	126.7	166.8	10.4
Less: Net (income) loss attributable to noncontrolling interests	(0.4)	0.8	0.8
Net income (loss) attributable to W. R. Grace & Co. shareholders	\$ 126.3	\$ 167.6	\$ 11.2
Earnings Per Share Attributable to W. R. Grace & Co. Shareholders			
Basic earnings per share:			
Net income (loss)	\$ 1.89	\$ 2.49	\$ 0.16
Weighted average number of basic shares	66.8	67.2	68.1
Diluted earnings per share:			
Net income (loss)	\$ 1.89	\$ 2.49	\$ 0.16
Weighted average number of diluted shares	66.9	67.3	68.2
Dividends per common share	\$ 1.08	\$ 0.96	\$ 0.84

The Notes to Consolidated Financial Statements are an integral part of these statements.

W. R. Grace & Co. and Subsidiaries
Consolidated Statements of Comprehensive Income (Loss)

(In millions)	Year Ended December 31,		
	2019	2018	2017
Net income (loss)	\$ 126.7	\$ 166.8	\$ 10.4
Other comprehensive income (loss), net of income taxes:			
Defined benefit pension and other postretirement plans	(0.7)	(0.9)	(1.3)
Currency translation adjustments	16.5	32.4	(26.0)
Gain (loss) from hedging activities	(4.9)	(5.7)	0.8
Total other comprehensive income (loss), net of income taxes	10.9	25.8	(26.5)
Comprehensive income (loss)	137.6	192.6	(16.1)
Less: comprehensive (income) loss attributable to noncontrolling interests	(0.4)	0.8	0.8
Comprehensive income (loss) attributable to W. R. Grace & Co. shareholders	\$ 137.2	\$ 193.4	\$ (15.3)

The Notes to Consolidated Financial Statements are an integral part of these statements.

W. R. Grace & Co. and Subsidiaries
Consolidated Statements of Cash Flows

(In millions)	Year Ended December 31,		
	2019	2018	2017
OPERATING ACTIVITIES			
Net income (loss)	\$ 126.7	\$ 166.8	\$ 10.4
Reconciliation to net cash provided by (used for) operating activities:			
Depreciation and amortization	100.3	100.8	111.5
Equity in earnings of unconsolidated affiliate	(27.8)	(31.8)	(25.9)
Dividends received from unconsolidated affiliate	—	—	19.0
Costs related to legacy product, environmental, and other claims	103.5	82.3	33.1
Cash paid for legacy product, environmental, and other claims	(19.3)	(22.9)	(54.5)
Provision for (benefit from) income taxes	56.8	78.1	200.5
Cash paid for income taxes	(52.8)	(54.0)	(61.8)
Income tax refunds received	10.5	0.7	34.2
Defined benefit pension expense (income)	104.3	0.7	64.1
Cash paid under defined benefit pension arrangements	(15.8)	(66.5)	(17.8)
Stock compensation expense	14.6	18.6	11.0
Loss on early extinguishment of debt	—	4.8	—
Accounts receivable reserve—Venezuela	—	—	10.0
Changes in assets and liabilities, excluding effect of currency translation and acquisitions:			
Trade accounts receivable	(18.7)	2.5	(4.9)
Inventories	(30.1)	(26.1)	4.4
Accounts payable	28.0	24.2	(2.5)
Deferred revenue	(5.3)	35.6	4.7
All other items, net	17.2	28.2	(16.3)
Net cash provided by (used for) operating activities	392.1	342.0	319.2
INVESTING ACTIVITIES			
Capital expenditures	(194.1)	(216.3)	(125.2)
Business acquired, net of cash acquired	(22.8)	(418.0)	(3.5)
Other investing activities	6.8	15.8	(0.5)
Net cash provided by (used for) investing activities	(210.1)	(618.5)	(129.2)
FINANCING ACTIVITIES			
Borrowings under credit arrangements	13.0	1,024.0	114.4
Repayments under credit arrangements	(24.2)	(587.8)	(143.9)
Cash paid for debt financing costs	—	(11.8)	—
Cash paid for repurchases of common stock	(29.8)	(80.0)	(65.0)
Proceeds from exercise of stock options	19.1	6.7	16.4
Dividends paid to shareholders	(72.6)	(64.6)	(57.3)
Cash received from hedge settlement	—	33.1	—
Other financing activities	(4.9)	(3.1)	0.6
Net cash provided by (used for) financing activities	(99.4)	316.5	(134.8)
Effect of currency exchange rate changes on cash and cash equivalents	(0.7)	(2.5)	7.7
Net increase (decrease) in cash and cash equivalents	81.9	37.5	62.9
Cash, cash equivalents, and restricted cash, beginning of period	201.0	163.5	100.6
Cash, cash equivalents, and restricted cash, end of period	<u>\$ 282.9</u>	<u>\$ 201.0</u>	<u>\$ 163.5</u>
Supplemental disclosure of cash flow information			
Cash paid for interest, net of amounts capitalized	\$ 67.7	\$ 75.2	\$ 68.7
Capital expenditures included in accounts payable	49.8	31.0	41.4
Expenditures for other investing activities included in accounts payable	16.2	16.9	2.7
Net share settled stock option exercises	9.7	8.2	1.2

The Notes to Consolidated Financial Statements are an integral part of these statements.

W. R. Grace & Co. and Subsidiaries
Consolidated Balance Sheets

(In millions, except par value and shares)	December 31,	
	2019	2018
ASSETS		
Current Assets		
Cash and cash equivalents	\$ 282.5	\$ 200.5
Restricted cash and cash equivalents	0.4	0.5
Trade accounts receivable, less allowance of \$13.3 (2018—\$11.6)	307.0	288.5
Inventories	309.9	281.1
Other current assets	235.1	86.7
Total Current Assets	1,134.9	857.3
Properties and equipment, net of accumulated depreciation and amortization of \$1,497.0 (2018—\$1,482.8)	1,143.8	1,011.7
Goodwill	556.9	540.4
Technology and other intangible assets, net	342.8	356.5
Deferred income taxes	517.6	529.4
Investment in unconsolidated affiliate	181.9	156.1
Other assets	54.7	113.9
Total Assets	\$ 3,932.6	\$ 3,565.3
LIABILITIES AND EQUITY		
Current Liabilities		
Debt payable within one year	\$ 23.1	\$ 22.3
Accounts payable	302.3	248.6
Other current liabilities	419.7	243.5
Total Current Liabilities	745.1	514.4
Debt payable after one year	1,957.3	1,961.0
Unfunded defined benefit pension plans	434.6	366.0
Underfunded defined benefit pension plans	85.2	67.1
Other liabilities	308.2	319.8
Total Liabilities	3,530.4	3,228.3
Commitments and Contingencies—Note 10		
Equity		
Common stock issued, par value \$0.01; 300,000,000 shares authorized; outstanding: 66,735,913 (2018—66,792,968)	0.7	0.7
Paid-in capital	477.9	481.1
Retained earnings	730.5	676.7
Treasury stock, at cost: shares: 10,720,720 (2018—10,663,659)	(892.2)	(895.5)
Accumulated other comprehensive income (loss)	78.8	67.9
Total W. R. Grace & Co. Shareholders' Equity	395.7	330.9
Noncontrolling interests	6.5	6.1
Total Equity	402.2	337.0
Total Liabilities and Equity	\$ 3,932.6	\$ 3,565.3

The Notes to Consolidated Financial Statements are an integral part of these statements.

W. R. Grace & Co. and Subsidiaries
Consolidated Statements of Equity

(In millions)	Common Stock and Paid-in Capital	Retained Earnings	Treasury Stock	Accumulated Other Comprehensive (Loss) Income	Noncontrolling Interests	Total Equity
Balance, December 31, 2016	\$ 488.0	\$ 619.3	\$ (804.9)	\$ 66.4	\$ 3.6	\$ 372.4
Net income (loss)	—	11.2	—	—	(0.8)	10.4
Repurchase of common stock	—	—	(65.0)	—	—	(65.0)
Stock-based compensation	11.0	—	—	—	—	11.0
Exercise of stock options	(18.9)	—	35.0	—	—	16.1
Payments in consideration of employee tax obligations related to stock-based compensation	(2.5)	—	—	—	—	(2.5)
Shares issued	(2.1)	—	2.8	—	—	0.7
Dividends declared	—	(57.4)	—	—	—	(57.4)
Contribution from joint venture partner	—	—	—	—	4.1	4.1
Other comprehensive income (loss)	—	—	—	(26.5)	—	(26.5)
Balance, December 31, 2017	475.5	573.1	(832.1)	39.9	6.9	263.3
Net income (loss)	—	167.6	—	—	(0.8)	166.8
Repurchase of common stock	—	—	(80.0)	—	—	(80.0)
Stock-based compensation	18.6	—	—	—	—	18.6
Exercise of stock options	(4.2)	—	10.6	—	—	6.4
Payments in consideration of employee tax obligations related to stock-based compensation	(2.9)	—	—	—	—	(2.9)
Shares issued	(5.2)	—	6.0	—	—	0.8
Dividends declared	—	(64.3)	—	—	—	(64.3)
Other comprehensive income (loss)	—	—	—	25.8	—	25.8
Effect of adopting ASC 606	—	2.5	—	—	—	2.5
Effect of adopting ASU 2018-02	—	(2.2)	—	2.2	—	—
Balance, December 31, 2018	481.8	676.7	(895.5)	67.9	6.1	337.0
Net income (loss)	—	126.3	—	—	0.4	126.7
Repurchase of common stock	—	—	(29.8)	—	—	(29.8)
Stock-based compensation	14.6	—	—	—	—	14.6
Exercise of stock options	(5.0)	—	24.1	—	—	19.1
Payments in consideration of employee tax obligations related to stock-based compensation	(4.9)	—	—	—	—	(4.9)
Shares issued	(7.9)	—	9.0	—	—	1.1
Dividends declared	—	(72.5)	—	—	—	(72.5)
Other comprehensive income (loss)	—	—	—	10.9	—	10.9
Balance, December 31, 2019	\$ 478.6	\$ 730.5	\$ (892.2)	\$ 78.8	\$ 6.5	\$ 402.2

The Notes to Consolidated Financial Statements are an integral part of these statements.

Notes to Consolidated Financial Statements

1. Basis of Presentation and Summary of Significant Accounting and Financial Reporting Policies

W. R. Grace & Co., through its subsidiaries, is engaged in specialty chemicals and specialty materials businesses on a global basis through two reportable segments: Grace Catalysts Technologies, which includes catalysts and related products and technologies used in petrochemical, refining, and other chemical manufacturing applications; and Grace Materials Technologies, which includes specialty materials, including silica-based and silica-alumina-based materials, used in consumer/pharma, coatings, and chemical process applications.

W. R. Grace & Co. conducts all of its business through a single wholly owned subsidiary, W. R. Grace & Co.–Conn. (“Grace–Conn.”). Grace–Conn. owns all of the assets, properties and rights of W. R. Grace & Co. on a consolidated basis, either directly or through subsidiaries.

As used in these notes, the term “Company” refers to W. R. Grace & Co. The term “Grace” refers to the Company and/or one or more of its subsidiaries and, in certain cases, their respective predecessors.

Separation Transaction In 2016, Grace completed a separation transaction with respect to GCP Applied Technologies Inc., then a wholly-owned subsidiary of Grace (“GCP”), which included Grace’s former Construction Products operating segment and the packaging technologies business of its Grace Materials Technologies operating segment (the “Separation”). The Separation was effected by means of a pro rata distribution to the Company’s stockholders of all of the outstanding shares of GCP common stock. As a result of the transaction, GCP became an independent public company.

Principles of Consolidation The Consolidated Financial Statements include the accounts of Grace and entities as to which Grace maintains a controlling financial interest. Intercompany transactions and balances are eliminated in consolidation. Investments in affiliated companies in which Grace can significantly influence operating and financial policies, but does not have a controlling financial interest, are accounted for under the equity method.

Grace conducts a portion of its business through joint ventures with unaffiliated third parties. For joint ventures in which Grace has a controlling financial interest, Grace consolidates the results of such joint ventures in the Consolidated Financial Statements. Grace recognizes a liability for cumulative amounts due to the third parties based on the financial results of the joint ventures, and deducts the amount of income attributable to noncontrolling interests in the measurement of its consolidated net income.

Reportable Segments Grace reports financial results of each of its reportable segments that engage in business activities that generate revenues and expenses and whose operating results are regularly reviewed by Grace’s Chief Executive Officer.

Use of Estimates The preparation of financial statements in conformity with U.S. generally accepted accounting principles (“U.S. GAAP”) requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the Consolidated Financial Statements, and the reported amounts of revenues and expenses for the periods presented. Actual amounts could differ from those estimates, and the differences could be material. Changes in estimates are recorded in the period identified. Grace’s accounting measurements that are most affected by management’s estimates of future events are:

- Realization values of net deferred tax assets, which depend on projections of future taxable income (see Note 7);
- Pension and postretirement liabilities, which depend on assumptions regarding participant life spans, future inflation, discount rates and total returns on invested funds (see Note 8);
- Carrying values of goodwill and other intangible assets, which depend on assumptions of future earnings and cash flows (see Note 4 and Note 20); and
- Contingent liabilities, which depend on an assessment of the probability of loss and an estimate of ultimate obligation, such as litigation, environmental remediation, and other legacy liabilities (see Note 10).

Notes to Consolidated Financial Statements (Continued)

1. Basis of Presentation and Summary of Significant Accounting and Financial Reporting Policies (Continued)

Revenue Recognition Grace generates revenues predominantly from sales of manufactured products to customers and in part from licensing of technology. Under ASC 606, revenue from customer arrangements is recognized when control is transferred to the customer.

Product Sales

Based on the promises made to customers in product sales arrangements, Grace determined that it has a performance obligation to manufacture and deliver products to its customers. Grace makes certain other promises in its customer arrangements that are immaterial in the context of the contracts. Revenue is recognized at amounts based on agreed-upon prices in sales contracts and/or purchase orders. Grace offers various incentives to its product sales customers that result in variable consideration, including but not limited to volume discounts, which reward bulk purchases by lowering the price for future purchases, and volume rebates, which encourage customers to purchase volume levels that would reduce their current prices. These incentives are immaterial in the context of the contracts.

For product sales, control is transferred at the point in time at which risk of loss and title have transferred to the customer, which is determined based on shipping terms and contract terms, respectively. Terms of delivery and terms of payment are generally included in customer contracts of sale, order confirmation documents, and invoices. Payment is generally due within 30 to 60 days of invoicing. Grace defers revenue recognition until no other significant Grace performance obligations remain. Grace's customer arrangements do not contain significant acceptance provisions.

Taxes that Grace collects that are assessed by a governmental authority, and that are both imposed on and concurrent with any of its revenue-producing activities, are excluded from revenue. Grace considers shipping and handling activities that it performs as activities to fulfill the sales of its products. Amounts billed for shipping and handling are included in "net sales," while costs incurred for shipping and handling are included in "cost of goods sold."

Technology Licensing

For Grace's technology licensing business, Grace determined that the customer arrangements contain multiple deliverables to enable licensees to realize the full benefit of the technology. These deliverables include licensing the technology itself; developing engineering design packages; and providing training, consulting, and technical services. Under these arrangements, the license grant is not a distinct performance obligation, as the licensee only can benefit from the license in conjunction with other integral services such as development of the engineering design package, training, consulting, or technical services provided over the contract period. Therefore, Grace accounts for the license grant and integral services as a single performance obligation. Certain deliverables and services not included in the core bundled deliverables are accounted for as separate performance obligations.

The transaction price is specified in the technology licensing agreements and is substantially fixed. Some services are priced on a per-diem basis, but these are not material in the context of the contracts. Grace invoices its technology licensing customers as certain project milestones are achieved. Payment terms are similar to those of Grace's product sales.

Revenue for each performance obligation is recognized when control is transferred to the customer, which is generally over a period of time. As a result, Grace generally recognizes revenue for each performance obligation ratably over the period of the contract, which is up to 8 years, depending on the scope of the licensee's project. Based on the timing of payments, Grace records deferred revenue related to these agreements. See Note 17.

Cash Equivalents Cash equivalents consist of liquid instruments and investments with maturities of three months or less when purchased. The recorded amounts approximate fair value.

Inventories Inventories are stated at the lower of cost or net realizable value. The method used to determine cost is first-in/first-out, or "FIFO." Market values for raw materials are based on current cost and, for

Notes to Consolidated Financial Statements (Continued)

1. Basis of Presentation and Summary of Significant Accounting and Financial Reporting Policies (Continued)

other inventory classifications, net realizable value. Inventories are evaluated regularly for salability, and slow moving and/or obsolete items are adjusted to expected salable value. Inventory values include direct and certain indirect costs of materials and production. Abnormal costs of production are expensed as incurred.

Long Lived Assets Properties and equipment are stated at cost. Depreciation of properties and equipment is generally computed using the straight-line method over the estimated useful life of the asset. Estimated useful lives range from 20 to 30 years for buildings, 3 to 7 years for information technology equipment, 5 to 25 years for operating machinery and equipment, and 5 to 10 years for furniture and fixtures. Interest is capitalized in connection with major project expenditures. Fully depreciated assets are retained in properties and equipment and related accumulated depreciation accounts until they are removed from service. In the case of disposals, assets and related accumulated depreciation are removed from the accounts and the net amount, less any proceeds from disposal, is charged or credited to earnings. Obligations for costs associated with asset retirements, such as requirements to restore a site to its original condition, are accrued at net present value and amortized along with the related asset.

During the 2018 first quarter, Grace, with the assistance of an outside accounting firm, completed a study to evaluate the useful lives of its operating machinery and equipment, including a review of historical asset retirement data as well as review and analysis of relevant industry practices. As a result of this study, effective January 1, 2018, Grace revised the accounting useful lives of certain machinery and equipment, which was determined to be a change in accounting estimate and is being applied prospectively. As a result of this change in accounting estimate, Grace's depreciation expense with respect to such machinery and equipment was reduced by \$23.5 million, resulting in an increase to net income of \$18.0 million or \$0.27 per diluted share for the year ended December 31, 2018. Estimated useful lives for operating machinery and equipment previously ranged from 3 to 10 years.

Intangible assets with finite lives consist of technology, customer lists, trademarks, and other intangibles and are amortized over their estimated useful lives, ranging from 1 to 30 years.

Grace reviews long-lived assets for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be fully recoverable. There were no impairment charges recorded in any of the periods presented.

Leases Grace leases certain real estate, office space, vehicles, railcars, and plant and office equipment, substantially all of which are accounted for as operating leases. Finance lease costs and sublease income are not material. Many of Grace's leases contain renewal options, which are exercisable at Grace's discretion and may be included in lease terms when they are reasonably certain to be exercised. Grace's lease agreements do not contain material restrictive covenants or material residual value guarantees. Grace has elected not to recognize in the Consolidated Balance Sheets short-term leases, which are those with an initial term of 12 months or less. Grace has also elected not to separate lease and non-lease components. These elections apply to all asset classes. Where available, Grace uses the interest rate implicit in the lease to calculate the estimated present value of lease payment obligations. Where such a rate is not available, Grace uses an incremental borrowing rate based on credit-adjusted and term-specific discount rates, using a third-party yield curve.

Goodwill Goodwill arises from business combinations, and it is reviewed for impairment on an annual basis at October 31 and whenever events or changes in circumstances indicate that the carrying amount may not be fully recoverable. Recoverability is assessed at the reporting unit level most directly associated with the business combination that generated the goodwill. For the purpose of measuring impairment, Grace has identified its operating segments as reporting units. Grace has evaluated its goodwill annually with no impairment charge required in any of the periods presented.

Financial Instruments Grace uses commodity forward, swap and/or option contracts; currency forward, swap, and/or option contracts; and interest rate swap contracts to manage exposure to fluctuations in commodity prices, currency exchange rates, and interest rates. Grace does not hold or issue derivative financial instruments for trading purposes. Derivative instruments are recorded at fair value in the Consolidated Balance Sheets as

Notes to Consolidated Financial Statements (Continued)

1. Basis of Presentation and Summary of Significant Accounting and Financial Reporting Policies (Continued)

either assets or liabilities. For derivative instruments designated as fair value hedges, changes in the fair values of the derivative instruments closely offset changes in the fair values of the hedged items in “other (income) expense, net” in the Consolidated Statements of Operations. For derivative instruments designated as cash flow hedges, the gain or loss on the hedge is reported in “accumulated other comprehensive income (loss)” in the Consolidated Balance Sheets until it is cleared to earnings during the same period in which the hedged item affects earnings. Forward points are excluded from the assessment of effectiveness and are amortized to income on a systematic basis. For derivative instruments designated as net investment hedges, the gains and losses on the hedge, adjusted for the impact of excluded components, are recorded net of tax to “currency translation adjustments” within “accumulated other comprehensive income (loss)” to offset the change in the carrying value of the net investment being hedged. Changes in the fair value of the hedging instrument related to time value, which are excluded from the assessment of hedge effectiveness, are recorded directly to interest expense on a systematic basis. The changes in the fair values of derivative instruments that are not designated as hedges are recorded in current period earnings. Cash flows from derivative instruments are reported in the same category as the cash flows from the items being hedged.

Income Taxes Deferred tax assets and liabilities are recognized with respect to the expected future tax consequences of events that have been recorded in the Consolidated Financial Statements. Grace reduces the carrying amounts of deferred tax assets by a valuation allowance if, based on the available evidence, it is more likely than not that such assets will not be realized. The need to establish valuation allowances for deferred tax assets is assessed quarterly.

In assessing the requirement for, and amount of, a valuation allowance in accordance with the more likely than not standard, Grace gives appropriate consideration to all positive and negative evidence related to the realization of the deferred tax assets. This assessment considers, among other matters, the nature, frequency, and severity of current and cumulative losses; forecasts of future profitability; domestic and foreign source income; the duration of statutory carryforward periods; and Grace’s experience with operating loss and tax credit carryforward expirations.

Tax benefits from an uncertain tax position are recognized only if it is more likely than not that the tax position will be sustained upon examination by the taxing authorities based on the technical merits of the position. Tax benefits recognized in the Consolidated Financial Statements from such a position are measured based on the largest benefit that has a greater than fifty percent likelihood of being realized upon ultimate settlement. Grace evaluates such likelihood based on relevant facts and tax law. Grace adjusts its recorded liability for income tax matters due to changes in circumstances or new uncertainties, such as amendments to existing tax law. Grace’s ultimate tax liability depends upon many factors, including negotiations with taxing authorities in the jurisdictions in which it operates, outcomes of tax litigation, and resolution of disputes arising from federal, state, and foreign tax audits. Due to the varying tax laws in each jurisdiction management, with the assistance of local tax advisors as necessary, assesses individual matters in each jurisdiction on a case-by-case basis. Grace researches and evaluates its income tax positions, including why it believes they are compliant with income tax regulations, and these positions are documented as appropriate.

The U.S. Tax Cuts and Jobs Act of 2017 (“TCJA”) subjects a U.S. entity to tax on global intangible low-taxed income (“GILTI”) earned by certain foreign subsidiaries. An entity can make an accounting policy election to either recognize deferred taxes for temporary basis differences expected to reverse as GILTI in future years or to provide for the tax expense related to GILTI in the year the tax is incurred as a period expense only. Grace has elected to account for GILTI as a period expense in the year the tax is incurred. Grace has also adopted the tax law ordering approach for evaluating the impact of GILTI on the assessment of the realizability of US deferred tax assets.

Pension Benefits Grace’s method of accounting for actuarial gains and losses relating to its global defined benefit pension plans is referred to as “mark-to-market accounting.” Under mark-to-market accounting, Grace’s pension costs consist of two elements: (1) ongoing costs recognized quarterly, which include service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits; and (2) mark-to-market gains and losses recognized annually in the fourth quarter resulting from changes in actuarial

Notes to Consolidated Financial Statements (Continued)

1. Basis of Presentation and Summary of Significant Accounting and Financial Reporting Policies (Continued)

assumptions, such as discount rates and the difference between actual and expected returns on plan assets. Should a significant event occur, Grace's pension obligation and plan assets are remeasured at an interim period, and the gains or losses on remeasurement are recognized in that period.

Stock-Based Compensation The Company recognizes expenses related to stock-based compensation payment transactions in which it receives employee services in exchange for (a) equity instruments of the Company or (b) liabilities that are based on the fair value of the Company's equity instruments or that may be settled by the issuance of equity instruments. Stock-based compensation cost for restricted stock units ("RSUs") and share settled performance-based units ("PBUs") are measured based on the high/low average of the Company's common stock on the date of grant. Cash-settled PBUs and RSUs are remeasured at the end of each reporting period based on the closing fair market value of the Company's common stock. Stock-based compensation cost for stock options is estimated at the grant date based on each option's fair value as calculated by the Black-Scholes option pricing model. The Company recognizes stock-based compensation cost as expense ratably on a straight-line basis over the requisite service period.

Currency Translation Assets and liabilities of foreign subsidiaries (other than those located in countries with highly inflationary economies) are translated into U.S. dollars at current exchange rates, while revenues, costs and expenses are translated at average exchange rates during each reporting period. The resulting translation adjustments are included in "accumulated other comprehensive income (loss)" in the Consolidated Balance Sheets. The financial statements of any subsidiaries located in countries with highly inflationary economies are remeasured as if the functional currency were the U.S. dollar; the remeasurement creates translation adjustments that are reflected in net income in the Consolidated Statements of Operations.

Reclassifications Certain amounts in prior years' Consolidated Financial Statements have been reclassified to conform to the current year presentation. Such reclassifications have not materially affected previously reported amounts in the Consolidated Financial Statements.

Recently Issued Accounting Standards In June 2016, the FASB issued ASU 2016-13 "Financial Instruments—Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments." This update requires companies to implement an impairment model based on expected credit losses, rather than probable incurred losses. This update is effective for Grace on January 1, 2020. Grace does not expect the update to have a material effect on the Consolidated Financial Statements.

In August 2018, the FASB issued ASU 2018-14 "Compensation—Retirement Benefits—Defined Benefit Plans—General (Subtopic 715-20): Disclosure Framework—Changes to the Disclosure Requirements for Defined Benefit Plans." This update revises disclosure requirements related to defined benefit pension and other postretirement plans. This update is effective for Grace on January 1, 2020. Grace does not expect the update to have a material effect on the Consolidated Financial Statements.

In December 2019, the FASB issued ASU 2019-12 "Income Taxes (Topic 740): Simplifying the Accounting for Income Taxes." This update clarifies and amends existing guidance, including removing certain exceptions to the general principles in Topic 740 and improves consistent application of and simplifies GAAP for other areas of Topic 740 by clarifying and amending existing guidance. This update is effective for Grace on January 1, 2021, with early adoption permitted. Grace is currently evaluating the effect and timing of adoption.

Recently Adopted Accounting Standards In October 2018, the FASB issued ASU 2018-16 "Derivatives and Hedging (Topic 815): Inclusion of the Secured Overnight Financing Rate (SOFR) Overnight Index Swap (OIS) Rate as a Benchmark Interest Rate for Hedge Accounting Purposes." This update permits use of the OIS rate based on SOFR as a U.S. benchmark interest rate for hedge accounting purposes under Topic 815. Grace currently carries debt and derivatives that rely on the London Interbank Offered Rate ("LIBOR") as a benchmark rate. LIBOR is expected to be phased out as a benchmark rate by the end of 2021. Grace expects its debt and financial instruments to continue to use LIBOR until the rate is no longer available. To the extent LIBOR ceases to exist, Grace may need to renegotiate any credit agreements and/or derivative contracts that utilize LIBOR as a

Notes to Consolidated Financial Statements (Continued)

1. Basis of Presentation and Summary of Significant Accounting and Financial Reporting Policies (Continued)

factor in determining the interest rate. Grace adopted this update in the 2019 first quarter, and it had no effect on Grace's Consolidated Financial Statements.

Leases (Topic 842)

In February 2016, the FASB issued ASU 2016-02 "Leases (Topic 842)." This update requires registrants to recognize lease assets and lease liabilities on the balance sheet and disclose key information about leasing arrangements. A lessee is now required to recognize in the statement of financial position a liability to make lease payments (the lease liability) and a right-of-use asset representing its right to use the underlying asset for the lease term, including payments to be made in optional periods where they are reasonably certain to occur. In July 2018, the FASB issued ASU 2018-11 "Leases (Topic 842): Targeted Improvements," which provided an additional transition method permitting entities to initially apply the new standard at the adoption date and recognize a cumulative-effect adjustment to the opening balance of retained earnings in the period of adoption.

Grace adopted these standards in the 2019 first quarter under the modified retrospective approach permitted by ASU 2018-11. Under this approach, the cumulative effect of the adoption of the standard is recorded at the effective date, with no changes to prior periods. The adoption did not result in an impact to retained earnings. Grace elected to utilize the package of transition practical expedients provided by the standard, which among other things, permits Grace not to reassess expired or existing contracts and leases. Additionally, Grace elected to use the practical expedient provided in ASU 2018-01 "Leases (Topic 842): Land Easement Practical Expedient for Transition to Topic 842," which permits Grace to elect not to evaluate under Topic 842 existing or expired land easements not previously accounted for as leases. Prior to the adoption of Topic 842, Grace typically had not evaluated easements for lease accounting.

As a result of this standard, Grace's Consolidated Balance Sheet as of December 31, 2019, includes operating lease right-of-use assets, net of accumulated amortization, of \$34.9 million and operating lease liabilities of \$35.5 million.

2. Inventories

Inventories are stated at the lower of cost or net realizable value, and cost is determined using FIFO. Inventories consisted of the following at December 31, 2019 and 2018:

(In millions)	December 31,	
	2019	2018
Raw materials	\$ 64.2	\$ 56.3
In process	55.7	49.1
Finished products	154.4	144.5
Other	35.6	31.2
	<u>\$ 309.9</u>	<u>\$ 281.1</u>

Notes to Consolidated Financial Statements (Continued)

3. Properties and Equipment, and Leases

(In millions)	December 31,	
	2019	2018
Land	\$ 29.5	\$ 28.4
Buildings	438.9	425.0
Information technology and equipment	131.3	142.9
Machinery, equipment and other	1,754.5	1,668.9
Projects under construction	286.6	229.3
Properties and equipment, gross	2,640.8	2,494.5
Accumulated depreciation and amortization	(1,497.0)	(1,482.8)
Properties and equipment, net	\$ 1,143.8	\$ 1,011.7

Capitalized interest costs amounted to \$7.5 million, \$3.2 million, and \$1.5 million in 2019, 2018, and 2017, respectively. Depreciation and finance lease amortization expense relating to properties and equipment was \$78.4 million, \$80.9 million, and \$96.1 million in 2019, 2018, and 2017, respectively.

The following table presents Grace's lease right-of-use assets, net of accumulated amortization, and operating lease liabilities as of December 31, 2019.

(in millions)	Amount	Balance Sheet Location
Operating lease right of use asset	\$ 34.9	Other assets
Operating lease liability—current	9.3	Other current liabilities
Operating lease liability—noncurrent	26.2	Other liabilities

The following table presents Grace's costs and cash flow information related to operating leases for the year ended December 31, 2019.

(In millions)	Year Ended December 31, 2019
Operating lease cost	\$ 12.1
Short-term and variable lease cost	17.9
Total lease cost	\$ 30.0
Cash payments related to operating leases	\$ 12.0
Right-of-use assets obtained in exchange for new operating lease liabilities	17.0

Grace's expense for operating leases was \$13.5 million and \$11.3 million in 2018 and 2017, respectively.

The following table presents the weighted average discount rate and weighted average remaining lease term related to Grace's operating leases.

	December 31, 2019
Weighted average discount rate	6.4%
Weighted average remaining lease term	8.2

Notes to Consolidated Financial Statements (Continued)

3. Properties and Equipment, and Leases (Continued)

The following maturity analysis presents minimum expected operating lease payments at December 31, 2019.

	(In millions)
2020	\$ 11.1
2021	8.0
2022	5.6
2023	3.2
2024	2.5
Thereafter	16.7
Total undiscounted lease payments	47.1
Less: imputed interest	11.6
Present value of lease liabilities	\$ 35.5

4. Goodwill and Other Intangible Assets

The carrying amount of goodwill attributable to each reportable segment and the changes in those balances during the years ended December 31, 2019 and 2018, are as follows:

(In millions)	Catalysts Technologies	Materials Technologies	Total Grace
Balance, December 31, 2017	\$ 357.7	\$ 44.7	\$ 402.4
Goodwill acquired during the year	140.6	—	140.6
Foreign currency translation	(2.0)	(0.6)	(2.6)
Balance, December 31, 2018	496.3	44.1	540.4
Goodwill acquired during the year	17.8	—	17.8
Foreign currency translation	(1.0)	(0.3)	(1.3)
Balance, December 31, 2019	\$ 513.1	\$ 43.8	\$ 556.9

Grace's net book value of other intangible assets at December 31, 2019 and 2018, was \$342.8 million and \$356.5 million, respectively, detailed as follows:

(In millions)	12/31/2019		12/31/2018	
	Gross Carrying Amount	Accumulated Amortization	Gross Carrying Amount	Accumulated Amortization
Technology	\$ 232.5	\$ 63.6	\$ 226.2	\$ 52.4
Customer lists	161.2	23.9	161.2	15.7
Trademarks	31.7	5.5	29.8	4.0
Other	16.1	5.7	16.1	4.7
Total	\$ 441.5	\$ 98.7	\$ 433.3	\$ 76.8

Amortization expense related to intangible assets was \$21.9 million, \$19.9 million, and \$15.4 million in 2019, 2018, and 2017, respectively.

Notes to Consolidated Financial Statements (Continued)

4. Goodwill and Other Intangible Assets (Continued)

At December 31, 2019, estimated future annual amortization expense for intangible assets is:

	(In millions)
2020	\$ 22.1
2021	21.8
2022	21.7
2023	21.7
2024	21.7
Thereafter	233.8
	\$ 342.8

5. Debt

Components of Debt

(In millions)	December 31,	
	2019	2018
2018 U.S. dollar term loan, net of unamortized debt issuance costs of \$7.2 at December 31, 2019 (2018—\$8.7)	\$ 930.9	\$ 938.9
5.125% senior notes due 2021, net of unamortized debt issuance costs of \$2.7 at December 31, 2019 (2018—\$4.2)	697.3	695.8
5.625% senior notes due 2024, net of unamortized debt issuance costs of \$2.4 at December 31, 2019 (2018—\$3.0)	297.6	297.0
Debt payable to unconsolidated affiliate	47.4	48.1
Other borrowings(1)	7.2	3.5
Total debt	1,980.4	1,983.3
Less debt payable within one year	23.1	22.3
Debt payable after one year	\$ 1,957.3	\$ 1,961.0
Weighted average interest rates on total debt	3.8%	3.9%

(1) Represents borrowings under various lines of credit and other borrowings, primarily by non-U.S. subsidiaries.

See Note 6 for a discussion of the fair value of Grace's debt.

The principal maturities of debt outstanding at December 31, 2019, were as follows:

	(In millions)
2020	\$ 23.1
2021	716.6
2022	18.5
2023	17.5
2024	313.0
Thereafter	891.7
Total debt	\$ 1,980.4

Notes to Consolidated Financial Statements (Continued)

5. Debt (Continued)

Credit Agreement

On April 3, 2018, Grace entered into a Credit Agreement (the "Credit Agreement"), which provides for new senior secured credit facilities, consisting of:

- (a) a \$950 million term loan due in 2025, with interest at LIBOR +175 basis points, and
- (b) a \$400 million revolving credit facility due in 2023, with interest at LIBOR +175 basis points.

The term loan amortizes in equal quarterly installments in aggregate annual amounts of \$9.5 million.

The Credit Agreement contains customary affirmative covenants, including, but not limited to:

(i) maintenance of existence, and compliance with laws; (ii) delivery of consolidated financial statements and other information; (iii) payment of taxes; (iv) delivery of notices of defaults and certain other material events; and (v) maintenance of adequate insurance. The Credit Agreement also contains customary negative covenants, including but not limited to restrictions on: (i) dividends on, and redemptions of, equity interests and other restricted payments; (ii) liens; (iii) loans and investments; (iv) the sale, transfer or disposition of assets and businesses; (v) transactions with affiliates; and (vi) a maximum first lien leverage ratio.

Events of default under the Credit Agreement include, but are not limited to: (i) failure to pay principal, interest, fees or other amounts under the Credit Agreement when due, taking into account any applicable grace period; (ii) any representation or warranty proving to have been incorrect in any material respect when made; (iii) failure to perform or observe covenants or other terms of the Credit Agreement subject to certain grace periods; (iv) a cross-default and cross-acceleration with certain other material debt; (v) bankruptcy events; (vi) certain defaults under ERISA; and (vii) the invalidity or impairment of security interests.

To secure its obligations under the Credit Agreement, Grace and certain of its U.S. subsidiaries have granted security interests in substantially all equity and debt interests in Grace-Conn. or any other Grace subsidiary owned by them and in substantially all their non-real estate assets and property.

Grace used a portion of the proceeds to repay in full the borrowings outstanding under its 2014 credit agreement, which was terminated, as well as to make a voluntary \$50.0 million accelerated contribution to its U.S. qualified pension plans. In connection with the repayment of debt, Grace recorded a \$4.8 million loss on early extinguishment of debt, which is included in "other (income) expense" in the Consolidated Statement of Operations.

Grace had no outstanding draws on its revolving credit facility as of December 31, 2019; however, the available credit under that facility was reduced to \$378.5 million by outstanding letters of credit.

Senior Notes

On September 16, 2014, Grace-Conn. (the "Issuer") issued \$1,000.0 million of senior unsecured notes (the "Notes") in two tranches:

- (a) \$700 million in aggregate principal amount of Notes due 2021 at a coupon rate of 5.125%, and
- (b) \$300 million in aggregate principal amount of Notes due 2024 at a coupon rate of 5.625%.

The Notes were priced at 100% of par and were offered and sold pursuant to exemptions from registration under the Securities Act of 1933, as amended, (the "Securities Act"). Interest is payable on the Notes on each April 1 and October 1.

Grace may redeem some or all of the Notes at any time at a price equal to the greater of (i) 100% of the principal amount of the Notes redeemed plus accrued and unpaid interest and (ii) the sum, as determined by an independent investment banker, of the present values of the remaining scheduled payments of principal and interest (exclusive of interest accrued to the date of redemption) discounted to the redemption date on a semiannual basis (assuming a 360-day year consisting of twelve 30-day months) at the treasury rate plus 50 basis points, in each case, plus accrued and unpaid interest. In the event of a change in control, Grace will be

Notes to Consolidated Financial Statements (Continued)

5. Debt (Continued)

required to offer to purchase the Notes at a price equal to 101% of the aggregate principal amount outstanding plus accrued and unpaid interest.

The Notes are jointly and severally guaranteed on a full and unconditional senior unsecured basis by the Company and Alltech Associates, Inc., a wholly-owned subsidiary of the Issuer (the “Guarantors”). The Notes and guarantees are senior obligations of the Issuer and the Guarantors, respectively, and will rank equally with all of the existing and future unsubordinated obligations of the Issuer and the Guarantors, respectively. The Notes are effectively subordinated to any secured indebtedness to the extent of the value of the assets securing such indebtedness, and structurally subordinated to the debt and other liabilities of Grace’s non-guarantor subsidiaries.

The Notes were issued subject to covenants that limit the Issuer’s and certain of its subsidiaries’ ability, subject to certain exceptions and qualifications, to (i) create or incur liens on assets, (ii) enter into any sale and leaseback transaction and (iii) in the case of the Issuer, merge or consolidate with another company. Grace is in compliance with these covenants.

The Notes were also issued subject to customary events of default which include (subject in certain cases to customary grace and cure periods), among others, nonpayment of principal or interest; breach of other agreements in the Indenture; failure to pay certain other indebtedness; failure to discharge a final judgment for the payment of \$75 million or more (excluding any amounts covered by insurance or indemnities) rendered against the Issuer or any of its significant subsidiaries; and certain events of bankruptcy or insolvency. Generally, if any event of default occurs, the trustee or the holders of at least 25% in aggregate principal amount of the then outstanding series of Notes may declare all the Notes of such series to be due and payable immediately.

The foregoing is a summary of the Credit Agreement, the indentures, and the Notes. Grace has filed the full text of such agreements with the SEC, which are readily available on the Internet at www.sec.gov.

6. Fair Value Measurements and Risk

Certain of Grace’s assets and liabilities are reported at fair value on a gross basis. ASC 820 “Fair Value Measurements and Disclosures” defines fair value as the value that would be received at the measurement date in the principal or “most advantageous” market. Grace uses principal market data, whenever available, to value assets and liabilities that are required to be reported at fair value.

Grace has identified the following financial assets and liabilities that are subject to the fair value analysis required by ASC 820:

Fair Value of Debt and Other Financial Instruments Debt payable is recorded at carrying value. Fair value is determined based on Level 2 inputs, including expected future cash flows (discounted at market interest rates), estimated current market prices, and quotes from financial institutions.

Notes to Consolidated Financial Statements (Continued)

6. Fair Value Measurements and Risk (Continued)

At December 31, 2019, the carrying amounts and fair values of Grace's debt were as follows:

(In millions)	December 31, 2019		December 31, 2018	
	Carrying Amount	Fair Value	Carrying Amount	Fair Value
2018 U.S. dollar term loan(1)	\$ 930.9	\$ 938.1	\$ 938.9	\$ 914.8
5.125% senior notes due 2021(2)	697.3	727.1	695.8	697.5
5.625% senior notes due 2024(2)	297.6	329.2	297.0	301.8
Other borrowings	54.6	54.6	51.6	51.6
Total debt	\$ 1,980.4	\$ 2,049.0	\$ 1,983.3	\$ 1,965.7

- (1) Carrying amounts are net of unamortized debt issuance costs and discounts of \$7.2 million and \$8.7 million as of December 31, 2019 and 2018, respectively.
- (2) Carrying amounts are net of unamortized debt issuance costs of \$2.7 million and \$2.4 million at December 31, 2019, and \$4.2 million and \$3.0 million as of December 31, 2018, related to the 5.125% senior notes due 2021 and 5.625% senior notes due 2024, respectively.

At December 31, 2019, the recorded values of other financial instruments such as cash equivalents and trade receivables and payables approximated their fair values, based on the short-term maturities and floating rate characteristics of these instruments.

Currency Derivatives Because Grace operates and/or sells to customers in over 60 countries and in over 30 currencies, its results are exposed to fluctuations in currency exchange rates. Grace seeks to minimize exposure to these fluctuations by matching sales with expenditures in the same currencies, but it is not always possible to do so. From time to time, Grace uses financial instruments such as currency forward contracts, options, swaps, or combinations thereof to reduce the risk of certain specific transactions. However, Grace does not have a policy of hedging all exposures, because management does not believe that such a level of hedging would be cost-effective. Forward contracts with maturities of not more than 36 months are used and designated as cash flow hedges of forecasted repayments of intercompany loans. The effective portion of gains and losses on these currency hedges is recorded in "accumulated other comprehensive income (loss)" and reclassified into "other (income) expense, net" to offset the remeasurement of the underlying hedged loans. Forward points are excluded from the assessment of effectiveness and are amortized to income on a systematic basis.

Grace also enters into foreign currency forward contracts and swaps to hedge a portion of its net outstanding monetary assets and liabilities. These forward contracts and swaps are not designated as hedging instruments under applicable accounting guidance, and therefore all changes in their fair value are recorded in "other (income) expense, net," in the Consolidated Statements of Operations. These forward contracts and swaps are intended to offset the foreign currency gains or losses associated with the underlying monetary assets and liabilities.

The valuation of Grace's currency exchange rate forward contracts and swaps is determined using an income approach. Inputs used to value currency exchange rate forward contracts and swaps consist of: (1) spot rates, which are quoted by various financial institutions; (2) forward points, which are primarily affected by changes in interest rates; and (3) discount rates used to present value future cash flows, which are based on the London Interbank Offered Rate (LIBOR) curve or overnight indexed swap rates. Total notional amounts for forward contracts and swaps outstanding at December 31, 2019, were \$206.4 million.

Cross-Currency Swap Agreements Grace uses cross-currency swaps designated as cash flow hedges to manage fluctuations in currency exchange rates and interest rates on variable rate debt. Gains and losses on these cash flow hedges are recorded in "accumulated other comprehensive income (loss)" and reclassified into "other (income) expense, net" and "interest expense and related financing costs" during the hedged period.

In April 2018, in connection with the Credit Agreement (see Note 5), Grace entered into new cross-currency swaps beginning on April 3, 2018, and maturing on March 31, 2023, to synthetically convert \$600.0 million of U.S.

Notes to Consolidated Financial Statements (Continued)

6. Fair Value Measurements and Risk (Continued)

dollar-denominated floating rate debt into €490.1 million of euro-denominated debt fixed at 2.0231%. These cross-currency swaps were de-designated and terminated on November 5, 2018, and replaced with new, at-market cross-currency swaps beginning on November 5, 2018, and maturing on March 31, 2023, to synthetically convert \$600.0 million of U.S. dollar-denominated floating rate debt into €525.9 million of euro-denominated debt fixed at 1.785%. Grace received \$33.1 million in cash proceeds from the swap settlement. The valuation of these cross-currency swaps is determined using an income approach, using LIBOR and EURIBOR (Euro Interbank Offered Rate) swap curves, currency basis spreads, and euro/U.S. dollar exchange rates.

Debt and Interest Rate Swap Agreements Grace uses interest rate swaps designated as cash flow hedges to manage fluctuations in interest rates on variable rate debt. The effective portion of gains and losses on these interest rate cash flow hedges is recorded in “accumulated other comprehensive income (loss)” and reclassified into “interest expense and related financing costs” during the hedged interest period.

In connection with its emergence financing, Grace entered into interest rate swaps beginning on February 3, 2015, and maturing on February 3, 2020, fixing the LIBOR component of the interest on \$250.0 million of Grace’s term debt at a rate of 2.393%. These interest rate swaps were de-designated and terminated in April 2018 in connection with Grace’s entry into the Credit Agreement (see Note 5).

In connection with the Credit Agreement, Grace entered into new interest rate swaps beginning on April 3, 2018, and maturing on March 31, 2023, fixing the LIBOR component of the interest on \$100.0 million of term debt at 2.775%. The valuation of these interest rate swaps is determined using an income approach, using prevailing market interest rates and discount rates to present value future cash flows based on the forward LIBOR yield curves. Credit risk is also incorporated into derivative valuations.

The following tables present the fair value hierarchy for financial assets and liabilities measured at fair value on a recurring basis as of December 31, 2019 and 2018:

Fair Value Measurements at December 31, 2019, Using					
(In millions)	Total	Quoted Prices in Active Markets for Identical Assets or Liabilities (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)	
Assets					
Currency derivatives	\$ 6.1	\$ —	\$ 6.1	\$ —	
Variable-to-fixed cross-currency derivatives	3.4	—	3.4	—	
Total Assets	\$ 9.5	\$ —	\$ 9.5	\$ —	
Liabilities					
Currency derivatives	\$ 0.9	\$ —	\$ 0.9	\$ —	
Interest rate derivatives	3.4	—	3.4	—	
Total Liabilities	\$ 4.3	\$ —	\$ 4.3	\$ —	

Notes to Consolidated Financial Statements (Continued)

6. Fair Value Measurements and Risk (Continued)

Fair Value Measurements at December 31, 2018, Using				
(In millions)	Total	Quoted Prices in Active Markets for Identical Assets or Liabilities (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Assets				
Currency derivatives	\$ 3.7	\$ —	\$ 3.7	\$ —
Total Assets	\$ 3.7	\$ —	\$ 3.7	\$ —
Liabilities				
Currency derivatives	\$ 10.5	\$ —	\$ 10.5	\$ —
Variable-to-fixed cross-currency derivatives	3.6		3.6	
Interest rate derivatives	0.8	—	0.8	—
Total Liabilities	\$ 14.9	\$ —	\$ 14.9	\$ —

The following tables present the location and fair values of derivative instruments included in the Consolidated Balance Sheets as of December 31, 2019 and 2018:

December 31, 2019 (In millions)	Asset Derivatives		Liability Derivatives	
	Balance Sheet Location	Fair Value	Balance Sheet Location	Fair Value
Derivatives designated as hedging instruments under ASC 815:				
Currency contracts	Other current assets	\$ 2.1	Other current assets	\$ (3.1)
Currency contracts	Other assets	4.0	Other liabilities	4.0
Interest rate contracts	Other current assets	—	Other current liabilities	1.0
Interest rate contracts	Other assets	—	Other liabilities	2.4
Variable-to-fixed cross-currency swaps	Other current assets	10.2	Other current liabilities	—
Variable-to-fixed cross-currency swaps	Other liabilities	(6.8)	Other liabilities	—
Derivatives not designated as hedging instruments under ASC 815:				
Currency contracts	Other current assets	—	Other current assets	(0.2)
Currency contracts	Other current assets	—	Other current liabilities	0.2
Total derivatives		\$ 9.5		\$ 4.3

December 31, 2018 (In millions)	Asset Derivatives		Liability Derivatives	
	Balance Sheet Location	Fair Value	Balance Sheet Location	Fair Value
Derivatives designated as hedging instruments under ASC 815:				
Currency contracts	Other current assets	\$ 2.4	Other current assets	\$ (2.9)
Currency contracts	Other assets	1.3	Other liabilities	12.9
Interest rate contracts	Other current assets	—	Other current liabilities	0.1
Interest rate contracts	Other assets	—	Other liabilities	0.7
Variable-to-fixed cross-currency swaps	Other current assets	—	Other current assets	(15.4)
Variable-to-fixed cross-currency swaps	Other assets	—	Other liabilities	19.0
Derivatives not designated as hedging instruments under ASC 815:				
Currency contracts	Other current assets	—	Other current assets	(0.1)
Currency contracts	Other current assets	—	Other current liabilities	0.6
Total derivatives		\$ 3.7		\$ 14.9

Notes to Consolidated Financial Statements (Continued)

6. Fair Value Measurements and Risk (Continued)

The following tables present the location and amount of gains and losses on derivative instruments included in the Consolidated Statements of Operations or, when applicable, gains and losses initially recognized in “other comprehensive income (loss)” (“OCI”) for the years ended December 31, 2019, 2018, and 2017:

Year Ended December 31, 2019 (In millions)	Amount of Gain (Loss) Recognized in OCI on Derivatives	Location of Gain (Loss) Reclassified from Accumulated OCI into Income	Amount of Gain (Loss) Reclassified from Accumulated OCI into Income
Derivatives in ASC 815 cash flow hedging relationships:			
Interest rate contracts	\$ (2.9)	Interest expense	\$ (0.3)
Currency contracts(1)	2.4	Other expense	1.4
Variable-to-fixed cross-currency swaps	9.1	Interest expense	13.2
Variable-to-fixed cross-currency swaps	12.5	Other expense	12.5
Total derivatives	\$ 21.1		\$ 26.8
		Location of Gain (Loss) Recognized in Income on Derivatives	Amount of Gain (Loss) Recognized in Income on Derivatives
Derivatives not designated as hedging instruments under ASC 815:			
Currency contracts		Other expense	\$ (0.4)

- (1) Amount of gain (loss) recognized in OCI includes \$0.6 million excluded from the assessment of effectiveness for which the difference between changes in fair value and periodic amortization is recorded in OCI.

Year Ended December 31, 2018 (In millions)	Amount of Gain (Loss) Recognized in OCI on Derivatives	Location of Gain (Loss) Reclassified from Accumulated OCI into Income	Amount of Gain (Loss) Reclassified from Accumulated OCI into Income
Derivatives in ASC 815 cash flow hedging relationships:			
Interest rate contracts	\$ 0.4	Interest expense	\$ (0.6)
Currency contracts(1)	6.3	Other expense	6.3
Variable-to-fixed cross-currency swaps	(0.6)	Interest expense	9.7
Variable-to-fixed cross-currency swaps	40.5	Other expense	40.5
Total derivatives	\$ 46.6		\$ 55.9
		Location of Gain (Loss) Recognized in Income on Derivatives	Amount of Gain (Loss) Recognized in Income on Derivatives
Derivatives not designated as hedging instruments under ASC 815:			
Currency contracts		Other expense	\$ (4.0)

- (1) Amount of gain (loss) recognized in OCI includes \$(0.4) million excluded from the assessment of effectiveness for which the difference between changes in fair value and periodic amortization is recorded in OCI.

Notes to Consolidated Financial Statements (Continued)

6. Fair Value Measurements and Risk (Continued)

Year Ended December 31, 2017 (In millions)	Amount of Gain (Loss) Recognized in OCI on Derivatives	Location of Gain (Loss) Reclassified from Accumulated OCI into Income	Amount of Gain (Loss) Reclassified from Accumulated OCI into Income
Derivatives in ASC 815 cash flow hedging relationships:			
Interest rate contracts	\$ 0.9	Interest expense	\$ (2.7)
Currency contracts(1)	(3.6)	Other expense	(2.9)
Total derivatives	<u>\$ (2.7)</u>		<u>\$ (5.6)</u>
		Location of Gain (Loss) Recognized in Income on Derivatives	Amount of Gain (Loss) Recognized in Income on Derivatives
Derivatives not designated as hedging instruments under ASC 815:			
Currency contracts		Other expense	<u>\$ 1.0</u>

(1) Amount of gain (loss) recognized in OCI includes \$(0.6) million excluded from the assessment of effectiveness for which the difference between changes in fair value and periodic amortization is recorded in OCI.

The following table presents the total amounts of income and expense line items presented in the Consolidated Statements of Operations in which the effects of cash flow hedges are reported.

(In millions)	Year Ended December 31,					
	2019		2018		2017	
	Interest expense	Other income (expense)	Interest expense	Other income (expense)	Interest expense	Other income (expense)
Total amounts of income and expense line items in the Consolidated Statements of Operations in which the effects of cash flow hedges are recorded	\$ (76.7)	\$ (80.6)	\$ (80.2)	\$ 18.4	\$ (79.5)	\$ (27.1)
Gain (loss) on cash flow hedging relationships in ASC 815						
Interest rate contracts						
Gain (loss) reclassified from accumulated OCI into income	\$ (0.3)	\$ —	\$ (0.6)	\$ —	\$ (2.7)	\$ —
Variable-to-fixed cross-currency swaps						
Gain (loss) reclassified from AOCI	13.2	12.5	9.7	40.5	—	—
Currency contracts						
Gain (loss) reclassified from accumulated OCI into income	—	1.4	—	6.3	—	(2.9)
Amount excluded from effectiveness testing recognized in earnings based on amortization approach (included in above)	—	2.8	—	3.0	—	0.6

Net Investment Hedges Grace uses cross-currency swaps as derivative hedging instruments in certain net investment hedges of its non-U.S. subsidiaries. The gains and losses attributable to these net investment hedges, adjusted for the impact of excluded components, are recorded net of tax to “currency translation adjustments” within “accumulated other comprehensive income (loss)” to offset the change in the carrying value of the net investment being hedged. Recognition in earnings of amounts previously recorded to “currency translation adjustments” is limited to circumstances such as complete or substantially complete liquidation of the net investment in the hedged foreign operation. Changes in the fair value of the hedging instrument related to time value, which are excluded from the assessment of hedge effectiveness, are recorded directly to interest expense on a systematic basis. These gains were \$3.3 million and \$2.3 million for the years ended December 31, 2019 and 2018, respectively. At December 31, 2019, the notional amount of €170.0 million of Grace’s cross-currency swaps was designated as a hedging instrument of its net investment in its European subsidiaries.

Grace has also used foreign currency-denominated debt and deferred intercompany royalties as non-derivative hedging instruments in certain net investment hedges. At December 31, 2019, Grace’s deferred

Notes to Consolidated Financial Statements (Continued)

6. Fair Value Measurements and Risk (Continued)

intercompany royalties have been fully amortized and de-designated as a hedging instrument of its net investment in its European subsidiaries. In April 2018, in connection with the Credit Agreement, Grace de-designated and repaid its euro-denominated term loan principal that had been designated as a hedge of its net investment in its European subsidiaries.

The following table presents the amount of gains and losses on derivative and non-derivative instruments designated as net investment hedges recorded to “currency translation adjustments” within “accumulated other comprehensive income (loss)” for the years ended December 31, 2019, 2018, and 2017. There were no reclassifications of the effective portion of net investment hedges out of OCI and into earnings for the periods presented.

(In millions)	Year Ended December 31,		
	2019	2018	2017
Derivatives in ASC 815 net investment hedging relationships:			
Cross-currency swap	\$ 9.1	\$ 6.0	\$ (21.9)
Non-derivatives in ASC 815 net investment hedging relationships:			
Foreign currency denominated debt	\$ —	\$ (4.4)	\$ (11.2)
Foreign currency denominated deferred intercompany royalties	0.1	0.5	(6.5)
	<u>\$ 0.1</u>	<u>\$ (3.9)</u>	<u>\$ (17.7)</u>

Credit Risk Grace is exposed to credit risk in its trade accounts receivable. Grace’s credit evaluation policies mitigate credit risk exposures, and it has a history of minimal credit losses. Grace does not generally require collateral for its trade accounts receivable, but may require a bank letter of credit in certain instances, particularly when selling to customers in cash-restricted countries.

Grace may also be exposed to credit risk in its derivatives contracts. Grace monitors counterparty credit risk and currently does not anticipate nonperformance by counterparties to its derivatives. Grace’s derivative contracts are with internationally recognized commercial financial institutions.

7. Income Taxes

Provision for Income Taxes The components of income from continuing operations before income taxes and the related provision for income taxes for 2019, 2018, and 2017 are as follows:

(In millions)	2019	2018	2017
Income from continuing operations before income taxes:			
Domestic	\$ 79.2	\$ 82.2	\$ 28.3
Foreign	104.3	162.7	182.6
Total	<u>\$ 183.5</u>	<u>\$ 244.9</u>	<u>\$ 210.9</u>
Benefit from (provision for) income taxes:			
Federal—current	\$ (6.3)	\$ (4.9)	\$ —
Federal—deferred	(19.8)	(29.3)	(144.6)
State and local—current	(0.5)	1.6	0.2
State and local—deferred	(5.8)	(3.5)	(1.7)
Foreign—current	(42.4)	(49.9)	(50.8)
Foreign—deferred	18.0	7.9	(3.6)
Total	<u>\$ (56.8)</u>	<u>\$ (78.1)</u>	<u>\$ (200.5)</u>

Notes to Consolidated Financial Statements (Continued)

7. Income Taxes (Continued)

The difference between the benefit from (provision for) income taxes on continuing operations at the U.S. federal income tax rate of 21% and Grace's overall income tax provision is summarized as follows:

(In millions)	2019	2018	2017
Tax provision at U.S. federal income tax rate	\$ (38.5)	\$ (51.4)	\$ (73.8)
Change in benefit (provision) resulting from:			
U.S. taxes on foreign earnings	(16.7)	(30.9)	(1.2)
Decrease (increase) in valuation allowance	(4.2)	(6.3)	(0.3)
Research and development credit	3.4	9.4	5.1
State and local income taxes, net	(3.4)	(1.9)	(1.8)
Provision to return adjustments	3.0	(0.7)	6.4
Effect of tax rate differential in foreign jurisdictions	(2.9)	(11.3)	13.3
Nontaxable income/non-deductible expenses	(2.5)	(1.6)	(2.6)
Unrecognized tax benefit (accruals) releases	2.3	5.7	—
Compensation-related adjustments	(1.7)	(3.4)	2.7
Benefits (charges) related to U.S. tax reform	—	17.1	(143.0)
Other	4.4	(2.8)	(5.3)
Benefit from (provision for) income taxes	\$ (56.8)	\$ (78.1)	\$ (200.5)

The TCJA was signed into law on December 22, 2017. In 2017 Grace estimated its provision for income taxes in accordance with the TCJA and guidance available at the time and as a result recorded a provisional income tax expense of \$143.0 million in the 2017 fourth quarter. The provisional amount related to the remeasurement of certain deferred tax assets and liabilities, based on the rates at which they are expected to reverse in the future, was \$120.1 million.

The provisional amounts related to the one-time transition tax on the mandatory deemed repatriation of foreign earnings and the state and foreign taxes on the unremitted earnings were \$37.4 million and \$4.9 million, respectively. Effective December 31, 2017, Grace is no longer indefinitely reinvested with respect to its historical unremitted earnings of its foreign subsidiaries. In the fourth quarter of 2018 Grace finalized the provisional amounts recorded in the fourth quarter of 2017, which resulted in reductions of \$9.5 million and \$2.7 million in the one-time transition tax of foreign earnings and the state and foreign taxes on the unremitted earnings, respectively. The net reduction of the transition tax was due primarily to additional review of historical tax attributes of Grace's foreign subsidiaries and changes in estimate based on guidance issued during the year.

The provision for income taxes in 2019 was lower than in 2018 primarily due to a decrease in taxable income in foreign jurisdictions where the statutory tax rates are higher than the statutory rates of the U.S., and a deduction against the GILTI inclusion under Internal Revenue Code ("IRC") Section 250 that was not available in 2018 due to U.S. federal net operating loss ("NOL") carryforwards.

Notes to Consolidated Financial Statements (Continued)

7. Income Taxes (Continued)

Deferred Tax Assets and Liabilities As of December 31, 2019 and 2018, the tax attributes giving rise to deferred tax assets and liabilities consisted of the following items.

(In millions)	December 31,	
	2019	2018
Deferred tax assets:		
Tax credit carryforwards	\$ 294.7	\$ 291.0
Pension liabilities	107.7	82.7
Net operating loss carryforwards	60.3	102.9
Environmental remediation liabilities	47.0	29.3
Research and development	26.6	24.6
Reserves and allowances	14.8	22.8
Unrealized currency gains and losses	12.1	12.8
Operating lease liabilities	8.1	—
Prepaid royalties	6.3	3.0
Compensation-related	5.4	6.5
Other	6.9	6.5
Total deferred tax assets	\$ 589.9	\$ 582.1
Deferred tax liabilities:		
Intangible assets	\$ (27.7)	\$ (24.9)
Properties and equipment	(18.6)	(13.2)
Operating lease assets	(8.0)	—
Other	(1.4)	(5.6)
Total deferred tax liabilities	\$ (55.7)	\$ (43.7)
Valuation allowances	(24.1)	(19.9)
Net deferred tax assets	\$ 510.1	\$ 518.5

Grace reduces the carrying amounts of deferred tax assets by a valuation allowance if, based on the available evidence, it is more likely than not that such assets will not be realized (see Note 1). The valuation allowance increased by \$4.2 million from December 31, 2018, to December 31, 2019, mostly due to a \$3.5 million increase to the valuation allowance for state deferred taxes, and a \$5.8 million increase related to foreign net deferred taxes, offset by \$4.9 million related to the write-off of expired U.S. federal foreign tax credits and the corresponding valuation allowance.

Tax Attributes—Tax Credit and Net Operating Loss Carryforwards Grace has \$302.5 million in federal tax credit carryforwards before unrecognized tax benefits. In order to fully utilize the credits before they expire (from 2021 to 2039), Grace would need to generate income of approximately \$1.4 billion.

Grace has state net operating loss carryforwards of \$51.2 million and state tax credits of \$1.9 million before valuation allowances and unrecognized tax benefits. In order to fully utilize the state tax attributes before they expire (from 2020 to 2036), Grace would need to generate approximately \$2.5 billion in state taxable income.

Notes to Consolidated Financial Statements (Continued)

7. Income Taxes (Continued)

The following table presents Grace's net operating loss carryforwards and the related valuation allowances.

(In millions)	December 31,	
	2019	2018
Net operating loss carryforwards		
U.S. state net operating losses	\$ 49.5	\$ 52.9
U.S. federal net operating losses	1.2	44.3
Foreign net operating losses	9.6	5.7
Net operating loss carryforwards	\$ 60.3	\$ 102.9
Net operating loss—valuation allowances		
U.S. state—NOL valuation allowances	\$ (10.1)	\$ (6.6)
Foreign—NOL valuation allowances	(8.0)	(4.2)
Net operating loss—valuation allowances	\$ (18.1)	\$ (10.8)

Unrecognized Tax Benefits The balance of unrecognized tax benefits at December 31, 2019, was \$15.4 million compared with \$14.1 million at December 31, 2018. A rollforward of the unrecognized tax benefits for the three years ended December 31, 2019, follows.

(In millions)	December 31,		
	2019	2018	2017
Balance at beginning of year	\$ 14.1	\$ 17.7	\$ 18.7
Increase (decrease) in positions taken in prior periods	2.6	1.2	(1.8)
Positions taken in the current period	2.9	0.9	0.8
Decrease due to settlements with tax authorities	(4.2)	(5.7)	—
Balance at end of year	\$ 15.4	\$ 14.1	\$ 17.7

If the balance of unrecognized tax benefits as of December 31, 2019, of \$15.4 million is ultimately recognized, it would reduce the effective tax rate. A portion of this balance relates to tax positions that impact Grace's deferred tax assets as of December 31, 2019. Grace accrues potential interest and any associated penalties related to unrecognized tax benefits in "benefit from (provision for) income taxes" in the Consolidated Statements of Operations. Grace accrued \$0.1 million of interest and penalties associated with these unrecognized tax benefits in 2019. Grace believes that the amount of the liability for unrecognized tax benefits will not change materially in the next 12 months.

Grace is subject to taxation in the U.S. and various states and foreign jurisdictions and is under continual audit by various tax authorities. As of December 31, 2019, tax years 2017 and 2018 are subject to examination by the U.S. tax authorities. In the significant non-U.S. jurisdiction, tax years 2014 and forward are subject to examination by the German tax authorities. Grace has tax attributes generated in prior years that are otherwise closed by statute and were carried forward into years that are open to examination. Those attributes may still be subject to adjustment to the extent utilized in open years.

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans

Pension Plans The following table presents the funded status of Grace's pension plans:

(In millions)	December 31,	
	2019	2018
Overfunded defined benefit pension plans	\$ 8.5	\$ 5.7
Underfunded defined benefit pension plans	(85.2)	(67.1)
Unfunded defined benefit pension plans	(434.6)	(366.0)
Total underfunded and unfunded defined benefit pension plans	(519.8)	(433.1)
Pension liabilities included in other current liabilities	(14.8)	(14.7)
Net funded status	\$ (526.1)	\$ (442.1)

Fully-funded plans include several advance-funded plans where the fair value of the plan assets exceeds the projected benefit obligation ("PBO"). Underfunded plans include a group of advance-funded plans that are underfunded on a PBO basis. Unfunded plans include several plans that are funded on a pay-as-you-go basis, and therefore, the entire PBO is unfunded.

Grace maintains defined benefit pension plans covering current and former employees of certain business units and divested business units who meet age and service requirements. Benefits are generally based on final average salary and years of service. Grace funds its U.S. qualified pension plans ("U.S. qualified pension plans") in accordance with U.S. federal laws and regulations. Non-U.S. pension plans ("non-U.S. pension plans") are funded under a variety of methods, as required under local laws and customs. The U.S. salaried plan was closed to new entrants after January 1, 2017.

Grace also provides, through nonqualified plans, supplemental pension benefits in excess of U.S. qualified pension plan limits imposed by federal tax law. These plans cover officers and higher-level employees and serve to increase the combined pension amount to the level that they otherwise would have received under the U.S. qualified pension plans in the absence of such limits. The nonqualified plans are unfunded and Grace pays the costs of benefits as they are due to the participants.

During 2018, Grace implemented a special lump sum and early commencement window for certain terminated vested participants who terminated employment prior to May 1, 2018, and had not previously commenced their pension benefits. As a result of the transaction, the U.S. qualified pension plans paid \$42.2 million in lump sum distributions that reduced the PBO by \$43.5 million and resulted in a \$1.3 million gain.

Additionally, in the 2018 fourth quarter, Grace entered into an agreement with Prudential Financial, Inc. ("Prudential Financial") to purchase a group annuity contract for \$116.4 million that transferred \$117.4 million of our U.S. pension plan obligations to Prudential Financial. Prudential Financial assumed responsibility to pay monthly annuities to certain retirees and beneficiaries that were receiving a monthly benefit from certain U.S. pension plans. Grace recognized a \$1.0 million gain on the settlement.

At the December 31, 2019, measurement date for Grace's defined benefit pension plans, the PBO was \$1,507.0 million as measured under U.S. GAAP compared with \$1,332.7 million as of December 31, 2018. The PBO reflects the present value (using a 3.13% weighted average discount rate for U.S. plans and a 1.41% weighted average discount rate for non-U.S. plans as of December 31, 2019) of vested and non-vested benefits earned from employee service to date, based upon current services and estimated future pay increases for active employees.

On an annual basis a full remeasurement of pension assets and pension liabilities is performed based on Grace's estimates and actuarial valuations. These valuations reflect the terms of each pension plan and use participant-specific information as well as certain key assumptions provided by management.

Defined Contribution Retirement Plans Grace sponsors a defined contribution retirement plan for its employees in the United States. This plan is qualified under section 401(k) of the U.S. tax code. Currently, Grace contributes an amount equal to 100% of employee contributions, up to 6% of an individual employee's salary or

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

wages. Grace's cost related to this benefit plan was \$13.9 million, \$12.6 million, and \$11.5 million for the years ended December 31, 2019, 2018, and 2017, respectively.

U.S. salaried employees and certain U.S. hourly employees hired on or after January 1, 2017, and employees in Germany hired on or after January 1, 2016, participate in enhanced defined contribution plans instead of defined benefit pension plans. For the U.S. plan, Grace contributes 4% of an individual employee's salary or wages. For the German plan, contributions vary based on the individual employee's contributions and other factors. Grace's cost related to these enhanced defined contribution plans established in the United States and Germany was \$3.7 million, \$1.9 million, and \$0.8 million for the years ended December 31, 2019, 2018, and 2017, respectively.

Analysis of Plan Accounting and Funded Status The following table summarizes the changes in benefit obligations and fair values of retirement plan assets during 2019 and 2018:

(In millions)	Defined Benefit Pension Plans					
	U.S.		Non-U.S.		Total	
	2019	2018	2019	2018	2019	2018
Change in Projected Benefit Obligation:						
Benefit obligation at beginning of year	\$1,027.1	\$1,325.6	\$ 305.6	\$ 323.1	\$1,332.7	\$1,648.7
Service cost	15.7	19.2	8.6	9.5	24.3	28.7
Interest cost	38.3	40.9	5.4	5.0	43.7	45.9
Settlements	—	(160.9)	—	—	—	(160.9)
Acquisitions	—	—	—	0.6	—	0.6
Actuarial (gain) loss—change in rates	144.1	(90.0)	58.2	(23.2)	202.3	(113.2)
Actuarial (gain) loss—other changes	(10.7)	(12.6)	4.1	11.3	(6.6)	(1.3)
Benefits paid	(76.7)	(95.1)	(8.4)	(8.4)	(85.1)	(103.5)
Currency exchange translation adjustments	—	—	(4.3)	(12.3)	(4.3)	(12.3)
Benefit obligation at end of year	<u>\$1,137.8</u>	<u>\$1,027.1</u>	<u>\$ 369.2</u>	<u>\$ 305.6</u>	<u>\$1,507.0</u>	<u>\$1,332.7</u>
Change in Plan Assets:						
Fair value of plan assets at beginning of year	\$ 871.1	\$1,109.8	\$ 19.5	\$ 21.5	\$ 890.6	\$1,131.3
Actual return on plan assets	154.6	(41.9)	4.1	(1.7)	158.7	(43.6)
Employer contributions	6.7	56.9	9.1	9.6	15.8	66.5
Settlements	—	(158.6)	—	—	—	(158.6)
Benefits paid	(76.7)	(95.1)	(8.4)	(8.4)	(85.1)	(103.5)
Currency exchange translation adjustments	—	—	0.9	(1.5)	0.9	(1.5)
Fair value of plan assets at end of year	<u>\$ 955.7</u>	<u>\$ 871.1</u>	<u>\$ 25.2</u>	<u>\$ 19.5</u>	<u>\$ 980.9</u>	<u>\$ 890.6</u>
Funded status at end of year (PBO basis)	<u>\$ (182.1)</u>	<u>\$ (156.0)</u>	<u>\$ (344.0)</u>	<u>\$ (286.1)</u>	<u>\$ (526.1)</u>	<u>\$ (442.1)</u>
Amounts recognized in the Consolidated Balance Sheets consist of:						
Noncurrent assets	\$ 8.5	\$ 5.7	\$ —	\$ —	\$ 8.5	\$ 5.7
Current liabilities	(7.3)	(7.0)	(7.5)	(7.7)	(14.8)	(14.7)
Noncurrent liabilities	(183.3)	(154.7)	(336.5)	(278.4)	(519.8)	(433.1)
Net amount recognized	<u>\$ (182.1)</u>	<u>\$ (156.0)</u>	<u>\$ (344.0)</u>	<u>\$ (286.1)</u>	<u>\$ (526.1)</u>	<u>\$ (442.1)</u>
Amounts recognized in Accumulated Other Comprehensive (Income) Loss consist of:						
Prior service credit	\$ (2.6)	\$ (3.2)	\$ (0.1)	\$ (0.1)	\$ (2.7)	\$ (3.3)
Net amount recognized	<u>\$ (2.6)</u>	<u>\$ (3.2)</u>	<u>\$ (0.1)</u>	<u>\$ (0.1)</u>	<u>\$ (2.7)</u>	<u>\$ (3.3)</u>

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

	Defined Benefit Pension Plans			
	U.S.		Non-U.S.	
	2019	2018	2019	2018
Weighted Average Assumptions Used to Determine Benefit Obligations as of December 31:				
Discount rate	3.13%	4.22%	1.41%	2.17%
Rate of compensation increase	4.50%	4.10%	2.59%	2.59%
Weighted Average Assumptions Used to Determine Net Periodic Benefit Cost for Years Ended December 31:				
Discount rate for determining service cost	4.46%	3.77%	2.42%	1.99%
Discount rate for determining interest cost	3.86%	3.20%	1.84%	1.57%
Expected return on plan assets	5.75%	5.25%	4.43%	4.69%
Rate of compensation increase	4.10%	4.10%	2.59%	2.64%

The following table presents the components of net periodic benefit cost (income) and other amounts recognized in “other comprehensive (income) loss.”

(In millions)	2019		2018		2017	
	U.S.	Non-U.S.	U.S.	Non-U.S.	U.S.	Non-U.S.
Net Periodic Benefit Cost (Income)						
Service cost	\$ 15.7	\$ 8.6	\$ 19.2	\$ 9.5	\$ 17.1	\$ 8.4
Interest cost	38.3	5.4	40.9	5.0	42.0	4.4
Expected return on plan assets	(48.2)	(0.9)	(57.2)	(1.0)	(57.5)	(0.9)
Amortization of prior service cost (credit)	(0.6)	—	(0.6)	—	(0.4)	—
Annual mark-to-market adjustment (gain) loss	26.8	59.1	(3.4)	(9.2)	36.0	13.2
Net curtailment and settlement gain	—	—	(2.3)	—	—	—
Net periodic benefit cost (income)	<u>\$ 32.0</u>	<u>\$ 72.2</u>	<u>\$ (3.4)</u>	<u>\$ 4.3</u>	<u>\$ 37.2</u>	<u>\$ 25.1</u>
Other Changes in Plan Assets and Benefit Obligations Recognized in OCI						
Amortization of prior service cost (credit)	\$ 0.6	\$ —	\$ 0.6	\$ —	\$ 0.4	\$ —
Total recognized in OCI	<u>0.6</u>	<u>—</u>	<u>0.6</u>	<u>—</u>	<u>0.4</u>	<u>—</u>
Total recognized in net periodic benefit cost (income) and OCI	<u>\$ 32.6</u>	<u>\$ 72.2</u>	<u>\$ (2.8)</u>	<u>\$ 4.3</u>	<u>\$ 37.6</u>	<u>\$ 25.1</u>

The estimated prior service credit for the defined benefit pension plans that will be amortized from “accumulated other comprehensive (income) loss” into net periodic benefit cost (income) over the next fiscal year is \$0.6 million.

The tables below present the funded status of U.S. and non-U.S. pension plans.

Funded Status of U.S. Pension Plans (In millions)	Fully-Funded U.S. Qualified Pension Plans(1)		Underfunded U.S. Qualified Pension Plans(1)		Unfunded Pay-As-You-Go U.S. Nonqualified Plans(2)	
	2019	2018	2019	2018	2019	2018
Projected benefit obligation	\$ 35.6	\$ 32.4	\$ 993.8	\$ 897.6	\$ 108.3	\$ 97.1
Fair value of plan assets	44.1	38.1	911.5	833.0	—	—
Funded status (PBO basis)	<u>\$ 8.5</u>	<u>\$ 5.7</u>	<u>\$ (82.3)</u>	<u>\$ (64.6)</u>	<u>\$ (108.3)</u>	<u>\$ (97.1)</u>

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

Funded Status of Non-U.S. Pension Plans (In millions)	Underfunded Non-U.S. Pension Plans(1)		Unfunded Pay-As-You-Go Non-U.S. Pension Plans(2)	
	2019	2018	2019	2018
Projected benefit obligation	\$ 29.0	\$ 22.7	\$ 340.2	\$ 282.9
Fair value of plan assets	25.2	19.5	—	—
Funded status (PBO basis)	\$ (3.8)	\$ (3.2)	\$ (340.2)	\$ (282.9)

(1) Plans intended to be advance-funded.

(2) Plans intended to be pay-as-you-go. The U.S. unfunded plan is a Supplemental Executive Retirement Plan, and the non-U.S. plans primarily relate to an unfunded German pension plan.

The accumulated benefit obligation for all defined benefit pension plans was approximately \$1,423 million and \$1,263 million as of December 31, 2019 and 2018, respectively.

The following table presents the funded status of defined benefit pension plans that are underfunded or unfunded on an accumulated benefit obligation basis.

(In millions)	U.S.		Non-U.S.		Total	
	2019	2018	2019	2018	2019	2018
Projected benefit obligation	\$ 1,102.1	\$ 994.8	\$ 342.1	\$ 284.5	\$ 1,444.2	\$ 1,279.3
Accumulated benefit obligation	1,058.6	960.1	306.7	253.2	1,365.3	1,213.3
Fair value of plan assets	911.6	833.0	0.8	0.7	912.4	833.7

Estimated Expected Future Benefit Payments Including Future Service for the Fiscal Years Ending (In millions)	Pension Plans		Total Payments
	U.S.	Non-U.S.(1)	
	Benefit Payments	Benefit Payments	
2020	\$ 82.4	\$ 8.3	\$ 90.7
2021	77.5	8.4	85.9
2022	76.5	8.7	85.2
2023	75.6	9.0	84.6
2024	74.8	9.3	84.1
2025 - 2029	352.0	53.4	405.4

(1) Non-U.S. estimated benefit payments for 2020 and future periods have been translated at the applicable December 31, 2019, exchange rates.

Discount Rate Assumption The assumed discount rate for pension plans reflects the market rates for high-quality corporate bonds currently available and is subject to change based on changes in overall market interest rates. For the U.S. qualified pension plans, the assumed weighted average discount rate of 3.13% as of December 31, 2019, was selected by Grace, in consultation with its independent actuaries, based on a yield curve constructed from a portfolio of high quality bonds for which the timing and amount of cash outflows approximate the estimated payouts of the plan.

As of December 31, 2019 and 2018, the German pension plans represented approximately 91% and 92%, respectively, of the benefit obligation of the non-U.S. pension plans. The assumed weighted average discount rate as of December 31, 2019, for Germany (1.25%) was selected by Grace, in consultation with its independent actuaries, based on a yield curve constructed from a portfolio of euro-denominated high quality bonds for which the timing and amount of cash outflows approximate the estimated payouts of the plans. The assumed discount rates for the remaining non-U.S. pension plans were determined based on the nature of the liabilities, local economic environments and available bond indices.

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

Investment Guidelines for Advance-Funded Pension Plans The investment goal for the U.S. qualified pension plans subject to advance funding is to earn a long-term rate of return consistent with the related cash flow profile of the underlying benefit obligation. The plans are pursuing a well-defined risk management strategy designed to reduce investment risks as their funded status improves.

The U.S. qualified pension plans have adopted a diversified set of portfolio management strategies to optimize the risk reward profile of the plans:

- Liability hedging portfolio: primarily invested in intermediate-term and long-term investment grade corporate bonds in actively managed strategies.
- Return-seeking portfolio: invested in a diversified set of assets designed to deliver performance in excess of the underlying liabilities with controls regarding the level of risk.
 - Global public equities: the portfolio contains both domestic U.S. and non-U.S. equities that are both passively and actively managed. Benchmarks for individual managers include S&P 500 and Russell 2000 benchmarks as well as MSCI ACWI ex US index.
 - Other investments: may include (a) high yield bonds: fixed income portfolio of securities below investment grade including non-U.S. issuers. These portfolios combine income generation and capital appreciation opportunities globally.
- Liquidity portfolio: invested in short-term assets intended to pay periodic plan benefits and expenses.

For 2019, the expected long-term rate of return on assets for the U.S. qualified pension plans was 5.75%. Average annual returns over one-, three-, five-, and ten-year periods were approximately 19%, 8%, 6%, and 8%, respectively.

The expected return on plan assets for the U.S. qualified pension plans for 2019 was selected by Grace, in consultation with its independent actuaries, using an expected return model. The model determines the weighted average return for an investment portfolio based on the target asset allocation and expected future returns for each asset class, which were developed using a building block approach based on observable inflation, available interest rate information, current market characteristics, and historical results.

The target allocation of investment assets at December 31, 2019, and the actual allocation at December 31, 2019 and 2018, for Grace's U.S. qualified pension plans are as follows:

U.S. Qualified Pension Plans Asset Category	Target Allocation	Percentage of Plan Assets December 31,	
	2019	2019	2018(1)
Global equities	22%	22%	14%
Multi-asset credit	3%	3%	2%
Liability-hedging assets	75%	75%	84%
Total	100%	100%	100%

- (1) In light of the two settlement transactions that occurred in 2018, the risk management strategy of the U.S. qualified pension plans was updated in 2019 to increase the return-seeking allocation, add diversification through rebalancing to global equity weights, increase the duration of the liability-hedging portfolio, and reduce interest rate sensitivity through adding long duration credit.

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

The following tables present the fair value hierarchy for the U.S. qualified pension plan assets measured at fair value as of December 31, 2019 and 2018.

Fair Value Measurements at December 31, 2019, Using				
(In millions)	Total	Quoted Prices in Active Markets for Identical Assets or Liabilities (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Common/collective trust funds	\$ 8.0	\$ —	\$ 8.0	\$ —
Annuity and immediate participation contracts	20.5	—	20.5	—
	\$ 28.5	\$ —	\$ 28.5	\$ —
Investments measured at net asset value(1)	927.2			
Total Assets at Fair Value	\$ 955.7			

- (1) In accordance with ASC 820-10, certain investments that are measured at net asset value (“NAV”) per share (or its equivalent) have not been classified in the fair value hierarchy. NAV is provided by the investment account manager as a practical expedient to estimate fair value. Fair values presented in the table are intended to permit reconciliation of the fair value hierarchy to the amounts presented in the Consolidated Balance Sheets.

Fair Value Measurements at December 31, 2018, Using				
(In millions)	Total	Quoted Prices in Active Markets for Identical Assets or Liabilities (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Common/collective trust funds	\$ 10.5	\$ —	\$ 10.5	\$ —
Annuity and immediate participation contracts	19.8	—	19.8	—
	\$ 30.3	\$ —	\$ 30.3	\$ —
Investments measured at net asset value(1)	840.8			
Total Assets at Fair Value	\$ 871.1			

- (1) In accordance with ASC 820-10, certain investments that are measured at NAV per share (or its equivalent) have not been classified in the fair value hierarchy. NAV is provided by the investment account manager as a practical expedient to estimate fair value. Fair values presented in the table are intended to permit reconciliation of the fair value hierarchy to the amounts presented in the Consolidated Balance Sheets.

Non-U.S. pension plans accounted for approximately 3% and 2% of total global pension assets at December 31, 2019 and 2018, respectively. Each of these plans, where applicable, follows local requirements and regulations. Some of the local requirements include the establishment of a local pension committee, a formal statement of investment policy and procedures, and routine valuations by plan actuaries.

The target allocation of investment assets for non-U.S. pension plans varies depending on the investment goals of the individual plans. The plan assets of the Canadian pension plan represent approximately 96% of the total non-U.S. pension plan assets at December 31, 2019 and 2018. The expected long-term rate of return on assets for the Canadian pension plan was 4.5% for 2019.

The target allocation of investment assets at December 31, 2019, and the actual allocation at December 31, 2019 and 2018, for the Canadian pension plan are as follows:

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

Canadian Pension Plan Asset Category	Target Allocation	Percentage of Plan Assets December 31,	
	2019	2019	2018
Equity securities	23%	25%	28%
Bonds	65%	62%	58%
Other investments	12%	13%	14%
Total	100%	100%	100%

The plan assets of the other country plans represent approximately 4% in the aggregate of total non-U.S. pension plan assets at December 31, 2019 and 2018.

The following tables present the fair value hierarchy for the non-U.S. pension plan assets measured at fair value as of December 31, 2019 and 2018.

Fair Value Measurements at December 31, 2019, Using				
(In millions)	Total	Quoted Prices in Active Markets for Identical Assets or Liabilities (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Corporate bonds	\$ 0.4	\$ —	\$ 0.4	\$ —
Insurance contracts and other investments	0.5	—	0.5	—
Cash	0.1	0.1	—	—
	\$ 1.0	\$ 0.1	\$ 0.9	\$ —
Investments measured at net asset value(1)	24.2			
Total Assets at Fair Value	\$ 25.2			

- (1) In accordance with ASC 820-10, certain investments that are measured at NAV per share (or its equivalent) have not been classified in the fair value hierarchy. NAV is provided by the investment account manager as a practical expedient to estimate fair value. Fair values presented in the table are intended to permit reconciliation of the fair value hierarchy to the amounts presented in the Consolidated Balance Sheets.

Fair Value Measurements at December 31, 2018, Using				
(In millions)	Total	Quoted Prices in Active Markets for Identical Assets or Liabilities (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Corporate bonds	\$ 0.4	\$ —	\$ 0.4	\$ —
Insurance contracts and other investments	0.4	—	0.4	—
Cash	0.1	0.1	—	—
	\$ 0.9	\$ 0.1	\$ 0.8	\$ —
Investments measured at net asset value(1)	18.6			
Total Assets at Fair Value	\$ 19.5			

- (1) In accordance with ASC 820-10, certain investments that are measured at NAV per share (or its equivalent) have not been classified in the fair value hierarchy. NAV is provided by the investment account manager as a practical expedient to estimate fair value. Fair values presented in the table are intended to permit reconciliation of the fair value hierarchy to the amounts presented in the Consolidated Balance Sheets.

Notes to Consolidated Financial Statements (Continued)

8. Pension Plans and Other Retirement Plans (Continued)

Plan Contributions and Funding Grace intends to satisfy its funding obligations under the U.S. qualified pension plans and to comply with all of the requirements of the Employee Retirement Income Security Act of 1974 (“ERISA”). For ERISA purposes, funded status is calculated on a different basis than under U.S. GAAP. Based on the U.S. qualified pension plans’ status as of December 31, 2019, there is a \$0.5 million minimum required payment under ERISA for 2020.

Grace intends to fund non-U.S. pension plans based on applicable legal requirements and actuarial and trustee recommendations. Grace expects to make contributions of approximately \$9 million related to its non-U.S. pension plans in 2020.

9. Other Balance Sheet Accounts

(In millions)	December 31,	
	2019	2018
Other Current Assets		
Plant under construction—unconsolidated affiliate (see Note 19)	\$ 173.9	\$ —
Non-trade accounts receivable	24.1	37.9
Fair value of currency, interest rate, and commodity contracts (see Note 6)	15.6	21.4
Income taxes receivable (see Note 7)	4.2	10.1
Other current assets	17.3	17.3
	<u>\$ 235.1</u>	<u>\$ 86.7</u>

(In millions)	December 31,	
	2019	2018
Other Current Liabilities		
Liability to unconsolidated affiliate for plant under construction (see Note 19)	\$ 173.9	\$ —
Accrued compensation	53.6	62.4
Deferred revenue (see Note 17)	35.0	40.6
Environmental contingencies (see Note 10)	17.8	19.5
Pension liabilities (see Note 8)	14.8	14.7
Accrued interest (see Note 5)	13.3	13.3
Operating lease liabilities (see Note 3)	9.3	—
Income taxes payable (see Note 7)	8.6	11.3
Liability for dam spillway replacement (see Note 10)	4.7	—
Other accrued liabilities	88.7	81.7
	<u>\$ 419.7</u>	<u>\$ 243.5</u>

Accrued compensation includes salaries and wages as well as estimated current amounts due under the annual and long-term incentive programs.

Notes to Consolidated Financial Statements (Continued)

9. Other Balance Sheet Accounts (Continued)

(In millions)	December 31,	
	2019	2018
Other Liabilities		
Environmental contingencies (see Note 10)	\$ 97.5	\$ 106.9
Liability for dam spillway replacement (see Note 10)	61.7	—
Deferred revenue (see Note 17)	29.5	29.2
Operating lease liabilities (see Note 3)	26.2	—
Legacy product liability (see Note 10)	24.0	—
Fair value of currency and interest rate contracts (see Note 6)	13.2	32.6
Retained obligations of divested businesses	12.7	10.0
Asset retirement obligation	9.4	8.8
Deferred income taxes (see Note 7)	7.5	10.9
Unrecognized tax benefits (see Note 7)	4.1	—
Liability to unconsolidated affiliate for plant under construction (see Note 19)	—	98.8
Other noncurrent liabilities	22.4	22.6
	\$ 308.2	\$ 319.8

10. Commitments and Contingent Liabilities

Legacy Matters

Over the years, Grace operated numerous types of businesses that are no longer part of its ongoing operations. As Grace divested or otherwise ceased operating these businesses, it retained certain liabilities and obligations, which Grace refers to as legacy liabilities. These liabilities include product, environmental, and other liabilities. Although the outcome of each of the matters discussed below cannot be predicted with certainty, Grace has assessed its risk and has recorded estimated liabilities as required under U.S. GAAP.

Legacy Product Liabilities Grace emerged from an asbestos-related Chapter 11 bankruptcy on February 3, 2014 (the “Effective Date”). Under its plan of reorganization, all pending and future asbestos-related claims are channeled for resolution to either a personal injury trust (the “PI Trust”) or a property damage trust (the “PD Trust”). The trusts are the sole recourse for holders of asbestos-related claims. The channeling injunctions issued by the bankruptcy court prohibit holders of asbestos-related claims from asserting such claims directly against Grace.

Grace has satisfied all of its financial obligations to the PI Trust. Grace has contingent financial obligations remaining to the PD Trust. With respect to property damage claims related to Grace’s former Zonolite attic insulation product (“ZAI PD Claims”), the PD Trust was funded with \$49.4 million (net of \$15 million of attorneys’ fees) to pay claims and expenses. Grace is also obligated to make up to 10 contingent deferred payments of \$8 million per year to the PD Trust during the 20-year period beginning on the fifth anniversary of the Effective Date, with each such payment due only if the assets of the PD Trust in respect of ZAI PD Claims fall below \$10 million during the preceding year. As of December 31, 2019, the PD Trust has paid out approximately \$29 million in ZAI PD Claims and expenses, leaving a balance of approximately \$23 million, including the benefit of realized investment gains.

Due to the limited claims history, the unique nature of this product, and the uncertainty of future claims patterns, an actuarial analysis was completed to estimate the range of possible future payments. The analysis was conducted by a third-party actuarial firm directed by Grace and using historical claims data provided by the ZAI trustee. Certain key assumptions employed in the analysis were (1) projections of the future number of filed claims, assuming a percentage increase in claims during earlier years and annual decreases in later years; (2) application of historical percentages of claims closed with indemnity payment compared to total closed claims, applied on a regional basis; and (3) application of the average claim payout, which reflects the average indemnity

Notes to Consolidated Financial Statements (Continued)

10. Commitments and Contingent Liabilities (Continued)

cost per claim closing with payment. As a result of the analysis and taking into account the relative uncertainty of future claims activity, Grace determined that contingent funding obligations beyond the next five years are not reasonably estimable. Grace estimates that the reasonable range of payments over the next five years is expected to be between \$16 million and \$24 million and projects that the first payment could be due in 2022. In the 2019 fourth quarter, Grace recorded a reserve in the amount of \$24.0 million related to probable future obligations to fund the PD Trust for ZAI PD Claims. Grace's maximum financial obligation over the next 19 years is \$80.0 million, and no single year's obligation can exceed \$8.0 million.

With respect to other asbestos property damage claims ("Other PD Claims"), claims unresolved as of the Effective Date are to be litigated in the bankruptcy court and any future claims are to be litigated in a federal district court, in each case pursuant to procedures approved by the bankruptcy court. To the extent any such Other PD Claims are determined to be allowed claims, they are to be paid in cash by the PD Trust. Grace is obligated to make a payment to the PD Trust every six months in the amount of any Other PD Claims allowed during the preceding six months plus interest (if applicable) and the amount of PD Trust expenses for the preceding six months (the "PD Obligation"). Grace has not paid any Other PD Claims since emergence. Annual expenses have been approximately \$0.2 million per year. The aggregate amount to be paid under the PD Obligation is not capped, and Grace may be obligated to make additional payments to the PD Trust in respect of the PD Obligation. Grace has accrued for those unresolved Other PD Claims that it believes are probable and estimable. Grace has not accrued for other unresolved or unasserted Other PD Claims as it does not believe that payment is probable.

All payments to the PD Trust required after the Effective Date are secured by the Company's obligation to issue 77,372,257 shares of Company common stock to the PD Trust in the event of default, subject to customary anti-dilution provisions.

This summary of the commitments and contingencies related to the Chapter 11 proceeding does not purport to be complete and is qualified in its entirety by reference to the plan of reorganization and the exhibits and documents related thereto, which have been filed with the SEC and are readily available on the internet at www.sec.gov.

Legacy Environmental Liabilities Grace is subject to loss contingencies resulting from extensive and evolving federal, state, local and foreign environmental laws and regulations relating to its manufacturing operations. Grace has procedures in place to minimize such contingencies; nevertheless, it has liabilities associated with past operations and additional claims may arise in the future, which may be material. To address its legacy liabilities, Grace accrues for anticipated costs of response efforts where an assessment has indicated that a probable liability has been incurred and the cost can be reasonably estimated. These accruals do not take into account any discounting for the time value of money.

Grace's environmental liabilities are reassessed regularly and adjusted when circumstances become better defined or response efforts and their costs can be better estimated, typically as a matter moves through the life-cycle of environmental investigation and remediation. These liabilities are evaluated based on currently available information relating to the nature and extent of contamination, risk assessments, feasibility of response actions, and apportionment amongst other potentially responsible parties, all evaluated in light of prior experience.

At December 31, 2019, Grace's estimated liability for legacy environmental response costs totaled \$115.3 million, compared with \$126.4 million at December 31, 2018, and was included in "other current liabilities" and "other liabilities" in the Consolidated Balance Sheets. These amounts are based on agreements in place or on Grace's estimate of costs where no formal remediation plan exists, yet there is sufficient information to estimate response costs.

Grace recorded pre-tax charges of \$1.7 million, \$73.8 million, and \$24.4 million for legacy environmental matters in 2019, 2018, and 2017, respectively, which is included in "costs related to legacy matters" in the Consolidated Statements of Operations.

Notes to Consolidated Financial Statements (Continued)

10. Commitments and Contingent Liabilities (Continued)

Vermiculite-Related Matters

Grace purchased a vermiculite mine in Libby, Montana, in 1963 and operated it until 1990. Vermiculite concentrate from the Libby mine was used in the manufacture of attic insulation and other products. Some of the vermiculite ore contained naturally occurring asbestos.

Grace is engaged with the U.S. Environmental Protection Agency (the "EPA") and other federal, state and local governmental agencies in a remedial investigation and feasibility study ("RI/FS") of the Libby mine and the surrounding area, known as Operable Unit 3 ("OU3"). The RI/FS will determine the specific areas within OU3 requiring remediation and will identify possible remedial action alternatives. Possible remedial actions within OU3 are wide-ranging, from institutional controls such as land use restrictions, to more active measures involving soil removal, containment projects, or other protective measures.

As part of the RI/FS process, Grace contracted an engineering and consulting firm to develop a range of possible remedial alternatives and associated cost estimates for OU3. Based on this work, Grace recorded a pre-tax charge of \$70.0 million in the 2018 third quarter for the estimated costs of remediation of OU3. Grace believes that this amount should provide for a protective remedy meeting the statutory requirements of the Comprehensive Environmental Response, Compensation, and Liability Act.

The estimated costs of remediation are preliminary and consist of several components, each of which may vary significantly as the remedial alternatives are further developed. It is reasonably possible that the ultimate costs of remediation could range between \$30 million and \$170 million. Grace is working closely with the EPA, and the ultimate remedy will be determined by the EPA after the RI/FS is finalized. Such remedy will be set forth in a Record of Decision ("ROD") that is currently expected to be issued by the EPA no earlier than 2021. Costs associated with the more active remedial alternatives would be expected to be incurred over a decade or more. Grace will reevaluate its estimated liability as remedial alternatives evolve based on further work by the engineering and consulting firm and discussions with the EPA as the RI/FS process moves toward a ROD. Technical memoranda expected prior to the issuance of the ROD may provide insight into the likely remedial alternatives ultimately selected, allowing Grace to update its cost of remediation estimate. Depending on the remedial alternatives that the EPA selects in the ROD, the total cost of remediating OU3 may exceed Grace's current estimate by material amounts.

Grace has cooperated with the EPA in investigating and remediating a number of formerly owned or operated sites that processed Libby vermiculite into finished products. Grace has recorded a liability for remaining expected EPA response and oversight costs, and for potential future site remediation, where a review has indicated that liability is probable and the cost is estimable. The EPA may commence additional investigations in the future at other sites that processed Libby vermiculite. Liability for unaccrued additional investigation and remediation costs is probable but not yet estimable, and could be material.

Grace recorded pre-tax charges of \$0.0 million, \$70.2 million, and \$9.5 million in 2019, 2018, and 2017, respectively, for future costs related to vermiculite-related matters. Grace's estimated liability for response costs that are currently estimable for OU3 and vermiculite processing sites outside of Libby at December 31, 2019 and 2018, totaled \$76.0 million and \$81.7 million, respectively. It is possible that Grace's ultimate liability for these vermiculite-related matters will exceed current estimates by material amounts.

Non-Vermiculite-Related Environmental Matters

Grace recorded pre-tax charges of \$1.7 million, \$3.6 million, and \$14.9 million (including \$7.2 million for ten years of operation and maintenance expenses following remediation at a former manufacturing site) to increase non-vermiculite-related environmental reserves in 2019, 2018, and 2017, respectively. At December 31, 2019, Grace's estimated legacy environmental liability for response costs at sites not related to its former vermiculite mining and processing activities totaled \$39.3 million, compared with \$44.7 million at December 31, 2018. This liability relates to Grace's former businesses or operations, including its share of liability at off-site disposal facilities. Grace's estimated liability is based upon regulatory requirements and environmental conditions at each site. As Grace receives new information, its estimated liability may change materially.

Notes to Consolidated Financial Statements (Continued)

10. Commitments and Contingent Liabilities (Continued)

Other Legacy Liabilities On April 3, 2019, the Montana Department of Natural Resources and Conservation issued a five-year operating permit for a dam at the Libby mine site. Grace constructed the dam in 1971 to prevent vermiculite ore tailings from moving into nearby creeks and rivers. The permit requires Grace to complete construction of a new spillway before the permit is further renewed in five years. Grace contracted a third-party engineering and consulting firm to develop a range of cost estimates for the project. Based on this work, Grace recorded pre-tax charges of \$68.0 million in 2019 for the estimated costs of the project. These costs are preliminary and may vary significantly as the project progresses. Based on the consultants' estimates, Grace believes it is reasonably possible that the ultimate costs of this project could range between \$50 million and \$100 million. Construction of the new spillway is expected to take three to four years.

Commercial and Financial Commitments and Contingencies

Purchase Commitments Grace uses purchase commitments to ensure supply and to minimize the volatility of major components of direct manufacturing costs including natural gas, certain metals, rare earths, and other materials. Such commitments are for quantities that Grace fully expects to use in its normal operations.

Guarantees and Indemnification Obligations Grace is a party to many contracts containing guarantees and indemnification obligations. These contracts primarily consist of:

- Product warranties with respect to certain products sold to customers in the ordinary course of business. These warranties typically provide that products will conform to specifications. Grace accrues a warranty liability on a transaction-specific basis depending on the individual facts and circumstances related to each sale.
- Performance guarantees offered to customers under certain licensing arrangements and with respect to certain products sold to customers in the ordinary course of business. Grace accrues a performance guarantee liability on a transaction-specific basis depending on the individual facts and circumstances related to each sale. Grace has not established a liability for performance guarantees offered under licensing arrangements based on past performance.
- Licenses of intellectual property by Grace to third parties in which Grace has agreed to indemnify the licensee against third party infringement claims.
- Contracts providing for the sale or spin-off of a former business unit or product line in which Grace has agreed to indemnify the buyer or resulting entity against certain liabilities related to activities prior to the closing of the transaction, including environmental, tax, and employee liabilities.
- Guarantees of real property lease obligations of third parties, typically arising out of (a) leases entered into by former subsidiaries of Grace, or (b) the assignment or sublease of a lease by Grace to a third party.

Financial Assurances Financial assurances have been established for a variety of purposes, including insurance and environmental matters, trade-related commitments and other matters. At December 31, 2019, Grace had gross financial assurances issued and outstanding of \$145.0 million, composed of \$68.7 million of surety bonds issued by various insurance companies and \$76.3 million of standby letters of credit and other financial assurances issued by various banks.

11. Restructuring Expenses and Repositioning Expenses

Restructuring Expenses Restructuring costs in 2019 primarily related to severance costs pertaining to the idling of our methanol-to-olefins ("MTO") manufacturing facility in China, which were substantially paid in 2019. Costs in 2018 primarily related to the closure of two small manufacturing plants, the activities from which were moved to larger, more cost-effective plants as part of Grace's strategy to capture synergies from catalysts acquisitions. Costs in 2017 primarily related to workforce reduction programs in Grace's manufacturing, supply chain, finance and IT functions. These costs are included in "restructuring and repositioning expenses" in the Consolidated Statements of Operations, and are not included in segment operating income.

Notes to Consolidated Financial Statements (Continued)

11. Restructuring Expenses and Repositioning Expenses (Continued)

The following table presents restructuring expenses by reportable segment for the years ended December 31, 2019, 2018, and 2017.

(In millions)	Year Ended December 31,		
	2019	2018	2017
Catalysts Technologies	\$ 1.6	\$ 13.7	\$ 3.7
Materials Technologies	1.0	0.5	(0.1)
Corporate	—	(0.2)	7.9
Total restructuring expenses	\$ 2.6	\$ 14.0	\$ 11.5

Substantially all costs related to the restructuring programs are expected to be paid by December 31, 2021, but could be paid earlier subject to negotiations around certain plant exit costs.

The following table presents components of the change in the restructuring liability for the years ended December 31, 2019, 2018, and 2017:

(In millions)	Total
Balance, December 31, 2016	\$ 9.6
Accruals for severance and other costs	11.4
Payments	(14.4)
Currency translation adjustments and other	0.1
Balance, December 31, 2017	\$ 6.7
Accruals for severance and other costs	10.1
Payments	(6.1)
Balance, December 31, 2018	\$ 10.7
Accruals for severance and other costs	2.6
Payments	(10.2)
Currency translation adjustments and other	0.7
Balance, December 31, 2019	\$ 3.8

Repositioning Expenses Repositioning expenses for the years ended December 31, 2019, 2018, and 2017 were \$11.1 million, \$32.4 million, and \$15.2 million respectively.

Expenses incurred in 2019, 2018, and 2017 relate to a multi-year program to transform manufacturing and business processes to extend Grace's competitive advantages and improve its cost position. Expenses in 2018 also included \$11.7 million of severance and stock compensation costs related to employee separations, and write-offs of \$8.5 million of previously capitalized plant engineering costs as a result of terminating a manufacturing plant expansion project no longer necessary due to the polyolefin catalysts acquisition (see Note 20). Expenses in 2017 also included costs related to the Separation. Excluding asset write-offs and stock compensation costs, substantially all of these costs have been or are expected to be settled in cash.

Notes to Consolidated Financial Statements (Continued)

12. Other (Income) Expense, net

Components of other (income) expense, net are as follows:

(In millions)	Year Ended December 31,		
	2019	2018	2017
Defined benefit pension (income) expense other than service cost	\$ 79.9	\$ (27.8)	\$ 38.6
Business interruption insurance recoveries	(10.7)	—	(26.6)
Net (gain) loss on sales of investments and disposals of assets	4.5	4.9	1.6
Third-party acquisition-related costs	3.6	7.3	2.9
Currency transaction effects	(0.8)	(3.6)	3.8
Loss on early extinguishment of debt	—	4.8	—
Accounts receivable reserve—Venezuela	—	—	10.0
Other miscellaneous expense (income)	4.1	(4.0)	(3.2)
Total other (income) expense, net	\$ 80.6	\$ (18.4)	\$ 27.1

In June 2019, a North American FCC catalysts customer filed for bankruptcy protection and announced it would not resume refinery operations following a fire in its refinery. Grace received \$8.0 million in payments from its third-party insurer in 2019 under its business interruption insurance policy for lost profits. The policy has a \$25 million limit per event.

In January 2017, a Catalysts Technologies customer experienced a fire resulting in an extended outage. Grace received \$25.0 million in payments from its third-party insurer in 2017 under its business interruption insurance policy for lost profits. The policy had a \$25 million limit per event.

During the 2017 third quarter, Grace recorded a \$10.0 million charge to fully reserve for a trade receivable from a Venezuela-based customer related to increased economic uncertainty and the recent political unrest and sanctions.

See Note 5 for more information related to Grace's early extinguishment of debt in 2018.

13. Other Comprehensive Income (Loss)

The following tables present the pre-tax, tax, and after-tax components of Grace's other comprehensive income (loss) for the years ended December 31, 2019, 2018, and 2017:

Year Ended December 31, 2019 (In millions)	Pre-Tax Amount	Tax Benefit/ (Expense)	After-Tax Amount
Amortization of net prior service credit included in net periodic benefit cost and other costs (credits), net	\$ (0.9)	\$ 0.2	\$ (0.7)
Currency translation adjustments	18.5	(2.0)	16.5
Gain (loss) from hedging activities	(7.0)	2.1	(4.9)
Other comprehensive income (loss) attributable to W. R. Grace & Co. shareholders	\$ 10.6	\$ 0.3	\$ 10.9
 Year Ended December 31, 2018 (In millions)	 Pre-Tax Amount	 Tax Benefit/ (Expense)	 After-Tax Amount
Amortization of net prior service credit included in net periodic benefit cost and other costs (credits), net	\$ (1.2)	\$ 0.3	\$ (0.9)
Currency translation adjustments	34.6	(2.2)	32.4
Gain (loss) from hedging activities	(10.0)	4.3	(5.7)
Other comprehensive income (loss) attributable to W. R. Grace & Co. shareholders	\$ 23.4	\$ 2.4	\$ 25.8

Notes to Consolidated Financial Statements (Continued)

13. Other Comprehensive Income (Loss) (Continued)

Year Ended December 31, 2017 (In millions)	Pre-Tax Amount	Tax Benefit/ (Expense)	After-Tax Amount
Amortization of net prior service credit included in net periodic benefit cost and other costs (credits), net	\$ (2.0)	\$ 0.7	\$ (1.3)
Currency translation adjustments	(23.1)	(2.9)	(26.0)
Gain (loss) from hedging activities	2.9	(2.1)	0.8
Other comprehensive income (loss) attributable to W. R. Grace & Co. shareholders	\$ (22.2)	\$ (4.3)	\$ (26.5)

The following table presents the changes in accumulated other comprehensive income (loss), net of tax, for the years ended December 31, 2019, 2018, and 2017:

	Defined Benefit Pension and Other Postretirement Plans	Currency Translation Adjustments	Gain (Loss) from Hedging Activities	Total
Balance, December 31, 2016	\$ 2.2	\$ 67.6	\$ (3.4)	\$ 66.4
OCI before reclassifications	(0.1)	(26.0)	(2.7)	(28.8)
Amounts reclassified from accumulated OCI	(1.2)	—	3.5	2.3
Net current-period other comprehensive income (loss)	(1.3)	(26.0)	0.8	(26.5)
Balance, December 31, 2017	\$ 0.9	\$ 41.6	\$ (2.6)	\$ 39.9
OCI before reclassifications	—	32.4	11.1	43.5
Amounts reclassified from accumulated OCI	(0.9)	—	(16.8)	(17.7)
Net current-period other comprehensive income (loss)	(0.9)	32.4	(5.7)	25.8
Effect of adopting ASU 2018-02	0.2	2.2	(0.2)	2.2
Balance, December 31, 2018	\$ 0.2	\$ 76.2	\$ (8.5)	\$ 67.9
OCI before reclassifications	—	16.5	14.0	30.5
Amounts reclassified from accumulated OCI	(0.7)	—	(18.9)	(19.6)
Net current-period other comprehensive income (loss)	(0.7)	16.5	(4.9)	10.9
Balance, December 31, 2019	\$ (0.5)	\$ 92.7	\$ (13.4)	\$ 78.8

Grace is a global enterprise operating in many countries with local currency generally deemed to be the functional currency for accounting purposes. The currency translation amount represents the adjustments necessary to translate the balance sheets valued in local currencies to the U.S. dollar as of the end of each period presented, and to translate revenues and expenses at average exchange rates for each period presented.

See Note 6 for a discussion of hedging activities. See Note 8 for a discussion of pension plans.

14. Shareholders' Equity

Under its Amended and Restated Certificate of Incorporation, the Company is authorized to issue 300,000,000 shares of common stock, \$0.01 par value per share. As of December 31, 2019, the W. R. Grace & Co. 2018 Stock Incentive Plan (together with the 2014 Stock Incentive Plan, collectively, the "Stock Incentive Plans") had 6,595,567 shares of unissued stock reserved for issuance in the event of the exercise of stock options or the issuance or settlement of stock-based compensation or awards. Shares issuable upon the exercise of stock options or the issuance or settlement of stock-based compensation or awards are covered by reissuing treasury stock, to the extent available; otherwise they are covered through newly issued shares. In 2019, 13,788 common shares were issued to members of the Board of Directors, in partial payment of their annual retainer; 820 shares were issued through net share settlement; and 80,188 shares were issued to settle vested PBUs and vested tranches of RSUs.

Notes to Consolidated Financial Statements (Continued)

14. Shareholders' Equity (Continued)

The following table sets forth information relating to common stock activity for the years ended December 31, 2019, 2018, and 2017:

(In millions, except shares)	Number of Shares	Aggregate Proceeds
Balance of outstanding shares, December 31, 2016	68,309,431	
Stock options exercised	386,300	\$ 16.4
Shares issued	49,897	
Shares forfeited through net share exercise	(29,783)	
Shares repurchased	(935,435)	
Balance of outstanding shares, December 31, 2017	67,780,410	
Stock options exercised	243,502	\$ 6.7
Shares issued	72,590	
Shares forfeited through net share exercise	(132,393)	
Shares repurchased	(1,171,141)	
Balance of outstanding shares, December 31, 2018	66,792,968	
Stock options exercised	388,174	\$ 19.1
Shares issued	94,796	
Shares forfeited through net share exercise	(130,256)	
Shares repurchased	(409,769)	
Balance of outstanding shares, December 31, 2019	66,735,913	

15. Stock Incentive Plans

The Stock Incentive Plans are administered by the Compensation Committee of the Board of Directors. Pursuant to the Stock Incentive Plans, the Company maintains Long-term Incentive Plans (the "LTIP") under which it issues RSUs, PBUs, and stock options.

The Company has granted nonstatutory stock options to certain key employees under the Stock Incentive Plans. Stock options are generally non-qualified and are at exercise prices not less than 100% of the average per share fair market value on the date of grant. Stock-based compensation awards granted under the Company's stock incentive plans are generally subject to a vesting period from the date of the grant ranging from 1 - 3 years. Currently outstanding options expire on various dates through July 2029.

On May 9, 2018, the Company's stockholders approved the W. R. Grace & Co. 2018 Stock Incentive Plan. Under this new plan, stock options have a 10-year life. The Company began issuing stock-based compensation awards from this plan in the second half of 2018. The Company's prior grants were issued under the previous plan in which options have a 5-year life.

Notes to Consolidated Financial Statements (Continued)

15. Stock Incentive Plans (Continued)

The following table sets forth information relating to such options during 2019, 2018, and 2017.

	Number of Shares	Average Exercise Price	Weighted- Average Grant Date Fair Value
Balance, December 31, 2016	1,940,785	\$ 66.83	
Options exercised	(386,300)	45.21	
Options forfeited	(34,545)	72.97	
Options terminated	(23,320)	75.60	
Options granted	316,830	71.37	\$ 13.00
Balance, December 31, 2017	1,813,450	72.04	
Options exercised	(243,502)	61.92	
Options forfeited	(90,862)	69.82	
Options terminated	(33,481)	75.07	
Options granted	428,190	67.36	\$ 12.30
Balance, December 31, 2018	1,873,795	72.34	
Options exercised	(388,174)	74.33	
Options forfeited	(35,216)	71.21	
Options terminated	(74,583)	77.30	
Options granted	189,787	78.11	\$ 17.94
Balance, December 31, 2019	1,565,609	72.30	

The following is a summary of nonvested option activity for the year ended December 31, 2019.

	Number Of Shares	Weighted- Average Grant Date Fair Value
Nonvested options outstanding at beginning of year	664,363	\$ 12.88
Granted	189,787	17.94
Vested	(237,758)	16.98
Forfeited	(109,799)	19.25
Nonvested options outstanding at end of year	506,593	14.81

As of December 31, 2019, the intrinsic value (the difference between the exercise price and the market price) for options outstanding was \$1.2 million and for options exercisable was \$0.7 million. The total intrinsic value of all options exercised during the years ended December 31, 2019, 2018, and 2017 was \$0.8 million, \$1.6 million and \$10.3 million, respectively. A summary of our stock options outstanding and exercisable at December 31, 2019, follows:

Exercise Price Range	Number Outstanding	Number Exercisable	Outstanding Weighted- Average Remaining Contractual Life (Years)	Exercisable Weighted- Average Exercise Price
\$60 - \$70	668,479	428,259	2.23	67.98
\$70 - \$80	897,130	630,757	2.66	75.59
	<u>1,565,609</u>	<u>1,059,016</u>		

Notes to Consolidated Financial Statements (Continued)

15. Stock Incentive Plans (Continued)

At December 31, 2019, the weighted-average remaining contractual term of all options outstanding and exercisable was 2.48 years.

Options Granted For the years ended December 31, 2019, 2018, and 2017, the Company recognized non-cash stock-based compensation expense with respect to stock option grants of \$3.1 million, \$5.8 million, and \$4.3 million, respectively, which is included in “selling, general and administrative expenses” in the Consolidated Statements of Operations. The actual tax benefit realized from stock options exercised totaled \$1.9 million, \$2.2 million, and \$7.4 million for the years ended December 31, 2019, 2018, and 2017, respectively.

The Company values options using the Black-Scholes option-pricing model, which was developed for use in estimating the fair value of traded options. The risk-free rate is based on the U.S. Treasury yield curve published as of the grant date, with maturities approximating the expected term of the options. The expected term of the options is estimated using the simplified method as allowed by ASC 718-20, whereby the average between the vesting period and contractual term is used. For options granted prior to 2018, the expected volatility was estimated using both actual stock volatility and the volatility of an industry peer group. The Company believes its actual stock volatility was not representative of future volatility during the time it was in Chapter 11. For options granted in 2018 and 2019, Grace actual stock volatility was used. The following summarizes the weighted average assumptions used for estimating the fair value of stock options granted during 2019, 2018, and 2017, respectively.

	2019	2018	2017
Expected volatility	22.7% - 23.1%	22.9% - 24.4%	23.8% - 25.1%
Weighted average expected volatility	23.0%	23.7%	24.8%
Expected term	5.5 - 6.5 years	3.0 - 6.5 years	3.0 - 4.0 years
Risk-free rate	2.58%	2.55%	1.66%
Dividend yield	1.4%	1.4%	1.2%

Total unrecognized stock-based compensation expense at December 31, 2019, was \$2.0 million, and the weighted-average period over which this expense will be recognized is 0.8 of a year.

Restricted Stock and Performance Based Units In 2019, the Company modified a majority of its 2017 and 2018 cash-settled LTIP awards to be stock-settled. The following is a summary of RSUs and PBUs awarded under the LTIP.

	2019	2018	2017
PBUs granted under the LTIP	88,174	93,216	115,158
RSUs granted under the LTIP	57,900	86,698	57,600
Shares covered by awards forfeited under the LTIP	17,323	44,279	16,395
Weighted average grant date fair value of PBUs	\$78.11	\$67.39	\$71.37
Weighted average grant date fair value of RSUs	\$76.91	\$67.54	\$71.37
Approximate percentage of awards expected to settle in common stock(1)	96%	94%	93%
Approximate percentage of awards expected to settle in cash(1)	4%	6%	7%

(1) Assumes full vesting.

The PBUs cliff vest after the completion of the performance periods ending December 31, 2021, 2020, and 2019. The RSUs vest in three equal annual installments. Vesting for all awards is subject to continued employment through the payment date (subject to certain exceptions for retirement, death or disability, change in control scenarios, and in the discretion of the Compensation Committee).

PBUs and RSUs are recorded at fair value at the date of grant. The common stock settled portion is considered an equity award with the payout being valued based on the Company's stock price on the grant date.

Notes to Consolidated Financial Statements (Continued)

15. Stock Incentive Plans (Continued)

The cash settled portion of the award is considered a liability award with payout being remeasured each reporting period based on the Company's current stock price. PBU equity and cash awards are remeasured each reporting period based on the expected payout of the award, which may range from 0% to 200% of the targets for such awards; therefore, these portions of the awards are subject to volatility until the payout is finally determined at the end of the performance period. During 2019, 2018, and 2017, the Company recognized \$9.2 million, \$13.2 million, and \$10.3 million in compensation expense for these awards. As of December 31, 2019, \$10.4 million of total unrecognized compensation expense related to the awards is expected to be recognized over the remaining weighted-average service period of 1.4 years.

16. Earnings Per Share

The following table shows a reconciliation of the numerators and denominators used in calculating basic and diluted earnings per share.

(In millions, except per share amounts)	2019	2018	2017
Numerators			
Net income (loss) attributable to W. R. Grace & Co. shareholders	\$ 126.3	\$ 167.6	\$ 11.2
Denominators			
Weighted average common shares—basic calculation	66.8	67.2	68.1
Dilutive effect of employee stock options	0.1	0.1	0.1
Weighted average common shares—diluted calculation	66.9	67.3	68.2
Basic earnings per share	\$ 1.89	\$ 2.49	\$ 0.16
Diluted earnings per share	\$ 1.89	\$ 2.49	\$ 0.16

There were approximately 1.0 million, 1.7 million and 1.5 million anti-dilutive options outstanding for the years ended December 31, 2019, 2018, and 2017, respectively.

On February 5, 2015, the Company announced that its Board of Directors had authorized a share repurchase program of up to \$500 million, which it completed on July 10, 2017. On February 8, 2017, the Company announced that its Board of Directors had authorized an additional share repurchase program of up to \$250 million. The timing of the repurchases and the actual amount repurchased will depend on a variety of factors, including the market price of the Company's shares, strategic priorities for the deployment of capital, and general market and economic conditions. During 2019, 2018, and 2017, the Company repurchased 409,769; 1,171,141; and 935,435 shares of Company common stock for \$29.8 million, \$80.0 million, and \$65.0 million, respectively, pursuant to the terms of the share repurchase programs. As of December 31, 2019, \$109.1 million remained under the current authorization.

17. Revenues

Grace generates revenues from customer arrangements primarily by manufacturing and delivering specialty chemicals, specialty materials, and the licensing of technology through its two reportable segments. See Note 18 for additional information about Grace's reportable segments.

Notes to Consolidated Financial Statements (Continued)

17. Revenues (Continued)

Disaggregation of Revenue The following tables present Grace's revenues by geography and product group, within its respective reportable segments, for the years ended December 31, 2019, 2018, and 2017.

Year Ended December 31, 2019 (In millions)	North America	Europe Middle East Africa (EMEA)	Asia Pacific	Latin America	Total
Refining Catalysts	\$ 291.4	\$ 288.4	\$ 171.7	\$ 39.9	\$ 791.4
Polyolefin and Chemical Catalysts	191.4	283.0	213.7	17.2	705.3
Total Catalysts Technologies	\$ 482.8	\$ 571.4	\$ 385.4	\$ 57.1	\$ 1,496.7
Consumer/Pharma	\$ 45.2	\$ 59.1	\$ 20.1	\$ 20.2	\$ 144.6
Coatings	25.9	67.8	36.9	9.2	139.8
Chemical process	38.1	79.1	32.3	6.6	156.1
Other	5.8	14.2	0.7	0.2	20.9
Total Materials Technologies	\$ 115.0	\$ 220.2	\$ 90.0	\$ 36.2	\$ 461.4
Total Grace	\$ 597.8	\$ 791.6	\$ 475.4	\$ 93.3	\$ 1,958.1

Year Ended December 31, 2018 (In millions)	North America	EMEA	Asia Pacific	Latin America	Total
Refining Catalysts	\$ 282.8	\$ 266.0	\$ 193.4	\$ 59.8	\$ 802.0
Polyolefin and Chemical Catalysts	192.6	255.4	193.2	20.3	661.5
Total Catalysts Technologies	\$ 475.4	\$ 521.4	\$ 386.6	\$ 80.1	\$ 1,463.5
Consumer/Pharma	\$ 36.2	\$ 58.0	\$ 19.0	\$ 19.4	\$ 132.6
Coatings	28.1	75.3	43.3	8.7	155.4
Chemical process	35.2	81.6	32.2	8.3	157.3
Other	6.8	15.9	0.4	0.2	23.3
Total Materials Technologies	\$ 106.3	\$ 230.8	\$ 94.9	\$ 36.6	\$ 468.6
Total Grace	\$ 581.7	\$ 752.2	\$ 481.5	\$ 116.7	\$ 1,932.1

Year Ended December 31, 2017 (In millions)	North America	EMEA	Asia Pacific	Latin America	Total
Refining Catalysts	\$ 269.5	\$ 236.4	\$ 199.3	\$ 52.9	\$ 758.1
Polyolefin and Chemical Catalysts	117.4	218.1	166.4	16.5	518.4
Total Catalysts Technologies	\$ 386.9	\$ 454.5	\$ 365.7	\$ 69.4	\$ 1,276.5
Consumer/Pharma	\$ 38.2	\$ 48.3	\$ 17.8	\$ 19.0	\$ 123.3
Coatings	26.0	66.9	41.3	8.0	142.2
Chemical process	28.5	83.7	34.8	6.5	153.5
Other	6.4	14.3	0.2	0.1	21.0
Total Materials Technologies	\$ 99.1	\$ 213.2	\$ 94.1	\$ 33.6	\$ 440.0
Total Grace(1)	\$ 486.0	\$ 667.7	\$ 459.8	\$ 103.0	\$ 1,716.5

(1) Under the modified retrospective method, prior-period information has not been adjusted and continues to be reported in accordance with Grace's historical accounting under ASC 605.

Contract Balances Grace invoices customers for product sales once performance obligations have been satisfied, generally at the point of delivery, at which point payment becomes unconditional. Accordingly, Grace's product sales contracts generally do not give rise to material contract assets or liabilities under ASC 606; however, from time to time certain customers may pay in advance. In the technology licensing business, Grace

Notes to Consolidated Financial Statements (Continued)

17. Revenues (Continued)

invoices licensees based on milestones achieved but has obligations to provide services in future periods, which results in contract liabilities.

The following table presents Grace's deferred revenue balances as of December 31, 2019 and 2018:

(In millions)	December 31,	
	2019	2018
Current	\$ 35.0	\$ 40.6
Noncurrent	29.5	29.2
Total	\$ 64.5	\$ 69.8

Grace records deferred revenues when cash payments are received or due in advance of performance. The change in deferred revenue reflects cash payments from customers received or due in advance of satisfying performance obligations, offset by \$27.1 million of revenue recognized that was included in the deferred revenue balance as of December 31, 2018.

The noncurrent portion of the deferred revenue will be recognized as performance obligations under the technology licensing agreements are satisfied, which is expected to be over the next 5 years.

Remaining performance obligations represent the estimated revenue expected to be recognized in the future related to performance obligations that are unsatisfied (or partially unsatisfied). The aggregate amount of the transaction price allocated to remaining performance obligations for such contracts with a duration of more than one year was approximately \$130 million as of December 31, 2019, and includes certain amounts reported as deferred revenue above. In accordance with the available practical expedient, Grace does not disclose information about remaining performance obligations that have original expected durations of one year or less, which generally relate to customer prepayments on product sales and are generally satisfied in less than one year. Grace expects to recognize revenue related to remaining performance obligations over several years, as follows:

Year	Approximate percentage of revenue related to remaining performance obligations recognized
2020	25%
2021	27%
2022	20%
2023	14%
Thereafter through 2027	14%
	100%

For the years ended December 31, 2019, 2018, and 2017, revenue recognized from performance obligations related to prior periods was not material. Grace has not capitalized any costs to obtain or fulfill contracts with customers under ASC 606. No material impairment losses have been recognized on any receivables or contract assets arising from contracts with customers.

18. Segment Information

Grace is a global producer of specialty chemicals and specialty materials. Grace's two reportable business segments are Grace Catalysts Technologies and Grace Materials Technologies. Grace Catalysts Technologies includes catalysts and related products and technologies used in petrochemical, refining, and other chemical manufacturing applications. Advanced Refining Technologies ("ART"), Grace's joint venture with Chevron Products Company, a division of Chevron U.S.A. Inc. ("Chevron"), is managed in this segment. (See Note 19.) Grace Catalysts Technologies comprises two operating segments, Grace Refining Technologies and Grace Specialty Catalysts, which are aggregated into one reportable segment based upon similar economic characteristics, the nature of the products and production processes, type and class of customer, and channels of

Notes to Consolidated Financial Statements (Continued)

18. Segment Information (Continued)

distribution. Grace Materials Technologies includes specialty materials, including silica-based and silica-alumina-based materials, used in consumer/pharma, coatings, and chemical process applications. The table below presents information related to Grace's reportable segments. Only those corporate expenses directly related to the reportable segments are allocated for reporting purposes. All remaining corporate items are reported separately and labeled as such.

Grace excludes defined benefit pension expense from the calculation of segment operating income. Grace believes that the exclusion of defined benefit pension expense provides a better indicator of its reportable segment performance as defined benefit pension expense is not managed at a reportable segment level.

Grace defines Adjusted EBIT to be net income attributable to W. R. Grace & Co. shareholders adjusted for interest income and expense; income taxes; costs related to legacy matters; restructuring and repositioning expenses and asset impairments; pension costs other than service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits; gains and losses on sales or exits of businesses, product lines, and certain other investments; third-party acquisition-related costs and the amortization of acquired inventory fair value adjustment; and certain other items that are not representative of underlying trends.

Reportable Segment Data

(In millions)	Year Ended December 31,		
	2019	2018	2017
Net Sales			
Catalysts Technologies	\$ 1,496.7	\$ 1,463.5	\$ 1,276.5
Materials Technologies	461.4	468.6	440.0
Total	\$ 1,958.1	\$ 1,932.1	\$ 1,716.5
Adjusted EBIT			
Catalysts Technologies segment operating income	\$ 466.5	\$ 440.5	\$ 395.4
Materials Technologies segment operating income	97.8	105.6	100.6
Corporate costs	(72.7)	(73.5)	(69.0)
Certain pension costs	(18.4)	(15.9)	(13.0)
Total	\$ 473.2	\$ 456.7	\$ 414.0
Depreciation and Amortization			
Catalysts Technologies	\$ 81.9	\$ 81.7	\$ 87.1
Materials Technologies	14.2	15.5	19.6
Corporate	4.2	3.6	4.8
Total	\$ 100.3	\$ 100.8	\$ 111.5
Capital Expenditures			
Catalysts Technologies	\$ 114.6	\$ 150.3	\$ 100.9
Materials Technologies	68.8	56.1	20.9
Corporate	10.7	9.9	3.4
Total	\$ 194.1	\$ 216.3	\$ 125.2
Total Assets			
Catalysts Technologies	\$ 2,556.1	\$ 2,326.6	\$ 1,757.1
Materials Technologies	430.3	375.9	326.8
Corporate	946.2	862.8	823.1
Total	\$ 3,932.6	\$ 3,565.3	\$ 2,907.0

Notes to Consolidated Financial Statements (Continued)

18. Segment Information (Continued)

Corporate costs include functional costs and other costs such as professional fees, incentive compensation, and insurance premiums. Certain pension costs include only ongoing costs recognized quarterly, which include service and interest costs, expected returns on plan assets, and amortization of prior service costs/credits.

See Note 17 for sales of similar products within each reportable segment.

Reconciliation of Reportable Segment Data to Financial Statements

Grace Adjusted EBIT for the years ended December 31, 2019, 2018, and 2017 is reconciled below to income (loss) before income taxes presented in the accompanying Consolidated Statements of Operations.

(In millions)	Year Ended December 31,		
	2019	2018	2017
Grace Adjusted EBIT	\$ 473.2	\$ 456.7	\$ 414.0
Costs related to legacy product, environmental and other claims	(103.5)	(82.3)	(33.1)
Pension MTM adjustment and other related costs, net	(85.9)	15.2	(51.1)
Restructuring and repositioning expenses	(13.7)	(46.4)	(26.7)
Benefit plan adjustment	(5.0)	—	—
Third-party acquisition-related costs	(3.6)	(7.3)	(2.9)
Write-off of MTO inventory	(3.6)	—	—
Amortization of acquired inventory fair value adjustment	—	(6.9)	—
Loss on early extinguishment of debt	—	(4.8)	—
Accounts receivable reserve—Venezuela	—	—	(10.0)
Interest expense, net	(74.8)	(78.5)	(78.5)
Net income (loss) attributable to noncontrolling interests	0.4	(0.8)	(0.8)
Income (loss) before income taxes	\$ 183.5	\$ 244.9	\$ 210.9

Notes to Consolidated Financial Statements (Continued)

18. Segment Information (Continued)

Geographic Area Data

The table below presents information related to the geographic areas in which Grace operates. Sales are attributed to geographic areas based on the location to which the product is transported.

(In millions)	Year Ended December 31,		
	2019	2018	2017
Net Sales			
United States	\$ 540.2	\$ 533.8	\$ 437.3
Canada	57.6	47.9	48.7
Total North America	597.8	581.7	486.0
Europe Middle East Africa	791.6	752.2	667.7
Asia Pacific	475.4	481.5	459.8
Latin America	93.3	116.7	103.0
Total	\$ 1,958.1	\$ 1,932.1	\$ 1,716.5
Long-Lived Assets(1)			
United States	\$ 937.9	\$ 793.0	\$ 599.8
Canada	18.9	16.5	15.5
Total North America	956.8	809.5	615.3
Germany	228.2	172.5	142.2
Rest of Europe Middle East Africa	45.2	48.9	45.3
Total Europe Middle East Africa	273.4	221.4	187.5
Asia Pacific	80.3	72.9	21.1
Latin America	7.2	6.7	7.9
Total	\$ 1,317.7	\$ 1,110.5	\$ 831.8

(1) Long-lived assets include properties and equipment and the current asset related to a hydroprocessing catalyst plant to be transferred to ART upon completion. (See Note 19.)

19. Related Party Transactions

Unconsolidated Affiliate Grace accounts for its 50% ownership interest in ART, its joint venture with Chevron, using the equity method of accounting. Grace's investment in ART amounted to \$181.9 million and \$156.1 million as of December 31, 2019 and 2018, respectively, and the amount included in "equity in earnings of unconsolidated affiliate" in the accompanying Consolidated Statements of Operations totaled \$27.8 million, \$31.8 million and \$25.9 million for the years ended December 31, 2019, 2018, and 2017, respectively. ART is a private, limited liability company, taxed as a partnership, and accordingly does not have a quoted market price available.

Notes to Consolidated Financial Statements (Continued)

19. Related Party Transactions (Continued)

The table below presents summary financial data related to ART's balance sheet and results of operations.

(In millions)	December 31,	
	2019	2018
Summary Balance Sheet information:		
Current assets	\$ 300.7	\$ 307.4
Noncurrent assets	237.8	160.2
Total assets	\$ 538.5	\$ 467.6
Current liabilities	\$ 177.1	\$ 158.3
Noncurrent liabilities	0.3	0.3
Total liabilities	\$ 177.4	\$ 158.6

(In millions)	Year Ended December 31,		
	2019	2018	2017
Summary Statement of Operations information:			
Net sales	\$ 527.5	\$ 487.5	\$ 447.3
Costs and expenses applicable to net sales	453.4	410.6	379.8
Income before income taxes	59.0	65.5	53.6
Net income	56.5	64.2	52.1

Grace and ART transact business on a regular basis and maintain several agreements in order to operate the joint venture. These agreements and the resulting transactions are treated as related party activities with an unconsolidated affiliate. Product manufactured by Grace for ART is accounted for on a net basis, with a mark-up, which reduces "cost of goods sold" in the Consolidated Statements of Operations. Grace also receives reimbursement from ART for fixed costs; research and development; selling, general and administrative services; and depreciation. Grace records reimbursements against the respective line items on Grace's Consolidated Statement of Operations. The table below presents summary financial data related to transactions between Grace and ART.

(In millions)	Year Ended December 31,		
	2019	2018	2017
Product manufactured for ART	\$ 260.8	\$ 229.1	\$ 213.8
Mark-up on product manufactured for ART included as a reduction of Grace's cost of goods sold	5.1	4.5	4.2
Charges for fixed costs; research and development; selling, general and administrative services; and depreciation to ART	51.1	41.8	41.7

Notes to Consolidated Financial Statements (Continued)

19. Related Party Transactions (Continued)

The table below presents balances in Grace's Consolidated Financial Statements related to ART.

(in millions)	December 31,	
	2019	2018
Accounts receivable	\$ 17.5	\$ 16.2
Current asset	173.9	—
Noncurrent asset	—	98.8
Accounts payable	37.7	32.0
Debt payable within one year	9.9	9.8
Debt payable after one year	37.5	38.3
Current liability	173.9	—
Noncurrent liability	—	98.8

The current asset and current liability (which were classified as noncurrent as of December 31, 2018) in the table above represent spending to date related to a residue hydroprocessing catalyst production plant that is under construction in Lake Charles, Louisiana. Grace manages the design and construction of the plant, and the asset will continue to be included in "other current assets" in Grace's Consolidated Balance Sheets until construction is completed. Grace has likewise recorded a liability for the transfer of the asset to ART upon completion, included in "other current liabilities" in the Consolidated Balance Sheets.

Grace and ART maintain an agreement whereby ART loans Grace funds for maintenance capital expenditures at manufacturing facilities used to produce catalysts for ART. Grace makes principal and interest payments on the loans on a monthly basis. These unsecured loans have repayment terms of up to 8 years, unless earlier repayment is demanded by ART. The loans bear interest at the three-month LIBOR plus 1.25%.

Grace and Chevron provide lines of credit in the amount of \$15.0 million each at a commitment fee of 0.1% of the credit amount. These agreements have been approved by the ART Executive Committee for renewal until February 2021. No amounts were outstanding at December 31, 2019 and 2018.

Joint Venture Arrangement In 2018, Grace formed a joint venture in a developing country in Asia. The purpose of the joint venture is to establish a logistics facility and catalyst testing laboratory and to be the exclusive FCC catalysts and additives supplier to certain customers in the country. Grace's joint venture partner is the parent company of the customers. Grace has an 87.5% ownership interest in the joint venture and consolidates the activities of the entity. Grace's Consolidated Balance Sheets as of December 31, 2019 and 2018, include trade accounts receivable of \$3.6 million and \$3.7 million, respectively, from these customers. Grace's Consolidated Statements of Operations for the years ended December 31, 2019 and 2018, include \$11.8 million and \$14.0 million, respectively, of revenues from these customers.

20. Acquisitions

Rive Technology, Inc. On June 17, 2019, Grace completed the acquisition of the business and assets of Rive Technology, Inc. for \$22.8 million. The business is included in the Refining Technologies operating segment of the Catalysts Technologies reportable segment. The acquisition included Rive's MOLECULAR HIGHWAY[®] zeolite technology for catalytic processes, which allows Grace to offer a broader spectrum of products for converting crude oil to petrochemical feedstocks.

Polyolefin catalysts business of Albemarle Corporation On April 3, 2018, using cash on hand and borrowings under the Credit Agreement, Grace acquired the assets of the polyolefin catalysts business of Albemarle Corporation. Grace acquired the business for \$418.0 million, net of cash acquired and including customary post-closing adjustments. The business is included in the Specialty Catalysts operating segment of the Catalysts Technologies reportable segment. The acquisition is complementary to Grace's existing specialty catalysts business and strengthens Grace's commercial relationships, catalysts technology portfolio, and manufacturing network.

Notes to Consolidated Financial Statements (Continued)

20. Acquisitions (Continued)

The acquisition purchase price has been allocated to the tangible and identifiable intangible assets and liabilities acquired based on their estimated fair values at the acquisition date in accordance with ASC 805 "Business Combinations." The excess of the purchase price over the fair value of the tangible and intangible assets acquired was recorded as goodwill. The purchase price allocation has been finalized, and during the measurement period, Grace recorded adjustments related to deferred taxes, working capital, and intangible assets. The goodwill recognized was \$140.6 million and is supported by the growth and operating synergies that Grace expects to realize from this acquisition. The full amount of goodwill generated will be deductible for U.S. income tax purposes.

The Consolidated Statements of Operations for the year ended December 31, 2018, includes approximately \$86 million of sales attributable to this acquisition. Disclosure of earnings attributable to this acquisition is not practicable due to the integration of operations into Grace's existing business.

The table below presents the finalized allocation of the acquisition purchase price.

	(In millions)
Accounts receivable	\$ 13.9
Inventories	28.6
Other current assets	0.7
Properties and equipment	119.8
Goodwill	140.6
Intangible assets	121.2
Other assets	0.5
Liabilities assumed	(7.3)
Net assets acquired, net of cash acquired	\$ 418.0

The table below presents the intangible assets acquired and the periods over which they will be amortized.

	Amount (In millions)	Weighted Average Amortization Period (in years)
Customer Lists	\$ 105.4	20.0
Technology	11.5	15.0
Trademarks	4.3	15.0
Total	\$ 121.2	19.3

Notes to Consolidated Financial Statements (Continued)

21. Quarterly Financial Information (Unaudited)

(In millions, except per share amounts)	March 31(2)	June 30	September 30	December 31(3)
2019				
Net sales	\$ 469.5	\$ 513.6	\$ 470.5	\$ 504.5
Gross profit	188.6	209.4	191.0	204.7
Net income (loss)	24.6	76.4	53.8	(28.1)
Net income (loss) attributable to W. R. Grace & Co. shareholders	24.7	76.2	53.7	(28.3)
Net income (loss) per share:(1)				
Basic earnings (loss) per share:	\$ 0.37	\$ 1.14	\$ 0.81	\$ (0.42)
Diluted earnings (loss) per share:	0.37	1.14	0.80	(0.42)
Dividends declared per share	0.27	0.27	0.27	0.27

- (1) Per share results for the four quarters may differ from full-year per share results, as a separate computation of the weighted average number of shares outstanding is made for each quarter presented.
- (2) First quarter "net income (loss)," "net income (loss) attributable to W. R. Grace & Co. shareholders," and the related earnings per share data include the effects of a pre-tax charge of \$45.0 million for the estimated costs to construct a new dam spillway at the former vermiculite mine site in Libby, Montana.
- (3) Fourth quarter "net income (loss)," "net income (loss) attributable to W. R. Grace & Co. shareholders," and the related earnings per share data include the effects of the annual pension mark-to-market adjustment, as well as charges related to legacy items (see Note 10).

(In millions, except per share amounts)	March 31	June 30	September 30(2)	December 31(3)
2018				
Net sales	\$ 431.5	\$ 485.7	\$ 494.9	\$ 520.0
Gross profit	169.5	198.7	202.2	196.3
Net income (loss)	43.4	38.6	15.9	68.9
Net income (loss) attributable to W. R. Grace & Co. shareholders	43.6	38.8	16.1	69.1
Net income (loss) per share:(1)				
Basic earnings (loss) per share:	\$ 0.64	\$ 0.58	\$ 0.24	\$ 1.03
Diluted earnings (loss) per share:	0.64	0.58	0.24	1.03
Dividends declared per share	0.24	0.24	0.24	0.24

- (1) Per share results for the four quarters may differ from full-year per share results, as a separate computation of the weighted average number of shares outstanding is made for each quarter presented.
- (2) Third quarter "net income (loss)," "net income (loss) attributable to W. R. Grace & Co. shareholders," and the related earnings per share data include the effects of a pre-tax charge of \$70.0 million for the estimated costs of future remediation-related activities at the former vermiculite mine site in Libby, Montana.
- (3) Fourth quarter "net income (loss)," "net income (loss) attributable to W. R. Grace & Co. shareholders," and the related earnings per share data include the effects of the annual pension mark-to-market adjustment.

W. R. GRACE & CO. AND SUBSIDIARIES
FINANCIAL STATEMENT SCHEDULE II—VALUATION AND QUALIFYING ACCOUNTS

For the Year Ended December 31, 2019

(In millions)	Balance at beginning of period	Additions charged to costs and expenses	Deductions	Other, net(1)	Balance at end of period
Valuation and qualifying accounts deducted from assets:					
Allowances for notes and accounts receivable	\$ 12.0	\$ 3.2	\$ (1.5)	\$ —	\$ 13.7
Valuation allowance for deferred tax assets(2)	19.9	9.2	(5.0)	—	24.1

For the Year Ended December 31, 2018

(In millions)	Balance at beginning of period	Additions charged to costs and expenses	Deductions	Other, net(1)	Balance at end of period
Valuation and qualifying accounts deducted from assets:					
Allowances for notes and accounts receivable	\$ 12.0	\$ —	\$ —	\$ —	\$ 12.0
Valuation allowance for deferred tax assets(3)	12.0	10.7	(2.8)	—	19.9

For the Year Ended December 31, 2017

(In millions)	Balance at beginning of period	Additions charged to costs and expenses	Deductions	Other, net(1)	Balance at end of period
Valuation and qualifying accounts deducted from assets:					
Allowances for notes and accounts receivable(4)	\$ 2.8	\$ 10.6	\$ (1.3)	\$ (0.1)	\$ 12.0
Valuation allowance for deferred tax assets(5)	31.4	0.3	(19.7)	—	12.0

(1) Effects of currency translation.

(2) The valuation allowance increased \$4.2 million from December 31, 2018, to December 31, 2019. The increase was primarily due to the projected taxable income in certain foreign jurisdictions.

(3) The valuation allowance increased \$7.9 million from December 31, 2017, to December 31, 2018. The increase was primarily due to changes in expected foreign tax credit utilization.

(4) The allowance for accounts receivable increased primarily due to a \$10.0 million charge to fully reserve for a trade receivable from a Venezuela-based customer related to increased economic uncertainty and the recent political unrest and sanctions.

(5) The valuation allowance decreased \$19.4 million from December 31, 2016, to December 31, 2017. The decrease was primarily due to the effects of U.S. tax reform.

Item 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE

None.

Item 9A. CONTROLS AND PROCEDURES

Except as provided below, the disclosure required by this Item appears in Item 8 under the headings “Management’s Report on Internal Control Over Financial Reporting” and “Report of Independent Registered Public Accounting Firm,” which disclosure is incorporated herein by reference.

There was no change in Grace’s internal control over financial reporting during the quarter ended December 31, 2019, that has materially affected, or is reasonably likely to materially affect, Grace’s internal control over financial reporting.

Item 9B. OTHER INFORMATION

None.

PART III

Item 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE

Incorporated by reference to the sections entitled “Proposal One: Election of Directors,” “—Nominees for Election as Directors,” “—Continuing Directors and the 40 North Designee,” and “—Corporate Governance;” “Questions and Answers About the Annual Meeting and the Voting Process—Question 29: Where can I find Grace corporate governance materials?;” and, if applicable, “Other Information—Delinquent Section 16(a) Reports,” of a definitive proxy statement that Grace will file with the SEC no later than 120 days after December 31, 2019 (the “2020 Proxy Statement”). Required information on executive officers of Grace appears at Part I after Item 4 of this report.

Item 11. EXECUTIVE COMPENSATION

Incorporated by reference to the sections entitled “Proposal One: Election of Directors—Corporate Governance,” and “—Director Compensation,” and “Executive Compensation” of the 2020 Proxy Statement.

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

Incorporated by reference to the sections entitled “Other Information—Stock Ownership of Certain Beneficial Owners and Management” and “—Equity Compensation Plan Information” of the 2020 Proxy Statement.

Item 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE

Incorporated by reference to the sections entitled “Proposal One: Election of Directors—Corporate Governance” and “Other Information—Related Party Transactions” of the 2020 Proxy Statement.

Item 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES

Incorporated by reference to the sections entitled “Proposal Two: Ratification of the Appointment of Independent Registered Public Accounting Firm—Principal Accountant Fees and Services” and “—Audit Committee Pre-Approval Policies and Procedures” of the 2020 Proxy Statement.

PART IV

Item 15. EXHIBITS, FINANCIAL STATEMENT SCHEDULES

Financial Statements and Schedules. The required information is set forth in Item 8, which is incorporated herein by reference.

Exhibits. The exhibits to this Report are listed below. Other than exhibits that are filed herewith, all exhibits listed below are incorporated by reference.

In reviewing the agreements included as exhibits to this and other Reports filed by Grace with the Securities and Exchange Commission, please remember they are included to provide you with information regarding their terms and are not intended to provide any other factual or disclosure information about Grace or other parties to the agreements. The agreements generally contain representations and warranties by each of the parties to the applicable agreement. These representations and warranties have been made solely for the benefit of the other parties to the applicable agreement. These representations and warranties:

- are not statements of fact, but rather are used to allocate risk to one of the parties if the statements prove to be inaccurate;
- may have been qualified by disclosures that were made to the other parties in connection with the negotiation of the applicable agreement, which disclosures are not necessarily reflected in the agreement;
- may apply standards of materiality in a way that is different from what may be viewed as material to you or other investors; and
- were made only as of the date of the applicable agreement or such other date or dates as may be specified in the agreement and do not reflect more recent developments.

Accordingly, these representations and warranties may not describe the actual state of affairs as of the date they were made or at any other time. Additional information about Grace may be found elsewhere in this report and Grace's other public filings, which are available without charge through the Securities and Exchange Commission's website at <http://www.sec.gov>.

Exhibit No.	Exhibit	Location
2.1	Joint Plan of Reorganization of W. R. Grace & Co. and its Debtor Subsidiaries.	Exhibit 2.01 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
2.2	Order Confirming Joint Plan of Reorganization.	Exhibit 2.02 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
2.3	Separation and Distribution Agreement, dated as of January 27, 2016, by and among W. R. Grace & Co., W. R. Grace & Co.-Conn. and GCP Applied Technologies Inc.	Exhibit 2.1 to Form 8-K (filed 1/28/16) SEC File No.: 001-13953
2.4	Amended and Restated Sale and Purchase Agreement, dated as of February 21, 2018, by and between Albemarle Corporation and W. R. Grace & Co.-Conn.	Exhibit 2.4 to Form 10-K (filed 2/22/18) SEC File No.: 001-13953
3.1	Amended and Restated Certificate of Incorporation.	Exhibit 3.01 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
3.2	Amended and Restated By-laws.	Exhibit 3.01 to Form 8-K (filed 1/23/15) SEC File No.: 001-13953
4.1	Credit Agreement, dated as of February 3, 2014, by and among W. R. Grace & Co., W. R. Grace & Co.-Conn., Grace GmbH & Co. KG, a Federal Republic of Germany limited partnership, each lender from time to time party thereto, and Goldman Sachs Bank USA, as Administrative Agent.	Exhibit 4.01 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953

Exhibit No.	Exhibit	Location
4.2	First Amendment and Consent to Credit Agreement and First Amendment to Security Agreement, dated as of November 25, 2015, by and among W. R. Grace & Co., W. R. Grace & Co.–Conn., Grace GmbH & Co. KG, Alltech Associates, Inc., each lender from time to time party thereto, and Goldman Sachs Bank USA, as Administrative Agent and lender.	Exhibit 10.1 to Form 8-K (filed 11/25/15) SEC File No.: 001-13953
4.3	Deferred Payment Agreement (PD), dated as of February 3, 2014, by and between W. R. Grace & Co.–Conn. and the WRG Asbestos PD Trust.	Exhibit 4.04 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
4.4	Guarantee Agreement (PD), dated as of February 3, 2014, by and between W. R. Grace & Co. and the WRG Asbestos PD Trust.	Exhibit 4.05 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
4.5	Deferred Payment Agreement (PD-ZAI), dated as of February 3, 2014, by and between W. R. Grace & Co.–Conn. and the WRG Asbestos PD Trust.	Exhibit 4.06 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
4.6	Guarantee Agreement (PD-ZAI), dated as of February 3, 2014, by and between W. R. Grace & Co. and the WRG Asbestos PD Trust.	Exhibit 4.07 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
4.7	Share Issuance Agreement, dated as of February 3, 2014, by and among W. R. Grace & Co., the WRG Asbestos PD Trust and the WRG Asbestos PI Trust.	Exhibit 4.08 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
4.8	Indenture, dated as of September 16, 2014, by and among W. R. Grace & Co.–Conn., the guarantors party there to and Wilmington Trust, National Association, as trustee.	Exhibit 4.1 to Form 8-K (filed 9/19/14) SEC File No.: 001-13953
4.9	First Supplemental Indenture, dated as of September 16, 2014, by and among W. R. Grace & Co.–Conn., the guarantors party thereto and Wilmington Trust, National Association, as trustee.	Exhibit 4.2 to Form 8-K (filed 9/19/14) SEC File No.: 001-13953
4.10	Form of 5.125% Note due 2021 (included as Exhibit A-1 to Exhibit 4.9).	Exhibit 4.3 (included as Exhibit A-1 to Exhibit 4.2) to Form 8-K (filed 9/19/14) SEC File No.: 001-13953
4.11	Form of 5.625% Note due 2024 (included as Exhibit A-2 to Exhibit 4.9).	Exhibit 4.4 (included as Exhibit A-2 to Exhibit 4.2) to Form 8-K (filed 9/19/14) SEC File No.: 001-13953
4.12	Credit Agreement, dated as of April 3, 2018, by and among W. R. Grace & Co., W. R. Grace & Co.–Conn., certain subsidiaries thereof, Goldman Sachs Bank USA, as Administrative Agent and Collateral Agent, and the other lenders from time to time party thereto.	Exhibit 4.1 to Form 8-K (filed 4/03/18) SEC File No.: 001-13953
4.13	Second Supplemental Indenture, dated as of April 3, 2018, by and among W. R. Grace & Co.–Conn., the guarantors party thereto and Wilmington Trust, National Association, as trustee.	Exhibit 4.2 to Form 10-Q (filed 5/09/18) SEC File No.: 001-13953
4.14	Description of W. R. Grace & Co. Securities.	Filed herewith.
10.1	WRG Asbestos Property Damage Settlement Trust Agreement, dated as of February 3, 2014, by and between W. R. Grace & Co., the Asbestos PD Future Claimants' Representative, the Official Committee of Asbestos Property Damage Claimants, the Asbestos PD Trustees, Wilmington Trust Company, and the members of the Zonolite Attic Insulation Trust Advisory Committee.	Exhibit 10.02 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953
10.2	W. R. Grace & Co. 2014 Stock Incentive Plan.	Exhibit 10.03 to Form 8-K (filed 2/07/14) SEC File No.: 001-13953*
10.3	Form of Performance-based Unit Agreement (2016).	Exhibit 10.2 to Form 8-K (filed 2/09/16) SEC File No.: 001-13953*
10.4	Form of Stock Option Award Agreement (2016).	Exhibit 10.1 to Form 8-K (filed 2/09/16) SEC File No.: 001-13953*
10.5	Form of Restricted Stock Award Agreement (2016).	Exhibit 10.3 to Form 8-K (filed 2/09/16) SEC File No.: 001-13953*
10.6	W. R. Grace & Co. Supplemental Executive Retirement Plan, as amended.	Exhibit 10.7 to Form 10-K (filed 3/28/02) SEC File No.: 001-13953*
10.7	W. R. Grace & Co. Executive Salary Protection Plan, as amended.	Exhibit 10.8 to Form 10-K (filed 3/28/02) SEC File No.: 001-13953*

Exhibit No.	Exhibit	Location
10.8	Form of Executive Change in Control Severance Agreement between Grace and certain officers.	Exhibit 10.17 to Form 10-K (filed 3/13/03) SEC File No.: 001-13953*
10.9	Severance Plan for Leadership Team Officers of W. R. Grace & Co.	Exhibit 10.2 to Form 8-K (filed 2/04/16) SEC File No.: 001-13953*
10.10	2015 Executive Annual Incentive Compensation Plan.	Exhibit 10.1 to Form 8-K (filed 5/12/15) SEC File No.: 001-13953*
10.11	Tax Sharing Agreement, dated as of January 27, 2016, by and among W. R. Grace & Co., W. R. Grace & Co.–Conn. and GCP Applied Technologies Inc.	Exhibit 10.1 to Form 8-K (filed 1/28/16) SEC File No.: 001-13953
10.12	Letter Agreement dated February 28, 2008, between Fred Festa, on behalf of Grace, and Hudson La Force III (includes indemnification provision).	Exhibit 10.1 to Form 8-K (filed 3/07/08) SEC File No.: 001-13953*
10.13	Letter Agreement dated November 13, 2013, between Fred Festa, on behalf of Grace, and Keith N. Cole (includes indemnification provision).	Exhibit 10.20 to Form 10-K (filed 2/25/15) SEC File No.: 001-13953*
10.14	Letter Agreement dated December 3, 2014, between Fred Festa, on behalf of Grace, and Elizabeth C. Brown (includes indemnification provision).	Exhibit 10.1 to Form 10-Q (filed 5/07/15) SEC File No.: 001-13953*
10.15	Restricted Stock Unit Award Agreement, dated February 22, 2018, between W. R. Grace & Co. and Fred Festa, in connection with transition to Non-executive Chairman.	Exhibit 10.1 to Form 10-Q (filed 5/09/18) SEC File No.: 001-13953*
10.16	Stock Option Award Agreement, dated February 22, 2018, between W. R. Grace & Co. and Fred Festa, in connection with transition to Non-Executive Chairman.	Exhibit 10.2 to Form 10-Q (filed 5/09/18) SEC File No.: 001-13953*
10.17	W. R. Grace & Co. 2018 Stock Incentive Plan.	Exhibit 10.1 to Form 8-K (filed 5/14/18) SEC File No.: 001-13953*
10.18	Form of W. R. Grace & Co. Performance-Based Units (“PBUs”) Grant Agreement (2018).	Exhibit 10.2 to Form 10-Q (filed 8/08/18) SEC File No.: 001-13953*
10.19	Form of W. R. Grace & Co. Restricted Share Units (“RSUs”) Grant Agreement (2018).	Exhibit 10.3 to Form 10-Q (filed 8/08/18) SEC File No.: 001-13953*
10.20	Form of W. R. Grace & Co. Nonstatutory Stock Option (“NSOs”) Grant Agreement (2018).	Exhibit 10.4 to Form 10-Q (filed 8/08/18) SEC File No.: 001-13953*
10.21	Separation Agreement and General Release, dated as of May 31, 2018, by and between W. R. Grace & Co.–Conn., et al., and Thomas E. Blaser.	Exhibit 10.5 to Form 10-Q (filed 8/08/18) SEC File No.: 001-13953*
10.22	Letter Agreement, dated as of February 20, 2019, by and among W. R. Grace & Co., 40 North Management LLC, 40 North GP III LLC, 40 North Latitude Master Fund Ltd. and 40 North Latitude Fund LP.	Exhibit 99.1 to Form 8-K (filed 2/20/19) SEC File No.: 001-13953*
21	List of Subsidiaries of W. R. Grace & Co.	Filed herewith
23	Consent of Independent Registered Public Accounting Firm.	Filed herewith
24	Powers of Attorney.	Filed herewith
31(i).1	Certification of Periodic Report by Chief Executive Officer under Section 302 of the Sarbanes-Oxley Act of 2002.	Filed herewith
31(i).2	Certification of Periodic Report by Chief Financial Officer under Section 302 of the Sarbanes-Oxley Act of 2002.	Filed herewith
32	Certification of Periodic Report by Chief Executive Officer and Chief Financial Officer under Section 906 of the Sarbanes-Oxley Act of 2002.	Furnished herewith
95	Mine Safety Disclosure Exhibit.	Filed herewith
101.INS	Inline XBRL Instance Document	The instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document.
101.SCH	Inline XBRL Taxonomy Extension Schema	Filed herewith
101.CAL	Inline XBRL Taxonomy Extension Calculation Linkbase	Filed herewith
101.DEF	Inline XBRL Taxonomy Extension Definition Linkbase	Filed herewith

Exhibit No.	Exhibit	Location
101.LAB	Inline XBRL Taxonomy Extension Label Linkbase	Filed herewith
101.PRE	Inline XBRL Taxonomy Extension Presentation Linkbase	Filed herewith
104	Cover Page Interactive Data File (formatted as Inline XBRL and included in Exhibit 101)	Filed herewith

* Management contracts and compensatory plans, contracts or arrangements required to be filed as exhibits to this Report.

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.

W. R. GRACE & CO.

By: /s/ HUDSON LA FORCE
Hudson La Force
President and Chief Executive Officer
(Principal Executive Officer)

By: /s/ WILLIAM C. DOCKMAN
William C. Dockman
Senior Vice President and Chief Financial Officer
(Principal Financial Officer and
Principal Accounting Officer)

Dated: February 27, 2020

Pursuant to the requirements of the Securities Exchange Act of 1934, this Report has been signed below by the following persons on behalf of the registrant and in the capacities indicated on February 27, 2020.

Signature		Title
R. F. Cummings, Jr.*	}	Directors
D. H. Gulyas*	}	
J. Fasone Holder*	}	
J. N. Quinn*	}	
K. G. Reiland*	}	
H. R. Slack*	}	
C. J. Steffen*	}	
M. E. Tomkins*	}	
S. Yanai*	}	

<u>/s/ HUDSON LA FORCE</u> Hudson La Force	President and Chief Executive Officer and Director (Principal Executive Officer)
<u>/s/ WILLIAM C. DOCKMAN</u> William C. Dockman	Senior Vice President and Chief Financial Officer (Principal Financial Officer and Principal Accounting Officer)

* By signing his name hereto, Mark A. Shelnitz is signing this document on behalf of each of the persons indicated above pursuant to powers of attorney duly executed by such persons and filed with the Securities and Exchange Commission.

By: /s/ MARK A. SHELNITZ
Mark A. Shelnitz
(Attorney-in-Fact)

GRACE

Talent | Technology | Trust™

W. R. Grace & Co. Leadership Team



Hudson La Force
President and
Chief Executive Officer



Elizabeth C. Brown
Senior Vice President and
Chief Human Resources
Officer



Keith N. Cole
Senior Vice President,
Government Relations
and Environment, Health,
and Safety



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Integrated Supply Chain



Tom Petti
President,
Refining Technologies



Jag Reddy
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Strategy and Growth;
Managing Director,
Advanced Refining
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Investor Information

TRANSFER AGENT

Inquiries and changes to shareholder accounts should be directed to our transfer agent:

EQ Shareowner Services
P.O. Box 64874
St. Paul, MN 55164-0874
U.S.A.

Or

EQ Shareowner Services
1110 Centre Pointe Curve, Suite 101
Mendota Heights, MN 55120-4100
U.S.A.

shareowneronline.com

+1 800.648.8392 (toll-free)

+1 651.450.4064 (outside the U.S.)

INVESTOR RELATIONS

Inquiries from shareholders and requests for Grace's securities filings should be directed to:

W. R. Grace & Co.
Investor Relations
7500 Grace Drive
Columbia, MD 21044
U.S.A.

+1 410.531.4167 (Investor Relations)

+1 410.531.4000 (main)

investor.relations@grace.com

grace.com

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