

CARBO CERAMICS INC
Form 10-K
March 08, 2018

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, 2017

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 No. 001-15903

CARBO Ceramics Inc.

(Exact name of registrant as specified in its charter)

DELAWARE 72-1100013
(State or other jurisdiction of (I.R.S. Employer

incorporation or organization) Identification Number)

575 North Dairy Ashford, Suite 300

Houston, Texas 77079

(Address of principal executive offices)
(281) 921-6400

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(Registrant's telephone number)

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

Title of each class	Name of each exchange on which registered
Common Stock, par value \$0.01 per share	New York Stock Exchange

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

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes 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 and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes No

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

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

Large accelerated filer	Accelerated filer
Non-accelerated filer	(Do not check if a smaller reporting company) Smaller reporting company
Emerging growth company	

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

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

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The aggregate market value of the Common Stock held by non-affiliates of the Registrant, based upon the closing sale price of the Common Stock on June 30, 2017, as reported on the New York Stock Exchange, was approximately \$112,118,204. Shares of Common Stock held by each director and executive officer and each person who owns 10% or more of the outstanding Common Stock have been excluded in that such persons may be deemed to be affiliates. This determination of affiliate status is not necessarily a conclusive determination for other purposes.

As of February 28, 2018, the Registrant had 27,414,445 shares of Common Stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the Proxy Statement for Registrant's Annual Meeting of Stockholders to be held May 22, 2018, are incorporated by reference in Part III.

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PART I

Item 1. Business

General

CARBO Ceramics Inc. (“we,” “us,” “our” or our “Company”) is a technology company that provides products and services to the global oil and gas and industrial markets to enhance value for its clients. The Company was incorporated in 1987 in Delaware. As used herein, “Company”, “CARBO”, “we”, “our” and “us” may refer to the Company and/or its consolidated subsidiaries.

The Company conducts its business within two operating segments: 1) Oilfield Technologies and Services and 2) Environmental Products and Services. These two operating segments provide products and services to several market segments in the oil and gas, and the industrial markets. Financial information about reportable operating segments is provided in Note 13 to the Company’s Consolidated Financial Statements.

Our Oilfield Technologies and Services segment includes the manufacturing and selling of proppant products for use primarily in the hydraulic fracturing of oil and natural gas wells, FracPro® software for the design of fracture treatments, and StrataGen® consulting services for the optimizing of well completions. Hydraulic fracturing is the most widely used method of increasing production from oil and natural gas wells. The hydraulic fracturing process consists of pumping fluids down a natural gas or oil well at pressures sufficient to create fractures in the hydrocarbon-bearing rock formation. A granular material, called proppant, is suspended and transported in the fluid and fills the fracture, “propping” it open once high-pressure pumping stops. The proppant filled fracture creates a conductive channel through which the hydrocarbons can flow more freely from the formation to the well and then to the surface.

There are three primary types of proppant that can be utilized in the hydraulic fracturing process: sand, resin coated sand and ceramic. Sand is the least expensive proppant, resin-coated sand is more expensive and ceramic proppant is typically the most expensive. The higher initial cost of ceramic proppant is justified by the fact that its use in certain well conditions results in an increase in the production rate of oil and natural gas, an increase in the total oil or natural gas that can be recovered from the well and, consequently, an increase in cash flow for the operators of the well. The increased production rates are primarily attributable to the higher strength and more uniform size and shape of ceramic proppant versus alternative materials. We are one of the world’s largest suppliers of ceramic proppant.

We manufacture various distinct ceramic proppants. Our technology suite of ceramic proppants include the following:

KRYPTOSPHERE® HD is a high-performance ceramic proppant engineered to deliver increased conductivity and durability in the highest closure stress wells. Even in challenging, high-cost environments such as deep water wells, KRYPTOSPHERE HD retains its integrity and enables greater Estimated Ultimate Recovery (“EUR”) from the reservoir.

KRYPTOSPHERE LD meets client needs for a lower density proppant than KRYPTOSPHERE HD, yet has similar characteristics and conductivity in high stress wells.

SCALEGUARD® is a porous ceramic proppant that is infused with scale-inhibiting chemicals and placed throughout the fracture as part of the hydraulic fracturing process. The infused scale inhibitor in SCALEGUARD is designed to be released into the fracture only on contact with water and thereby reduce or eliminate expensive remedial maintenance programs. We also are developing SALTGUARD® and PARAGUARD™ to help prevent salt and paraffin wax buildup in wells.

Our FUSION® technology improves well productivity by forming a stable, high-permeability proppant pack that prevents proppant washout from the non-compressive annulus and near-wellbore areas.

CARBOAIR® is a high-transport, ultra-low-density ceramic proppant technology that has been developed primarily to increase production and EUR from slickwater fracturing operations. The technology enables exploration and production (“E&P”) operators to avoid the introduction of gel into their fracs while improving reservoir contact and fracture conductivity.

In addition, we manufacture CARBONRT®, a detectable proppant that utilizes a non-radioactive tracer material to assist operators in determining the locations of fractures in a natural gas or oil well. This tracer is added to the proppant granules during the manufacturing process, and can be added to most of the types of proppant that the Company sells.

Our base ceramic suite of products include:

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CARBOHSP® and CARBOPROP® are high and intermediate density ceramic proppants, respectively, designed primarily for use in deep oil and natural gas wells.

CARBOLITE®, CARBOECONOPROP® and CARBOHYDROPROP® are low-density ceramic proppants. CARBOLITE® is used in medium depth oil and natural gas wells, where higher production rates can be achieved due to the product's uniform size and spherical shape. CARBOECONOPROP was introduced to provide a lower cost ceramic to compete more directly with resin-coated sand and sand proppant, and CARBOHYDROPROP was introduced to improve performance in "slickwater" fracture treatments.

We produce resin-coated ceramic (CARBOBOND LITE®), which addresses a niche market in which oil and natural gas wells are subject to the risk of proppant flow-back.

Our sand proppants include CARBO NORTHERN-WHITE, which is a frac sand that is used by operators that still value quality, but do not wish to pay the higher costs associated with ceramic or resin-coated proppants.

Our manufacturing facilities also produce ceramic media for use in various industrial technology applications, including but not limited to the casting and milling markets. New ceramic media products have been developed specifically for industrial applications expanding our market opportunities outside the oil and natural gas industry. We also have begun plant trials at our manufacturing facilities to produce products other than ceramic proppant and media for contract manufacturing clients. Those mineral processing plant trials have proven successful and have led to increased revenue generation. One example, we recently signed a multi-year contract manufacturing agreement to be the exclusive toll processor for a product in the agricultural industry.

Through our wholly-owned subsidiary StrataGen, Inc., our Oilfield Technologies and Services segment also promotes increased production and EUR of oil and natural gas by selling one of the most widely used fracture stimulation software under the brand FracPro, and providing fracture design and consulting services to oil and natural gas E&P companies under the brand StrataGen.

FracPro provides a suite of stimulation software solutions used for designing fracture treatments and for on-site real-time analysis. Use of FracPro has enabled our clients to recognize and remedy potential stimulation problems. FracPro has also been integrated with third party reservoir simulation software, furthering its reach and utility.

StrataGen, our specialized consulting team, works with operators around the world to help optimize well placement, fracture treatment design and production enhancement. The broad range of expertise of the StrataGen consultants includes: fracture treatment design; completion support; on-site treatment supervision, quality control; post-treatment evaluation and optimization; reservoir and fracture studies; rock mechanics; and software application and training.

Our Environmental Products and Services segment is intended to protect operators' assets, minimize environmental risks, and lower lease operating expense ("LOE"). Asset Guard Products Inc. ("AGPI"), the only wholly-owned subsidiary of ours to operate in this segment, provides spill prevention, containment and countermeasure systems for the oil and gas and industrial industry. AGPI uses proprietary technology to make products designed to enable its clients to extend the life of their storage assets, reduce the potential for hydrocarbon spills and provide containment of stored materials.

Current demand for proppant is extremely dynamic. Most of our oilfield products and services depend primarily on the supply of and demand for oil and natural gas, as well as on the number of natural gas and oil wells drilled, completed or re-completed worldwide. More specifically, the demand for most of our products and services is dependent on the number of oil and natural gas wells that are hydraulically fractured to stimulate production. The

demand for our products and services is also dependent on the commodity price of oil and natural gas, and lower commodity prices result in fewer purchases of our premium products. In addition, our results of operations are also significantly affected by a host of other factors, including but not limited to (a) rig counts, (b) well completions activity, which is not necessarily correlated with rig count, (c) customer preferences, (d) new product and technology adoption, (e) imports and competition, (f) changes in the product mix of what we sell, (g) costs of developing our products and services and running our business, and (h) changes in our strategy and execution.

During the year ended December 31, 2017, we generated approximately 79% of our revenues in the United States and 21% in international markets.

Competition

As the demand for ceramic proppant (including proppant produced by us) continued to be negatively impacted by the severe decline in the oil and natural gas industry in 2017, the number of domestic and international competitors in the marketplace continued to decrease, and many of our competitors have shut down plants and/or reduced production. However, we do not have full visibility as to the extent or duration of these shut-downs and reductions. One of our worldwide proppant competitors is Saint-Gobain

Proppants (“Saint-Gobain”). Saint-Gobain is a division of Compagnie de Saint-Gobain, a large French glass and materials company. Saint-Gobain manufactures a variety of ceramic proppants that it markets in competition with some of our products. Saint-Gobain’s primary manufacturing facilities are located in Fort Smith and Bauxite, Arkansas. Saint-Gobain also manufactures ceramic proppant in China. Mineracao Curimbaba (“Curimbaba”), based in Brazil, also manufactures and markets ceramic proppant in competition with some of our products. Imerys, S.A., a competitor based in France (“Imerys”), has ceramic proppant manufacturing facilities in Andersonville and Wrens, Georgia and also competes with some of our products.

We are aware of two major manufacturers of ceramic proppant in Russia. One of which is FORES Refractory Plant (“FORES”) located in Ekaterinburg, Russia. Although we have limited information about FORES, we believe that FORES manufactures intermediate-density and low-density ceramic proppant lines and markets its products both inside and outside of Russia. We are also aware of a large number of manufacturers in China. Most of these companies produce intermediate-density and low-density ceramic proppants that are marketed both inside and outside of China. Chinese proppant imports into the United States increased beginning in 2010 and 2011, which contributed to an over-supply of ceramic proppant beginning in 2012. However, beginning in early 2015, imports declined significantly.

Our KRYPTOSPHERE product line is replacing both CARBOHSP and CARBOPROP. Historically, competition for CARBOHSP and CARBOPROP principally includes ceramic proppant manufactured by Saint-Gobain, Curimbaba, as well as various manufacturers located in China. Our CARBOLITE, CARBOECONOPROP and CARBOHYDROPROP products compete primarily with ceramic proppant produced by Saint-Gobain, Curimbaba and Imerys and with sand-based proppant for use in the hydraulic fracturing of natural gas and oil wells. At this time, there is not in our view a comparable competitor’s product to our KRYPTOSPHERE product line, which is the subject of patent protection.

The leading suppliers of mined sand are Unimin Corp., U.S. Silica Company, Fairmount Minerals Limited, Inc., Hi-Crush Partners LP, and Badger Mining Corp. The leading suppliers of resin-coated sand are Hexion and Santrol, a subsidiary of Fairmount Minerals.

We believe that some of the significant factors that influence a customer’s decision to purchase our ceramic proppant are (i) reservoir and geological characteristics, (ii) price/performance ratio, (iii) on-time delivery performance, (iv) technical support, (v) proppant availability and (vi) the financial status of E&P operators. We believe that our products are competitively priced and that our delivery performance is far better than the competition. Lastly, our superior technical support has enabled us to persuade customers to use our technology products in an increasingly broad range of applications which in turn has increased the overall market for our technology products.

Product Development

We continually conduct testing and development activities with respect to alternative raw materials to be used in our existing and alternative production methods. During 2015, we completed the first line of a plant retrofit to enable production of KRYPTOSPHERE products including both KRYPTOSPHERE LD and KRYPTOSPHERE HD. We introduced KRYPTOSPHERE HD in 2013, a proppant with greatly increased strength and conductivity when compared to our traditional proppants. This proppant is intended for use in ultra-high stress wells. In 2015, we introduced KRYPTOSPHERE LD, a lower density proppant than KRYPTOSPHERE HD. For information regarding our research and development expenditures, see Note 1 to the “Notes to Consolidated Financial Statements.”

SCALEGUARD, our proppant-delivered, scale-inhibiting technology continues to show positive performance results in multiple basins across North America. SCALEGUARD has now been successfully used in hundreds of hydraulic fracturing stages. We are pursuing the development of other infused proppant technologies, some of which underwent

field trials in 2016 and 2017.

Going beyond our existing proppant detection capabilities, we are developing technology for far-field detection of proppant in a fracture, which has shown positive results.

We are aware of others engaged in the development of alternative products for use as proppants in the hydraulic fracturing process, but are uncertain of the financial status and product viability of these potential competitors. We believe that while there are potential specialty applications for such products, they will not significantly impact the use of ceramic proppants. Further, we believe that the “know-how” and trade secrets necessary to efficiently manufacture a product of consistently high quality are difficult barriers to entry to overcome.

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Customers and Marketing

Our clients include both oil and gas customers, and industrial customers. Our largest customers are participants in the hydraulic fracturing industry. Specifically, Halliburton Energy Services, Inc. and Keane Group each accounted for more than 10% of our 2017 revenues. However, the end users of our products are principally the operators of natural gas and oil wells that hire the pressure pumping service companies to hydraulically fracture wells. We work both with the pressure pumping service companies and with the operators of natural gas and oil wells to present the technical and economic advantages of using ceramic proppant. We generally supply our customers with products on a just-in-time basis, as specified in individual purchase orders. Continuing sales of product depend on our direct customers and the operators being satisfied with product quality, availability and delivery performance. In addition, our ability to increase sales of all of our products depends significantly on a favorable level of activity in the upstream natural gas and oil industries. We sell our software products and consulting services directly to operators of oil and natural gas wells as well as to service companies involved in hydraulic fracturing.

We recognize the importance of a technical marketing program in demonstrating long-term economic advantages when selling products and services that offer financial benefits over time. We have a broad technical sales force to advise end users on the benefits of using ceramic proppant, fracture simulation software, and related consulting services.

Although originally our ceramic products were intended for use in deeper, higher-stress wells that require high-strength proppant, we believe that there is economic benefit to operators of using ceramic proppant in shallower, lower-stress wells. We also believe that our new product introductions and education-based technical marketing efforts have enabled us to maintain our position not only as one of the world's largest suppliers of ceramic proppant but also as a leading innovator in our industry.

We provide a variety of technical support services and have developed computer software that models the return on investment achievable by using our ceramic proppant versus alternatives in the hydraulic fracturing of a natural gas or oil well. In addition to the technical marketing effort, from time to time, we engage in field trials to demonstrate the economic benefits of our products and validate the findings of our computer simulations. Periodically, we provide proppant to operators for field trials on a discounted basis in exchange for their agreement to provide production data for direct comparison of the results of fracturing with ceramic proppant as compared to alternative proppants.

Our international marketing efforts are conducted primarily through our sales offices in the United Arab Emirates, Canada, Russia, and South America. Our products and services are used worldwide by U.S. customers operating domestically and abroad, and by foreign customers. Sales outside the United States accounted for 21%, 34% and 29% of our sales for 2017, 2016 and 2015, respectively. The distribution of our international and domestic revenues is shown below, based upon the region in which the customer used the products and services:

	For the years ended December 31,		
	2017	2016	2015
	(\$ in millions)		
Location			
United States	\$149.0	\$67.6	\$199.2
International	39.7	35.4	80.4
Total	\$188.8	\$103.0	\$279.6

Production Capacity

We have constructed adequate capacity to support present and foreseeable demand for our ceramic proppant. We continue to incorporate new methods and technologies to reduce our manufacturing costs and make our products more cost-competitive. As production levels increase, our manufacturing costs per unit tend to decrease.

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Stated capacity of our facilities varies based on the mix of products we expect to produce. The following table sets forth the current stated capacity of each of our existing ceramic manufacturing and other facilities:

Location	Annual Capacity (millions of pounds)	
Eufaula, Alabama	245	*
McIntyre, Georgia	275	*
Toomsboro, Georgia	1,000	*
Millen, Georgia	250	*
Total ceramic manufacturing capacity	1,770	
Marshfield, Wisconsin – sand processing	1,500	
New Iberia, Louisiana – resin-coating	330	**
Total current capacity	3,600	

* Given market conditions, our Millen manufacturing facility is currently mothballed and output levels at our Eufaula, McIntyre and Toomsboro facilities are at reduced levels.

** Processing activities at the New Iberia facility primarily involve resin-coating of previously manufactured ceramic proppant substrate.

The retrofit of the first production line at our Eufaula, Alabama plant to produce KRYPTOSPHERE was completed in late 2015. With this retrofit, we can now produce up to approximately 100 million pounds of KRYPTOSPHERE annually. While this retrofit enables production of our new KRYPTOSPHERE technology products, it did not add additional production capacity. The retrofit of a second production line at this plant has been deferred until market conditions warrant moving forward with the project.

During 2017, our overall total ceramic plant utilization, excluding our Russia plant, which we sold in September 2017, was approximately 18% of stated capacity. Our sand processing plant in Marshfield operated at approximately 82% of its stated capacity during 2017. We do not expect any significant improvements to our ceramic proppant plant utilization in 2018, except possibly to due to mineral processing growth. We expect utilization at our sand processing plant to improve during 2018. Depending on industry conditions, we can modify output levels or idle operations at plants as needed. Refer to our discussion of impairment considerations in the “Critical Accounting Policies” section of Item 7 - Management’s Discussion and Analysis of Financial Condition and Results of Operations. Construction of additional manufacturing capacity beyond our existing facilities is not expected in the foreseeable future, and would be dependent on the expected future demand for our products, access to needed capital and the ability to obtain necessary environmental permits.

Long-Lived Assets by Geographic Area

Long-lived assets, consisting of net property, plant and equipment, goodwill, intangibles, and other long-term assets as of December 31 in the United States and other countries are as follows:

	2017	2016	2015
	(\$ in millions)		
Long-lived assets:			

United States	\$332.6	\$496.0	\$538.8
International (primarily Canada for 2017; China, Russia, and Canada for 2016 and 2015)	6.5	10.2	12.3
Total	\$339.1	\$506.2	\$551.1

Distribution

We maintain finished goods inventories at each of our manufacturing facilities and at remote stocking facilities. Our North American remote stocking facilities consist of bulk storage silos with truck trailer loading facilities, as well as rail yards for direct transloading from rail cars to tank trucks. International remote stocking sites are duty-free warehouses operated by independent owners. North American sites are typically supplied by rail, and international sites are typically supplied by container ship. In total, we lease approximately 2,225 rail cars for use in the distribution of our products, of which we have subleased approximately 745 rail cars. The price of our products sold for delivery in the lower 48 United States and Canada typically includes just-in-time delivery of proppant to the operator's well site, which eliminates the need for customers to maintain an inventory of ceramic proppant.

Raw Materials

Ceramic proppant and ceramic media are made from alumina-bearing ores (commonly referred to as clay, bauxite, bauxitic clay or kaolin, depending on the alumina content) that are readily available on the world market. The main known deposits of alumina-bearing ores in the United States are in Arkansas, Alabama and Georgia; other economically mineable known deposits are located in Australia, Brazil, China, Gabon, Guyana, India, Jamaica, Russia and Surinam. Bauxite is largely used in the production of aluminum metal, refractory material and abrasives. We believe that our ability to purchase bauxite on the open market coupled with our current bauxite inventories will sufficiently provide for our bauxite needs in the United States during 2018.

Our Eufaula, McIntyre, Toombsboro and Millen facilities primarily use locally mined kaolin for the production of CARBOLITE, CARBOECONOPROP and CARBOHYDROPROP. We have entered into bi-lateral contracts that require a supplier to sell to us, and require us to purchase from the supplier, at least fifty percent of the Eufaula facility's and Millen facility's annual kaolin requirements. The Eufaula contract runs through May 2020, with an option for us to extend this agreement for additional three year terms. The Millen contract, which commenced in July 2014, has an initial term of five years with options to extend the agreement for additional five year terms. Our Millen facility is currently idled. We have obtained ownership rights in acreage in Wilkinson County, Georgia, which contains in excess of a twelve year supply of kaolin for our Georgia facilities based on full capacity production rates. We have entered into a long-term agreement with a third party to mine and transport this material at a fixed price subject to annual adjustment. The agreement requires us to utilize the third party to mine and transport a majority of the McIntyre and Toombsboro facility's annual kaolin requirement. Overall, we estimate that our fee simple and leasehold mineral rights in the states of Alabama and Georgia contain approximately 20.1 million tons of kaolin suitable for use in production of our kaolin-based proppants.

We utilize our own Northern White sand, CARBO NORTHERN-WHITE, and purchase third party wet processed sand reserves for our sand processing facility in Marshfield, Wisconsin, which supplies raw frac sand to the proppant market.

Ceramic Production Process

Ceramic proppants are made by grinding or dispersing ore to a fine powder, combining the powder into small pellets and firing the pellets in a rotary kiln. We use three different methods to produce ceramic proppant. Industrial ceramic media follows a similar process.

Our plant in McIntyre, Georgia uses a dry process, which utilizes clay, bauxite, bauxitic clay or kaolin. The raw material is ground, pelletized and screened. The manufacturing process is completed by firing the product in a rotary kiln.

Our plants in Eufaula, Alabama, Toombsboro, Georgia, and Millen, Georgia, use a wet process, which starts with kaolin that is formed into slurry. The slurry is then pelletized in a dryer and the pellets are then fired in a rotary kiln.

The portion of our plant in New Iberia, Louisiana that manufactures ceramic proppant, as well as one line at our Eufaula, Alabama facility, uses a new manufacturing process associated with the Company's KRYPTOSPHERE product line.

Our rotary kilns are primarily heated by the use of natural gas.

Patent Protection and Intellectual Property

We make ceramic proppant and ceramic media used in foundry and scouring processes (the latter two items comprising a minimal volume of overall sales) by processes and techniques that involve a high degree of proprietary technology, some of which is protected by patents.

We own multiple patents in the United States and various foreign countries that relate to different types of ceramic proppant and production methods used for ceramic proppant and media; however, depending on market conditions, production of products pursuant to these patents may not necessarily constitute a material portion of our output. We also own multiple U.S. and foreign patents that relate to methods for the detection of subterranean fractures and material, including gravel packs, in the near-borehole region. We also own multiple U.S. patents that relate to detectable proppant.

During 2014 and 2015, we obtained three U.S. patents relating to our KRYPTOSPHERE manufacturing process, and during 2017, we obtained one U.S. patent covering the KRYPTOSPHERE product. We expect these patents to provide assistance in the future sales of this product line. During 2015, 2016 and 2017, we obtained four U.S. patents relating to our far-field proppant detection products, systems, and methods which relate to our iON™ product line and the QUANTUM™ service line, which are still under development.

We own multiple U.S. patent applications (together with a number of counterpart applications pending in foreign jurisdictions). A portion of the U.S. patent applications cover ceramic proppant, detectable proppant, processes for making ceramic proppant and detectable proppant, detection of subterranean fractures, and our GUARD™, FUSION and AIR™ product lines and methods for making and using these products. Another portion of the U.S. patent applications cover non-oilfield or industrial products, such as water treatment compositions, foundry media, building materials and ceramic media for use in solar power plants. The applications are in various stages of the patent prosecution process, and patents may not issue on such applications in any jurisdiction for some time, if they issue at all.

AGPI (formerly Falcon) owns three U.S. patents, which expire in 2026, 2027 and 2034 and relate to construction of secondary containment areas. In addition, AGPI owns four U.S. patents, which expire in 2030 and 2031 and relate to polyurea-encapsulated tank bases. AGPI also owns multiple U.S. patent applications (together with a number of counterpart applications pending in foreign jurisdictions), each of which relates to tank bases or methods of constructing secondary containment areas.

We believe that our patents have historically been important in enabling us to compete in the market to supply proppant to the natural gas and oil industry. We intend to enforce, and have in the past vigorously enforced, our patents. We may from time to time be involved in litigation to determine the enforceability, scope and validity of our patent rights. In addition to patent rights, and perhaps more notably, we use a significant amount of trade secrets, or “know-how,” and other proprietary information and technology in the conduct of our business. None of this “know-how” and technology is licensed from third parties. However, we have negotiated a long term license for some third party intellectual property used or jointly developed in connection with our QUANTUM service line.

Seasonality

Historically, our business has not been subject to regular material seasonality fluctuations. However, with the activity in resource plays in the northern and eastern United States, we have experienced higher levels of proppant sales activities during warmer weather periods and less during colder weather months. In addition, sales activities can be decreased by the spring snow and ice “break-up” in Canada, North Dakota, Montana, and the Northeast U.S., as well as the winter holidays in December and January.

Environmental and Other Governmental Regulations

We believe that our operations are in substantial compliance with applicable domestic and foreign federal, state and local environmental and safety laws and regulations.

Existing federal environmental requirements such as the Clean Air Act and the Clean Water Act, as amended, impose certain restrictions on air and water pollutants from our operations via permits and regulations. Those pollutants include volatile organic compounds, nitrogen oxides, sulfur dioxide, particulate matter, storm water and wastewater discharges and other by-products. In addition to meeting environmental requirements for existing operations, we must also demonstrate compliance with environmental regulations in order to obtain permits prior to any future expansion. The United States Environmental Protection Agency (“EPA”) and state programs require covered facilities to obtain individual permits or have coverage under an EPA general permit issued to groups of facilities. A number of federal and state agencies, including but not limited to, the EPA, the Texas Commission of Environmental Quality, the Louisiana Department of Environmental Quality, the Alabama Department of Environmental Management, the Wisconsin Department of Natural Resources, and the Georgia Environmental Protection Division, have environmental regulations applicable to our operations in the states in which we do business. Historically we have been able to obtain permits, where necessary, to build new facilities and modify existing facilities that allow us to continue compliant operations. Obtaining these permits in a timely manner will continue to be an important factor in our

ability to do so in the future.

Employees

As of December 31, 2017, we had 424 employees worldwide. In addition to the services of our employees, we employ the services of consultants as required. Our employees are not represented by labor unions. There have been no work stoppages or strikes during the last three years that have resulted in the loss of production or production delays. We believe our relations with our employees are satisfactory.

Executive Officers of the Registrant

Gary A. Kolstad (age 59) was elected in June 2006, by our Board of Directors to serve as President and Chief Executive Officer and a Director of the Company. Mr. Kolstad previously served in a variety of positions over 21 years with Schlumberger. Mr. Kolstad became a Vice President of Schlumberger in 2001, where he last held the positions of Vice President, Oilfield Services – U.S. Onshore and Vice President, Global Accounts.

Ernesto Bautista III (age 46) joined the Company as a Vice President and Chief Financial Officer in January 2009. From July 2006 until joining the Company, Mr. Bautista served as Vice President and Chief Financial Officer of W-H Energy Services, Inc., a Houston, Texas based diversified oilfield services company (“W-H Energy”). From July 2000 to July 2006, he served as Vice President and Corporate Controller of W-H Energy. From September 1994 to May 2000, Mr. Bautista served in various positions at Arthur Andersen LLP, most recently as a manager in the assurance practice, specializing in emerging, high growth companies. Mr. Bautista is a certified public accountant in the State of Texas.

Don P. Conkle (age 53) was appointed Vice President, Marketing and Sales in October 2012. Mr. Conkle previously held a variety of domestic and international managerial positions in engineering, marketing and sales, and technology development over a 26 year period with Schlumberger. He served in the positions of Vice President of Stimulation Services from 2007 until 2009, as GeoMarket Manager (Qatar & Yemen) from 2009 until 2011 and as Production Group Marketing and Technology Director from 2011 until he joined the Company.

Roger Riffey (age 59) joined the Company in July 2006 as Director of Logistics and Customer Service. He was appointed Plant Manager of the Toombsboro, Georgia, facility in July 2010, and was named Vice President, Manufacturing in May 2013. Previously, Mr. Riffey held positions with Rio Tinto Energy in Special Projects, U.S. Borax as Global Logistics Manager and Kerr-McGee Coal Corporation as Manager of Marketing.

Robert J. Willette (age 42) joined the Company in October 2017 as Vice President, General Counsel, Corporate Secretary and Chief Compliance Officer. Prior to his current role, Mr. Willette served as General Counsel and Corporate Secretary for Texon Distributing L.P. beginning in 2009. From 2006 to 2009, Mr. Willette served as Corporate Counsel for Ferrellgas L.P.

All officers are elected for one-year terms or until their successors are duly elected. There are no arrangements between any officer and any other person pursuant to which he was selected as an officer. There is no family relationship between any of the named executive officers or between any of them and the Company’s directors.

Forward-Looking Information

The Private Securities Litigation Reform Act of 1995 provides a “safe harbor” for forward-looking statements. This Form 10-K, our Annual Report to Shareholders, any Form 10-Q or any Form 8-K of the Company or any other written or oral statements made by or on behalf of the Company may include forward-looking statements which reflect the Company’s current views with respect to future events and financial performance. The words “believe”, “expect”, “anticipate”, “project”, “estimate”, “forecast”, “plan” or “intend” and similar expressions identify forward-looking statements. Readers are cautioned not to place undue reliance on these forward-looking statements, each of which speaks only as of the date the statement was made. We undertake no obligation to publicly update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. Our forward-looking statements are based on assumptions that we believe to be reasonable but that may not prove to be accurate. All of our forward-looking information is subject to risks and uncertainties that could cause actual results to differ materially from the results expected. Although it is not possible to identify all factors, these risks and uncertainties include the risk factors discussed below.

Our results of operations could be adversely affected if our business assumptions do not prove to be accurate or if adverse changes occur in our business environment, including but not limited to:

- changes in the cost of raw materials and natural gas used in manufacturing our products;
- risks related to our ability to access needed cash and capital;

our ability to meet our current and future debt service obligations, including our ability to maintain compliance with our debt covenants;

our ability to manage distribution costs effectively;

our ability to successfully implement strategic changes in our business;

changes in demand and prices charged for our products;

technological, manufacturing and product development risks;

our dependence on and loss of key customers and end users;

- potential declines or increased volatility in oil and natural gas prices that adversely affect our customers, the energy industry or our production costs;

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potential reductions in spending on exploration and development drilling in the oil and natural gas industry that reduce demand for our products and services;

- seasonal sales fluctuations;
- an increase in competition in the proppant market, including imports from foreign countries;
- logistical and distribution challenges relating to certain resource plays that do not have the type of infrastructure systems that are needed to efficiently support oilfield services activities;
- the development of alternative stimulation techniques that would not benefit from the use of our existing products and services, such as extraction of oil or gas without fracturing;
- changes in foreign and domestic governmental regulations, including environmental restrictions on operations and regulation of hydraulic fracturing;
- increased regulation of emissions from our manufacturing facilities;
- the development and utilization of alternative proppants for use in hydraulic fracturing;
- general global economic and business conditions;
- weather-related risks and other risks and uncertainties;
- changes in foreign and domestic political and legislative risks;
- risks of war and international and domestic terrorism;
- risks associated with foreign operations and foreign currency exchange rates and controls; and
- the potential expropriation of assets by foreign governments.

Our results of operations could also be adversely affected as a result of worldwide economic, political and military events, including, but not limited to, war, terrorist activity or initiatives by the Organization of the Petroleum Exporting Countries (“OPEC”). For further information, see “Item 1A. Risk Factors.”

Available Information

Our annual reports on Form 10-K, proxy statements, 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 (“Exchange Act”) are made available free of charge on our internet website at <http://www.carboceramics.com> as soon as reasonably practicable after such material is filed with, or furnished to, the Securities and Exchange Commission (“SEC”).

The public may read and copy any materials that we file with the SEC at the SEC’s Public Reference Room at 100 F Street, Room 1580, N.E., Washington, D.C. 20549. The public may obtain information on the operation of the Public Reference Room by calling the SEC at 1-800-SEC-0330. The SEC maintains an Internet site that contains reports, proxy and information statements, and other information regarding issuers that file electronically with the SEC, at <http://www.sec.gov>.

Item 1A. Risk Factors

You should consider carefully the trends, risks and uncertainties described below and other information in this Form 10-K and subsequent reports filed with the SEC before making any investment decision with respect to our securities. If any of the following trends, risks or uncertainties actually occurs or continues, our business, financial condition or operating results could be materially adversely affected, the trading prices of our securities could decline, and you could lose all or part of your investment.

Our business and financial performance largely depends on the level of activity in the natural gas and oil industries.

Our operations are materially dependent upon the levels of activity in natural gas and oil exploration, development and production. More specifically, the demand for our products is closely related to the number of natural gas and oil wells completed in geologic formations where ceramic or sand proppants are used in fracture treatments. These activity levels are affected by both short-term and long-term trends in oil and natural gas prices. In recent years, oil and natural gas prices and, therefore, the level of exploration, development and production activity, have experienced significant fluctuations. Worldwide economic, political and military events, including war, terrorist activity, events in the Middle East and initiatives by OPEC, have contributed, and are likely to continue to contribute, to price volatility. Despite recent initiatives to curb supply, the global supply of oil is currently at historically

high levels, and there is potential for geopolitical and regulatory events, such as normalization of trade relations with the Islamic Republic of Iran, to further increase the supply of oil. Additionally, warmer than normal winters in North America and other weather patterns may adversely impact the short-term demand for natural gas and, therefore, demand for our products and services. Natural gas prices experienced a significant decline during 2012 and, although they have increased since then, remain relatively low on a historic basis, resulting in generally lower gas drilling activity. Further, the price of oil declined precipitously from the second half of 2014 through mid-2016 and, although the price has rebounded from its low, it still remains at weakened levels for industry activity. This reduction in oil and natural gas prices has depressed the level of natural gas and oil exploration, development, production and well completions activity, resulting in significantly reduced demand and pricing for our products. This decline has had, and continues to have, a significant adverse impact on our results. If oil and natural gas prices and well completion activity do not materially improve and/or demand for our products does not otherwise increase, this decline could reasonably be expected to have a material adverse effect on our financial condition or operations, including, but not limited to, the temporary idling of all, or a portion of all, of our facilities until such time as market conditions improve.

We may not have sufficient cash and/or be able to access liquidity alternatives in the credit and capital markets to meet our liquidity needs.

Our primary sources of liquidity are cash on hand and cash flow from operations. Our ability to fund our working capital and capital expenditures and other obligations depends on our future operating performance and cash from operations and other liquidity-generating transactions, which are in turn subject to prevailing oil and natural gas prices, economic conditions and other factors, many of which are beyond our control.

If our future operating performance falls materially below our expectations, our plans prove to be materially inaccurate, or industry conditions do not materially improve, we may require additional financing. Even if additional or alternative financing becomes available to us, future financing transactions may significantly increase the Company's interest expense, which could in turn reduce our financial flexibility and our ability to fund other activities, and could make us more vulnerable to changes in operating performance or economic downturns generally. The inability to generate sufficient cash, modify our New Credit Agreement, or obtain replacement or additional financing, or an event of default under our New Credit Agreement, could have a material adverse effect on our financial condition.

We therefore cannot provide any assurance that we will be able to access the capital or credit markets on acceptable terms or timing, or at all. Access to the capital markets and the cost and availability of credit may be adversely affected by factors beyond our control, including turmoil in the financial services industry, volatility in securities trading markets, the continuing downturn in the oil and gas industry and general economic conditions. Currently, we do not qualify as a "well-known seasoned issuer," which otherwise would allow us to, among other things, file automatically effective shelf registration statements. Now, even if we are able to access the public capital markets, any attempt to do so could be more expensive or subject us to significant delays when compared with previous periods.

Our business and financial performance has suffered and could suffer further if the levels of hydraulic fracturing continue to decline or cease as a result of the low commodity price of oil and natural gas, development of new processes, increased regulation or a continued decrease in drilling activity.

Substantially all of our products are proppants used in the completion and re-completion of natural gas and oil wells through the process of hydraulic fracturing. Completion activity is directly impacted by the price of oil and natural gas. In addition, demand for our proppants is substantially higher in the case of horizontally drilled wells, which allow for multiple hydraulic fractures within the same well bore but are more expensive to develop than vertically drilled wells. A reduction in horizontal drilling or the development of new processes for the completion of natural gas

and oil wells leading to a reduction in, or discontinuation of the use of, hydraulic fracturing could cause a decline in demand for our products. Additionally, increased regulation or environmental restrictions on hydraulic fracturing or the materials used in this process could negatively affect our business by increasing the costs of compliance or resulting in operational delays, which could cause operators to abandon the process due to commercial impracticability. Moreover, future federal, state, local or foreign laws or regulations could otherwise limit or ban hydraulic fracturing. Several states in which our customers operate have adopted, or are considering adopting, regulations that have imposed, or could impose, more stringent permitting, transparency, disposal and well construction requirements on hydraulic fracturing operations. Some states, such as New York, have banned the process of hydraulic fracturing altogether. Any of these events could have a material adverse effect on our results of operations and financial condition. As stated elsewhere, the upstream oil and natural gas industry is in the midst of a severe contraction, resulting in a significant reduction in horizontal drilling and further resulting in a material decline in demand for our products and services.

We face distribution and logistical challenges in our business

As oil and natural gas prices fluctuate, our customers may shift their focus back and forth between different resource plays, some of which can be located in geographic areas that do not have well-developed transportation and distribution infrastructure systems. Transportation and logistical operating expenses continue to comprise a significant portion of our total delivered cost of sales. Therefore, serving our clients in these less-developed areas presents distribution and other operational challenges that affect our sales and negatively impact our operating costs. Disruptions in transportation services, including shortages of rail cars or a lack of rail transportation services or developed infrastructure, could affect our ability to timely and cost effectively deliver products to our customers and could provide a competitive advantage to competitors located in closer proximity to customers. Additionally, increases in the price of diesel fuel could negatively impact operating costs if we are unable to pass those increased costs along to our customers. Failure to find long-term solutions to these logistical challenges could adversely affect our ability to respond quickly to the needs of our customers or result in additional increased costs, and thus could negatively impact our results of operations and financial condition.

We operate in an increasingly competitive market.

The proppant market is highly competitive. We compete with other domestic and international suppliers of ceramic proppant, as well as with suppliers of sand for use as proppant, in the hydraulic fracturing of natural gas and oil wells. The expiration of key patents owned by the Company has resulted in additional competition in the market for ceramic proppant. The entry of additional competitors into the market to supply ceramic proppant and/or a surge in the level of ceramic proppant imports into North America from existing competitors could have a material adverse effect on our results of operations and financial condition.

We have been and may continue to be adversely affected by decreased demand for our proppant or the development by our competitors of alternative proppants.

Ceramic proppant is a premium product capable of withstanding higher pressure and providing more highly conductive fractures than mined sand, which is the most commonly used proppant type. We continue to see operators that have traditionally used ceramic proppant shifting to use mined sand instead. Despite recently improving commodity prices in the oil and natural gas industry, continued pressure on operators to reduce cost or to evaluate returns on a shorter horizon has had a detrimental impact on the demand for ceramic proppant, which is a higher cost product than mined sand. Although we believe that the use of quality ceramic proppant in appropriate geologic formations typically generates higher production rates and more favorable long-term production economics than mined sand, the shifting of customer demand to lower cost products, such as mined sand, has had an adverse effect on our results of operations and its continuation could have a material adverse effect on our financial condition. The development and use of alternative proppant could also cause a decline in demand for our products, and could have a material adverse effect on our results of operations and financial condition.

We have no current plans to pay cash dividends on our common stock for the foreseeable future and our Amended Credit Agreement contains restrictions on our ability to pay dividends; therefore, you may not receive any return on investment unless you sell your common stock for a price greater than you paid.

We do not plan to declare dividends on shares of our common stock in the foreseeable future. In addition, our Amended Credit Agreement prohibits us from paying such dividends. We currently intend to retain any future earnings to finance the operation of our business and meet our debt obligations. As a result, you may only receive a return on your investment in our common stock if the market price of our common stock increases. Further, one of our financing options involves the issuance of equity securities, which would dilute current stockholders and could reduce our stock price.

The outstanding indebtedness under our New Credit Agreement is secured by a substantial portion of our domestic assets and guaranteed by our two domestic operating subsidiaries, subject to certain exceptions.

The outstanding indebtedness under our New Credit Agreement is secured by (i) a pledge of all accounts receivable and inventory, (ii) cash in certain accounts, (iii) domestic distribution assets residing on owned real property, (iv) our Marshfield, Wisconsin and Toombsboro, Georgia plant facilities and equipment, and (v) certain real property interests in mines and minerals. In the event of a default, our lenders may (1) elect to declare all outstanding borrowings made under the New Credit Agreement and the guaranties of the two operating subsidiaries, together with accrued interest and other fees, to be immediately due and payable; (2) exercise their set-off rights; and/or (3) enforce and foreclose on their security interest and liquidate some or all of such pledged assets. Any of these actions could, individually or in the aggregate, have a substantial negative impact on our financial condition and results of operations.

We rely upon, and receive a significant percentage of our revenues from, a limited number of key customers and end users.

During 2017, our key customers included several of the largest participants in the worldwide petroleum pressure pumping industry. Two of these customers each accounted for more than 10% of our 2017 revenues. However, the end users of our products are numerous operators of natural gas and oil wells that hire pressure pumping service companies to hydraulically fracture wells. During 2017, a majority of our ceramic proppant sales were directed to a concentrated number of end users. We generally supply our domestic pumping service customers with products on a just-in-time basis, with transactions governed by individual purchase orders and/or a master supply agreement. Because of their purchasing power, our key customers may have greater bargaining leverage than us with respect to the negotiation of prices and other terms of the sale in their supply contracts with us, which in turn, could adversely affect our profit margins associated with those contracts. Disparities in bargaining leverage, when combined with the Company's desire to maintain long-term relationships with key customers, could limit our practical ability to assert certain terms of our supply agreements with them. Continuing sales of our products depend on our direct customers and the end user well operators being satisfied with product quality, pricing, availability, and delivery performance. While we believe we have satisfactory relations with our customers and our end users, a material decline in the level of sales to any one of our major customers or loss of a key end user due to unsatisfactory product performance, pricing, delivery delays or any other reason could have a material adverse effect on our results of operations and financial condition.

The operations of our customers, and thus the results of our operations, are subject to a number of operational risks, interruptions and seasonal trends.

As hydraulic fracturing jobs have increased in size and intensity, common issues such as weather, equipment delays or changes in the location and types of oil and natural gas plays can result in increased variability in proppant sales volumes. Our business operations and those of our customers involve a high degree of operational risk. Natural disasters, adverse weather conditions, collisions and operator error could cause personal injury or loss of life, severe damage to and destruction of property, equipment and the environment, and suspension of operations. Our customers perform work that is subject to unexpected or arbitrary interruption or termination. The occurrence of any of these events could result in work stoppage, loss of revenue, casualty loss, increased costs and significant liability to third parties. With the increase in resource plays in the northern and eastern United States, as well as our operations in Marshfield, Wisconsin, our results of operations are increasingly exposed to seasonal variations and inclement weather. Operations in certain regions involve more seasonal risk in the winter months, and work is hindered during other inclement weather events. This variability makes it more difficult to predict sales and can result in greater fluctuations to our quarterly financial results. These quarterly fluctuations could result in operating results that are below the expectations of public market analysts and investors, and therefore may adversely affect the market price for our common stock.

The ability of our customers to complete work, as well as our ability to mine sand from cold climate areas, could be affected during the winter months. Our revenue and profitability could decrease during these periods, as well as in other severe weather conditions, because work is either prevented or more costly to complete. If a substantial amount of production is interrupted, our cash flow and, in turn, our results of operations could be materially and adversely affected.

Our North American ceramic proppant production is manufactured at two plants. The vast majority of our mined sand is processed at one plant. Any adverse developments at those plants could have a material adverse effect on our financial condition and results of operations.

With the mothballing of our Millen plant and the very limited production at our McIntyre plant, we are producing the majority of our North American ceramic production from two plants, our Eufaula and our Toombsboro plant. Our Marshfield, Wisconsin plant represents the vast majority of our annual mined sand processing capacity. Any adverse developments at these plants, including a material disruption in production, an inability to supply the plant with raw materials at a competitive cost, or adverse developments due to catastrophic events, could have a material adverse effect on our financial condition and results of operations.

We provide environmental warranties on certain of our containment and spill prevention products.

AGPI's tank liners, secondary containments and related products and services are designed to contain or avoid spills of hydrocarbons and other materials. If a release of these materials occurs, it could be harmful to the environment.

Although we attempt to negotiate appropriate limitations of liability in the applicable terms of sale, some customers have required expanded warranties, indemnifications or other terms that could hold AGPI responsible in the event of a spill or release under particular circumstances. If AGPI is held responsible for a spill or release of materials from one of its customer's facilities, it could have a material adverse effect on our results of operations and financial condition.

We rely upon intellectual property to protect our proprietary rights. Failure to protect our intellectual property rights may affect our competitive position, and protecting our rights or defending against third-party allegations of infringement may be costly.

The Company uses a significant amount of trade secrets, or “know-how,” and other proprietary information and technology in the conduct of its business. In some cases, we rely on trade secrets, trademarks or contractual restrictions to protect intellectual property rights that are not patented. The steps we take to protect the non-patented intellectual property may not be sufficient to protect it and any loss or diminishment of such intellectual property rights could negatively impact our competitive advantage. Additionally, our competitors could independently develop the same or similar technologies that are only protected by trade secret and thus do not prevent third parties from competing with us. Furthermore, even protected intellectual property rights can be infringed upon by third parties. Monitoring unauthorized use of Company intellectual property can be difficult and expensive, and adequate remedies may not be available.

Although the Company does not believe that it is infringing upon the intellectual property rights of others by using such proprietary information and technology, it is possible that such a claim might be asserted against the Company in the future. In the event any third party makes a claim against us for infringement of patents or other intellectual property rights of a third party, such claims, with or without merit, could be time-consuming and result in costly litigation. In addition, the Company could experience loss or cancellation of customer orders, experience product shipment delays, or be subject to significant liabilities to third parties. If our products or services were found to infringe on a third party’s proprietary rights, the Company could be required to enter into royalty or licensing agreements to continue selling its products or services. Royalty or licensing agreements, if required, may not be available on acceptable terms, if at all, which could seriously harm our business. Involvement in any patent dispute or other intellectual property dispute or action to protect trade secrets and expertise could have a material adverse effect on the Company’s business.

Significant increases in fuel prices for any extended periods of time will increase our operating expenses.

The price and supply of natural gas are unpredictable, and can fluctuate significantly based on international, political and economic circumstances, as well as other events outside of our control, such as changes in supply and demand due to weather conditions, actions by OPEC and other oil and gas producers, regional production patterns and environmental concerns. Natural gas is a significant component of our direct manufacturing costs and price escalations will likely increase our operating expenses and can have a negative impact on income from operations and cash flows. We operate in a competitive marketplace and may not be able to pass through all of the increased costs that could result from an increase in the cost of natural gas.

Environmental compliance costs and liabilities could reduce our earnings and cash available for operations.

We are subject to increasingly stringent laws and regulations relating to environmental protection, including laws and regulations governing air emissions, water discharges and waste management. The technical requirements of complying with these environmental laws and regulations are becoming increasingly expensive and complex, and may affect the Company’s ability to expand its operations. Our ability to continue the expansion of our manufacturing capacity to meet market demand is contingent upon obtaining required environmental permits and compliance with their terms, which continue to be more restrictive and require longer lead times to obtain in anticipation of any efforts to expand and increase capacity. We incur, and expect to continue to incur, capital and operating costs to comply with environmental laws and regulations.

In addition, we use some hazardous substances and generate certain industrial wastes in our operations. Many of our current and former properties are, or have been, used for industrial purposes. Accordingly, we could become subject

to potentially material liabilities relating to the investigation and cleanup of contaminated properties, and to claims alleging personal injury or property damage as the result of exposures to, or releases of, hazardous substances. These laws also may provide for “strict liability” for damages to natural resources or threats to public health and safety. Strict liability can render a party liable for environmental damage without regard to negligence or fault on the part of the party. Some environmental laws provide for joint and several strict liability for remediation of spills and releases of hazardous substances.

Stricter enforcement of existing laws and regulations, new laws and regulations, the discovery of previously unknown contamination or the imposition of new or increased requirements could restrict our expansion efforts, require us to incur costs, or become the basis of new or increased liabilities. Any of these events could reduce our earnings and our cash available for operations.

Our international operations subject us to risks inherent in doing business on an international level that could adversely impact our results of operations.

International revenues accounted for approximately 21%, 34% and 29% of our total revenues in 2017, 2016 and 2015, respectively. We may not succeed in overcoming the risks that relate to or arise from operating in international markets. Risks inherent in doing business on an international level include, among others, the following:

- economic and political instability (including as a result of the threat or occurrence of armed international conflict or terrorist attacks);
- potential declines or increased volatility in oil and natural gas prices that would adversely affect our customers, the energy industry or our production costs;
- changes in regulatory requirements, economic sanctions, tariffs, customs, duties and other trade barriers;
- transportation delays and costs;
- power supply shortages and shutdowns;
- difficulties in staffing and managing foreign operations and other labor problems;
- currency rate fluctuations, convertibility and repatriation;
- taxation of our earnings and the earnings of our personnel;
- potential expropriation of assets by foreign governments; and
- other risks relating to the administration of or changes in, or new interpretations of, the laws, regulations and policies of the jurisdictions in which we conduct our business.

Undetected defects in our fracture simulation software could adversely affect our business.

Despite extensive testing, our software could contain defects, bugs or performance problems. If any of these problems are not detected, the Company could be required to incur extensive development costs or costs related to product recalls or replacements. The existence of any defects, errors or failures in our software products may subject us to liability for damages, delay the development or release of new products and adversely affect market acceptance or perception of our software products or related services, any one of which could materially and adversely affect the Company's business, results of operations and financial condition.

The market price of our common stock will fluctuate, and could fluctuate significantly.

The market price of the Company's common stock will fluctuate, and could fluctuate significantly, in response to various factors and events, including the following:

- the liquidity of the market for our common stock;
- seasonal or quarterly sales fluctuations;
- differences between our actual financial or operating results and those expected by investors and analysts;
- changes in analysts' recommendations or projections;
- a substantial short position in our stock;
- new statutes or regulations or changes in interpretations of existing statutes and regulations affecting our business;
- changes in general economic or market conditions; and
- broad market fluctuations.

Our actual results could differ materially from results anticipated in forward-looking statements we make.

Some of the statements included or incorporated by reference in this Form 10-K are forward-looking statements. These forward-looking statements include statements relating to trends in the natural gas and oil industries, the demand for ceramic proppant and our performance in the "Management's Discussion and Analysis of Financial Condition and Results of Operations" and "Business" sections of this Form 10-K. In addition, we have made and may continue to make forward-looking statements in other filings with the SEC, and in written material,

press releases and oral statements issued by us or on our behalf. Forward-looking statements include statements regarding the intent, belief or current expectations of the Company or its officers. Our actual results could differ materially

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from those anticipated in these forward-looking statements, and our financial forecasts are particularly sensitive to changes in the current market conditions. Further, our financial forecasts have been less accurate during the recent downturn. See "Business–Forward-Looking Information."

The success of our business depends on achieving our strategic objectives, including the diversification of our product and service portfolio

As we continue to expand our portfolio of product and service offerings to industrial and other new markets, we face certain risks associated with these new business strategies, including unknown regulatory changes and product acceptance by these new markets, that could affect our future financial results. In addition, lower than expected sales in these new markets could have a material adverse effect on our results from operations and financial condition.

Item 1B. Unresolved Staff Comments

Not applicable.

Item 2. Properties

We maintain our corporate headquarters in leased office space in Houston, Texas and also lease space for our technology center in Houston. We own our manufacturing facilities, land and substantially all of the related production equipment in New Iberia, Louisiana, and Eufaula, Alabama, and lease our McIntyre, Toombsboro, and Millen, Georgia, facilities. We own the buildings and production equipment at our facility in Luoyang, China, and have been granted use of the land on which the facility is located through 2051 under the terms of a land use agreement with the People's Republic of China. The Luoyang, China facility was shut down during 2015, and we do not intend to resume production.

The facilities in McIntyre and Toombsboro, Georgia, include real property, plant and equipment that we lease from the Development Authority of Wilkinson County. The original lease was executed in 1997 and was last amended in 2008. The term of the current lease, which covers both locations was automatically extended through November 1, 2021. Under the terms of the lease, we are responsible for all costs incurred in connection with the premises, including costs of construction of the plant and equipment. At the termination of the lease, title to all of the real property, plant and equipment is to be conveyed to us in exchange for nominal consideration. We have the right to purchase the property, plant and equipment at any time during the term of the lease for a nominal price.

In November 2012, we entered into a lease with the Development Authority of Jenkins County for the land and improvements associated with the construction of a plant in Millen, Georgia. The lease term continues until the tenth anniversary of the completion of the last phase of the facility. Similar to lease terms of the two other Georgia facilities, the Millen lease requires us to be responsible for all costs (including construction costs) incurred in connection with the premises. Moreover, title to the real property, plant and equipment of the facility is to be conveyed to us at the end of the lease term for nominal consideration, and may be purchased by us at any time for a nominal price. We completed construction and commenced operations of the first 250 million pound ceramic production line in Millen during 2014. We began the construction on a second 250 million pound production line in Millen. However, due to current market conditions, the construction and completion of this second line has been

suspended until market conditions warrant completion.

The Marshfield, Wisconsin sand processing plant, which became operational during 2012, is located on land owned by us. We decided not to move forward with construction of a resin coating plant in Marshfield, Wisconsin for which we had previously developed engineering plans and procured certain equipment that had long-lead delivery times.

We own or otherwise utilize distribution facilities in multiple locations around the world. See “Item 1. Business – Distribution.”

We own approximately 4,618 acres of land and leasehold interests near our plants in Georgia and Alabama. The land contains raw material for use in the production of our lightweight ceramic proppants. We also hold approximately 113 acres of land and leasehold interests in Wisconsin.

AGPI owns its service facility located in Decatur, Texas, and leases other regional service facilities within the United States.

Item 3. Legal Proceedings

From time to time, we are the subject of legal proceedings arising in the ordinary course of business. We do not believe that any of these proceedings will have a material adverse effect on our business or our results of operations.

Item 4. Mine Safety Disclosure

Several of our U.S. manufacturing facilities process mined minerals, and therefore are viewed as mine operations subject to regulation by the federal Mine Safety and Health Administration under the Federal Mine Safety and Health Act of 1977. 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 the recently proposed Item 106 of Regulation S-K (17 CFR 229.106) is included in Exhibit 95 to this annual report.

PART II

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

Common Stock Market Prices, Dividends and Stock Repurchases

Our common stock is traded on the New York Stock Exchange (ticker symbol CRR). The number of record and beneficial holders of our common stock as of February 1, 2018 was approximately 11,515.

The following table sets forth the high and low sales prices of our common stock on the New York Stock Exchange and dividends for the last two fiscal years:

Quarter Ended	2017		Cash Dividends Declared	2016		Cash Dividends Declared
	Sales Price			Sales Price		
	High	Low		High	Low	
March 31	\$16.28	\$10.26	—	\$23.68	\$14.20	—
June 30	13.04	6.02	—	16.70	10.63	—
September 30	8.79	6.12	—	14.91	10.00	—
December 31	10.66	6.44	—	11.87	6.08	—

In January 2016, our Board of Directors suspended our policy of paying quarterly cash dividends, and there can be no assurance as to the payment of future dividends because they depend on future earnings, capital requirements and financial condition.

On January 28, 2015, our Board of Directors authorized the repurchase of up to two million shares of our common stock. Shares are effectively retired at the time of purchase. As of March 7, 2018, we had not repurchased any shares under this plan.

Securities Authorized for Issuance Under Equity Compensation Plans

For information regarding securities authorized for issuance under equity compensation plans, refer to “ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS” and “NOTE 10 — Stock Based Compensation” in the accompanying “Notes to Consolidated Financial Statements” in this Annual Report.

The following table provides information about our repurchases of common stock during the quarter ended December 31, 2017, all of which represent shares surrendered to us for tax withholding obligations upon the vesting of restricted stock:

ISSUER PURCHASES OF EQUITY SECURITIES

Period	Total Number	Average	Total Number of Shares	Maximum
	of Shares	Price Paid	Purchased as Part of Publicly	Number of

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	Purchased	per Share	Announced Plan (1)	Shares that May be Purchased Under the Plan (2)
10/01/17 to 10/31/17	514	(3)\$ 8.63	—	2,000,000
11/01/17 to 11/30/17	—	—	—	2,000,000
12/01/17 to 12/31/17	—	—	—	2,000,000
Total	514		—	

(1) On January 28, 2015, we announced the authorization by our Board of Directors for the repurchase of up to two million shares of our Common Stock.

(2) Represents the maximum number of shares that may be repurchased under the plan as of period end. As of March 7, 2018, a maximum of 2,000,000 shares may be repurchased under the plan.

(3) Represents shares of stock withheld for the payment of withholding taxes upon the vesting of restricted stock.

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Stock Performance Graph

The graph below compares the cumulative shareholder return on our common stock with the cumulative returns of the the S&P 500 index, and the S&P SmallCap 600 - Oil & Gas Equipment & Services index. The graph tracks the performance of a \$100 investment in our common stock and in each of the indexes (with the reinvestment of all dividends) from December 31, 2012 to December 31, 2017.

Item 6. Selected Financial Data

The following selected financial data are derived from our audited consolidated financial statements. The data should be read in conjunction with Management's Discussion and Analysis of Financial Condition and Results of Operations and the consolidated financial statements and notes thereto included elsewhere in this Form 10-K.

	Years ended December 31,				
	2017	2016	2015	2014	2013
	(\$ in thousands, except per share data)				
Statement of Income Data:					
Revenues	\$188,756	\$103,051	\$279,574	\$648,325	\$667,398
Cost of sales	242,081	188,065	335,699	467,045	474,403
Gross (loss) profit	(53,325)	(85,014)	(56,125)	181,280	192,995
Selling, general, & administrative expenses	42,533	39,984	62,199	72,535	68,447
Other operating expenses (income) (1)	152,525	904	44,908	15,890	(43)
Operating (loss) profit	(248,383)	(125,902)	(163,232)	92,855	124,591
Other (expense) income, net	(6,760)	(5,306)	(517)	16	610
(Loss) income before income taxes	(255,143)	(131,208)	(163,749)	92,871	125,201
Income tax (benefit) expense	(2,027)	(51,081)	(54,205)	37,283	40,315
Net (loss) income	\$(253,116)	\$(80,127)	\$(109,544)	\$55,588	\$84,886
(Loss) earnings per share:					
Basic	\$(9.49)	\$(3.29)	\$(4.76)	\$2.41	\$3.67
Diluted	\$(9.49)	\$(3.29)	\$(4.76)	\$2.41	\$3.67

	December 31,				
	2017	2016	2015	2014	2013
	(\$ in thousands, except per share data)				
Balance Sheet Data:					
Current assets	\$195,797	\$217,223	\$285,277	\$337,611	\$371,382
Current liabilities	42,431	34,804	70,290	77,415	56,688
Property, plant and equipment, net	324,186	494,103	537,731	568,716	478,535
Total assets	540,598	723,457	836,369	934,226	878,951
Total shareholders' equity	405,765	616,570	642,306	776,057	768,587
Cash dividends per share	—	—	\$0.63	\$1.26	\$1.14

(1) Other operating expenses primarily include gains/losses on disposal or impairment of assets. In 2017, it also included a loss on the sale of our Russian proppant business.

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

CARBO Ceramics Inc. is a technology company that generates revenue primarily through the sale of products and services to the global oil and natural gas industry for production enhancement and environmental products and services, and through the sale of products and services to industrial market segments.

The Company conducts its business within two operating segments: 1) Oilfield Technologies and Services and 2) Environmental Products and Services. These two operating segments provide products and services to several market segments in the oil and gas, and the industrial markets. Our Environmental Products and Services segment is limited to production and sales by our AGPI subsidiary.

Our Oilfield Technologies and Services segment includes the manufacturing and selling of proppant products for use primarily in the hydraulic fracturing of oil and natural gas wells, FracPro software for the design of fracture treatments, and StrataGen consulting services for the optimization of well completions. These products include ceramic proppant and raw frac sand. Our manufacturing facilities also produce ceramic pellets for use in various industrial technology applications, including but not limited to, casting and milling. We also have begun plant trials at our manufacturing facilities to produce products other than base ceramic proppant. Those mineral processing plant trials have proven successful and have led to increased revenue generation. Through our wholly-owned subsidiary StrataGen, Inc., we promote increased operators' production and EUR by providing one of the industry's most widely used hydraulic fracture simulation software under the brand FracPro, as well as hydraulic fracture design and consulting services under the brand StrataGen. Our Environmental Products and Services segment, through AGPI, a wholly-owned subsidiary of ours, uses proprietary technology to provide products that are designed to enable its clients to extend the life of their storage assets, reduce the potential for hydrocarbon spills and provide containment of stored materials. This business is intended to protect operators' assets, minimize environmental risk, and lower LOE.

Our products and services help oil and gas producers increase production and recovery rates from their wells, thereby lowering overall finding and development costs. As a result, our business is dependent to a large extent on the level of drilling and hydraulic fracturing activity in the oil and gas industry worldwide. Although our ceramic proppants are more expensive than alternative non-ceramic proppants, we have been able to demonstrate the cost-effectiveness of our products to numerous operators of oil and gas wells by marketing our technical expertise. We believe our future prospects benefit from both an increase in drilling and hydraulic fracturing activity worldwide and the desire of industry participants to improve production results and lower their overall development costs.

Our ceramic media for use in various industrial technology applications improve the quality of end products and industrial processes primarily in the casting and milling markets. We believe growth in our industrial business will in part benefit from recent changes in the regulatory environment, a corresponding conversion to ceramic media, and our expanded product portfolio.

International revenues represented 21%, 34% and 29% of total revenues in 2017, 2016 and 2015, respectively.

Operating profit margin for our ceramic proppant business is principally impacted by sales volume, product mix, sales price, distribution costs, manufacturing costs, including natural gas, and our production levels as a percentage of our capacity. The level of selling, general and administrative spending, as well as other operating expenses, can also impact operating profit margins.

As a result of the depressed commodity price for oil during 2017, there has been a negative impact on industry activity levels which has in turn negatively impacted the demand for ceramic proppant, so we continue to focus on cash preservation and cost reduction strategies. Beginning in 2015, we slowed and idled proppant production to assist in

managing cash and inventory levels. We mothballed our proppant facility in Millen, Georgia and McIntyre, Georgia and shut down our facility in Luoyang, China. However, we are now utilizing our McIntyre, Georgia facility only in a limited capacity primarily to supply the industrial market. These events resulted in significant negative impact to the financial results of our operations. Additionally, we suspended completion of two large construction projects. We suspended completion of the second production line at Millen, Georgia indefinitely, and we are exploring ways to monetize these assets. We also suspended completion of the second phase of the retrofit of our Eufaula, Alabama plant with our new KRYPTOSPHERE® technology until such time that market conditions improves enough to warrant completion. During the three months ended September 30, 2017, we recorded an impairment on the Millen, Georgia facility. As of December 31, 2017, the value of the projects relating to these two assets totaled approximately 85% of the Company's total construction in progress and we estimate that both projects are over 90% complete. See "Item 1 - Business" and "Item 1A - Risk Factors".

Although most direct manufacturing expenses have been relatively stable or predictable over time, we have experienced volatility in the cost of natural gas, which is used in production by our manufacturing facilities. The cost of natural gas has been a significant component of total monthly direct production expense. In recent years, the price of natural gas has been low compared to historical

prices, as well as fairly stable from period to period. However, in an effort to mitigate volatility in the cost of natural gas purchases and reduce exposure to short term spikes in the price of this commodity, we contract in advance for portions of our future natural gas requirements. Our gas contract commitments can extend several years into the future. Despite the efforts to reduce exposure to changes in natural gas prices, it is possible that, given the significant portion of manufacturing costs represented by this item, gross margins as a percentage of sales may decline and changes in revenue may not directly correlate to changes in net income. Due to the severe decline in industry activity beginning in early 2015, we significantly reduced production levels and consequently did not take delivery of all of the contracted natural gas quantities. As a result, we have accounted for the relevant contracts as derivative instruments.

General Business Conditions

Our Oilfield Technologies and Services segment is impacted by the number of natural gas and oil wells drilled in North America, and the need to hydraulically fracture these wells. In markets outside North America, sales of our products are also influenced by the overall level of drilling and hydraulic fracturing activity. Furthermore, because the decision to use ceramic proppant is based on comparing the higher initial costs to the future value derived from increased production and recovery rates, our business is influenced by the current and expected prices of natural gas and oil.

Beginning in late 2014, a severe decline in oil and continued decline in natural gas prices led to a significant decline in oil and natural gas industry drilling activities and capital spending. During 2017, however, the average price of West Texas Intermediate (“WTI”) crude oil rose 18% to \$50.88 per barrel compared to \$43.14 per barrel in 2016. The average North American rig count also rose 69% in 2017 to 1,081 rigs compared to 640 rigs in 2016. Despite these improvements, E&P operators continued to use lowest-cost completions, a trend that we expect to continue in 2018, as our customers remain under pressure to consider lower cost alternatives, notwithstanding the superior performance results of our products. These events, along with an oversupplied ceramic proppant market and depressed oil and natural gas prices, kept demand and average prices low for our proppants.

Current demand for proppant is extremely dynamic. In addition to rig counts and commodity prices, our results of operations are also significantly affected by a host of other factors, including but not limited to (a) completion activity, which is not necessarily correlated with rig count, (b) customer preferences, (c) new product and technology adoption, (d) imports and competition, (e) changes in the product mix of what we sell, (f) costs of developing our products and services and running our business, and (g) changes in our strategy and execution.

Beginning early in 2015, we implemented a number of initiatives to preserve cash and lower costs, including: (1) reducing workforce across our organization, (2) lowering our production output levels in order to align with lower demand, including through idling and mothballing of some of our production facilities (3) limiting capital expenditures and (4) eliminating dividends. In 2016, we idled the majority of the production activities at our New Iberia, Louisiana plant until such time as market conditions warrant bringing them back online. Our facility in Millen, Georgia remains idled due to market conditions. However, in late 2016 we recommenced processing at our Marshfield, Wisconsin sand processing facility. Our remaining plants remain at reduced output levels. As a result of operating some of our plants below their normal production capacity, we expensed \$40.7 million of production overhead costs in excess of amounts that would have been allocated to each unit of production at normal production levels. We continue to rationalize headcount as needed.

During the third quarter of 2017, we closed on the sale of our Russian proppant business and received gross proceeds of \$22.0 million. We expect to receive additional proceeds on the sale of approximately \$4.0 million related to net debt and net working capital purchase price adjustments. Although we remain in active discussions with the buyer regarding the purchase price adjustments, in January 2018, we filed a Notice of Arbitration related to this purchase

price adjustment against the buyer. Loss on the sale was \$26.7 million, which included the reclassification of \$33.3 million of foreign currency cumulative translation loss from shareholders' equity and approximately \$1.6 million expenses related to the sale. Net assets included in the calculation of the loss on the sale were \$17.8 million.

The Company's Environmental Products and Services segment is also impacted by the global drilling and hydraulic fracturing activity, and has been negatively impacted by the significant decline in oil and natural gas industry drilling activities and capital spending.

Critical Accounting Policies

Our Consolidated Financial Statements are prepared in accordance with accounting principles generally accepted in the U.S., which require us to make estimates and assumptions (see Note 1 to the Consolidated Financial Statements). We believe that, of our significant accounting policies, the following may involve a higher degree of judgment and complexity.

Revenue is recognized when title passes to the customer (generally upon delivery of products) or at the time services are performed. We generate a significant portion of our revenues and corresponding accounts receivable from sales to the petroleum pressure pumping industry. In addition, we generate a significant portion of our revenues and corresponding accounts receivable from sales to two major customers, both of which are in the petroleum pressure pumping industry. As of December 31, 2017, approximately 26% of the balance in trade accounts receivable was attributable to those two customers. We record an allowance for doubtful accounts based on our assessment of collectability risk and periodically evaluate the allowance based on a review of trade accounts receivable. Trade accounts receivable are periodically reviewed for collectability based on customers' past credit history and current financial condition, and the allowance is adjusted, if necessary. If the economic downturn in the petroleum pressure pumping industry worsens or does not materially improve or, for some other reason, any of our primary customers were to experience significant adverse conditions, our estimates of the recoverability of accounts receivable could be reduced by a material amount and the allowance for doubtful accounts could be increased by a material amount. As of December 31, 2017, the allowance for doubtful accounts totaled \$1.6 million.

We value inventory using the weighted average cost method. Assessing the ultimate realization of inventories requires judgments about future demand and market conditions. We regularly review inventories to determine if the carrying value of the inventory exceeds market value and we record an adjustment to reduce the carrying value to market value, as necessary. Future changes in demand and market conditions could cause us to be exposed to additional obsolescence or slow moving inventory. If actual market conditions are less favorable than those projected by management, lower of cost or market adjustments may be required. There was no lower of cost or market inventory adjustment for the year ended December 31, 2017. We recorded a \$1.5 million lower of cost or market inventory adjustment for the year ended December 31, 2016.

Income taxes are provided for in accordance with ASC Topic 740, "Income Taxes". This standard takes into account the differences between financial statement treatment and tax treatment of certain transactions. Deferred tax assets ("DTAs") and liabilities ("DTLs") are recognized for the future tax consequences attributable to differences between the financial statement carrying value of existing assets and liabilities and their respective tax bases. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect of a change in tax rates is recognized as income or expense in the period that includes the enactment date. This calculation requires us to make certain estimates about our future operations. Changes in state, federal and foreign tax laws, as well as changes in the Company's financial condition, could affect these estimates.

Accounting Standards Codification ("ASC") Topic 740, Income Taxes, provides the carrying value of DTAs should be reduced by the amount not expected to be realized. A company should reduce deferred tax assets by a valuation allowance if, based on the weight of all available evidence, it is no longer more likely than not that some portion or all of the deferred tax assets will be realized. The valuation allowance should be sufficient to reduce the deferred tax asset to the amount that is more likely than not to be realized. ASC 740 requires all available evidence, both positive and negative, be considered to determine whether a valuation allowance for deferred tax assets is needed in the financial statements. Additionally there can be statutory limitations and losses also assessed on the deferred tax assets should certain conditions arise.

As a result of the significant decline in oil and gas activities and net losses incurred over the past several quarters, we determined during the year ending December 31, 2017 that it was more likely than not that a portion of our deferred tax assets will not be realized in the future. Accordingly, we established a \$52.7 million valuation allowance against our deferred tax assets. Our assessment of the realizability of our deferred tax assets is based on the weight of all available evidence, both positive and negative, including future reversals of deferred tax liabilities. Income tax benefit

was \$2.0 million, or 0.8% of pretax loss, for the year ending December 31, 2017 compared to income tax benefit of \$51.1 million, or 38.9% of pretax loss, for the same period in 2016. The decrease was primarily due to the valuation allowance recorded against our deferred tax assets.

Long-lived assets, which include net property, plant and equipment, goodwill, intangibles and other long-term assets, comprise a significant amount of the Company's total assets. The Company makes judgments and estimates in conjunction with the carrying values of these assets, including amounts to be capitalized, depreciation and amortization methods and useful lives. Additionally, the carrying values of these assets are periodically reviewed for impairment or whenever events or changes in circumstances indicate that the carrying amounts may not be recoverable. An impairment loss is recorded in the period in which it is determined that the carrying amount is not recoverable. This requires the Company to make long-term forecasts of its future revenues and costs related to the assets subject to review. These forecasts require assumptions about demand for the Company's products and services, future market conditions and technological developments. Significant and unanticipated changes to these assumptions could require a provision for impairment in a future period.

As of September 30, 2017, the Company concluded that the Company's Toombsboro and Millen, Georgia facilities should no longer be evaluated together as a group of assets because the facilities are no longer interchangeable and will no longer manufacture like products. As a result of the sustained and long-term shift away from base ceramic proppant to less expensive frac sand, the

Company has made a strategic decision to focus on growing technology, industrial and mineral processing revenue streams. Our Toombsboro, Georgia plant is being repurposed to produce technology and industrial products, as well as for use in toll processing of minerals. Our Millen, Georgia facility is currently only able to produce base ceramic proppants, but given our current long-term outlook on base ceramic proppant demand, we do not expect to utilize this plant to produce base ceramic proppant. We are currently evaluating opportunities to monetize our assets at our Millen facility. As a result, we evaluated the Toombsboro and Millen, Georgia plants separately for indicators of impairment during the third quarter of 2017.

Given the change in the asset groupings of the two facilities and lack of estimated future cash flows associated with the base ceramic production at the Millen, Georgia facility, the Company identified indicators of impairment at the Millen, Georgia facility as of September 30, 2017. The Company determined that the projected cash flows attributable to our Millen, Georgia facility did not exceed the carrying value of the assets; therefore the Company concluded there was an impairment at that facility. The Company engaged the services of a third party consulting firm to assist with the determination of the fair value of the related assets and concluded that the assets were impaired. The key assumptions and inputs impacting the fair value include third party commentary with respect to the property and equipment at our Millen, Georgia facility. For machinery and equipment and construction in progress, we used a cost approach to estimate the valuation. We applied a 65 percent downward adjustment to calculated replacement cost based on an analysis of construction documents and historical expenditures to remove non-saleable soft costs such as engineering and installation that would have no value to a market participant. Based on discussions with market participants, a salvage value multiplier ranging from 12 percent to 50 percent of the remaining replacement cost basis was applied to arrive at the estimated fair value for the machinery and equipment and construction in progress subject to impairment. For real property, the value of comparable property ranged from approximately \$30 to \$40 per square foot, and the concluded value of the property at the Millen, Georgia facility was approximately \$35 per square foot. We applied a 94% downward adjustment to the calculated value from a cost approach for the buildings and site improvements as a representation of economic obsolescence. As a result, during the three months ended September 30, 2017, we recognized a \$125.8 million impairment of long-lived assets, primarily relating to machinery and equipment and construction in progress. As of December 31, 2017, the remaining carrying value of the impaired assets at the Millen facility was approximately \$18.5 million.

As of December 31, 2017, there were no indicators of additional impairment. We continue to monitor whether or not events or circumstances would indicate that the carrying value of any of our long-lived assets might not be recoverable.

At December 31, 2016, as a result of the continued severity of the market downturn, the Company identified indicators of impairments related to each of its domestic manufacturing plant asset groups. The Company completed undiscounted cash flow analyses on that date and determined no impairment charge was necessary at that time. During the year ended December 31, 2015, as a result of worsening conditions in the oil and natural gas industry during the fourth quarter of 2015, we recorded a \$43.7 million impairment of long-lived assets, primarily relating to machinery and equipment at our McIntyre, Georgia manufacturing plant and our Marshfield, Wisconsin sand processing facility. As of December 31, 2017, the remaining carrying value of machinery and equipment relating to those previously impaired facilities was approximately \$3.1 million.

We account for certain natural gas contracts as derivative instruments, which requires us to recognize the gas contracts as either assets or liabilities at fair value with an offsetting entry in earnings. We use the income approach in determining the fair value of our derivative instruments. The model used considers the difference, as of each balance sheet date, between the contracted prices and the New York Mercantile Exchange (“NYMEX”) forward strip price for each contracted period. The estimated cash flows from these contracts are discounted using a discount rate of 8.0%, which reflects the nature of the contracts as well as the timing and risk of estimated cash flows associated with the contracts. The discount rate had an immaterial impact on the fair value of the contracts for the year ended December

31, 2017. The last natural gas contract will expire in December 2018. During the year ended December 31, 2017 and 2016, we recognized a loss on derivative instruments of \$0.9 million and a gain on derivative instruments of \$1.9 million, respectively, in cost of sales. As of December 31, 2017, gas contracts covering 1,680,000 MMBtu are subject to accounting as derivative instruments. Future decreases in the NYMEX forward strip prices will result in additional derivative losses while future increases in the NYMEX forward strip prices will result in derivative gains. Future gains or losses will approximate the change in NYMEX natural gas prices relative to the total quantity of natural gas under contracts subject to accounting as derivatives.

Low production levels triggered the component of our inventory accounting policy relating to operating at production levels below normal capacity. To determine the amount of production costs that we expense during each period, the Company allocates fixed production overheads to the costs of conversion based on the normal capacity of each production facility, generally considered to be 65% of a facility's stated capacity or higher.

When a production facility operates at normal capacity, all of its fixed production overheads are allocated to costs of conversion of each product manufactured, based on the actual level of production. This determination is made facility-by-facility on a monthly basis in order to calculate the initial measurement value to recognize as cost of goods produced in a month by a given facility.

When a facility's total production in a month drops below 65% of its normal capacity, it is considered to be operating at an abnormally low production level. In such cases, each unit of production receives an allocation of fixed overheads in the amount that would have been allocated at the lower-end of normal capacity. The remaining unallocated excess fixed overhead cost for the facility is recognized as expense in the period and classified as Cost of Sales.

Materials are the only variable component of production. Plant labor and all other overhead costs incurred in the production of the Company's products are either semi-fixed or fixed in nature, therefore all are included in the monthly evaluation of costs allocable to costs of conversion at normal capacity.

The Company maintains a rate for each production facility that represents the maximum fixed production overhead cost per unit of production allocable to costs of conversion. The rates are based on an analysis of a recent historical period considered representative of a normal operating environment in which the facility operated at normal capacity. The maximum rate is calculated by recasting the fixed production overhead cost per unit of production on a pro forma basis as if the facility had operated at the lower-end threshold of its range of normal capacity, generally 65% of stated capacity. The current rates are based on 2014 as the representative year. Implied in this method is the assumption that 2014 production costs relative to sales prices yield a normal profit margin. A significant, permanent deterioration in the average selling prices of the Company's products could result in a significant lowering of the rates, thereby increasing the periodic charge. The most recent period in which normal capacity was achieved was the year-ended December 31, 2014.

Results of Operations

Net Loss

		Percent		Percent	
(\$ in thousands)	2017	Change	2016	Change	2015
Net Loss	\$(253,116)	(216)%	\$(80,127)	27%	\$(109,544)

For the year ended December 31, 2017, we reported net loss of \$253.1 million, which was 216% larger than the \$80.1 million net loss reported in the previous year. Net loss in 2017 was driven by a \$125.8 million loss on disposal or impairment of assets and a \$26.7 million loss on the sale of our Russian proppant business. Excluding the impact of income taxes, the loss on disposal or impairment of assets, and the loss on the sale of our Russian proppant business, net loss in 2017 improved by \$29.5 million, or 22%, primarily due to a 69% increase in the North American rig count which resulted in higher ceramic proppant sales volumes, including an increase in technology sales volumes. In addition, slowing and idling costs were reduced by \$6.7 million, and severance costs were \$6.1 million lower as compared to 2016. For the year ended December 31, 2016, there was also a \$1.5 million railcar lease termination fee and \$1.5 million lower of cost or market inventory adjustment, neither of which reoccurred in 2017.

For the year ended December 31, 2016, we reported net loss of \$80.1 million, a decrease of 27% compared to the \$109.5 million net loss reported in the previous year. Operations in 2016 continued to be negatively impacted by the severe decline in the oil and natural gas industry. Net loss in 2016 was impacted by a 45% reduction in the North American rig count which resulted in lower ceramic proppant sales volumes, a decrease in the average selling price of ceramic proppant, and \$47.3 million in production costs expensed as a result of low production levels and idled and mothballed facilities. Further impacting net loss were \$6.4 million in severance costs, \$1.5 million of lower of cost or

market inventory adjustments, and a \$1.5 million railcar lease termination fee. Net loss was partially offset by actions taken throughout 2016 to reduce our cost base and a \$1.9 million gain on natural gas derivative instruments.

Individual components of financial results by reportable operating segment are discussed below.

Revenues

		Percent		Percent	
(\$ in thousands)	2017	Change	2016	Change	2015
Consolidated revenues	\$188,756	83 %	\$103,051	(63)%	\$279,574
Revenues by operating segment:					
Oilfield Technologies and Services	\$165,557	85 %	\$89,351	(65)%	\$257,373
Environmental Products and Services	\$23,199	69 %	\$13,700	(38)%	\$22,201

Oilfield Technologies and Services segment revenues of \$165.6 million for the year ended December 31, 2017 increased 85% compared to \$89.4 million in 2016. The increase was mainly attributable to an increase in ceramic technology product sales and an

increase in frac sand sales. These increases were largely attributable to a 69% increase in the North American rig count and an 18% increase in oil prices.

Oilfield Technologies and Services segment revenues of \$89.4 million for the year ended December 31, 2016 decreased 65% compared to \$257.4 million in 2015. The decrease was mainly attributable to a decrease in proppant sales volumes, in conjunction with market-driven declines in the average selling prices of proppant, both which are presented in the table below. The decline in ceramic sales volume was largely attributable to a 45% reduction in the North American rig count and depressed oil prices and the resulting negative impact on industry activity levels, along with E&P operators continuing to use a higher percentage of raw frac sand as an alternative to proppant due to its lower cost.

Worldwide proppant sales volumes were as follows.

Product Sales Volumes (Volumes in million pounds)	For the years ended December 31,					
	2017		2016		2015	
	Volumes	Price \$ lb	Volumes	Price \$ lb	Volumes	Price \$ lb
Ceramic	389	\$0.27	356	\$0.22	818	\$0.27
Resin Coated Sand	—	—	—	—	19	0.19
Northern White Sand	2,190	0.02	311	0.02	819	0.03
Total	2,579	0.06	667	0.13	1,656	\$0.15

North American (defined as Canada and the U.S.) ceramic proppant sales volume increased 25% in 2017 compared to 2016. International (excluding Canada) ceramic proppant sales volume decreased 13% in 2017 compared to 2016, primarily due to decreases in Russia.

North American (defined as Canada and the U.S.) ceramic proppant sales volume decreased 67% in 2016 compared to 2015. International (excluding Canada) ceramic proppant sales volume decreased 19% in 2016 compared to 2015, primarily due to decreases in Europe, Latin America, and China, partially offset by an increase in Russia.

All of our Northern White Sand sales are in North America.

Environmental Products and Services segment revenues of \$23.2 million for the year ended December 31, 2017 increased 69% compared to \$13.7 million in 2016. These increases were mainly attributable to a strengthening commodity price environment and the resulting positive impact on industry activity levels. Environmental Products and Services segment revenues of \$13.7 million for the year ended December 31, 2016 decreased 38% compared to \$22.2 million in 2015. The decrease was mainly attributable to the depressed commodity price environment and the resulting negative impact on industry activity levels.

Gross (Loss) Profit

(\$ in thousands)	2017	Percent		Percent	
		Change	2016	Change	2015

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Consolidated gross loss	\$(53,325)	37	%	\$(85,014)	(51)	%	\$(56,125)
Consolidated as a % of revenues	(28)		%	(82)		%	(20)
Gross loss by operating segment:							
Oilfield Technologies and Services	\$(56,397)	34	%	\$(84,866)	(44)	%	\$(58,801)
Oilfield Technologies and Services %	(34)		%	(95)		%	(23)
Environmental Products and Services	\$3,072	2176	%	\$(148)	(106)	%	\$2,676
Environmental Products and Services %	13		%	(1)		%	12

Our cost of sales related to our Oilfield Technologies and Services segment consists of manufacturing costs, packaging and transportation expenses associated with the delivery of our products to our customers and handling costs related to maintaining finished goods inventory and operating our remote stocking facilities. Variable manufacturing costs include raw materials, while labor, utilities and repair and maintenance supplies are semi-fixed. Fixed manufacturing costs include depreciation, property taxes on production facilities, insurance and factory overhead.

Oilfield Technologies and Services segment gross loss for the year ended December 31, 2017 was \$56.4 million, or (34)% of revenues, compared to gross loss of \$84.9 million, or (95)% of revenues, for 2016. The improvement in gross loss in 2017 was primarily attributable to the strengthening commodity price environment and the resulting positive impact on industry activity levels. Improved gross loss was further impacted by lower slowing and idling production costs, lower severance and other charges, and a

railcar lease termination fee and inventory adjustment in 2016 that did not reoccur in 2017. We expect to incur slowing and idling production costs in the future until our production levels return to normal capacity.

Oilfield Technologies and Services segment gross loss for the year ended December 31, 2016 was \$84.9 million, or (95)% of revenues, compared to gross loss of \$58.8 million, or (23)% of revenues, for 2015. Gross loss in 2016 was primarily the result of a 56% decline in worldwide ceramic proppant sales volumes and a decrease in the average selling price of ceramic proppant, resulting in a 65% decrease in revenues. Also negatively affecting gross loss during 2016 was \$47.3 million in production costs that were not offset by increases in revenue, as a result of low production levels and idled and mothballed facilities. Gross loss was further impacted by \$6.2 million in severance costs, a \$1.5 million lower of cost or market inventory adjustment, and a \$1.5 million railcar lease termination fee to preserve cash in future years for unused railcars. Gross loss was partially offset by a \$1.9 million gain on natural gas derivative instruments.

Environmental Products and Services segment gross profit for the year ended December 31, 2017 was \$3.1 million, or 13% of revenues, compared to gross loss of \$0.1 million, or (1)% of revenues, for 2016. This increase in gross profit were primarily the result of the strengthening commodity price environment and the resulting positive impact on industry activity levels. Environmental Products and Services segment gross loss for the year ended December 31, 2016 was \$0.1 million, or (1)% of revenues, compared to gross profit of \$2.7 million, or 12% of revenues, for 2015. This decrease in gross profit were primarily the result of the depressed commodity price environment and the resulting negative impact on industry activity levels.

Consolidated cost of sales for the years ended December 31, 2017, 2016 and 2015 included the following:

(In thousands)	2017	2016	2015
Primary cost of sales	\$200,213	\$133,431	\$274,554
Slowing and idling production	40,664	47,318	33,724
Loss (gain) on derivative instruments	917	(1,886)	15,040
Railcar lease termination fee	—	1,500	—
Lower of cost or market inventory adjustment	—	1,515	4,546
Severance and other charges	287	6,187	7,835
Total Cost of Sales	\$242,081	\$188,065	\$335,699

Selling, General & Administrative (SG&A) and Other Operating Expenses

		Percent		Percent	
(\$ in thousands)	2017	Change	2016	Change	2015
Consolidated SG&A and start-up	\$42,533	6 %	\$39,999	(37)%	\$62,996
Consolidated as a % of revenues	23 %		39 %		23 %
Consolidated loss on disposal or impairment of assets	\$125,778	14048 %	\$889	(98)%	\$44,111
Loss on sale of Russian proppant business	\$26,747		\$—		\$—
SG&A and start-up by operating segments:					
Oilfield Technologies and Services	\$39,403	7 %	\$36,908	(36)%	\$57,738
Oilfield Technologies and Services %	24 %		41 %		22 %
Environmental Products and Services	\$3,130	1 %	\$3,091	(41)%	\$5,258
Environmental Products and Services %	13 %		23 %		24 %

Oilfield Technologies and Services segment SG&A was \$39.4 million for the year ended December 31, 2017 compared to \$36.9 million for 2016. The increase in SG&A expenses primarily resulted from an increase in sales and marketing expenses to support the growth of this segment. Consolidated loss on disposal or impairment of assets in 2017 consisted of a \$125.8 million impairment of our Millen, Georgia proppant manufacturing facility. Consolidated loss on sale of Russian proppant business of \$26.7 million was related to the sale of our Russian proppant business. As a percentage of revenues, Oilfield Technologies and Services segment SG&A expenses for 2017 decreased to 24% compared to 41% in 2016, primarily due to the increase in revenues.

Oilfield Technologies and Services segment SG&A and start-up expenses was \$36.9 million for the year ended December 31, 2016 compared to \$57.7 million for 2015. The decrease in SG&A expenses primarily resulted from actions we took during 2015 to reduce our cost base and preserve cash in light of the severe decline in the oil and natural gas industry. These savings were partially offset by \$0.2 million in SG&A related severance costs in 2016. Consolidated loss on disposal or impairment of assets in 2016 consisted of \$1.1 million impairment of the long-term portion of bauxite raw materials partially offset by \$0.2 million gain on disposal

of assets. As a percentage of revenues, Oilfield Technologies and Services segment SG&A and start-up expenses for 2016 increased to 41% compared to 22% in 2015, primarily due to the decrease in revenues.

Environmental Products and Services segment SG&A of \$3.1 million for the year ended December 31, 2017 was flat compared to 2016. Environmental Products and Services segment SG&A of \$3.1 million for the year ended December 31, 2016 decreased 41% compared to \$5.3 million in 2015. This decrease was primarily the result of actions we took, beginning in 2015, to reduce our cost base and preserve cash in light of the severe decline in the oil and natural gas industry.

Income Tax Benefit

	Percent		Percent		
(\$ in thousands)	2017	Change	2016	Change	2015
Income Tax Benefit	\$(2,027)	(96)%	\$(51,081)	(6)%	\$(54,205)
Effective Income Tax Rate	0.8 %		38.9 %		33.1 %

Income taxes are not allocated between our operating segments. Consolidated income tax benefit was \$2.0 million, or 0.8% of pretax loss, for the year ended December 31, 2017 compared to \$51.1 million, or 38.9% of pretax loss for 2016 and \$54.2 million, or 33.1% of pretax loss for 2015. Net operating losses generated in 2015 were carried back to 2013 and 2014. Net operating losses generated in 2016 and 2017 are carried forward, a portion of which are reserved by a valuation allowance in 2017. As a result of the net operating loss in 2015, we lost the benefit of our Section 199 manufacturing deduction, which negatively impacted the effective tax rate for 2015. In 2016, the effective tax rate increased as it normalized and due to a change in election for certain foreign tax credits. In 2017, the effective tax rate was significantly lower due to the application of the valuation allowance.

Outlook

A key goal in 2018 is continued progress on our transformation strategy to diversify revenue streams. It is our belief that execution on this transformation strategy will result in profitable growth and positive cash from operating activities. Although we expect that weather will impact the first half of 2018, we believe our revenue and operating cash will show improvement in the first half of 2018 compared to the first half of 2017.

We believe revenues will grow in 2018. We expect revenues from both of our operating segments should follow industry activity. Within both segments, we believe revenue from industrial markets should see strong double-digit growth year over year.

If the recent strengthening in oil price continues in 2018, we believe base ceramic demand could improve in 2018. In addition, based on early indications from clients, we believe ceramic technology sales will increase in our KRYPTOSPHERE and GUARD family of products. We anticipate KRYPTOSPHERE HD sales will be down slightly in 2018 due to a decrease in Gulf of Mexico activity, while KRYPTOSPHERE LD sales should exhibit steady growth globally. SCALEGUARD, a scale-inhibiting production assurance product, continues to be successful due to its ability to prevent scale buildup and lower lease operating expense for E&P operators. The pipeline of opportunities is promising and we have been awarded additional work in 2018 for a customer's Permian basin wells, which should result in increased revenues compared to 2017.

Regarding our sand business, first sales for our North East project began in January. We will continue to utilize various business models, including an 'asset-lite' model like this, to serve client demand.

We achieved steady growth in our industrial ceramics business during 2017, and we believe we will, while we continue to seek opportunities to monetize other businesses, continue to grow this business significantly in 2018 and well into the foreseeable future. It is important that we continue to expand in the markets we serve today as well as develop new markets and continue to develop new products specifically designed for industrial markets. We expect to add additional resources in 2018 to meet our objectives to grow this business by strong double digits again in 2018.

We expect to develop additional contract manufacturing opportunities in mineral processing during 2018 for our underutilized manufacturing plants. Recently, we signed a multi-year agreement to toll process an agricultural product.

Our Environmental Products and Services segment bounced back from the weather impacts of the third quarter of 2017. Given that the results in this segment tend to correlate to results in the Oil and Gas sector, we believe it should also follow industry activity in 2018. In addition, we are targeting revenue streams in the Industrial sector and expect strong year-over-year growth in those sales.

We believe growth of industrial ceramic and technology sales, broader sources of revenue, an improving commodity price environment and a corresponding increase in industry activity will improve our results of operations in 2018. This view, including increased demand for our products, is based on changing industry conditions and interactions with our customers. Despite our outlook for an improved operating environment in 2018, we have found generating accurate financial forecasts in the industry downturn has been difficult.

In addition, we continue to explore certain asset monetization opportunities to further strengthen the balance sheet.

Liquidity and Capital Resources

At December 31, 2017, we had cash and cash equivalents and restricted cash of \$78.4 million compared to cash and cash equivalents and restricted cash of \$91.7 million at December 31, 2016. During the year ended December 31, 2017, we received net proceeds of \$21.2 million relating to the sale of our Russian proppant business, and net cash provided by financing activities was \$6.3 million. Uses of cash included \$38.8 million in operating activities and \$2.2 million for capital expenditures. There were no major capital spending projects in 2017. Capital spending in 2017 primarily related to various plant maintenance as well as equipment purchases for our consulting and environmental businesses.

We estimate our total capital expenditures in 2018 will be less than \$5.0 million. Due to market conditions, the completion of the second line at the manufacturing facility in Millen, Georgia and the second phase of a plant retrofit with new KRYPTOSPHERE® technology have been suspended until such time that market conditions warrant completion. Currently, we do not intend to complete the second line at the Millen, Georgia facility.

The Company anticipates that cash on hand will be sufficient to meet planned operating expenses and other cash needs for the next 12 months from the date of this Form 10-K. The Company's view regarding sufficiency of cash and liquidity is primarily based on our financial forecast for 2018, which is impacted by various assumptions regarding demand and sales prices for our products. Generally, we expect demand for our products and the sales prices to increase in 2018 compared to 2017. Although we have observed certain factors in the fourth quarter 2017 that support improving industry conditions, our financial forecasts are based on estimates of customer demand, which is highly volatile in the current operating environment, and we have no committed sales backlog with our customers. As a result, there is inherent uncertainty in our forecasts.

Off-Balance Sheet Arrangements

We had no off-balance sheet arrangements as of December 31, 2017.

Contractual Obligations

The following table summarizes our contractual obligations as of December 31, 2017:

(\$ in thousands)	Total	Payments due in period			More than 5 years
		Less than 1 year	1 - 3 years	3 - 5 years	
Long-term debt obligations	\$92,040	—	\$27,040	\$65,000	\$—
Capital lease obligations	—	—	—	—	—
Operating lease obligations:					

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- Primarily railroad equipment (net of subleases)	94,627	11,404	28,511	30,052	24,660
Purchase obligations:					
- Natural gas contracts	9,334	9,334	—	—	—
- Raw materials contracts	11,200	5,600	5,600	—	—
Other long-term obligations	—	—	—	—	—
Total contractual obligations	\$207,201	\$26,338	\$61,151	\$95,052	\$24,660

See Note 3, Note 5, and Note 15 to the Notes to the Consolidated Financial Statements.

Operating lease obligations relate primarily to railroad equipment leases and include leases of other property, plant and equipment.

We use natural gas to power our manufacturing plants. From time to time, we enter into contracts to purchase a portion of the anticipated natural gas requirements at specified prices. As of December 31, 2017, the last such contract was due to expire in December 2018.

We have entered into contracts to supply raw materials, primarily kaolin, bauxite, slurry and various forms of sand, to our manufacturing plants. Four outstanding contracts do not require us to purchase minimum annual quantities, but do require the purchase of minimum annual percentages, ranging from 50% to 100% of the respective plants' requirements for the specified raw materials. Three outstanding contract requires us to purchase a minimum annual quantity of frac sand. Each of the contracts is described in Note 15 to the Notes to the Consolidated Financial Statements.

Item 7A. Quantitative and Qualitative Disclosures about Market Risk

As of December 31, 2017, the Company does not have a material net investment that is subject to foreign currency fluctuations.

As of December 31, 2017, we had a \$65.0 million fully drawn term loan and a \$27.0 million notes payable. Under the terms of the term loan agreement, the interest rate is set at 9.00% and terms of the notes payable, the interest rate is set at 7.00%. We do not believe that we have any material exposure to market risk associated with interest rates.

We are subject to the risk of market price fluctuations of certain commodities, such as natural gas, and utilize forward purchase contracts to manage or reduce market risks relating to these costs. We do not enter into these transactions for speculative or trading purposes. As of December 31, 2017, we have contracted for a total of 1,800,000 MMBtu of natural gas at an average price of \$4.40 per MMBtu through December 31, 2018.

Item 8. Financial Statements and Supplementary Data

The information required by this Item is contained in pages F-3 through F-25 of this Report.

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

Not applicable.

Item 9A. Controls and Procedures

(a) Evaluation of Disclosure Controls and Procedures

Disclosure controls and procedures are designed to ensure that information required to be disclosed in the reports filed or submitted under the Securities Exchange Act of 1934 (the “Exchange Act”) is recorded, processed, summarized and reported, within the time periods specified in the SEC’s rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed in the reports filed under the Exchange Act is accumulated and communicated to management, including the Chief Executive Officer and Chief Financial Officer, as appropriate to allow timely decisions regarding required disclosure.

As of December 31, 2017, management carried out an evaluation, under the supervision and with the participation of the Chief Executive Officer and Chief Financial Officer, of the effectiveness of the design and operation of the Company’s disclosure controls and procedures. There are inherent limitations to the effectiveness of any system of disclosure controls and procedures. Accordingly, even effective disclosure controls and procedures can only provide reasonable assurances of achieving their control objectives. Based upon and as of the date of that evaluation, the Chief Executive Officer and Chief Financial Officer have concluded that the Company’s disclosure controls and procedures were effective to ensure that information required to be disclosed by the Company in the reports it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC’s rules and forms, and to ensure that information required to be disclosed by the Company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the Company’s management, including its Chief Executive Officer and Chief Financial Officer, as appropriate to allow timely decisions regarding required disclosure.

(b) Management’s Report on Internal Control Over Financial Reporting
For Management’s Report on Internal Control Over Financial Reporting, see page F-1 of this Report.

(c) Report of Independent Registered Public Accounting Firm

For the Report of Independent Registered Public Accounting Firm on the Company's internal control over financial reporting, see page F-2 of this Report.

(d) Changes in Internal Control over Financial Reporting

There were no changes in our internal control over financial reporting during the quarter ended December 31, 2017 that materially affected or are reasonably likely to materially affect, those controls.

Item 9B. Other Information

Not applicable.

PART III

Certain information required by Part III is omitted from this Report. We will file a definitive proxy statement pursuant to Regulation 14A (the "Proxy Statement") not later than 120 days after the end of the fiscal year covered by this Report and certain information included therein is incorporated herein by reference. Only those sections of the Proxy Statement that specifically address the items set forth herein are incorporated by reference. Such incorporation does not include the Compensation Committee Report included in the Proxy Statement.

Item 10. Directors, Executive Officers and Corporate Governance

Information concerning executive officers under Item 401 of Regulation S-K is set forth in Part I of this Form 10-K. The other information required by this Item is incorporated by reference to the portions of the Company's Proxy Statement entitled "Security Ownership of Certain Beneficial Owners and Management," "Election of Directors," "Board of Directors, Committees of the Board of Directors and Meeting Attendance," "Code of Business Conduct and Ethics," "Section 16(a) Beneficial Ownership Reporting Compliance" and "Report of the Audit Committee."

Item 11. Executive Compensation

The information required by this Item is incorporated by reference to the portions of the Company's Proxy Statement entitled "Compensation of Executive Officers," "Director Compensation" and "Potential Termination and Change in Control Payments."

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

The information required by this Item is incorporated by reference from our Proxy Statement under the captions "Securities Ownership of Certain Beneficial Owners and Management" and "Equity Compensation Plan Information."

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

The information required by this Item is incorporated by reference to the portion of our Proxy Statement entitled "Election of Directors."

Item 14. Principal Accounting Fees and Services

The information required by this Item is incorporated by reference to the portion of our Proxy Statement entitled "Ratification of Appointment of our Independent Registered Public Accounting Firm."

PART IV

Item 15. Exhibits, Financial Statement Schedules

(a) Exhibits, Financial Statements and Financial Statement Schedules:

1. Consolidated Financial Statements

The Consolidated Financial Statements of CARBO Ceramics Inc. listed below are contained in pages F-3 through F-25 of this Report:

Report of Independent Registered Public Accounting Firm

Consolidated Balance Sheets at December 31, 2017 and 2016

Consolidated Statements of Operations for each of the three years ended December 31, 2017, 2016 and 2015

Consolidated Statements of Comprehensive Loss for each of the three years ended December 31, 2017, 2016 and 2015

Consolidated Statements of Shareholders' Equity for each of the three years ended December 31, 2017, 2016 and 2015

Consolidated Statements of Cash Flows for each of the three years ended December 31, 2017, 2016 and 2015

2. Consolidated Financial Statement Schedules

All schedules have been omitted since they are either not required or not applicable.

3. Exhibits

The exhibits listed on the accompanying Exhibit Index are filed as part of, or incorporated by reference into, this Report.

Item 16. Form 10-K Summary

None

MANAGEMENT'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING

Management is responsible for establishing and maintaining adequate internal control over financial reporting, as defined in Rules 13a-15(f) and 15d-15(f) under the Securities Exchange Act of 1934. The Company's internal control over financial reporting is designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external reporting purposes in accordance with U.S. generally accepted accounting principles.

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.

Management, including our Chief Executive Officer and our Chief Financial Officer, assessed the effectiveness of the Company's internal control over financial reporting as of December 31, 2017. In making this assessment, it used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) in Internal Control-Integrated Framework (2013). Based on its assessment and those criteria, management has concluded that the Company maintained effective internal control over financial reporting as of December 31, 2017.

The Company's independent registered public accounting firm, Ernst & Young LLP, has issued an attestation report on the Company's internal control over financial reporting. That report is included herein.

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and Shareholders of CARBO Ceramics Inc.

Opinion on Internal Control over Financial Reporting

We have audited CARBO Ceramic Inc.'s internal control over financial reporting as of December 31, 2017, based on criteria established in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (the COSO criteria). In our opinion, CARBO Ceramics Inc. (the Company) maintained, in all material respects, effective internal control over financial reporting as of December 31, 2017, based on the COSO criteria.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated balance sheets as of December 31, 2017 and 2016, the related consolidated statements of operations, comprehensive loss, shareholders' equity and cash flows for each of the three years in the period ended December 31, 2017, and the related notes of the Company and our report dated March 7, 2018 expressed an unqualified opinion thereon.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting included in the accompanying Management's Report on Internal Control Over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects.

Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

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

/s/ Ernst & Young LLP

New Orleans, Louisiana

March 7, 2018

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REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and Shareholders of CARBO Ceramics Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of CARBO Ceramics Inc. (the Company) as of December 31, 2017 and 2016, the related consolidated statements of operations, comprehensive loss, shareholders' equity and cash flows for each of the three years in the period ended December 31, 2017, and the related notes (collectively referred to as the "consolidated financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2017 and 2016, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2017, in conformity with U.S. generally accepted accounting principles.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2017, based on criteria established in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) and our report dated March 7, 2018 expressed an unqualified opinion thereon.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 1987.

New Orleans, Louisiana

March 7, 2018

CARBO CERAMICS INC.

CONSOLIDATED BALANCE SHEETS

(\$ in thousands, except per share data)

	December 31,	
	2017	2016
ASSETS		
Current assets:		
Cash and cash equivalents	\$68,169	\$91,680
Restricted cash	6,935	—
Trade accounts and other receivables, net	37,705	23,622
Inventories:		
Finished goods	59,519	74,133
Raw materials and supplies	19,480	23,041
Total inventories	78,999	97,174
Prepaid expenses and other current assets	3,989	3,548
Prepaid income taxes	—	1,199
Total current assets	195,797	217,223
Restricted cash	3,281	—
Income tax receivable	2,389	—
Property, plant and equipment:		
Land and land improvements	41,590	45,530
Land-use and mineral rights	19,696	19,696
Buildings	72,427	87,318
Machinery and equipment	455,863	647,753
Construction in progress	36,138	92,704
Total	625,714	893,001
Less accumulated depreciation and amortization	301,528	398,898
Net property, plant and equipment	324,186	494,103
Goodwill	3,500	3,500
Intangible and other assets, net	11,445	8,631
Total assets	\$540,598	\$723,457
LIABILITIES AND SHAREHOLDERS' EQUITY		
Current liabilities:		
Long-term debt, current portion	\$—	\$13,000
Accounts payable	19,417	7,782
Accrued payroll and benefits	6,056	3,434
Accrued freight	2,292	593
Accrued utilities	1,552	1,169
Derivative instruments	2,537	1,599
Other accrued expenses	10,577	7,227
Total current liabilities	42,431	34,804
Deferred income taxes	230	1,236
Long-term debt, net	60,698	42,404
Notes payable, related parties	27,040	25,000

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Other long-term liabilities	4,434	3,443
Shareholders' equity:		
Preferred stock, par value \$0.01 per share, 5,000 shares authorized, none outstanding	—	—
Common stock, par value \$0.01 per share, 80,000,000 shares authorized; 27,133,614 and 26,881,066 shares issued and outstanding at December 31, 2017 and 2016, respectively	271	269
Additional paid-in capital	125,715	117,192
Retained earnings	279,779	533,435
Accumulated other comprehensive loss	—	(34,326)
Total shareholders' equity	405,765	616,570
Total liabilities and shareholders' equity	\$540,598	\$723,457

See accompanying notes to consolidated financial statements.

CARBO CERAMICS INC.

CONSOLIDATED STATEMENTS OF OPERATIONS

(\$ in thousands, except per share data)

	Years ended December 31,		
	2017	2016	2015
Revenues	\$188,756	\$103,051	\$279,574
Cost of sales	242,081	188,065	335,699
Gross loss	(53,325)	(85,014)	(56,125)
Selling, general and administrative expenses	42,533	39,984	62,199
Start-up costs	—	15	797
Loss on disposal or impairment of assets, net	125,778	889	44,111
Loss on sale of Russian proppant business	26,747	—	—
Operating loss	(248,383)	(125,902)	(163,232)
Other expense:			
Interest expense, net	(7,700)	(5,435)	(470)
Foreign currency exchange gain, net	35	119	94
Other income (expense), net	905	10	(141)
	(6,760)	(5,306)	(517)
Loss before income taxes	(255,143)	(131,208)	(163,749)
Income tax benefit	(2,027)	(51,081)	(54,205)
Net loss	\$(253,116)	\$(80,127)	\$(109,544)
Loss per share:			
Basic	\$(9.49)	\$(3.29)	\$(4.76)
Diluted	\$(9.49)	\$(3.29)	\$(4.76)

See accompanying notes to consolidated financial statements.

CARBO CERAMICS INC.

CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS

(\$ in thousands)

	Years ended December 31,		
	2017	2016	2015
Net loss	\$(253,116)	\$(80,127)	\$(109,544)
Other comprehensive income (loss):			
Foreign currency translation adjustment	979	3,376	(5,880)
Reclassification of Russia cumulative translation loss to Net Loss upon sale	33,347	—	—
Reclassification of China cumulative translation gain to Net Loss upon substantial liquidation	—	—	(8,853)
Other comprehensive income (loss)	34,326	3,376	(14,733)
Comprehensive loss	\$(218,790)	\$(76,751)	\$(124,277)

See accompanying notes to consolidated financial statements.

CARBO CERAMICS INC.

CONSOLIDATED STATEMENTS OF SHAREHOLDERS' EQUITY

(\$ in thousands, except per share data)

	Additional		Accumulated		
	Common	Paid-In	Retained	Other	
	Stock	Capital	Earnings	Income (Loss)	Total
Balances at January 1, 2015	231	59,297	739,498	(22,969)	776,057
Net loss	—	—	(109,544)	—	(109,544)
Foreign currency translation adjustment	—	—	—	(5,880)	(5,880)
Reclassification of China cumulative translation gain to					
Net Loss upon substantial liquidation	—	—	—	(8,853)	(8,853)
Comprehensive loss					(124,277)
Tax expense from stock based compensation	—	(1,768)	—	—	(1,768)
Stock granted under restricted stock plan, net	2	698	—	—	700
Stock based compensation	—	6,840	—	—	6,840
Shares surrendered by employees to pay taxes	—	—	(580)	—	(580)
Cash dividends (\$0.63 per share)	—	—	(14,666)	—	(14,666)
Balances at December 31, 2015	\$ 233	\$ 65,067	\$ 614,708	\$ (37,702)	\$ 642,306
Net loss	—	—	(80,127)	—	(80,127)
Foreign currency translation adjustment	—	—	—	3,376	3,376
Comprehensive loss					(76,751)
Cumulative effect of change in accounting policy	—	697	(697)	—	—
Stock sold under ATM program	34	45,530	—	—	45,564
Stock granted under restricted stock plan, net	2	478	—	—	480
Stock based compensation	—	5,420	—	—	5,420
Shares surrendered by employees to pay taxes	—	—	(449)	—	(449)
Balances at December 31, 2016	\$ 269	\$ 117,192	\$ 533,435	\$ (34,326)	\$ 616,570
Net loss	—	—	(253,116)	—	(253,116)
Foreign currency translation adjustment	—	—	—	979	979
Reclassification of Russia cumulative translation loss to					
Net Loss upon sale	—	—	—	33,347	33,347
Comprehensive income					(218,790)
Issuance of warrant	—	3,870	—	—	3,870
Stock granted under restricted stock plan, net	2	398	—	—	400
Stock based compensation	—	4,255	—	—	4,255
Shares surrendered by employees to pay taxes	—	—	(540)	—	(540)

Balances at December 31, 2017	\$ 271	\$ 125,715	\$ 279,779	\$ —	\$ 405,765
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See accompanying notes to consolidated financial statements.

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CARBO CERAMICS INC.

CONSOLIDATED STATEMENTS OF CASH FLOWS

(\$ in thousands)

	Years ended December 31,		
	2017	2016	2015
Operating activities			
Net loss	\$(253,116)	\$(80,127)	\$(109,544)
Adjustments to reconcile net loss to net cash (used in) provided by operating activities:			
Depreciation and amortization	45,337	48,451	54,457
Provision for doubtful accounts	589	918	1,857
Deferred income taxes	(2,134)	(50,535)	(56,800)
Lower of cost or market inventory adjustment	—	1,515	4,546
Loss on disposal or impairment of assets	125,778	889	44,111
Loss on sale of Russian proppant business	25,101	—	—
Foreign currency transaction gain, net	(35)	(119)	(94)
Stock compensation expense	4,892	5,939	7,547
PIK accrual on notes payable, related parties	2,040	—	—
Change in fair value of derivative instruments	(930)	(7,687)	11,155
Changes in operating assets and liabilities:			
Trade accounts and other receivables	(20,533)	24,569	81,371
Inventories	10,524	6,433	27,022
Prepaid expenses and other current assets	724	1,726	1,437
Accounts payable	11,666	631	(7,861)
Accrued expenses	8,687	(8,405)	(9,104)
Other, net	2,949	1,730	697
Income tax receivable, net	(357)	36,137	19,780
Net cash (used in) provided by operating activities	(38,818)	(17,935)	70,577
Investing activities			
Capital expenditures	(2,152)	(6,848)	(62,747)
Net proceeds from sale of Russian proppant business	21,154	—	—
Net cash provided by (used in) investing activities	19,002	(6,848)	(62,747)
Financing activities			
Proceeds from long-term debt	12,349	—	70,000
Proceeds from issuance of common stock under ATM program	—	45,564	—
Repayments on long-term debt	(3,250)	(32,099)	(7,000)
Repayments on insurance financing agreement	(1,296)	(917)	—
Payment of debt issuance costs	(989)	(339)	—
Proceeds from notes payable, related parties	—	25,000	—
Dividends paid	—	—	(14,666)
Purchase of common stock	(539)	(450)	(580)
Net cash provided by financing activities	6,275	36,759	47,754
Effect of exchange rate changes on cash	246	838	(1,016)
Net (decrease) increase in cash and cash equivalents and restricted cash	(13,295)	12,814	54,568
Cash and cash equivalents and restricted cash at beginning of year	91,680	78,866	24,298

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Cash and cash equivalents and restricted cash at end of year	\$78,385	\$91,680	\$78,866
Supplemental cash flow information			
Interest paid	\$2,319	\$5,269	\$2,613
Income taxes paid	\$457	\$—	\$—

See accompanying notes to consolidated financial statements

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CARBO CERAMICS INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

(\$ in thousands, except per share data)

1. Significant Accounting Policies

Description of Business

CARBO Ceramics Inc. (the “Company”) was formed in 1987 and is a manufacturer of ceramic proppants and also produces resin-coated ceramic proppants. The Company has production plants in: New Iberia, Louisiana; Eufaula, Alabama; McIntyre, Georgia; Toombsboro, Georgia; and Millen, Georgia; and a sand processing facility in Marshfield, Wisconsin. The Company predominantly sells its proppant products through pumping service companies that perform hydraulic fracturing for oil and gas companies. Finished goods inventories are stored at the plant sites and various domestic and international remote distribution facilities. The Company also provides one of the industry’s most widely used hydraulic fracture simulation software FracPro®, as well as hydraulic fracture design and consulting services. In addition, the Company provides a broad range of technologies for spill prevention, containment and countermeasures.

Beginning in late 2014, a severe decline in oil and natural gas prices led to a significant decline in oil and natural gas industry drilling activities and capital spending. Beginning in 2015, the Company implemented a number of initiatives to preserve cash and lower costs, including: reducing workforce across the organization, lowering production output levels in order to align with lower demand, limiting capital expenditures and reducing dividends. The Company incurred severance costs of \$287 and \$6,426 during 2017 and 2016, respectively, as a result of these actions.

Temporarily idled facilities are expected to remain closed for a short period of time, generally less than one year. Mothballed facilities are expected to remain closed for one year or longer. The accounting treatment is the same for both temporarily idled and mothballed facilities, except that mothballed assets are evaluated for possible impairment while temporarily idled assets are not necessarily assessed for impairment. The Company continues to depreciate both temporarily idled and mothballed assets.

As of December 31, 2017, we are producing ceramic proppants predominantly from our Eufaula, Alabama manufacturing facility, and processing sand at our Marshfield, Wisconsin facility. We are currently producing ceramic pellets in a limited capacity at our McIntyre, Georgia facility. Our Millen, Georgia facility is currently mothballed and not expected to resume ceramic proppant production in the near future. We are currently using our Toombsboro, Georgia facility in a limited capacity to primarily process minerals for third parties. The Company continues to assess liquidity needs and manage cash flows and, if industry conditions do not improve and/or demand for its products does not otherwise increase, the Company would expect to temporarily idle all or a portion of our currently active facilities in the short term. As a result of the steps the Company has taken to enhance its liquidity, the Company currently believes that cash on hand will enable the Company to meet its working capital, capital expenditure, debt service and other funding requirements for at least one year from the date this Form 10-K is issued. The Company’s view regarding sufficiency of cash and liquidity is primarily based on our financial forecast for 2018, which is impacted by various assumptions regarding demand and sales prices for our products. Generally, we expect demand for our products and the sales prices to increase in 2018 compared to 2017, and this expectation is included within our 2018 financial forecast. Although we have observed certain factors in 2017 that support improving industry conditions, our financial forecasts in recent periods have proven less reliable given customer demand, which is highly volatile in the current operating environment and no committed sales backlog exists with our

customers. As a result, there is no guarantee that our financial forecast, which projects sufficient cash will be available to meet planned operating expenses and other cash needs, will be accurate.

Additionally, the Company suspended completion of two large construction projects. We suspended completion of the second production line at the Millen, Georgia facility indefinitely, and we are exploring way to monetize these assets. The second phase of the retrofit of our Eufaula, Alabama plant with the new KRYPTOSPHERE® technology has been suspended until such time that market conditions improve enough to warrant completion. During the three months ended September 30, 2017, we recorded a \$125,759 impairment on the Millen, Georgia facility, which included an impairment of construction in progress of \$50,170. As of December 31, 2017, the value of the assets relating to these two projects, after consideration of the impairment, totaled approximately 85% of the Company's total construction in progress and both projects are over 90% complete.

Principles of Consolidation

The consolidated financial statements include the accounts of CARBO Ceramics Inc. and its operating subsidiaries. All significant intercompany transactions have been eliminated.

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Concentration of Credit Risk, Accounts Receivable and Other Receivables

The Company performs periodic credit evaluations of its customers' financial condition and generally does not require collateral. Receivables are generally due within 30 days. The majority of the Company's receivables are from customers in the petroleum pressure pumping industry. The Company establishes an allowance for doubtful accounts based on its assessment of collectability risk and periodically evaluates the balance in the allowance based on a review of trade accounts receivable. Trade accounts receivable are periodically reviewed for collectability based on customers' past credit history and current financial condition, and the allowance is adjusted if necessary. Credit losses historically have been insignificant. The allowance for doubtful accounts at December 31, 2017 and 2016 was \$1,602 and \$2,804, respectively. Other receivables were \$546 and \$650 as of December 31, 2017 and 2016, respectively, of which related mainly to miscellaneous receivables in the United States.

Cash Equivalents

The Company considers all highly liquid investments with a maturity of three months or less when purchased to be cash equivalents. The carrying amounts reported in the balance sheet for cash equivalents approximate fair value.

Restricted Cash

As a result of the repayment of the Wells Fargo term loan, combined with the continued use of letters of credit and corporate cards with Wells Fargo, a portion of the Company's cash balance is now restricted to its use in order to provide collateral to Wells Fargo. As of December 31, 2017 and 2016, restricted cash was \$10,216 and 0, respectively.

Inventories

Inventories are stated at the lower of cost (weighted average) or market. Finished goods inventories include costs of materials, plant labor and overhead incurred in the production of the Company's products and costs to transfer finished goods to distribution centers.

The Company evaluated the carrying values of its inventories and concluded that market prices had fallen below carrying costs for certain inventory. Consequently, the Company recognized \$1,515 and \$4,546 lower of cost or market adjustments in cost of sales in 2016 and 2015, respectively, to adjust finished goods and raw materials carrying values to the lower market prices. No adjustments were required in 2017.

Property, Plant and Equipment

Property, plant and equipment are stated at cost. Repair and maintenance costs are expensed as incurred. Depreciation is computed on the straight-line method for financial reporting purposes using the following estimated useful lives:

Buildings and improvements	15 to 30 years
Machinery and equipment	3 to 30 years
Land-use rights	30 years

The Company holds approximately 4,618 acres of land and leasehold interests containing kaolin reserves near its plants in Georgia and Alabama. The Company also holds approximately 113 acres of land and leasehold interests containing sand reserves near its sand processing facility in Marshfield, Wisconsin. The capitalized costs of land and

mineral rights as well as costs incurred to develop such property are amortized using the units-of-production method based on estimated total tons of these reserves.

Impairment of Long-Lived Assets and Intangible Assets

Long-lived assets to be held and used and intangible assets that are subject to amortization are reviewed for impairment whenever events or circumstances indicate their carrying amounts might not be recoverable. Recoverability is assessed by comparing the undiscounted expected future cash flows from the assets with their carrying amount. If the carrying amount exceeds the sum of the undiscounted future cash flows an impairment loss is recorded. The impairment loss is measured by comparing the fair value of the assets with their carrying amounts. Intangible assets that are not subject to amortization are tested for impairment at least annually by comparing their fair value with the carrying amount and recording an impairment loss for any excess of carrying amount over fair value. Fair values are generally determined based on discounted expected future cash flows or appraised values, as appropriate. For additional information on the Company's long-lived assets and intangible assets impairment assessment, please refer to Note 4 - Impairment of Long-Lived Assets.

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Manufacturing Production Levels Below Normal Capacity

As a result of the Company substantially reducing manufacturing production levels, including by idling and mothballing certain facilities, the component of the Company's accounting policy for inventory relating to operating at production levels below normal capacity was triggered and resulted in certain production costs being expensed instead of being capitalized into inventory. The Company expenses fixed production overhead amounts in excess of amounts that would have been allocated to each unit of production at normal production levels. For the years ended December 31, 2017, 2016 and 2015 the Company expensed \$40,664, \$47,318 and \$33,724, respectively, in production costs.

Capitalized Software

The Company capitalizes certain software costs, after technological feasibility has been established, which are amortized utilizing the straight-line method over the economic lives of the related products, generally not to exceed five years.

Goodwill

Goodwill represents the excess of the cost of companies acquired over the fair value of their net assets at the date of acquisition. Goodwill relating to each of the Company's reporting units is tested for impairment annually, during the fourth quarter, as well as when an event, or change in circumstances, indicates an impairment is more likely than not to have occurred. For additional information on the Company's goodwill impairment assessment, please refer to Note 4 - Impairment of Long-Lived Assets.

Revenue Recognition

Revenue from proppant sales is recognized when title passes to the customer, generally upon delivery. Revenue from consulting and geotechnical services is recognized at the time service is performed. Revenue from the sale of fracture simulation software is recognized when title passes to the customer at time of shipment. Revenue from the sale of spill prevention services is recognized at the time service is performed. Revenue from the sale of containment goods is recognized at the time goods are delivered.

Shipping and Handling Costs

Shipping and handling costs are classified as cost of sales. Shipping costs consist of transportation costs to deliver products to customers. Handling costs include labor and overhead to maintain finished goods inventory and operate distribution facilities.

Cost of Start-Up Activities

Start-up activities, including organization costs, are expensed as incurred. Start-up costs for 2016 and 2015 related to the start-up of the first phase of a retrofit of an existing plant to produce KRYPTOSPHERE® products. There were no start-up costs for 2017.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States requires management to make estimates and assumptions that affect the amounts reported in the financial statements and accompanying notes. Actual results could differ from those estimates.

Research and Development Costs

Research and development costs are charged to operations when incurred and are included in Selling, General and Administrative expenses. The amounts incurred in 2017, 2016 and 2015 were \$4,417, \$3,817 and \$7,047, respectively.

New Accounting Pronouncements

In November 2016, the FASB issued ASU No. 2016-18, "Statement of Cash Flows (Topic 230) – Restricted Cash," which requires that a statement of cash flows explain the change during the period in the total of cash, cash equivalents, and amounts generally described as restricted cash or restricted cash equivalents. The Company adopted this guidance as of January 1, 2017. The adoption did not have a material impact on its consolidated financial statements and related disclosures.

In February 2016, the FASB issued ASU No. 2016-02, "Leases (Topic 842)," which amends current lease guidance. This guidance requires, among other things, that lessees recognize the following for all leases (with the exception of short-term leases) at

the commencement date: (1) a lease liability, which is a lessee’s obligation to make lease payments arising from a lease, measured on a discounted basis; and (2) a right-of-use asset, which is an asset that represents the lessee’s right to use, or control the use of, a specified asset for the lease term. Lessees and lessors must apply a modified retrospective transition approach for leases existing at, or entered into after, the beginning of the earliest comparative period presented in the financial statements. The new guidance will be effective for the interim and annual periods beginning after December 15, 2018 with early adoption permitted. The Company is currently evaluating the potential impact of adopting this new guidance on the consolidated financial statements and related disclosures.

In August 2015, the FASB issued ASU No. 2015-14, “Revenue from Contracts with Customers (Topic 606) – Deferral of the Effective Date,” which revises the effective date of ASU No. 2014-09, “Revenue from Contracts with Customers (Topic 606),” (“ASU 2014-09”) to interim and annual periods beginning after December 15, 2017, with early adoption permitted no earlier than interim and annual periods beginning after December 15, 2016. In May 2014, the FASB issued ASU 2014-09, which amends current revenue guidance. The core principle of the guidance is that an entity should recognize revenue to depict the transfer of promised goods or services to customers in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. The Company’s analysis of sales contracts under ASC 606 supports the recognition of revenue at a point in time, typically when title passes to the customer upon delivery, for the majority of contracts, which is consistent with the current revenue recognition model. The Company utilized the modified retrospective approach, which requires a cumulative adjustment to retained earnings and no adjustments to prior periods. The Company adopted this guidance as of January 1, 2018. There was no material impact on the Company’s consolidated financial statements or disclosures.

In July 2015, the FASB issued ASU No. 2015-11, “Inventory (Topic 330),” (“ASU 2015-11”) which amends and simplifies the measurement of inventory. The main provisions of the standard require that inventory be measured at the lower of cost and net realizable value. Prior to the issuance of the standard, inventory was measured at the lower of cost or market (where market was defined as replacement cost, with a ceiling of net realizable value and floor of net realizable value less a normal profit margin). The Company adopted ASU 2015-11 as of January 1, 2017. The adoption did not have a material impact on the Company’s consolidated financial statements and related disclosures.

2. Intangible and Other Assets

Following is a summary of intangible assets as of December 31:

	2017		2016		
	Weighted				
	Average	Gross	Accumulated	Gross	Accumulated
	Life	Amount	Amortization	Amount	Amortization
Intangibles:					
Patents and licenses, software and hardware designs	6 years	\$5,320	\$ 3,540	\$5,033	\$ 3,187
Developed technology	10 years	2,782	2,295	2,782	2,017
Customer relationships and non-compete	9 years	2,838	2,621	2,838	2,331
		\$10,940	\$ 8,456	\$10,653	\$ 7,535

Amortization expense for 2017, 2016 and 2015 was \$921, \$915 and \$1,235, respectively. Estimated amortization expense for each of the ensuing years through December 31, 2022 is \$889, \$602, \$341, \$323 and \$40, respectively.

Following is a summary of other assets as of December 31:

	2017	2016
Other assets:		
Bauxite raw materials:		
Inventories	\$3,527	\$3,989
Other assets	5,434	1,524
	\$8,961	\$5,513

Bauxite raw materials are used in the production of heavyweight ceramic products. As of December 31, 2017 and 2016, the Company has classified as long-term assets those bauxite raw materials inventories that are not expected to be consumed in production during the upcoming twelve month period. For additional information, refer to Note 4 – Impairment of Long-Lived Assets. Other assets as of December 31, 2017 includes a \$4,000 receivable relating to additional money owed us relating to the sale of our Russian proppant business. For additional information, refer to Note 17 – Sale of Russian Proppant Business.

3. Long-Term Debt and Notes Payable

On March 2, 2017, the Company entered into an Amended and Restated Credit Agreement (the “New Credit Agreement”) with Wilks Brothers, LLC (“Wilks”) to replace its current term loan with Wells Fargo Bank, National Association (“Wells Fargo”) and provide the Company with additional liquidity for a longer term. The New Credit Agreement is a \$65,000 facility maturing on December 31, 2022, that consists of a \$52,651 term loan that was made at closing to pay off Wells Fargo and an additional term loan of \$12,349 that was made to the Company after the Company satisfied certain post-closing conditions. The \$52,651 term loan was a non-cash transaction to the Company as Wilks directly paid Wells Fargo and assumed the New Credit Agreement. The Company’s obligations bear interest at 9.00% and are guaranteed by its two operating subsidiaries. No principal repayments are required until maturity (except in unusual circumstances), and there are no financial covenants. In lieu of making cash interest payments, the Company has the option during the first two years of the loan to make interest payments as payment-in-kind, or PIK, by applying an 11.00% rate to the interest payment due (instead of the 9.00% cash interest rate) and capitalizing the resulting amount to the outstanding principal balance of the loan. The Company is required to provide Wilks 30 day notice of its intent to exercise this option for an interest payment. The Company does not anticipate utilizing this option and has therefore accrued interest expense using the 9.00% cash interest rate.

The loan cannot be prepaid during the first three years without making the lenders whole for interest that would have been payable over the entire remaining term of the loan. The Company’s obligations under the New Credit Agreement are secured by: (i) a pledge of all accounts receivable and inventory, (ii) cash in certain accounts, (iii) domestic distribution assets residing on owned real property, (iv) the Company’s Marshfield, Wisconsin and Toombsboro, Georgia plant facilities and equipment, and (v) certain real property interests in mines and minerals. Other liens previously in favor of Wells Fargo were released.

As of December 31, 2017, the Company’s outstanding debt under its New Credit Agreement was \$65,000. During the year ended December 31, 2017, the Company expensed \$455 of debt issuance costs relating to the previous Wells Fargo Amended Credit Agreement. As of December 31, 2017, the Company had \$853 of unamortized debt issuance costs relating to the New Credit Agreement that are presented as a direct reduction from the carrying amount of the long-term debt obligation. The Company had \$9,230 and \$11,980 in standby letters of credit issued through Wells Fargo as of December 31, 2017 and December 31, 2016, respectively, primarily as collateral relating to our natural gas commitments and railcar leases. As of December 31, 2016, the Company’s outstanding debt under its previous Wells Fargo Amended Credit Agreement was \$55,901, of which \$13,000 was classified as current and \$42,901 was classified as long-term. As of December 31, 2016, the Company had \$497 of debt issuance costs that are presented as a direct reduction from the carrying amount of the long-term debt obligation. For the year ended December 31, 2016, the weighted average interest rate was 6.447% based on LIBOR-based rate borrowings.

On March 2, 2017, in connection with entry into the New Credit Agreement, the Company issued a Warrant (the “Warrant”) to Wilks. Subject to the terms of the Warrant, the Warrant entitles the holder thereof to purchase up to 523,022 shares of the Common Stock, at an exercise price of \$14.91 per share, payable in cash. The Warrant expires on December 31, 2022. Based on a Form 4 filing with the SEC on December 29, 2017, Wilks owned approximately 11.4% of the Company’s outstanding common stock, and should Wilks fully exercise the Warrant to purchase an additional 523,022 shares, it would hold approximately 13.1% of the Company’s outstanding common stock. The Company allocated the proceeds received of \$52,651 to each of these two instruments based on their relative fair values. Accordingly, the Company recorded long-term debt of \$48,780 and warrants of \$3,871 at inception. The amount associated with the Warrant was recorded as an increase to additional paid-in capital. The original issue discount of the long-term debt will be amortized using the effective interest method over the term of the loan. As of

December 31, 2017, the unamortized original issue discount was \$3,448.

In May 2016, the Company received proceeds of \$25,000 from the issuance of separate unsecured Promissory Notes (the "Notes") to two of the Company's Directors. Each Note matures on April 1, 2019 and bears interest at 7.00%. On March 2, 2017, in connection with the New Credit Agreement, the Notes were amended to provide for payment-in-kind, or PIK, interest payments at 8.00% until the lenders under the New Credit Agreement receive two consecutive semi-annual cash interest payments. On April 1, 2017, the Company made a \$997 interest payment as PIK, and capitalized the resulting amount to the outstanding principal balance. On October 1, 2017, the Company made a \$1,043 interest payment as PIK, and capitalized the resulting amount to the outstanding principal balance. As of March 7, 2018, the outstanding principal balance of the Notes was \$27,040.

Interest cost for the years ended December 31, 2017, 2016 and 2015 was \$8,058, \$6,022, and \$2,973, respectively, of which \$0, \$80, and \$2,038 was capitalized into the cost of property, plant and equipment in the years ended December 31, 2017, 2016, and 2015, respectively. Interest cost primarily includes interest expense relating to our debts as well as amortization and the write-off of debt issuance costs and amortization of the original issue discount associated with the New Credit Agreement and Warrant.

4. Impairment of Long-Lived Assets

During 2017, 2016 and 2015, the Company recorded losses totaling \$125,759, \$1,065 and \$43,697, respectively, on impairment of certain long-lived assets as market conditions changed with regard to demand for certain products offered by the Company.

A decline in oil and natural gas prices during the second half of 2014 resulted in a severe decline in market conditions beginning in early 2015. During the fourth quarter of 2015, industry conditions further deteriorated as oil prices fell below \$30 per barrel. As a result of these worsening conditions, the Company evaluated substantially all of its long-lived assets for possible impairment as of December 31, 2015. Key assumptions used in the analysis varied by facility. However, the overriding assumptions included: 1) the industry downturn would last longer than originally anticipated, taking up to five years to fully recover; 2) production levels would rise over the recovery period eventually returning to production levels within normal capacity; 3) market pricing would be similar to lower 2015 levels, thus conservatively reducing expected gross profit and thus cash flows; 4) the Company's wet process manufacturing plants (Toombsboro and Millen, Georgia and Eufaula, Alabama) were evaluated as a group of assets because these facilities manufacture like products; and 5) other facilities were separately evaluated. Pursuant to that analysis, the Company determined that the projected gross cash flows attributable to certain assets did not exceed the carrying value of the assets; therefore, the Company concluded that there was indication of possible impairment. The Company engaged the services of a third party consulting firm to assist with the determination of the fair market value of the related assets and concluded that the assets were impaired. The key assumptions and inputs impacting the fair value analysis were the weighted average cost of capital and perpetuity growth rate as well as certain market data with respect to the property and equipment at each facility. As a result, during the year-ended December 31, 2015, the Company recorded a \$36,177 impairment of long-lived assets, primarily relating to machinery and equipment at the McIntyre, Georgia manufacturing plant and Marshfield, Wisconsin sand processing facility. As of December 31, 2017, the remaining carrying value of the previously impaired assets at the McIntyre, Georgia manufacturing plant and Marshfield, Wisconsin sand processing facility was approximately \$3,144.

During the year-ended December 31, 2016, industry conditions remained depressed, but showed signs of improvement with oil prices above \$50 per barrel. The Company evaluated substantially all of its long-lived assets for impairment as of December 31, 2016. Key assumptions were not materially different from the December 31, 2015 analysis, except that we evaluated the Eufaula facility separate from the Toombsboro and the Millen facilities given the completion of our KRYPTOSPHERE technology retrofitting in 2016. Pursuant to the December 31, 2016 analysis, the Company determined that the projected gross cash flows attributable to each asset group exceeded the carrying value; therefore, the Company concluded there was no impairment for the year-ended December 31, 2016.

As of September 30, 2017, the Company concluded that the Company's Toombsboro and Millen, Georgia facilities should no longer be evaluated together as a group of assets because the facilities are no longer interchangeable and will not manufacture like products. As a result of the sustained and long-term shift away from base ceramic proppant to less expensive frac sand, the Company has made a strategic decision to focus on growing technology, industrial and mineral processing revenue streams. Our Toombsboro, Georgia plant is being repurposed to produce technology and industrial products, as well as for use in toll processing of minerals. Our Millen, Georgia facility is currently only able to produce base ceramic proppants, but given our current long-term outlook on base ceramic proppant demand, we do not expect to utilize this plant to produce base ceramic proppant. We are currently evaluating opportunities to monetize our assets at our Millen facility. As a result, we evaluated the Toombsboro and Millen, Georgia plants separately for indicators of impairment during the third quarter of 2017.

Given the change in the asset groupings of the two facilities and lack of estimated future cash flows associated with the base ceramic production at the Millen facility, the Company identified indicators of impairment at the Millen,

Georgia facility as of September 30, 2017. The Company determined that the projected cash flows attributable to our Millen, Georgia facility did not exceed the carrying value of the assets; therefore the Company concluded there was an impairment at that facility. The Company engaged the services of a third party consulting firm to assist with the determination of the fair value of the related assets and concluded that the assets were impaired. The key assumptions and inputs impacting the fair value include third party data and commentary with respect to the property and equipment at our Millen facility. For machinery and equipment and construction in progress, we used a cost approach to estimate the valuation. We applied a 65 percent downward adjustment to calculated replacement cost based on an analysis of construction documents and historical expenditures to remove non-saleable soft costs such as engineering and installation that would have no value to a market participant. Based on discussions with market participants, a salvage value multiplier ranging from 12 percent to 50 percent of the remaining replacement cost basis was applied to arrive at the estimated fair value for the machinery and equipment and construction in progress subject to impairment. For real property, we used a market and cost approach and reconciled the two approaches. In using the market approach, we determined that the value of comparable property ranged from approximately \$30 to \$40 per square foot, and the concluded value of the property at the Millen facility was approximately \$35 per square foot. In using the cost approach, we applied a 94% downward adjustment to the calculated value for the buildings and site improvements as a representation of economic obsolescence. As a result of these valuation procedures, which included the use of Level 3 inputs as defined in Note 9, the Company recognized a \$125,759 impairment of long-lived assets, primarily relating to buildings, machinery and equipment, and construction in progress. As of September 30, 2017, as a result of our

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valuation procedures, the fair value of the Millen facility, including land, buildings, machinery and equipment and construction in progress, was approximately \$18,786. As of September 30, 2017, related to the other asset groups, there were no events or circumstances that would indicate that carrying amounts of long-lived and other noncurrent assets might be impaired given that results for the first nine months of 2017 generally met our expectations from our analysis as of December 31, 2016 and given that our future outlook of cash flows associated with those asset groups has not significantly changed since that date.

There were no additional indicators of impairment during the fourth quarter of 2017.

As of December 31, 2017, the remaining carrying value of the impaired assets at the Millen facility was approximately \$18,471, which included \$6,753 classified as construction in progress.

The Company also evaluated the carrying value of the long-term portion of bauxite raw materials. Much of the bauxite raw material was intended for use in production at the McIntyre facility. Based upon this evaluation, during 2016 and 2015, the Company recognized an impairment charge of \$1,065 and \$6,488, respectively, on the long-term portion of the bauxite raw material inventories. There was no such impairment during 2017.

The Company assesses goodwill for possible impairment annually or sooner if circumstances indicate possible impairment may have occurred. The Company evaluated goodwill during the fourth quarter of 2015, and as a result of the further decline in the oil and natural gas industry during the fourth quarter of 2015, concluded that Asset Guard Products Inc. ("AGPI") projected future cash flows were negatively impacted and thus indicated possible impairment of the AGPI goodwill. AGPI was formerly known as Falcon Technologies and Services, Inc. The Company engaged a third party to assist in the evaluation and concluded that impairment had occurred. Fair value, which was determined using a discounted cash flows method, fell below the carrying value. Consequently, during the fourth quarter of 2015, the Company recorded an \$8,664 impairment of AGPI goodwill and an \$833 impairment of the indefinite-lived AGPI Trademark intangible asset, both the full value of each of those assets. Evaluation of the StrataGen goodwill resulted in no indication of possible impairment. There were no such impairments during 2017 or 2016.

During the years ended December 31, 2017, 2016 and 2015, the Company recognized a loss of \$19, gain of \$176, and gain of \$230, respectively, on disposal of various assets.

Components of loss (gain) on disposal or impairment of assets are as follows:

	For the years ended		
	December 31,		
	2017	2016	2015
Domestic long-lived assets impairment	\$125,759	\$1,065	\$42,664
China assets impairment	—	—	1,033
Goodwill and intangible assets impairment	—	—	9,497
China CTA gain realization	—	—	(8,853)
Loss (gain) on disposal of assets	19	(176)	(230)
Total	\$125,778	\$889	\$44,111

5. Leases

The Company leases certain property, plant and equipment under operating leases, primarily consisting of railroad equipment leases. Net minimum future rental payments due under non-cancelable operating leases with remaining terms in excess of one year as of December 31, 2017 are as follows:

2018	\$ 11,404
2019	12,272
2020	16,239
2021	16,393
2022	13,660
Thereafter	24,660
Total	\$94,628

Leases of railroad equipment generally provide for renewal options at their fair rental value at the time of renewal. In the normal course of business, operating leases for railroad equipment are generally renewed or replaced by other leases. For the years ended December 31, 2018, 2019 and 2020, minimum future rental payments in the table above are presented net of sublease income

related to subleases of railroad equipment of \$3,933, \$2,853 and \$440, respectively. Rent expense for all operating leases was \$20,310 in 2017, \$22,040 in 2016 and \$23,757 in 2015. For the years ended December 31, 2017, 2016 and 2015, rent expense is stated net of sublease income of \$3,040, \$4,778 and \$5,031, respectively.

6. Income Taxes

Deferred income taxes reflect the net tax effects of temporary differences between the carrying amounts of assets and liabilities for financial reporting purposes and the amounts used for income tax purposes. Significant components of the Company's deferred tax assets and liabilities as of December 31 are as follows:

	2017	2016
Deferred tax assets:		
Employee benefits	\$836	\$1,349
Inventories	2,309	8,811
Natural gas derivatives	610	1,281
Goodwill & other intangibles	3,179	4,881
Net operating loss	59,536	51,722
Foreign tax credits	667	—
Other	2,029	2,028
Total deferred tax assets	69,166	70,072
Deferred tax liabilities:		
Depreciation	14,332	71,308
Indefinite-lived intangibles	209	—
Foreign	26	—
Total deferred tax liabilities	14,567	71,308
Valuation Allowance	54,829	—
Net deferred tax liabilities	\$(230)	\$(1,236)

Significant components of the provision for income taxes for the years ended December 31 are as follows:

	2017	2016	2015
Current:			
Federal	\$(375)	\$(495)	\$1,509
State	(99)	(496)	120
Foreign	581	445	966
Total current	107	(546)	2,595
Deferred	(2,134)	(50,535)	(56,800)
	\$(2,027)	\$(51,081)	\$(54,205)

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The reconciliation of income taxes computed at the U.S. statutory tax rate to the Company's income tax expense for the years ended December 31 is as follows:

	2017		2016		2015	
	Amount	Percent	Amount	Percent	Amount	Percent
U.S. statutory rate	\$(89,300)	(35.0)%	\$(45,923)	(35.0)%	\$(57,312)	(35.0)%
State income taxes, net of federal tax benefit	(5,684)	(2.2)	(3,283)	(2.5)	(3,474)	(2.1)
Mining depletion	(619)	(0.2)	(378)	(0.3)	(1,557)	(0.9)
Change in election for foreign tax credits	(667)	(0.3)	(2,753)	(2.1)	1,442	0.9
Foreign tax assets valuation allowance	—	—	—	—	1,230	0.7
Foreign investments	8,569	3.4	(323)	(0.2)	847	0.5
Stock compensation excess tax deficiency	876	0.3	789	0.6	—	—
Other permanent differences	1,806	0.7	790	0.6	4,619	2.8
Tax reform deferred rate change	28,163	11.0	—	—	—	—
Valuation allowance	54,829	21.5	—	—	—	—
	\$(2,027)	(0.8)%	\$(51,081)	(38.9)%	\$(54,205)	(33.1)%

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As a result of the significant decline in oil and gas activities and net losses incurred over the past several quarters, the Company determined during the year ending December 31, 2017 that it was more likely than not that a portion of our deferred tax assets will not be realized in the future. Accordingly, we established a \$54,829 valuation allowance against our deferred tax assets. Our assessment of the realizability of our deferred tax assets is based on the weight of all available evidence, both positive and negative, including future reversals of deferred tax liabilities.

In December 2017, the Tax Cuts and Jobs Act (“Tax Legislation”) was enacted. The Tax Legislation significantly revises the U.S. corporate income tax by, among other things, lowering corporate income tax rates, implementing the territorial tax system and imposing a repatriation tax on deemed repatriated earnings of foreign subsidiaries. As of December 31, 2017, the Company has not completed its accounting for the tax effects of enactment of the Tax Act. The Securities and Exchange Commission issued Staff Accounting Bulletin No. 118, or SAB 118, to address the accounting and reporting of the Tax Legislation. SAB 118 allows companies to take a reasonable period, which should not extend beyond one year from enactment of the Tax Legislation, to measure and recognize the effects of the new tax law. The Company has made a reasonable estimate of the effects on existing deferred tax balances and recognized a provisional reduction of approximately \$28,163 in the Company’s net deferred tax assets before consideration of the valuation allowance, due primarily to the remeasurement of U.S. deferred tax assets at the lower enacted corporate rate. The Company recorded the adjustment during the fourth quarter of 2017; however, because of an offsetting change in our valuation allowance, there was zero net impact to net income during 2017 as a result of the legislation. The Company is still analyzing certain aspects of the Tax Legislation and refining its calculations, which could potentially affect the measurement of these balances or potentially give rise to new deferred tax amounts. The Company will complete this analysis within the measurement period in accordance with SAB 118. The Company also continues to evaluate the impacts of the newly enacted global intangible low-taxed income (“GILTI”) provisions which subject the Company’s foreign earnings to a minimum level of tax. Because of the complexities of the new legislation, the Company has not elected an accounting policy for GILTI at this time. Recent FASB guidance indicates that accounting for GILTI either as part of deferred taxes or as a period cost are both acceptable methods. Once further information is gathered and interpretation and analysis of the tax legislation evolves, the Company will make an appropriate accounting method election.

Provision has been made for deferred U.S. income taxes on all foreign earnings based on the Company’s intent to repatriate foreign earnings. During the years ended December 31, 2017 and 2016, the Company did not recognize benefits on foreign investments due to the uncertainty of the Company being able to realize the foreign tax assets in light of current market conditions in China and Russia. This treatment decreased (increased) income tax benefit by \$8,569 and (\$323) for the years ended December 31, 2017 and 2016, respectively.

During 2017, 2016, and 2015, the Company incurred a net operating loss in the United States. Net operating losses associated with the 2015 tax return have been carried back in full, while certain of the net operating losses incurred in 2016 and 2017 are carried forward to offset future taxable income. The cumulative recorded tax benefit of these net operating loss carryforwards totals \$59,536 and \$51,722 as of December 31, 2017 and 2016, respectively, and is included in the deferred income tax asset on those respective dates. The recorded tax benefit of \$59,536 as of December 31, 2017 includes the impact of the change in corporate income tax rate following the enactment of the Tax Legislation. The Company filed amended 2013 and 2014 Federal income tax returns to claim \$37,397 of the tax benefit which was received as a refund in April 2016. After finalization of the 2015 Federal return and a change in the attribute of the NOL carryback, additional refunds for 2012 through 2014 tax years are being claimed in the amount of \$2,206. These amounts are included within income tax receivable as of December 31, 2017. The federal NOLs generated in 2017 and 2016 will be carried forward until they are utilized or their expiration in 2037 and 2036, respectively.

The Company elected to claim bonus tax depreciation totaling \$29,221 and \$61,781 on assets placed in service in the United States during 2015 and 2014, respectively. This election increased the net operating loss in 2015 and reduced

current taxable income in 2014. No such bonus depreciation was elected in 2016 and is not anticipated for 2017.

The Company has not recognized any uncertain tax positions as of December 31, 2017. The reserve recorded as of December 31, 2015 of \$153 was associated with a period no longer subject to audit and thus was reduced to \$0 during 2016.

The Company files its tax returns as prescribed by the tax laws of the jurisdictions in which it operates, the most significant of which are U.S. federal and certain state jurisdictions. In 2016, the Company received an audit notice from the Internal Revenue Service for periods 2013-2015. The Company does not anticipate any material findings. The 2016 federal tax year is also subject to examination. Various U.S. state jurisdiction tax years remain open to examination as well, although the Company believes assessments, if any, would be immaterial to its consolidated financial statements.

7. Shareholders' Equity

Common Stock

Holders of Common Stock are entitled to one vote per share on all matters to be voted on by shareholders and do not have cumulative voting rights. Subject to preferences of any Preferred Stock, the holders of Common Stock are entitled to receive ratably such dividends, if any, as may be declared from time to time by the Board of Directors out of funds legally available for that purpose. In the event of liquidation, dissolution or winding up of the Company, holders of Common Stock are entitled to share ratably in all assets remaining after payment of liabilities, subject to prior distribution rights of any Preferred Stock then outstanding. The Common Stock has no preemptive or conversion rights or other subscription rights. There are no redemption or sinking fund provisions applicable to the Common Stock. All outstanding shares of Common Stock are fully paid and non-assessable.

On January 19, 2016, the Board of Directors suspended the Company's policy of paying quarterly cash dividends.

Preferred Stock

The Company's charter authorizes 5,000 shares of Preferred Stock. The Board of Directors has the authority to issue Preferred Stock in one or more series and to fix the rights, preferences, privileges and restrictions thereof, including dividend rights, conversion rights, voting rights, terms of redemption, redemption prices, liquidation preferences and the number of shares constituting any series or the designation of such series, without further vote or action by the Company's shareholders.

Common Stock Repurchase Program

On January 28, 2015, the Company's Board of Directors authorized the repurchase of up to two million shares of the Company's common stock. Shares are effectively retired at the time of purchase. As of December 31, 2017, the Company had not repurchased any shares under the plan.

Equity Offering Program

On July 28, 2016, the Company filed a prospectus supplement and associated sales agreement related to an at-the-market ("ATM") equity offering program pursuant to which the Company may sell, from time to time, common stock with an aggregate offering price of up to \$75,000 through Cowen and Company LLC, as sales agent, for general corporate purposes. As of December 31, 2017, the Company sold a total of 3,405,709 shares of its common stock under the ATM program for \$46,612, or an average of \$13.69 per share, and received proceeds of \$45,564, net of commissions of \$1,048. These sales occurred during August and September 2016, and the Company has not utilized the program since those sales.

8. Natural Gas Derivative Instruments

Natural gas is used to fire the kilns at the Company's manufacturing plants. In an effort to mitigate potential volatility in the cost of natural gas purchases and reduce exposure to short-term spikes in the price of this commodity, from time to time, the Company enters into contracts to purchase a portion of the anticipated monthly natural gas requirements at specified prices. Contracts are geographic by plant location. Historically, the Company has taken delivery of all natural gas quantities under contract, which exempted the Company from accounting for the contracts as derivative instruments. However, due to the severe decline in industry activity beginning in early 2015, the Company significantly reduced production levels and consequently did not take delivery of all of the contracted natural gas quantities. As a result, the Company began to account for relevant contracts as derivative instruments.

Derivative accounting requires the natural gas contracts to be recognized as either assets or liabilities at fair value with an offsetting entry in earnings. The Company uses the income approach in determining the fair value of these derivative instruments. The model used considers the difference, as of each balance sheet date, between the contracted prices and the New York Mercantile Exchange (“NYMEX”) forward strip price for each contracted period. The estimated cash flows from these contracts are discounted using a discount rate of 8.0%, which reflects the nature of the contracts as well as the timing and risk of estimated cash flows associated with the contracts. The discount rate had an immaterial impact on the fair value of the contracts for the year ended December 31, 2017 and 2016. The last natural gas contract will expire in December 2018. As a result, during the year ended December 31, 2017 and 2016, the Company recognized a loss on derivative instruments of \$917 and a gain on derivative instruments of \$1,886, respectively in cost of sales. The cumulative present value of the losses on these natural gas derivative contracts as of December 31, 2017 and 2016 are presented as current and long-term liabilities, as applicable, in the Consolidated Balance Sheet.

At December 31, 2017, the Company has contracted for delivery a total of 1,800,000 MMBtu of natural gas at an average price of \$4.40 per MMBtu through December 31, 2018. Contracts covering 1,680,000 MMBtu are subject to accounting as derivative instruments. Future decreases in the NYMEX forward strip prices will result in additional derivative losses while future increases in

the NYMEX forward strip prices will result in derivative gains. Future gains or losses will approximate the change in NYMEX natural gas prices relative to the total quantity of natural gas under contracts now subject to accounting as derivatives. The historical average NYMEX natural gas contract settlement prices for the years ended December 31, 2017 and 2016 were \$3.11 per MMBtu and \$2.46 per MMBtu, respectively.

9. Fair Value Measurements

The Company's derivative instruments are measured at fair value on a recurring basis. U.S. GAAP establishes a fair value hierarchy that has three levels based on the reliability of the inputs used to determine the fair value. These levels include: Level 1, defined as inputs such as unadjusted quoted prices in active markets for identical assets or liabilities; Level 2, defined as inputs other than quoted prices in active markets that are either directly or indirectly observable; and Level 3, defined as unobservable inputs for use when little or no market data exists, therefore requiring an entity to develop its own assumptions.

The Company's natural gas derivative instruments are included within the Level 2 fair value hierarchy. For additional information on the derivative instruments, refer to Note 8 – Natural Gas Derivative Instruments. The following table sets forth by level within the fair value hierarchy the Company's assets and liabilities that were accounted for at fair value:

	Fair value as of December 31, 2017			
	Level 1	Level 2	Level 3	Total
Liabilities:				
Derivative instruments	\$—	\$(2,537)	\$ —	\$(2,537)
Total fair value	\$—	\$(2,537)	\$ —	\$(2,537)

	Fair value as of December 31, 2016			
	Level 1	Level 2	Level 3	Total
Liabilities:				
Derivative instruments	\$—	\$(3,468)	\$ —	\$(3,468)
Total fair value	\$—	\$(3,468)	\$ —	\$(3,468)

At December 31, 2017, the fair value of the Company's long-term debt approximated the carrying value.

10. Stock Based Compensation

On May 20, 2014, the shareholders approved the 2014 CARBO Ceramics Inc. Omnibus Incentive Plan (the “2014 Omnibus Incentive Plan”). The 2014 Omnibus Incentive Plan replaces the expired 2009 Omnibus Incentive Plan. In May 2017, the shareholders approved the Amended and Restated 2014 CARBO Ceramics Inc. Omnibus Incentive Plan (the “Amended 2014 Omnibus Plan”). Under the Amended 2014 Omnibus Incentive Plan, the Company may grant cash-based awards, stock options (both non-qualified and incentive) and other equity-based awards (including stock appreciation rights, phantom stock, restricted stock, restricted stock units, performance shares, deferred share units or share-denominated performance units) to employees and non-employee directors. The amount paid under the Amended 2014 Omnibus Incentive Plan to any single participant in any calendar year with respect to any cash-based award shall not exceed \$5,000. Awards may be granted with respect to a number of shares of the Company’s Common Stock that in the aggregate does not exceed 1,450,000 shares prior to the fifth anniversary of its effective date, plus (i) the number of shares that are forfeited, cancelled or returned, and (ii) the number of shares that are withheld from the participants to satisfy an option exercise price or minimum statutory tax withholding obligations. No more than 100,000 shares may be granted to any single participant in any calendar year. Equity-based awards may be subject to performance-based and/or service-based conditions. With respect to stock options and stock appreciation rights granted, the exercise price shall not be less than the market value of the underlying Common Stock on the date of grant. The maximum term of an option is ten years. Restricted stock awards granted generally vest (i.e., transfer and forfeiture restrictions on these shares are lifted) proportionately on each of the first three anniversaries of the grant date, but subject to certain limitations, awards may specify other vesting periods. As of December 31, 2017, 759,326 shares were available for issuance under the Amended 2014 Omnibus Incentive Plan.

A summary of restricted stock activity and related information for the year ended December 31, 2017 is presented below:

	Shares	Weighted-Average Grant-Date Fair Value Per Share
Nonvested at January 1, 2017	339,140	\$ 28.59
Granted	297,685	\$ 10.30
Vested	(145,643)	\$ 36.69
Forfeited	(50,063)	\$ 17.19
Nonvested at December 31, 2017	441,119	\$ 14.87

As of December 31, 2017, there was \$3,183 of total unrecognized compensation cost related to restricted shares granted under Amended and Restated 2014 Omnibus Incentive Plan. That cost is expected to be recognized over a weighted-average period of 1.6 years. The weighted-average grant date fair value of restricted stock granted during the years ended December 31, 2017, 2016 and 2015 was \$10.30, \$17.27 and \$34.62, respectively. The total fair value of shares vested during the years ended December 31, 2017, 2016 and 2015 was \$2,023, \$6,532 and \$6,910, respectively.

As of December 31, 2017, the Company's outstanding market-based cash awards to certain executives of the Company had a total Target Award of \$2,822. The amount of awards that will ultimately vest can range from 0% to 200% based on the Company's Relative Total Shareholder Return calculated over a three year period beginning January 1 of the year each grant was made.

The Company also made phantom stock awards to key employees pursuant to the Amended 2014 Omnibus Incentive Plan. The units subject to an award vest and cease to be forfeitable in equal annual installments over a three-year period. Participants awarded units of phantom stock are entitled to a lump sum cash payment equal to the fair market value of a share of Common Stock on the vesting date. In no event will Common Stock of the Company be issued with regard to outstanding phantom stock awards. As of December 31, 2017, there were 163,215 units of phantom stock granted under the Amended 2014 Omnibus Incentive Plan, of which 4,189 have vested and 12,950 have been forfeited. As of December 31, 2017, nonvested units of phantom stock under the Amended 2014 Omnibus Incentive Plan have a total value of \$1,487, a portion of which is accrued as a liability within Accrued Payroll and Benefits.

11. Loss Per Share

ASC Topic 260, "Earnings Per Share", provides that unvested share-based payment awards that contain non-forfeitable rights to dividends or dividend equivalents (whether paid or unpaid) are participating securities and shall be included in the computation of earnings per share pursuant to the two-class method. The Company's outstanding non-vested restricted stock awards are participating securities. Accordingly, earnings per common share are computed using the two-class method. The impact of the Company's Warrant issued to Wilks in March 2017 was not included in the computation of diluted loss per share because the average price for our common stock was less than the strike price of

the Warrant and, therefore, the Warrant was not dilutive for 2017. The Warrant entitles the holder thereof to purchase up to 523,022 shares of the Common Stock, at an exercise price of \$14.91 per share, payable in cash. Refer to Note 3.

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The following table sets forth the computation of basic and diluted loss per share under the two-class method:

	2017	2016	2015
Numerator for basic and diluted loss per share:			
Net loss	\$(253,116)	\$(80,127)	\$(109,544)
Effect of reallocating undistributed earnings of			
participating securities	—	—	—
Net loss available under the two-class			
method	\$(253,116)	\$(80,127)	\$(109,544)
Denominator:			
Denominator for basic loss per			
share—weighted-average shares	26,664,247	24,377,839	22,999,318
Effect of dilutive potential common shares			
Denominator for diluted loss per	—	—	—
share—adjusted weighted-average shares	26,664,247	24,377,839	22,999,318
Basic loss per share	\$(9.49)	\$(3.29)	\$(4.76)
Diluted loss per share	\$(9.49)	\$(3.29)	\$(4.76)

12. Quarterly Operating Results—(Unaudited)

Quarterly results for the years ended December 31, 2017 and 2016 were as follows:

	Three Months Ended			
	March 31	June 30	September 30	December 31
2017				
Revenues	\$34,670	\$43,572	\$50,173	\$60,341
Gross loss	(19,458)	(13,433)	(14,523)	(5,911)
Net loss	(32,444)	(24,822)	(178,465)	(17,384)
Loss per share:				
Basic	\$(1.22)	\$(0.93)	\$(6.69)	\$(0.65)
Diluted	\$(1.22)	\$(0.93)	\$(6.69)	\$(0.65)
2016				
Revenues	\$33,102	\$20,651	\$20,241	\$29,058
Gross loss	(23,641)	(20,012)	(20,865)	(20,495)
Net loss	(24,684)	(20,296)	(19,950)	(15,197)
Earnings per share:				
Basic	\$(1.07)	\$(0.88)	\$(0.81)	\$(0.57)
Diluted	\$(1.07)	\$(0.88)	\$(0.81)	\$(0.57)

Quarterly data may not sum to full year data reported in the Consolidated Financial Statements due to rounding.

13. Segment Information

The Company has two operating segments: 1) Oilfield Technologies and Services and 2) Environmental Products and Services. Discrete financial information is available for each operating segment. Management of each operating segment reports to our Chief Executive Officer, the Company's chief operating decision maker, who regularly evaluates revenue and income (loss) before income taxes as the measure to evaluate segment performance and to allocate resources. The accounting policies of each segment are the same as those described in the summary of significant accounting policies in Note 1.

The Company's Oilfield Technologies and Services segment manufactures and sells ceramic proppants on a global basis for use primarily in the hydraulic fracturing of natural gas and oil wells. All of the Company's ceramic proppant products have similar production processes and economic characteristics and are marketed predominantly to pressure pumping companies that perform hydraulic fracturing for major oil and gas companies. The Company's manufacturing facilities also produce ceramic pellets for use in various industrial technology applications, including but not limited to casting and milling. This segment also promotes increased production and Estimated Ultimate Recovery ("EUR") of oil and natural gas by providing industry leading technology to Design, Build, and Optimize the Frac™. Through our wholly-owned subsidiary StrataGen, Inc., we sell one of the most widely used fracture

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stimulation software under the brand FracPro® and provide fracture design and consulting services to oil and natural gas E&P companies under the brand StrataGen.

Our Environmental Products and Services segment is intended to protect operators' assets, minimize environmental risks, and lower lease operating expense ("LOE"). AGPI, a wholly-owned subsidiary of ours, provides spill prevention, containment and countermeasure systems for the oil and gas industry. AGPI uses proprietary technology designed to enable its clients to extend the life of their storage assets, reduce the potential for hydrocarbon spills and provide containment of stored materials.

Summarized financial information for the Company's operating segments for the three-year period ended December 31, 2017 is shown in the following tables. Intersegment sales are not material.

	Oilfield Technologies and Services	Environmental Products and Services	Total
	(\$ in thousands)		
2017			
Revenue from external customers	\$ 165,557	\$ 23,199	\$ 188,756
Loss before income taxes	(255,097)	(46)	(255,143)
Total assets	524,952	15,646	540,598
Capital expenditures, net	2,228	(76)	2,152
Depreciation and amortization	44,060	1,277	45,337
2016			
Revenue from external customers	\$ 89,351	\$ 13,700	\$ 103,051
Loss before income taxes	(128,128)	(3,080)	(131,208)
Total assets	709,180	14,277	723,457
Capital expenditures, net	7,008	(160)	6,848
Depreciation and amortization	46,871	1,580	48,451
2015			
Revenue from external customers	\$ 257,373	\$ 22,201	\$ 279,574
Loss before income taxes	(151,772)	(11,977)	(163,749)
Total assets	817,845	18,524	836,369
Capital expenditures, net	62,996	(249)	62,747
Depreciation and amortization	52,451	2,006	54,457

Geographic Information

Long-lived assets, consisting of net property, plant and equipment and other long-term assets, as of December 31 in the United States and other countries are as follows:

	2017	2016	2015
Long-lived assets:			
United States	\$ 326,665	\$ 489,374	\$ 531,518

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International	6,482	10,241	12,320
Total	\$333,147	\$499,615	\$543,838

Revenues outside the United States accounted for 21%, 34% and 29% of the Company's revenues for 2017, 2016 and 2015, respectively. Revenues for the years ended December 31 in the United States, Canada and other countries are as follows:

	2017	2016	2015
Revenues:			
United States	\$149,040	\$67,609	\$199,187
Canada	7,439	7,460	33,614
Other international	32,276	27,982	46,773
Total	\$188,756	\$103,051	\$279,574

Sales to Customers

The following schedule presents customers, primarily from the Oilfield Technologies and Services segment, from whom the Company derived 10% or more of total revenues for the years ended December 31:

	Major Customers			
	A	B	C	D
2017	—	16.1%	—	10.2%
2016	—	20.4%	11.1%	—
2015	10.7%	26.9%	—	—

14. Benefit Plans

The Company has defined contribution savings and profit sharing plans pursuant to Section 401(k) of the Internal Revenue Code. Benefit costs recognized as expense under these plans consisted of the following for the years ended December 31:

	2017	2016	2015
Contributions:			
Profit sharing	\$—	\$—	\$—
Savings	953	939	1,547
	\$953	\$939	\$1,547

All contributions to the plans are 100% participant directed. Participants are allowed to invest up to 20% of contributions in the Company's Common Stock.

15. Commitments

In January 2011, the Company entered into an agreement with one of the Company's existing suppliers to purchase from the supplier at least 70 percent of the annual kaolin requirements for the Eufaula, Alabama plant at specified contract prices. The term of the agreement was three years, with options to extend for an additional six years. In May 2012, the agreement was amended to require the Company to purchase from the supplier at least 50 percent of the annual kaolin requirements for the Eufaula, Alabama plant at specified contract prices for the remainder of 2012 and the ensuing five calendar years. In May 2017, the agreement was automatically extended for an additional three years. For the years ended December 31, 2017, 2016 and 2015, the Company purchased from the supplier \$2,207, \$968 and \$2,380, respectively, of kaolin under the agreement.

In January 2003, the Company entered into a mining agreement with a contractor to provide kaolin for the Company's McIntyre, Georgia plant at specified contract prices, from lands owned or leased by either the Company or the

contractor. The term of the agreement, which commenced on January 1, 2003, and remains in effect until such time as all Company-owned minerals have been depleted, previously required the Company to accept delivery from the contractor of at least 80 percent of the McIntyre plant's annual kaolin requirements. In 2006, the Company's plant in Toombsboro, Georgia commenced operations and became part of this agreement. In November 2015, the agreement was amended to require the Company to accept delivery from the contractor of 100 percent of the annual kaolin requirements for the plants in McIntyre and Toombsboro. For the years ended December 31, 2017, 2016 and 2015, the Company purchased \$950, \$1,196 and \$3,245, respectively, of kaolin under the agreement.

In July 2011, the Company entered into an agreement with a supplier to provide hydro sized sand for the Company's Marshfield, Wisconsin plant at a specified contract price. The term of the agreement was five years commencing on July 30, 2011 and required the Company to purchase a minimum of 40,000 tons and 100,000 tons of hydro sized sand during 2011 and 2012, respectively. Effective January 30, 2012, the agreement was amended and requires the Company to purchase a minimum of 150,000 tons of hydro sized sand annually during 2012 and 2013 and a minimum of 350,000 tons of hydro sized sand in 2014, all at a stated contract price. There were no purchase commitments required during 2015 through May 2017. Effective June 2017, the Company entered into an agreement to purchase a minimum of 360,000 tons of hydro sized sand in 2017, all at a stated contract price. There are no additional minimum purchase requirements under this contract. For the years ended December 31, 2017, 2016, and 2015, the Company purchased \$3,876, \$0 and \$3,997, respectively, of sand under this agreement.

In May 2012, the Company entered into a supply agreement with a contractor to provide kaolin for the Company's manufacturing plant in Millen, Georgia at specified contract prices, from lands owned or leased by either the Company or the contractor. The term of the agreement, which commenced in July 2014, has an initial term of five years with options to extend for an additional five years and requires the Company to accept delivery from the contractor of at least 50 percent of the Millen plant's

annual kaolin requirements. For the years ended December 31, 2017, 2016 and 2015, the Company purchased \$0, \$0 and \$561, respectively, of kaolin under this agreement.

In October 2014, the Company entered into an agreement with a supplier to mine kaolin and process into a slurry for the Company's manufacturing plant in Millen, Georgia at specified contract prices. The term of the agreement was five years with automatic two (2) year extensions and requires the Company to source at least 50 percent of the Millen plant's annual slurry requirement from the supplier. For the years ended December 31, 2017, 2016 and 2015, the Company purchased \$0, \$0 and \$1,300, respectively, of slurry under this agreement.

In November 2014, the Company entered into an agreement with a supplier to provide frac sand for the Company's Marshfield, Wisconsin plant at a specified contract price. The term of the agreement, which commenced on November 13, 2014, remains in effect until the specified sand is depleted and required the Company to purchase a minimum of 300,000 tons of frac sand during 2015 and 400,000 tons of frac sand for each year thereafter. Effective October 12, 2015, the Company entered into a Letter Agreement with the supplier resulting in the adjustment of required annual minimum purchased tons of frac sand to 123,203 and 116,599 for years 2015 and 2016, respectively. In July 2016, the Company entered into a Letter Agreement with the supplier which removed the required annual minimum purchased tons of frac sand for 2016. In April 2017, the Company entered into a Letter Agreement with the supplier to purchase a minimum of 400,000 tons in 2017, all at a stated price. The minimum purchase requirements of 400,000 tons for years 2018 and thereafter until the specified sand is depleted remains unchanged. For the years ended December 31, 2017, 2016 and 2015, the Company purchased \$3,837, \$252 and \$1,751, respectively, of frac sand under this agreement.

In September 2017, the Company entered into an agreement with a supplier to provide frac sand for the Company's Marshfield, Wisconsin plant at a specified contract price. The contract requires us purchase 16,000 tons of frac sand per month through February 2018. For the year ended December 31, 2017, the Company purchased \$675 of frac sand under this agreement.

In November 2017, the Company entered into an agreement with a supplier to provide hydro sized sand for the Company's Marshfield, Wisconsin plant at a specified contract price. The Company agreed to purchase a minimum of 40,000 tons with the option to purchase additional hydro sized sand at the Company's discretion. As of December 31, 2017, the Company had not yet purchased any hydro sized sand under this agreement.

The Company entered into a lease agreement dated November 1, 2008 ("2008 Agreement") with the Development Authority of Wilkinson County (the "Wilkinson County Development Authority") and a lease agreement dated November 1, 2012 ("2012 Agreement") with the Development Authority of Jenkins County (the "Jenkins County Development Authority" and together with the Wilkinson County Development Authority, the "Development Authorities") each in the State of Georgia. Pursuant to the 2008 Agreement, the Wilkinson County Development Authority holds the title to the real and personal property of the Company's McIntyre and Toombsboro manufacturing facilities and leases the facilities to the Company for an annual rental fee of \$50 per year through November 1, 2017, and includes a Company renewal option to extend through November 1, 2021. Pursuant to the 2012 Agreement, the Jenkins County Development Authority holds title to the real estate and personal property of the Company's Millen, Georgia manufacturing facility, and leases the facility to the Company until the tenth anniversary of completion of the final phase of the facility. At any time prior to the scheduled termination of either lease, the Company has the option to terminate the lease and purchase the property for a nominal fee plus the payment of any rent payable through the balance of the lease term. Furthermore, the Company has security interests in the titles held by the Development Authorities. The Company has also entered into a Memorandum of Understanding (the "MOU") with the Development Authorities and other local agencies, under which the Company receives tax incentives in exchange for its commitment to invest in the county and increase employment. The MOU with the Jenkins County Development Authority also requires the Company to pay an administrative payment of \$50 per year during the term of the Millen

lease. The Company is required to achieve certain employment levels in order to retain its tax incentives. In the event the Company does not meet the agreed-upon employment targets or the MOU is otherwise terminated, the Company would be subjected to additional property taxes annually. Based on adverse economic conditions beyond the Company's control that negatively impacted employment levels, a notice dated December 1, 2015 sent by the Company to the Development Authority of Jenkins County declared a force majeure, which suspended employment levels defined in the original agreement and preserved tax incentives until further notification of the restart of plant operations. The suspension period defined in the amended agreement cannot extend beyond January 1, 2021. Based on adverse economic conditions beyond the Company's control that negatively impacted employment levels, a notice dated February 1, 2016 sent by the Company to the Development Authority of Wilkinson County declared a force majeure, which suspended employment levels defined in the original agreement and preserved tax incentives until further notification of the restart of plant operations. The Development Authority of Jenkins County and the Development Authority of Wilkinson County has not challenged the Company's declaring a force majeure. The properties subject to these lease agreements are included in Property, Plant and Equipment (net book value of \$262,319 at December 31, 2017) in the accompanying consolidated financial statements.

16. Employment Agreements

The Company has an employment agreement through December 31, 2018 with its President and Chief Executive Officer. The agreement provides for an annual base salary and incentive bonus. If the President and Chief Executive Officer is terminated early without cause, the Company will be obligated to pay two years base salary and a prorated incentive bonus. Under the agreement, the timing of the payment of severance obligations to the President in the event of the termination of his employment under certain circumstances has been conformed so that a portion of such obligations will be payable in a lump sum, with the remainder of the obligations to be paid over an 18 month period. The agreement also contains a two-year non-competition covenant that would become effective upon termination for any reason. The employment agreement extends automatically for successive one-year periods without prior written notice.

17. Sale of Russian Proppant Business

On July 21, 2017, subsidiaries of the Company Carbo Ceramics (Mauritius) Inc. and Carbo LLC (together, the "Sellers") entered into a Share Purchase Agreement with Petro Welt Technologies AG and PeWeTe Evolution Limited (together, the "Purchasers") to sell the Company's Russian proppant business. The adjusted purchase price is approximately \$26,000 for all of the shares of CARBO Ceramics Cyprus Limited held by the Sellers. The transaction received local regulatory approval and closed on September 21, 2017.

During the third quarter of 2017, the Company received gross proceeds of \$22,000 related to the sale. We expect to receive additional proceeds on the sale of approximately \$4,000 related to net debt and net working capital purchase price adjustments. Although the Company remains in active discussions with the Purchasers regarding the purchase price adjustments, in January 2018, the Company filed a Notice of Arbitration related to this purchase price adjustment against the Purchasers. The net assets included in the calculation of the loss on the sale were \$17,754, including cash and cash equivalents of \$846, accounts receivable of \$6,047, total inventory of \$8,573, net PP&E of \$2,763, other net assets of \$670, and accrued expenses of \$1,145. The Company incurred approximately \$1,646 in expenses relating to the sale. Gain on the sale before consideration of the cumulative translation adjustment was approximately \$6,599. However, as a result of the sale, the Company reclassified the foreign currency cumulative translation loss of \$33,347 from accumulated other comprehensive loss within shareholders' equity to net loss which offset the initial gain on the sale. As a result, the Company's net loss on the sale was approximately \$26,747, presented as a separate line item within operating loss on the consolidated statement of operations.

As of December 31, 2017, the Company does not have a material net investment that is subject to foreign currency fluctuations.

18. Legal Proceedings and Regulatory Matters

The Company is subject to legal proceedings, claims and litigation arising in the ordinary course of business. While the outcome of these matters is currently not determinable, management does not expect that the ultimate costs to resolve these matters will have a material adverse effect on the Company's consolidated financial position, results of operations, or cash flows.

19. Subsequent Events

In January 2018, the Company awarded the following:

334,638 shares of restricted stock to certain employees. The fair value of the stock award on the date of grant totaled \$4,069, which will be recognized as expense, less actual forfeitures as they occur, on a straight-line basis over the three-year vesting period.

51,401 units of phantom shares to certain employees. The fair value of the phantom shares on the date of grant totaled \$625. Compensation expense for these shares will be recognized over the three-year vesting period. The amount of compensation expense recognized each period will be based on the fair value of the Company's common stock at the end of each period.

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Exhibit Index

- 3.1 Restated Certificate of Incorporation of CARBO Ceramics Inc. (incorporated by reference to Exhibit 3.1 of the Registrant's Form 10-Q filed for the period ending June 30, 2012)
- 3.2 Second Amended and Restated By-Laws of CARBO Ceramics Inc. (incorporated by reference to Exhibit 3.1 of the Registrant's Form 8-K Current Report filed July 17, 2013)
- 4.1 Form of Common Stock Certificate of CARBO Ceramics Inc. (incorporated by reference to Exhibit 4.1 of the Registrant's Form S-1 Registration Statement No. 333-1884 filed July 19, 1996) (P)
- 4.2 Certificate of Designations of Series A Preferred Stock (incorporated by reference to Exhibit 2 of the Registrant's Form 8-A12B Registration Statement No. 001-15903 filed February 25, 2002)
- **10.1 Amended and Restated Mining Agreement dated as of November 30, 2015 between CARBO Ceramics Inc. and Arcilla Mining & Land Co. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2015)
- **10.2 Proppant Supply Agreement dated as of August 28, 2008 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.3 of the Registrant's Form 10-Q Quarterly Report for the quarter ended September 30, 2008)
- **10.3 Amendment No. 1 to Proppant Supply Agreement dated as of February 28, 2011 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2011)
- 10.4 Side Letter to Proppant Supply Agreement dated as of August 26, 2011 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended September 30, 2011)
- 10.5 Amendment No. 3 to Proppant Supply Agreement dated as of March 24, 2014 by and between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2014)
- **10.6 Amendment No. 4 to Proppant Supply Agreement dated as of September 25, 2015 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended September 30, 2015)
- **10.7 Amendment No. 5 to Proppant Supply Agreement dated as of September 25, 2015 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.10 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2015)
- 10.8 Amendment No. 6 to Proppant Supply Agreement dated as of April 30, 2016 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2016)
- 10.9 Promissory Note between CARBO Ceramics Inc. and Williams C. Morris (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2016)
- 10.10 Promissory Note between CARBO Ceramics Inc. and Robert S. Rubin (incorporated by reference to Exhibit 10.3 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2016)
- **10.11 Master Purchase Agreement for Goods and Services dated as of January 18, 2017 between CARBO Ceramics Inc. and Halliburton Energy Services, Inc. (incorporated by reference to Exhibit 10.15 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2016)
- 10.12 Lease Agreement dated as of November 1, 2008 between the Development Authority of Wilkinson County and CARBO Ceramics Inc. (incorporated by reference to Exhibit 10.1 of the Registrant's Form 8-K Current Report filed December 30, 2008)
- 10.13 Option Agreement dated as of November 1, 2008 between the Development Authority of Wilkinson County and CARBO Ceramics Inc. (incorporated by reference to Exhibit 10.2 of the Registrant's Form 8-K Current Report filed December 30, 2008)

- 10.14 Lease Agreement dated as of November 1, 2012 between the Development Authority of Jenkins County and CARBO Ceramics Inc. (incorporated by reference to Exhibit 10.9 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2012)
- *10.15 Amended and Restated 2014 CARBO Ceramics Inc. Omnibus Incentive Plan (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2017)
- *10.16 Form of Officer Restricted Stock Award Agreement for Amended and Restated 2014 Omnibus Incentive Plan
- *10.17 Form of Non-Employee Director Restricted Stock Award Agreement for Amended and Restated 2014 Omnibus Incentive Plan
- *10.18 Form of Officer Restricted Stock Unit Award Agreement for Amended and Restated Omnibus 2014 Incentive Plan

- *10.19 Description of Annual Non-Employee Director Stock Grants (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2010)
- *10.20 Description of Modification to Annual Non-Employee Director Stock Grants (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2011)
- *10.21 Description of Modification to the Annual Non-Employee Director Stock Grants (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2012)
- *10.22 Description of Modification to Annual Non-Employee Director Stock Grants (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2013)
- *10.23 Description of Modification to Annual Non-Employee Director Stock Grants (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2014)
- 10.24 Office Lease dated as of January 20, 2009 between I-10 EC Corridor #2 Limited Partnership and CARBO Ceramics Inc. (incorporated by reference to Exhibit 10.27 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2009)
- 10.25 First Amendment to Lease dated as of January 15, 2010 between I-10 EC Corridor #2 Limited Partnership and CARBO Ceramics Inc. (incorporated by reference to Exhibit 10.28 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2009)
- 10.26 Second Amendment to Lease dated as of March 1, 2015 between I-10 EC Corridor #2 Limited Partnership and CARBO Ceramics Inc. (incorporated by reference to Exhibit 10.2 of the Registrant's Form 8-K Current Report filed March 16, 2015)
- 10.27 Credit Agreement, dated as of January 29, 2010, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.1 of the Registrant's Form 8-K Current Report filed February 4, 2010)
- 10.28 Amendment No. 1, dated as of March 5, 2012, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.1 of the Registrant's Form 8-K Current Report filed March 6, 2012)
- 10.29 Amendment No. 2 to Credit Agreement, dated as of July 25, 2013, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2013)
- 10.30 Amendment No. 3 to Credit Agreement, dated as of October 31, 2014, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended September 30, 2014)
- 10.31 Amendment No. 4 to Credit Agreement, dated as of July 27, 2015, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2015)
- 10.32 Amendment No. 5 to Credit Agreement, dated as of September 14, 2015, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended September 30, 2015)
- 10.33 Amendment No. 6 to Credit Agreement, dated as of February 26, 2016, among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent, issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.37 of the Registrant's Form 10-K Annual Report for the year ended December 31, 2015)
- 10.34 Agreement and Amendment No. 7 to the Credit Agreement, dated as of April 27, 2016, by and among CARBO Ceramics Inc., as borrower, Wells Fargo Bank, National Association, as administrative agent,

- issuing lender and swing line lender, and the lenders named therein (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2016)
- 10.35 Amended and Restated Pledge and Security Agreement, dated as of April 27, 2016, by and between CARBO Ceramics Inc., as borrower and Wells Fargo Bank, National Association, as administrative agent (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2016)
- 10.36 Patent and Trademark Security Agreement dated as of April 27, 2016 by and among CARBO Ceramics Inc., as borrower, certain Material Domestic Subsidiaries of the Borrower and Wells Fargo Bank, National Association, as administrative agent (incorporated by reference to Exhibit 10.3 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2016)
- 10.37 Waiver Agreement dated as of April 27, 2016, by and among CARBO Ceramics Inc., as borrower, certain Lenders parties thereto and Wells Fargo Bank, National Association, as administrative agent (incorporated by reference to Exhibit 10.4 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2016)

- 10.38 Guaranty Agreement dated as of April 27, 2016, by and among certain Guarantors of CARBO Ceramics Inc. thereto and Wells Fargo Bank, National Association, as administrative agent (incorporated by reference to Exhibit 10.5 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2016)
- 10.39 Security Agreement, dated July 27, 2015, among CARBO Ceramics Inc., as borrower and Wells Fargo Bank, National Association, as administrative agent (incorporated by reference to Exhibit 10.3 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2015)
- *10.40 Form of Change in Control Severance Agreement (incorporated by reference to Exhibit 10.1 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2012)
- 10.41 Sales Agreement between CARBO Ceramics Inc. and Cowen and Company, LLC, dated July 28, 2016 (incorporated by reference to Exhibit 10.1 of the Registrant's Form 8-K Current Report filed July 28, 2016)
- 10.42 Amended and Restated Credit Agreement dated as of March 2, 2017, by and between CARBO Ceramics Inc., as borrower, and Wilks Brothers, LLC, as lender and administrative agent (incorporated by reference to Exhibit 10.1 of the Registrant's Form 8-K Current Report filed March 6, 2017)
- 10.43 Letter Agreement, dated as of March 2, 2017, by and between Carbo Ceramics Inc., Wilks Brothers, LLC, William C. Morris, Robert S. Rubin and Gary A. Kolstad (incorporated by reference to Exhibit 10.2 of the Registrant's Form 8-K Current Report filed March 6, 2017)
- 10.44 Registration Rights Agreement, dated as of March 2, 2017, by and between Carbo Ceramics Inc. and Wilks Brothers, LLC (incorporated by reference to Exhibit 10.3 of the Registrant's Form 8-K Current Report filed March 6, 2017)
- 10.45 Warrant, dated as of March 2, 2017, issued by Carbo Ceramics Inc. to Wilks Brothers, LLC (incorporated by reference to Exhibit 10.4 of the Registrant's Form 8-K Current Report filed March 6, 2017)
- 10.46 Second Amended and Restated Pledge and Security Agreement, dated as of March 2, 2017, by and among CARBO Ceramics Inc., as borrower, and Wilks Brothers, LLC, as administrative agent (incorporated by reference to Exhibit 10.5 of the Registrant's Form 8-K Current Report filed March 6, 2017)
- *10.47 Fifth Amended and Restated Employment Agreement dated as of March 20, 2017, by and between CARBO Ceramics Inc. and Gary A. Kolstad (incorporated by reference to Exhibit 10.6 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2017)
- 10.48 Letter Agreement, dated as of March 2, 2017, between CARBO Ceramics Inc. and William C. Morris (incorporated by reference to Exhibit 10.7 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2017)
- 10.49 Letter Agreement, dated as of March 2, 2017, between CARBO Ceramics Inc. and Robert S. Rubin (incorporated by reference to Exhibit 10.8 of the Registrant's Form 10-Q Quarterly Report for the quarter ended March 31, 2017)
- ***10.50 Share Purchase Agreement between Carbo Ceramics (Mauritius) Inc. and CARBO LLC and Petro Welt Technologies AG and PeWeTe Evolution Limited, dated as of July 21, 2017 (incorporated by reference to Exhibit 10.2 of the Registrant's Form 10-Q Quarterly Report for the quarter ended June 30, 2017)
- 21 Subsidiaries
- 23 Consent of Independent Registered Public Accounting Firm
- 31.1 Rule 13a-14(a)/15d-14(a) Certification by Gary A. Kolstad
- 31.2 Rule 13a-14(a)/15d-14(a) Certification by Ernesto Bautista III
- 32 Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002
- 95 Mine Safety Disclosure
- 101 The following financial information from the Company's Annual Report on Form 10-K for the year ended December 31, 2017, formatted in XBRL: (i) Consolidated Balance Sheets; (ii) Consolidated Statements of Operations; (iii) Consolidated Statements of Comprehensive Loss; (iv) Consolidated Statements of Shareholders' Equity; (v) Consolidated Statements of Cash Flows; and (vi) Notes to the Consolidated Financial Statements.
- *Management contract or compensatory plan or arrangement filed as an exhibit pursuant to Item 15(b) of the requirements for an Annual Report on Form 10-K.
- **Pursuant to Rule 24b-2 of the Securities Exchange Act of 1934, as amended, confidential portions of these exhibits have been omitted and filed separately with the Securities and Exchange Commission pursuant to a request for confidential treatment.

*** The schedules and Exhibit A to the Share Purchase Agreement have been omitted from this filing pursuant to Item 601(b)(2) of Regulation S-K. The Company agrees to furnish supplementally a copy of any omitted schedule to the SEC upon request.

(P) Paper exhibits

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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.

CARBO Ceramics Inc.

By: /s/ Gary A Kolstad
Gary A. Kolstad
President and Chief Executive Officer

By: /s/ Ernesto Bautista III
Ernesto Bautista III
Vice President and
Chief Financial Officer

Dated: March 7, 2018

POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Gary A. Kolstad and Ernesto Bautista III, jointly and severally, his attorneys-in-fact, each with the power of substitution, for him in any and all capacities, to sign any amendments to this Report on Form 10 K, and to file the same, with exhibits thereto and other documents in connection therewith, with the Securities and Exchange Commission, hereby ratifying and confirming all that each of said attorneys-in-fact, or his substitute or substitutes, may do or cause to be done by virtue hereof.

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

Signature	Title	Date
/s/ William C. Morris William C. Morris	Chairman of the Board	March 7, 2018
/s/ Gary A. Kolstad Gary A. Kolstad	President, Chief Executive Officer and Director (Principal Executive Officer)	March 7, 2018
/s/ Ernesto Bautista III Ernesto Bautista III	Vice President and Chief Financial Officer (Principal Financial and Accounting Officer)	March 7, 2018
/s/ Sigmund L. Cornelius Sigmund L. Cornelius	Director	March 7, 2018
/s/ Chad C. Deaton Chad C. Deaton	Director	March 7, 2018
/s/ H.E. Lentz, Jr. H.E. Lentz, Jr.	Director	March 7, 2018
/s/ Randy L. Limbacher Randy L. Limbacher	Director	March 7, 2018
/s/ Robert S. Rubin Robert S. Rubin	Director	March 7, 2018

