

FUEL TECH, INC.
Form 10-K
March 14, 2019
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SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

Form 10-K
(Mark One)

ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended: December 31, 2018
OR

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

For the transition period from _____ to _____
Commission File Number 001-33059

Fuel Tech, Inc.
(Exact name of registrant as specified in its charter)

Delaware 20-5657551
(State of Incorporation) (I.R.S. ID)

Fuel Tech, Inc.
27601 Bella Vista Parkway
Warrenville, IL 60555-1617
(630) 845-4500
www.ftek.com

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

COMMON STOCK, \$0.01 par value per share NASDAQ
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 Exchange 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 (§229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.

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

Large Accelerated Filer Accelerated Filer

Non-accelerated Filer Smaller reporting company

Emerging growth company

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. Yes No

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

As of June 30, 2018, the aggregate market value of the registrant's common stock held by non-affiliates of the registrant was approximately \$23,336,583 based on the closing sale price as reported on the NASDAQ National Market System.

As of February 28, 2019, there were 24,186,824 shares of common stock outstanding.

Documents incorporated by reference:

Portions of the definitive Proxy Statement to be delivered to shareholders in connection with the Annual Meeting of Shareholders to be held on May 16, 2019 are incorporated by reference into Part III.

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TABLE OF DEFINED TERMS

Term	Definition
ACE	
AIG	Ammonia Injection Grid
ASCR™	A trademark used to describe our Advanced Selective Catalytic Reduction process
CAIR	Clean Air Interstate Rule
CSAPR	Cross-State Air Pollution Rule
CFD	Computational Fluid Dynamics
EPA	The U.S. Environmental Protection Agency
ESP	Electrostatic Precipitator
FGC	Flue Gas Conditioning
FUEL CHEM®	A trademark used to describe our fuel and flue gas treatment processes, including its TIFI® Targeted In-Furnace Injection™ technology to control slagging, fouling, corrosion and a variety of sulfur trioxide-related issues
GSG™	Graduated Straightening Grid
HERT™ High Energy Reagent Technology™	A trademark used to describe one of our SNCR processes for the reduction of NO _x Systems can include LNB, OFA, and SNCR components, along with SCR technology, Ammonia Injection Grid (AIG), and Graduated Straightening Grid (GSG™) system
I-NO _x ®	Oxides of nitrogen
NO _x	
NO _x OUT®	A trademark used to describe one of our SNCR processes for the reduction of NO _x
NO _x OUT-SCR®	A trademark used to describe our direct injection of urea as a catalyst reagent
NO _x OUT-CASCADE®	A trademark used to describe our process for the combination of SNCR and SCR technologies
SCR	Selective Catalytic Reduction
SNCR	Selective Non-Catalytic Reduction
TIFI® Targeted In-Furnace Injection™	A trademark used to describe our proprietary technology that enables the precise injection of a chemical reagent into a boiler or furnace as part of a FUEL CHEM program
UDI™	Urea Direct Injection as the process to provide urea reagent directly into a duct for SCR applications
ULTRA®	A trademark used to describe our process for generating ammonia for use as a Selective Catalytic Reduction reagent
BREF	Best Available Reference Technology. European emission requirements.
ACE	Affordable Clean Energy. EPA rule to address greenhouse gas emissions.
DGI™	Dissolved Gas Infusion
BACT	Best Available Control Technology

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PART I

Forward-Looking Statements

This Annual Report on Form 10-K contains “forward-looking statements,” as defined in Section 21E of the Securities Exchange Act of 1934, as amended, that are made pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995 and reflect our current expectations regarding our future growth, results of operations, cash flows, performance and business prospects, and opportunities, as well as assumptions made by, and information currently available to, our management. We have tried to identify forward-looking statements by using words such as “anticipate,” “believe,” “plan,” “expect,” “intend,” “will,” and similar expressions, but these words are not the exclusive means of identifying forward-looking statements. These statements are based on information currently available to us and are subject to various risks, uncertainties, and other factors, including, but not limited to, those discussed herein under the caption “Risk Factors” that could cause our actual growth, results of operations, financial condition, cash flows, performance and business prospects and opportunities to differ materially from those expressed in, or implied by, these statements. Except as expressly required by the federal securities laws, we undertake no obligation to update such factors or to publicly announce the results of any of the forward-looking statements contained herein to reflect future events, developments, or changed circumstances or for any other reason. Investors are cautioned that all forward-looking statements involve risks and uncertainties, including those detailed in our filings with the Securities and Exchange Commission. See “Risk Factors” in Item 1A.

ITEM 1 - BUSINESS

As used in this Annual Report on Form 10-K, the terms “we,” “us,” or “our,” refer to Fuel Tech, Inc. and our wholly-owned subsidiaries.

GENERAL

We are a leading technology company engaged in the worldwide development, commercialization and application of state-of-the-art proprietary technologies for air pollution control, process optimization, water treatment and advanced engineering services. These technologies enable our customers to operate efficiently in a cost-effective and environmentally sustainable manner.

The Company’s nitrogen oxide (NO_x) reduction technologies include advanced combustion modification techniques and post-combustion NO_x control approaches, including NO_xOUT[®], HERT[™], and Advanced SNCR systems, ASCR[™] Advanced Selective Catalytic Reduction systems, and I-NO_x[®] Integrated NO_x Reduction Systems, which utilize various combinations of these systems, along UDI[™] Urea Direct Injection system for SCR reagent supply, and the ULTRA[®] process for safe ammonia generation. These technologies have established Fuel Tech as a leader in NO_x reduction, with installations on over 900 units worldwide.

Fuel Tech’s APC technologies include particulate control with Electrostatic Precipitator (ESP) products and services including complete turnkey capability for ESP retrofits, with experience on units up to 700 MW. Flue gas conditioning (FGC) systems include treatment using sulfur trioxide (SO₃) and ammonia (NH₃) based conditioning to improve the performance of ESPs by modifying the properties of fly ash particles. Fuel Tech’s particulate control technologies have been installed on more than 125 units worldwide.

Our FUEL CHEM technologies revolve around the unique application of chemical injection programs which improve the efficiency, reliability, fuel flexibility, boiler heat rate and environmental status of combustion units by controlling slagging, fouling, corrosion, opacity and acid plume, as well as the formation of sulfur trioxide, ammonium bisulfate, particulate matter (PM_{2.5}), sulfur dioxide (SO₂), and carbon dioxide (CO₂). We use our patented TIFI[®] Targeted In-Furnace Injection[™] processes to apply specialty chemical programs to units burning a wide variety of fuels including coal, heavy oil, biomass, and municipal waste. These TIFI programs incorporate design, modeling, equipment, reagent, and service to provide complete customized on-site programs designed to improve plant operations and provide a return on investment in addition to helping meet emission regulatory requirements.

Water treatment technologies include DGI™ Dissolved Gas Infusion Systems which utilize a patented nozzle to provide a competitive advantage over conventional utility and industrial aeration. An innovative alternative to current aeration technology among other applications, DGI systems can deliver supersaturated oxygen solutions and other gas-water combinations to target process applications or environmental issues. This infusion process has a variety of applications in the water and wastewater industries, including remediation, treatment, biological activity and wastewater odor management. DGI technology benefits include reduced energy consumption, installation costs, and operating costs, while improving treatment performance.

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Many of our products and services rely heavily on our computational fluid dynamics and chemical kinetics modeling capabilities, which are enhanced by internally developed, high-end visualization software. These capabilities, coupled with our innovative technologies and multi-disciplined team approach, enable us to provide practical solutions to some of our customers' most challenging issues.

AIR POLLUTION CONTROL**Regulations and Markets: Domestic**

The continued growth of our APC technology segment is dependent upon the adoption and enforcement of environmental regulations in the U.S. and globally. In the U.S., federal and state laws regulating the emission of NO_x are the primary driver in our APC technology segment. The principal regulatory drivers currently in effect are as follows:

Clean Air Act: The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to establish national ambient air quality standards (NAAQS) at levels that are protective of public health with an adequate margin of safety. The six pollutants specified include: Ozone (O₃), Particulate Matter (PM), Nitrogen Dioxide (NO₂), Sulfur Dioxide (SO₂), Lead, and Carbon Monoxide (CO). The NAAQS provisions require that states comply with ozone and particulate emissions standards. NO_x emissions are a precursor to ozone formation and also contribute to fine particulate emissions (PM_{2.5}), which has been the recent regulatory driver through the Cross-State Air Pollution Rule (CSAPR). NO_x emissions were targeted as contributors to fine particulate emissions and ozone emissions. Since 1990, programs have been established by the EPA at the regional and federal level to help states in their mission to define and meet their State Implementation Plans (SIPs) for attainment. NAAQS PM standards were issued in 1997, with more stringent standards issued in 2006 and 2012. The NAAQS ozone standards issued in 1997 were made more stringent in 2008. On October 1, 2015, the EPA strengthened the NAAQS for ground-level ozone by reducing the minimum acceptable level from 75 to 70 parts per billion (ppb). Implementation of the 2015 NAAQS standards started in 2018 with finalization of the area designations. A number of Eastern States are considering NO_x reduction system upgrades for existing sources to meet the 70 ppb requirement.

Cross-State Air Pollution Rule (CSAPR): In 2011, the Environmental Protection Agency passed the Cross-State Air Pollution Rule (CSAPR) under the “good neighbor” provision of the Clean Air Act to reduce emissions of SO₂ and NO_x from power plants in the eastern half of the United States. Under CSAPR, state emission caps were designated to mitigate the emission impact on downwind states by controlling emissions from upwind states. If sources within a state caused the state to exceed its assurance limit, severe penalties including a two-for-one reduction based on each source’s contribution percentage of the state overage would be applied. The timing of CSAPR’s implementation has been affected by a number of court actions. In December 2011, CSAPR was stayed prior to implementation due to lawsuits filed by various states and combustion sources, and in August 2012 the U.S. Circuit Court of Appeals, D.C. Circuit, vacated CSAPR and remanded it to the EPA. The U.S. Supreme Court reversed that decision in April 2014. Following the remand of the case to the D.C. Circuit, the EPA requested that the court lift the CSAPR stay and toll the CSAPR compliance deadlines by three years. In October 2014, the D.C. Circuit granted the EPA’s request and, accordingly, CSAPR Phase 1 implementation commenced in 2015, with Phase 2 implementation starting in 2018 for the May to September ozone season, one year later than originally planned.

Clean Air Visibility Rule (CAVR): The Clean Air Visibility Rule (CAVR), also known as the Regional Haze rule, is part of the Clean Air Act and was finalized in 2005. Under CAVR, certain States are required to submit implementation plans to the EPA to comply with the Regional Haze requirements, and updates are required every five years. A new CAVR was issued in January 2017 which requires states to implement new air pollution controls by 2021. The overall obligation of CAVR is to return the US scenic areas to “active” visibility by 2064.

New Unit Permits: New gas fired units for both electricity generation and industrial use will require BACT technology as a permit requirement. SCR technology is very often BACT for NO_x, and these permit requirements generate new market opportunities.

Consent Decrees: Consent decree activity through the US Department of Justice or EPA may require emission sources to meet individual requirements. Sources may also agree to specific air pollution requirements with states or environmental groups.

Regulations and Markets: International

We also sell NO_x control systems outside the United States, specifically in Europe, Latin America, India (under a license agreement) and in the Pacific Rim, including the People's Republic of China (China). The demand for our technologies comes from specific governmental regulations in NO_x and PM emission limits which vary by country. We expect that there will be further opportunities to implement our technologies globally in established as well as new geographies in 2019.

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In China, the implementation of the ultra-low emission rules first announced in 2015, is close to completion on large utility boilers and the focus has now shifted to the industrial sector where low-cost local suppliers are well established and preferred. We anticipate that Fuel Tech's technologies will encounter significant price competition in this sector, and will only be sought after occasionally by clients in critical process industries such as petro-chemical and LCD manufacturing, who value high performance over low cost.

The European Union published the BREF (Best Available Reference Technology) emission guidelines in mid 2017 that further lowered emission targets over a span of the next four years. These measures are expected to lower the environment impact of more than 3,000 large combustion plants throughout the European Union. Moreover, European countries that are not current EU members are expected to adopt these new standards as part of their approach to gain EU membership. Despite the significant expansion of renewable energy throughout Europe, the EU and neighboring states still rely heavily on coal generation to provide a stable base load to their power and heating demands. The BREF guidelines reduce NO_x limit values by up to 25% which will require an upgrade of first generation NO_x abatement systems, and that is expected to present new opportunities for Fuel Tech. However, the place of implementation will still be dependent on each country's internal processes.

The Indian government's initial compliance deadline of December 2017 has been delayed, but adoption of emission control technologies has started and it is expected to progress at a faster pace in 2019. After a wave of FGD implementation to address SO_x, the focus is now shifting to NO_x and PM control. This shift is expected to result in a higher demand for Fuel Tech's SNCR and flue gas conditioning technologies, which will be implemented through a collaboration with our local partner ISGEC.

Elsewhere in Southeast Asia, particulate emissions due to poor performing ESPs have been gaining attention by local authorities. Power generators in several countries like Vietnam, Malaysia and the Philippines are actively looking for corrective options and this presents Fuel Tech with opportunities to bring our DFGC technology to these markets.

Products

Our NO_x reduction and particulate control technologies are installed worldwide on over 1,000 combustion units, including utility, industrial and municipal solid waste applications. Our products include customized NO_x control systems and our patented ULTRA[®] technology, which converts urea-to-ammonia on site and provides safe reagent for use in Selective Catalytic Reduction (SCR) systems.

SNCR Systems: Our NO_xOUT[®] and HERT[™] SNCR processes use non-hazardous urea as the reagent rather than ammonia. Both the NO_xOUT[®] and HERT[™] processes on their own are capable of reducing NO_x by up to 25% - 50% for utilities and by potentially significantly greater amounts for industrial units in many types of plants with capital costs ranging from \$5 - \$20/kW for utility boilers and with total annualized operating costs ranging from \$1,000 - \$2,000/ton of NO_x removed. Advanced SNCR systems are also available to improve performance and minimize reagent costs through in-furnace monitoring and an advanced control system.

I-NO_x[®] Systems: Our I-NO_x[®] systems can include LNB, OFA, and SNCR components, along with SCR technology, Ammonia Injection Grid (AIG), and Graduated Straightening Grid (GSG[™]) system. Together, these systems provide up to 90% NO_x reduction at significantly lower capital and operating costs than conventional SCR systems while providing greater operational flexibility to plant operators. The capital costs for I-NO_x[®] systems can range from \$30 - \$150/kW depending on boiler size and configuration, which is significantly less than that of conventional SCRs, which can cost \$300/kW or more, while operating costs are competitive with those experienced by SCR systems. Our SCR systems utilize urea or ammonia as the SCR catalyst reagent to achieve NO_x reductions of up to 85% from industrial combustion sources.

ULTRA Technology: Our ULTRA[®] process is designed to convert urea to ammonia safely and economically for use as a reagent in the SCR process for NO_x reduction. Recent local objections in the ammonia permitting process have raised concerns regarding the safety of ammonia shipment and storage in quantities sufficient to supply SCR. In

addition, the Department of Homeland Security has characterized anhydrous ammonia as a Toxic Inhalation Hazard commodity. Our ULTRA[®] process is believed to be a market leader for the safe conversion of urea to ammonia just prior to injection into the flue gas duct, which is particularly important near densely populated cities, major waterways, harbors or islands, or where the transport of anhydrous or aqueous ammonia is a safety concern. Ammonia feed systems provide reagent flexibility for SCR reagent feed system, while our UDI[™] Urea Direct Injection systems utilize direct injection of reagent without the need for an ammonia injection grid.

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SCR Processes and Services: Our SCR group provides process design optimization, performance testing and improvement, and catalyst selection services for SCR systems on coal-fired boilers. In addition, other related services, including start-ups, maintenance support and general consulting services for SCR systems, Ammonia Injection Grid design and tuning to help optimize catalyst performance, and catalyst management services to help optimize catalyst life, are now offered to customers around the world. We also specialize in computational fluid dynamics models, which simulate fluid flow by generating a virtual replication of real-world geometry and operating inputs. We design flow corrective devices, such as turning vanes, ash screens, static mixers and our patented GSG® Graduated Straightening Grid. Our models help clients optimize performance in flow critical equipment, such as selective catalytic reactors in SCR systems, where the effectiveness and longevity of catalysts are of utmost concern. The Company's modeling capabilities are also applied to other power plant systems where proper flow distribution and mixing are important for performance, such as flue gas desulfurization- scrubbers, electrostatic precipitators, air heaters, exhaust stacks and carbon injection systems for mercury removal.

ESP Processes and Services: ESP technologies for particulate control include Electrostatic Precipitator (ESP) products and services including ESP Inspection Services, Performance Modeling, and Performance and Efficiency Upgrades, along with complete turnkey capability for ESP retrofits. Flue gas conditioning (FGC) systems include treatment using sulfur trioxide (SO₃) and ammonia (NH₃) based systems to improve the performance of ESPs by modifying the properties of the fly ash particle. Our ULTRA technology can provide the ammonia system feed requirements for FGC applications as a safe alternative to ammonia reagent based systems. FGC systems offer a lower capital cost approach to improving ash particulate capture versus the alternative of installing larger ESPs or utilizing fabric filter technology to meet targeted emissions and opacity limits. Fuel Tech's particulate control technologies have been installed on more than 125 units worldwide.

Burner Systems: Low NO_x Burners and Ultra Low NO_x Burners (LNB and ULNB) are available for coal-, oil-, and gas-fired industrial and utility units. Each system application is specifically designed to maximize NO_x reduction. Computational fluid dynamics combustion modeling is used to validate the design prior to fabrication of equipment. NO_x reductions can range from 40%-60% depending on the fuel type. Over-Fire Air (OFA) systems stage combustion for enhanced NO_x reduction. Additional NO_x reductions, beyond Low NO_x Burners, of 35% - 50% are possible on different boiler configurations on a range of fuel types. Combined overall reductions range from 50% - 70%, with overall capital costs ranging from \$10 - \$20/kW and total costs ranging from \$300 - \$1,500/ton of NO_x removed, depending on the scope.

A key market dynamic for the APC product line is the continued use of coal for global electricity production. Coal currently accounts for approximately 30% of all U.S. electricity generation and roughly 69% of Chinese electricity generation. Major coal consumers include China, the United States and India. The growth of natural gas in the U.S. for industrial applications has increased the need for SCR technology since it often meets the definition of Best Available Control Technology and is required on new industrial units.

Sales of APC products were \$38.4 million, \$27.8 million, and \$34.1 million for the years ended December 31, 2018, 2017 and 2016, respectively.

APC Competition

Competition with our NO_x reduction suite of products may be expected from companies supplying SCR Systems and ammonia SNCR Systems, urea SNCR systems, ESP retrofits and FGC technologies. In addition, we experience competition in the urea-to-ammonia conversion market.

The SCR process is an effective and proven method of control for removal of NO_x up to 90%. SCR systems have a high capital cost of \$300+/kW on retrofit coal applications. Such companies as GE, Babcock Power, Babcock & Wilcox (B&W) Company, CECO Environmental and Mitsubishi Hitachi, are active SCR system and reagent feed system providers.

The use of both urea and ammonia as the reagent for the SNCR process can reduce NO_x by 30% - 70%, depending on a number of factors. Ammonia can be effective on incinerators and on Circulating Fluidized Bed combustion units, but has limited applicability for most utility boilers, where urea is dominant. Both urea and ammonia SNCR system capital costs range from \$5 - \$20/kW, with annualized operating costs ranging from \$1,000 - \$3,000/ton of NO_x removed. The ammonia-based systems utilize either anhydrous or aqueous ammonia, both of which are hazardous substances. Competitors for ammonia based SNCR include CECO Environmental, B&W, and Wahlco, with Hamon and B&W for urea based SNCR systems.

ESP retrofit competitors include B&W, Southern Environmental and Hamon. Flue Gas Conditioning competition includes Wahlco, Inc. and Chemithon, Inc.

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Lastly, with respect to urea-to-ammonia conversion technologies, a competitive approach to our controlled urea decomposition system competes with Wahlco, Inc., which manufactures a system that hydrolyzes urea under high temperature and pressure.

APC Backlog

Consolidated APC segment backlog at December 31, 2018 was \$12.4 million versus backlog at December 31, 2017 of \$22.1 million. A substantial portion of the backlog as of December 31, 2018 should be recognized as revenue in fiscal 2019, although the timing of such revenue recognition in 2019 is subject to the timing of the expenses incurred on existing projects.

FUEL CHEM

Product and Markets

The FUEL CHEM® technology segment revolves around the unique application of specialty chemicals to improve the efficiency, reliability and environmental status of plants operating in the electric utility, industrial, pulp and paper, waste-to-energy, and university and district heating markets. FUEL CHEM programs are currently in place on combustion units in North America, Mexico and Europe, treating a wide variety of solid and liquid fuels, including coal, heavy oil, black liquor, biomass and municipal waste.

Central to the FUEL CHEM approach is the introduction of chemical reagents, such as magnesium hydroxide, to combustion units via in-body fuel application (pre-combustion) or via direct injection (post-combustion) utilizing our proprietary TIFI® technology. By attacking performance-hindering problems, such as slagging, fouling and corrosion, as well as the formation of sulfur trioxide (SO₃), and ammonium bisulfate (ABS), our programs offer numerous operational, financial and environmental benefits to owners of boilers, furnaces and other combustion units.

A key market dynamic for this product line is the continued use of coal for global electricity production. Coal currently accounts for approximately 30% of all U.S. electricity generation and roughly 69% of Chinese electricity generation. Major coal consumers include the United States, China and India. Additional market dynamics include a growing, worldwide utilization of biomass for both steam and electrical production, as well as the strengthening of the pulp and paper industry worldwide, resulting in black liquor recovery boilers needing to maximize throughput. A new potential driver in the US is the Affordable Clean Energy (ACE) Rule issued by EPA in 2018 as a replacement for the Clean Power Plan which EPA has repealed. This Rule calls for the use of a wide range of available boiler heat rate improvement technologies to improve efficiency to reduce greenhouse gas emissions.

The principal markets for this product line are electric power plants burning coals with slag-forming constituents such as sodium, iron and high levels of sulfur. Sodium is typically found in the Powder River Basin coals of Wyoming and Montana. Iron is typically found in coals produced in the Illinois Basin region. High sulfur content is typical of Illinois Basin coals and certain Appalachian coals. High sulfur content can give rise to unacceptable levels of SO₃ formation especially in plants with SCR systems and flue gas desulphurization units (scrubbers). As coal units strive to compete in electricity supply markets, lower cost, higher slagging fuels can create more operational challenges which TIFI Programs can help mitigate.

The combination of slagging coals and SO₃-related issues, such as “blue plume” formation, air pre-heater fouling and corrosion, SCR fouling and the proclivity to suppress certain mercury removal processes, represents an attractive market potential for Fuel Tech.

Sales of the FUEL CHEM products were \$18.1 million, \$17.4 million, and \$21.1 million for the years ended December 31, 2018, 2017 and 2016, respectively.

Competition

Competition for our FUEL CHEM product line includes chemicals sold by specialty chemical companies, such as Imerys, Environmental Energy Services, Inc., and SUEZ Water Technologies. No technologically comparable substantive competition currently exists for our TIFI technology, which is designed primarily for slag control and SO₃

abatement, but there can be no assurance that such lack of substantive competition will continue.

INTELLECTUAL PROPERTY

The majority of our products are protected by U.S. and non-U.S. patents. We own 53 granted patents worldwide and 15 allowed utility model patents in China. We have 15 patent applications pending; including 4 in the United States and 11 in non-U.S. Jurisdictions. These patents and applications cover some 29 inventions, 16 associated with our NO_x reduction business, 12 associated with the FUEL CHEM business, and one associated with water treatment. Our granted patents have expiration dates ranging from October of 2019 to October of 2035.

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Management believes that the protection provided by the numerous claims in the above referenced patents or patent applications is substantial, and afford us a significant competitive advantage in our business. Accordingly, any significant reduction in the protection afforded by these patents or any significant development in competing technologies could have a material adverse effect on our business.

EMPLOYEES

At December 31, 2018, we had 113 employees, 82 in North America, 23 in China and eight in Europe. We enjoy good relations with our employees and are not a party to any labor management agreement.

RELATED PARTIES

Douglas G. Bailey, a member of our Board, is a stockholder of American Bailey Corporation (ABC), which is a related party. Please refer to Note 11 to the consolidated financial statements in this Form 10-K for information about our transactions with ABC. Additionally, see the more detailed information relating to this subject under the caption "Certain Relationships and Related Transactions" in our definitive Proxy Statement to be distributed in connection with our 2019 Annual Meeting of Stockholders, which information is incorporated by reference.

AVAILABLE INFORMATION

We are a fully integrated company using a suite of advanced technologies to provide boiler optimization, efficiency improvement and air pollution reduction and control solutions to utility and industrial customers worldwide.

Originally incorporated in 1987 under the laws of the Netherlands Antilles as Fuel-Tech N.V., we were domesticated in the United States on September 30, 2006, and continue as a Delaware corporation with our corporate headquarters at 27601 Bella Vista Parkway, Warrenville, Illinois, 60555-1617. Fuel Tech maintains an Internet website at www.ftek.com. Our Annual Report on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and any amendments to those reports filed or furnished pursuant to Section 13(a) of the Exchange Act are made available through our website as soon as reasonably practical after we electronically file or furnish the reports to the Securities and Exchange Commission. Our website also contains our Corporate Governance Guidelines and Code of Ethics and Business Conduct, as well as the charters of the Audit, Compensation, and Nominating and Corporate Governance committees of the Board of Directors. All of these documents are available in print without charge to stockholders who request them. Information on our website is not incorporated into this report.

ITEM 1A - RISK FACTORS

Investors in our Common Shares should be mindful of the following risk factors relative to our business.

Our Product Portfolio Lacks Diversification

We have two broad technology segments that provide advanced engineering solutions to meet the pollution control, efficiency improvement, and operational optimization needs of coal-fired energy-related facilities worldwide. They are as follows:

¶The Air Pollution Control technology segment includes technologies to reduce NO_x emissions in flue gas from boilers, incinerators, furnaces and other stationary combustion sources. These include Low and Ultra Low NO_x Burners (LNB and ULNB), Over-Fire Air (OFA) systems, NO_xOUT[®] and HERT[™] Selective Non-Catalytic Reduction (SNCR) systems, and Advanced Selective Catalytic Reduction (ASCR[™]) systems. The ASCR system includes ULNB, OFA, and SNCR components, along with a downsized SCR catalyst, Ammonia Injection Grid (AIG), and Graduated Straightening Grid (GSG[™]) systems to provide high NO_x reductions at significantly lower capital and operating costs than conventional SCR systems. The NO_xOUT CASCADE[®] and NO_xOUT-SCR[®] processes are basic types of ASCR systems, using just SNCR and SCR catalyst components. ULTRA[®] technology creates ammonia at a plant site using safe urea for use with any SCR application. ESP technologies make use of electrostatic precipitator products and services to reduce particulate matter. Flue Gas Conditioning systems are chemical injection systems offered in

markets outside the U.S. and Canada to enhance electrostatic precipitator and fabric filter performance in controlling particulate emissions.

The FUEL CHEM[®] technology segment which uses chemical processes in combination with advanced Computational Fluid Dynamics (CFD) and Chemical Kinetics Modeling (CKM) boiler modeling for the control of slagging, fouling, corrosion, opacity and other sulfur trioxide-related issues in furnaces and boilers through the addition of chemicals into the furnace using TIFI[®] Targeted In-Furnace Injection[™] technology.

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An adverse development in our advanced engineering solution business as a result of competition, technological change, government regulation, customers converting to use natural gas or other fuels, or any other factor could have a significantly greater impact than if we maintained more diverse operations.

We Face Substantial Competition

Competition in the Air Pollution Control market comes from competitors utilizing their own NO_x reduction processes, including SNCR systems, Low NO_x Burners, Over-Fire Air systems, flue gas recirculation, ammonia SNCR and SCR, which do not infringe our patented technologies. Indirect competition will also arise from business practices such as the purchase rather than the generation of electricity, fuel switching, closure or de-rating of units, and sale or trade of pollution credits and emission allowances. Utilization by customers of such processes or business practices or combinations thereof may adversely affect our pricing and participation in the NO_x control market if customers elect to comply with regulations by methods other than the purchase of our Air Pollution Control products. See Item 1 “Products” and “APC Competition” in the Air Pollution Control segment overview.

Competition for our FUEL CHEM markets include chemicals sold by specialty chemical companies, such as Imerys, Environmental Energy Services, Inc., and SUEZ Water Technologies.

Demand for Our APC and FUEL CHEM Products is Affected by External Market Factors

Reduced coal-fired electricity demand across the United States has led to coal-fired electricity production declines. Contributing to this decline in coal-fired generations were 1) lower natural gas prices which allowed utility operators to increase the amount of power generated from natural gas plants, 2) increased cost of environmental compliance with current environmental regulations, 3) constrained funding for capital projects, and 4) the uncertainty of regulation resulted in electricity generating unit operators delaying investment in NO_x emission remediation plans until such time as the United States Environmental Protection Agency further clarifies the regulations.

Our Business Is Dependent on Continuing Air Pollution Control Regulations and Enforcement

Our business is significantly impacted by and dependent upon the regulatory environment surrounding the electricity generation market. Our business will be adversely impacted to the extent that regulations are repealed or amended to significantly reduce the level of required NO_x reduction, or to the extent that regulatory authorities delay or otherwise minimize enforcement of existing laws. Additionally, long-term changes in environmental regulation that threaten or preclude the use of coal or other fossil fuels as a primary fuel source for electricity production which result in the reduction or closure of a significant number of fossil fuel-fired power plants may adversely affect our business, financial condition and results of operations. See Item 1 above under the caption “Regulations and Markets” in the Air Pollution Control segment overview.

We May Not Be Able to Successfully Protect our Patents and Proprietary Rights

We hold licenses to or own a number of patents for our products and processes. In addition, we also have numerous patent applications pending both in the U.S. and abroad. There can be no assurance that any of our pending patent applications will be granted or that our outstanding patents will not be challenged, overturned or otherwise circumvented by competitors. In foreign markets, the absence of harmonized patent laws makes it more difficult to ensure consistent respect for our patent rights in emerging markets. In addition, certain critical technical information relating to our products which is not patented is held as trade secret, and protected by trade secret laws and restrictions on disclosure contained in our confidentiality and licensing agreements. There can be no assurance that such protections will prove adequate or that we will have adequate remedies against contractual counterparties for disclosure of our trade secrets or other violations of our intellectual property rights. See Item 1 above under the caption “Intellectual Property.”

Our Results May Be Affected By Foreign Operations

In 2007, we expanded our operations in China by establishing a wholly-owned subsidiary in Beijing. On January 17, 2019, we announced the suspension of further business development activity for its Air Pollution Control operation in Beijing. Our future financial results will be impacted by our ability to successfully complete the wind-down activities in Beijing during 2019.

In 2012, we expanded our operations in Latin and South America by establishing a wholly-owned subsidiary in Chile. The future business opportunities in these markets are dependent on the continued implementation and enforcement of regulatory policies that will benefit our technologies, the acceptance of our engineering solutions in such markets, the ability of potential customers to utilize our technologies on a competitive, cost-effective basis, and our ability to protect and enforce our intellectual property rights.

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Our Operating Results May Be Adversely Affected by Product Pricing

The onset of significant competition for either of the technology segments might require us to lower our product prices in order to remain competitive and have a corresponding adverse impact on our realized gross margins and operating profitability. See the risk factor entitled “We Face Substantial Competition” above.

We May Not Be Able to Purchase Raw Materials on Commercially Advantageous Terms

Our FUEL CHEM technology segment is dependent, in part, upon a supply of magnesium hydroxide. Any adverse changes in the availability of this chemical will likely have an adverse impact on ongoing operation of our FUEL CHEM programs. On March 4, 2009, we entered into a Restated Product Supply Agreement (“PSA”) with Martin Marietta Magnesia Specialties, LLC (MMMS) in order to assure the continuance of a stable supply from MMMS of magnesium hydroxide products for our requirements in the United States and Canada. The term of the PSA expires on December 31, 2019. Pursuant to the PSA, MMMS supplies us with magnesium hydroxide products manufactured pursuant to our specifications and we have agreed to purchase from MMMS, and MMMS has agreed to supply, 100% of our requirements for such magnesium hydroxide products for our customers who purchase such products for delivery in the United States and Canada. There can be no assurance that we will be able to obtain a stable source of magnesium hydroxide in markets outside the United States.

Our Customer Base Is Highly Concentrated

A small number of customers have historically accounted for a significant portion of our revenues. There can be no assurance that our current customers will continue to place orders, that orders by existing customers will continue at the levels of previous periods, or that we will be able to obtain orders from new customers. The loss of one or more of our customers could have a material adverse effect on our sales and operating results.

We May Not Be Able to Borrow Funds Pursuant to our Credit Facilities

We are party to a \$5.5 million domestic revolving credit agreement with JPMorgan Chase Bank, N.A. As of December 31, 2018, there were no outstanding borrowings on this facility, and we had advanced \$5.0 million of Letters of Credit. The Facility is secured by cash held by the Company in a separate restricted use designated JPM Chase deposit account, which is not readily available for our operating needs. The balance in this restricted cash account is \$6,020 as of December 31, 2018. In addition, our Chinese subsidiary, Beijing Fuel Tech Environmental Technologies Company, Ltd., has a RMB 2.625 million (approximately \$382) revolving credit facility with JPMorgan Chase Bank (China) Company Limited. As of December 31, 2018, there were no outstanding borrowings under this facility, and we had outstanding bank guarantees of approximately \$0. In the event of any default on our part under either of these agreements, the lender is entitled to accelerate payment of any amounts outstanding and may, under certain circumstances, cancel the facilities. If we were unable to obtain a waiver for a breach of covenant and the lender accelerated the payment of any outstanding amounts, such acceleration may cause our cash position to significantly deteriorate or, if cash on hand were insufficient to satisfy the payment due, may require us to obtain alternate financing.

The domestic revolving credit facility will expire in June 2019. While the Company is actively pursuing the renewal of its credit agreement, there is no assurance that the Company will be successful in the renewal of its credit agreement, or if obtained, that such financing will be in a similar amount or be on similar terms and conditions as the Company's current credit agreement.

We may not be able to recover a significant portion of our carrying value of our assets held for sale associated with our Fuel Conversion business segment

Effective June 28, 2017, the Company has suspended all operations associated with the Fuel Conversion business segment. We may not be able to realize as much value from the sale of the assets as we expect and we may incur higher than expected, or unforeseen, costs associated with the disposal related activities. Any of the foregoing could have a material adverse effect on our business, financial position and results of operations.

ITEM 1B - UNRESOLVED STAFF COMMENTS

None

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ITEM 2 - PROPERTIES

We own an office building in Warrenville, Illinois, which has served as our corporate headquarters since June 23, 2008. This facility, with approximately 40,000 square feet of office space, is sufficient to meet our requirements for the foreseeable future.

We also operate from leased office facilities and we do not segregate any of these leased facilities by operating business segment. The terms of the Company's eight primary lease arrangements are as follows:

• The Stamford, Connecticut building lease, for approximately 6,440 square feet, runs from February 1, 2010 to December 31, 2019. The facility houses certain administrative functions.

• The Beijing, China building lease, for approximately 9,000 square feet, runs from June 1, 2017 to May 31, 2020. This facility serves as the operating headquarters for our Beijing Fuel Tech operation. As a result of our announcement on January 17, 2019 related to the suspension of our APC business in Beijing, we notified the landlord of our intention to early terminate the lease on July 22, 2019.

• The Durham, North Carolina building lease, for approximately 2,590 square feet, runs from July 1, 2016 to July 31, 2019. This facility houses engineering operations.

• The Gallarate, Italy building lease, for approximately 1,636 square feet, runs from May 1, 2013 to April 30, 2019. This facility serves as the operating headquarters for our European operations.

• The Westlake, Ohio building lease, for approximately 3,000 square feet, runs from May 1, 2017 to April 30, 2020. This facility houses engineering operations.

• The Aurora, IL warehouse lease, for approximately 11,000 square feet, runs from September 1, 2013 to December 31, 2020. This facility serves as an outside warehouse facility.

• The Overland Park, KS lease, for approximately 600 square feet, runs from October 16, 2018 to October 15, 2021. This facility serves primarily as a sales office.

ITEM 3 - LEGAL PROCEEDINGS

From time to time we are involved in litigation with respect to matters arising from the ordinary conduct of our business. In the opinion of management, based upon presently available information, either adequate provision for anticipated costs have been accrued or the ultimate anticipated costs will not materially affect our consolidated financial position, results of operations, or cash flows.

See Note 9 "Commitments and Contingencies" in the Notes to the Consolidated Financial Statements in this Annual Report on Form 10-K.

ITEM 4 – MINE SAFETY DISCLOSURES

Not Applicable

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PART II

ITEM 5 - MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASE OF EQUITY SECURITIES

Market

Our Common Shares have been traded since September 1993 on The NASDAQ Stock Market, Inc, where it trades under the symbol FTEK.

Prices

The table below sets forth the high and low sales prices during each calendar quarter since January 2017.

2018	High	Low
Fourth Quarter	\$ 1.49	\$ 1.15
Third Quarter	1.42	0.97
Second Quarter	1.42	1.00
First Quarter	1.57	1.00

2017	High	Low
Fourth Quarter	\$ 1.17	\$ 0.91
Third Quarter	1.14	0.79
Second Quarter	0.99	0.76
First Quarter	1.28	1.02

Dividends

We have never paid cash dividends on the Common Shares and have no current plan to do so in the foreseeable future. The declaration and payment of dividends on the Common Shares are subject to the discretion of our Board of Directors. The decision of the Board of Directors to pay future dividends will depend on general business conditions, the effect of a dividend payment on our financial condition, and other factors the Board of Directors may consider relevant. The current policy of the Board of Directors is to reinvest earnings in operations to promote future growth.

Holdings

As of February 28, 2019, there were 98 holders of record of our common stock, which does not include the number of beneficial owners whose common stock was held in street name or through fiduciaries.

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Performance Graph

The following line graph compares our total return to stockholders per common share for the five years ended December 31, 2018 to that of the NASDAQ Composite Index and the WilderHill Progressive Energy Index for the period December 31, 2013 through December 31, 2018. The graph tracks the performance of a \$100 investment in the Company's common stock and in each of the indexes (with the reinvestment of all dividends) on December 31, 2013.

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ITEM 6 - SELECTED FINANCIAL DATA

Selected financial data are presented below as of the end of and for each of the fiscal years in the five-year period ended December 31, 2018. The selected financial data should be read in conjunction with the audited consolidated financial statements as of and for the year ended December 31, 2018, and “Management’s Discussion and Analysis of Financial Condition and Results of Operations” included elsewhere in this report and the schedules thereto.

CONSOLIDATED STATEMENT OF OPERATIONS DATA (in thousands of dollars, except for share and per-share data)	For the years ended December 31				
	2018	2017	2016	2015	2014
Revenues	\$56,535	\$45,166	\$55,161	\$73,664	\$79,017
Cost of sales	36,471	27,144	36,367	45,107	43,889
Selling, general and administrative	18,564	20,933	25,564	30,897	35,432
Restructuring charge	—	119	1,428	219	—
Research and development	1,073	1,070	1,752	1,447	1,459
Impairment and abandonment charges	317	2,965	2,074	1,425	23,400
Operating (loss) income from continuing operations	110	(7,065)	(12,024)	(5,431)	(25,163)
Net loss from continuing operations	85	(6,535)	(14,588)	(9,554)	(17,448)
Loss from discontinued operations	(113)	(3,914)	(2,800)	(2,826)	(277)
Net loss	\$(28)	\$(10,449)	\$(17,388)	\$(12,380)	\$(17,725)
Net loss per common share:					
Basic					
Continuing operations	\$—	\$(0.28)	\$(0.62)	\$(0.41)	\$(0.77)
Discontinued operations	—	(0.16)	(0.12)	(0.13)	(0.01)
Basic net loss per common share	\$—	\$(0.44)	\$(0.74)	\$(0.54)	\$(0.78)
Diluted					
Continuing operations	\$—	\$(0.28)	\$(0.62)	\$(0.41)	\$(0.77)
Discontinued operations	—	(0.16)	(0.12)	(0.13)	(0.01)
Diluted net loss per common share	\$—	\$(0.44)	\$(0.74)	\$(0.54)	\$(0.78)
Weighted-average basic shares outstanding	24,164,000	23,872,000	23,365,000	23,101,000	22,782,000
Weighted-average diluted shares outstanding	24,164,000	23,872,000	23,365,000	23,101,000	22,782,000

CONSOLIDATED BALANCE SHEET DATA (in thousands of dollars)	December 31				
	2018	2017	2016	2015	2014
Working capital	\$23,556	\$18,025	\$26,585	\$35,865	\$39,688
Total assets	51,719	50,484	57,788	76,011	91,471
Long-term obligations	335	420	346	501	520
Total liabilities	17,667	16,312	15,099	17,740	19,170
Stockholders’ equity (1)	34,052	34,172	42,689	58,271	72,301

Notes:

Stockholders’ equity includes the principal amount of nil coupon non-redeemable perpetual loan notes. See Note 7 to the consolidated financial statements; Refer to Note 1 of the Notes to the Consolidated Financial Statements for (1) further detail related to a revision made in the previously issued financial statements as a result of an error discovered in the preparation of the current year income tax provision.

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ITEM 7 - MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS (amounts in thousands of dollars)

Background

We have two broad technology segments that provide advanced engineered solutions to meet the pollution control, efficiency improvement and operational optimization needs of energy-related facilities worldwide. They are as follows:

Air Pollution Control Technologies

The Air Pollution Control technology segment includes technologies to reduce NO_x emissions in flue gas from boilers, incinerators, furnaces and other stationary combustion sources. These include Low and Ultra Low NO_x Burners (LNB and ULNB), OFA systems, NO_xOUT and HERT SNCR systems, and ASCR systems. The ASCR system includes ULNB, OFA, and SNCR components, along with a downsized SCR catalyst, AIG, and GSG systems to provide high NO_x reductions at significantly lower capital and operating costs than conventional SCR systems. The NO_xOUT CASCADE and NO_xOUT-SCR processes are basic types of ASCR systems, using just SNCR and SCR catalyst components. ULTRA technology creates ammonia at a plant site using safe urea for use with any SCR application. Our ESP products and services include complete turnkey ESP retrofits and related services. Flue Gas Conditioning systems are chemical injection systems offered in markets outside the U.S. and Canada to enhance electrostatic precipitator and fabric filter performance in controlling particulate emissions. We distribute our products through our direct sales force and third-party sales agents.

FUEL CHEM Technologies

The FUEL CHEM technology segment, which uses chemical processes in combination with advanced CFD and CKM boiler modeling, for the control of slagging, fouling, corrosion, opacity and other sulfur trioxide-related issues in furnaces and boilers through the addition of chemicals into the furnace using TIFI Targeted In-Furnace Injection technology. Fuel Tech sells its FUEL CHEM program through its direct sales force and agents to industrial and utility power-generation facilities. FUEL CHEM programs have been installed on combustion units in North America, Europe, China, and India, treating a wide variety of solid and liquid fuels, including coal, heavy oil, biomass and municipal waste. The FUEL CHEM program improves the efficiency, reliability and environmental status of plants operating in the electric utility, industrial, pulp and paper, waste-to-energy, university and district heating markets and offers numerous operational, financial and environmental benefits to owners of boilers, furnaces and other combustion units.

The key market dynamic for both technology segments is the continued use of fossil fuels, especially coal, as the principal fuel source for global electricity production. Coal currently accounts for approximately 30% of all U.S. electricity generation and roughly 69% of Chinese electricity generation. Major coal consumers include China, the United States and India.

Critical Accounting Policies and Estimates

The consolidated financial statements are prepared in accordance with accounting principles generally accepted in the United States of America, which require us to make estimates and assumptions. We believe that of our accounting policies (see Note 1 to the consolidated financial statements), the following involve a higher degree of judgment and complexity and are deemed critical. We routinely discuss our critical accounting policies with the Audit Committee of the Board of Directors.

Revenue Recognition

Change in Accounting Policy

On January 1, 2018, we adopted ASC 606 "Revenue from Contracts with Customers" ("ASC 606") using the modified retrospective method applied to those contracts which were not completed as of January 1, 2018. Results for reporting periods beginning after January 1, 2018 are presented under ASC 606, while prior period amounts are not adjusted and continue to be reported in accordance with our legacy accounting under Accounting Standards Codification Topic 605: Revenue Recognition (ASC 605).

For the years ended prior to January 1, 2018

Revenues from the sales of chemical products are recorded when title transferred, either at the point of shipment or at the point of destination, depending on the contract with the customer in accordance with ASC 605. We used the percentage of completion method of accounting for equipment construction, equipment supply and license contracts that are sold within the Air Pollution Control technology segment. Under the percentage of completion method, revenues are recognized as work is performed based

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on the relationship between actual construction costs incurred and total estimated costs at completion. Construction costs include all direct costs such as materials, labor, and subcontracting costs, and indirect costs allocable to the particular contract such as indirect labor, tools and equipment, and supplies. Revisions in completion estimates and contract values are made in the period in which the facts giving rise to the revisions become known and can influence the timing of when revenues are recognized under the percentage of completion method of accounting. Such revisions have historically not had a material effect on the amount of revenue recognized. Provisions are made for estimated losses on uncompleted contracts in the period in which such losses are determined.

Years beginning after January 1, 2018

The Company recognizes revenue when control of the promised goods or services is transferred to our customers, in amount that reflects the consideration we expect to be entitled to in exchange for those goods or services. Fuel Tech's sales of products to customers represent single performance obligations, which are not impacted upon the adoption of ASC 606. The majority of our contracts have a single performance obligation as the promise to transfer the individual goods or services is not separately identifiable from other promises in the contracts and, therefore, not distinct. Revenue is measured as the amount of consideration we expect to receive in exchange for transferring goods or providing services. Sales, value add, and other taxes we collect concurrent with revenue-producing activities are excluded from revenue.

FUEL CHEM

Revenues from the sale of chemical products are recognized when control transfers to customer upon shipment or delivery of the product based on the applicable shipping terms. We generally recognize revenue for these arrangements at a point in time based on our evaluation of when the customer obtains control of the promised goods or services.

Air Pollution Control Technology

Fuel Tech's APC contracts are typically six to eighteen months in length. A typical contract will have three or four critical operational measurements that, when achieved, serve as the basis for us to invoice the customer via progress billings. At a minimum, these measurements will include the generation of engineering drawings, the shipment of equipment and the completion of a system performance test.

As part of most of its contractual APC project agreements, Fuel Tech will agree to customer-specific acceptance criteria that relate to the operational performance of the system that is being sold. These criteria are determined based on modeling that is performed by Fuel Tech personnel, which is based on operational inputs that are provided by the customer. The customer will warrant that these operational inputs are accurate as they are specified in the binding contractual agreement. Further, the customer is solely responsible for the accuracy of the operating condition information; typically all performance guarantees and equipment warranties granted by us are voidable if the operating condition information is inaccurate or is not met.

Since control transfers over time, revenue is recognized based on the extent of progress towards completion of the single performance obligation. Fuel Tech uses the cost-to-cost input measure of progress for our contracts since it best depicts the transfer of assets to the customer which occurs as we incur costs on our contracts. Under the cost-to-cost input measure of progress, the extent of progress towards completion is measured based on the ratio of costs incurred to date to the total estimated costs at completion of the performance obligation. Revenues are recorded proportionally as costs are incurred. Costs to fulfill include all internal and external engineering costs, equipment charges, inbound and outbound freight expenses, internal and site transfer costs, installation charges, purchasing and receiving costs, inspection costs, warehousing costs, project personnel travel expenses and other direct and indirect expenses specifically identified as project- or product-line related, as appropriate (e.g. test equipment depreciation and certain insurance expenses).

Fuel Tech has installed over 1,000 units with APC technology and normally provides performance guarantees to our customers based on the operating conditions for the project. As part of the project implementation process, we perform system start-up and optimization services that effectively serve as a test of actual project performance. We believe that this test, combined with the accuracy of the modeling that is performed, enables revenue to be recognized prior to the receipt of formal customer acceptance.

As of December 31, 2018, we had five construction contracts in progress that were identified as loss contracts and a provision for losses in the amount of \$123 was recorded in other accrued liabilities on the consolidated balance sheet. As of December 31, 2017, we had four construction contract in progress that were identified as a loss contract and a provision for losses in the amount of \$117 was recorded in other accrued liabilities on the consolidated balance sheet.

In our Air Pollution Control Technology segment, amounts are billed as work progresses in accordance with agreed-upon contractual terms. Generally, billing occurs subsequent to revenue recognition, resulting in contract assets. These assets are reported on the

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consolidated balance sheet on a contract-by-contract basis at the end of each reporting period. At December 31, 2018, 2017 and 2016, contract assets were approximately \$5,540, \$7,894 and \$6,755 respectively, and are included in accounts receivable on the consolidated balance sheets.

However, the Company will periodically bill in advance of costs incurred before revenue is recognized, resulting in contract liabilities. These liabilities are reported on the consolidated balance sheet on a contract-by-contract basis at the end of each reporting period. Contract liabilities were \$1,234, \$2,403 and \$1,730 at December 31, 2018, 2017 and 2016 respectively, and are included in other accrued liabilities on the consolidated balance sheets.

Allowance for Doubtful Accounts

The allowance for doubtful accounts is management's best estimate of the amount of credit losses in accounts receivable. In order to control and monitor the credit risk associated with our customer base, we review the credit worthiness of customers on a recurring basis. Factors influencing the level of scrutiny include the level of business the customer has with us, the customer's payment history and the customer's financial stability. Receivables are considered past due if payment is not received by the date agreed upon with the customer, which is normally 30 days. Representatives of our management team review all past due accounts on a weekly basis to assess collectability. At the end of each reporting period, the allowance for doubtful accounts balance is reviewed relative to management's collectability assessment and is adjusted if deemed necessary through a corresponding charge or credit to bad debts expense, which is included in selling, general, and administrative expenses in the consolidated statements of operations. Bad debt write-offs are made when management believes it is probable a receivable will not be recovered.

Inventories

Inventories consist primarily of spare parts and are stated at the lower of cost or net realizable value, using the weighted-average cost method. Usage is recorded in cost of sales in the period that parts were issued to a project or used to service equipment. Inventories are periodically evaluated to identify obsolete or otherwise impaired parts and are written off when management determines usage is not probable. The Company estimates the balance of excess and obsolete inventory by analyzing inventory by age using last used and original purchase date and existing sales pipeline for which the inventory could be used.

Assessment of Potential Impairments of Goodwill and Intangible Assets

Goodwill is not amortized, but rather is reviewed annually (in the fourth quarter) or more frequently if indicators arise, for impairment. We do not have any indefinite-lived intangible assets other than goodwill. Such indicators include a decline in expected cash flows, a significant adverse change in legal factors or in the business climate, unanticipated competition, a decrease in our market capitalization to an amount less than the carrying value of our assets, or slower growth rates, among others.

Goodwill is allocated among and evaluated for impairment at the reporting unit level, which is defined as an operating segment or one level below an operating segment. We have two reporting units: the FUEL CHEM segment and the APC technology segment.

Our evaluation of goodwill impairment involves first assessing qualitative factors to determine whether it is more likely than not that the fair value of a reporting unit is less than its carrying amount. We may bypass this qualitative assessment, or determine that based on our qualitative assessment considering the totality of events and circumstances including macroeconomic factors, industry and market considerations, current and projected financial performance, a sustained decrease in our share price, or other factors, that additional impairment analysis is necessary. This additional analysis involves comparing the current fair value of a reporting unit to its carrying value. Fuel Tech uses a discounted

cash flow (DCF) model to determine the current fair value of its two reporting units as this methodology was deemed to best quantify the present values of our expected future cash flows and yield a fair value that should be in line with the aggregate market value placed on the outstanding number of Common Shares as reflected by the current stock price multiplied by the outstanding common shares. A number of significant assumptions and estimates are involved in the application of the DCF model to forecast operating cash flows, including markets and market share, sales volumes and prices, costs to produce and working capital changes. Events outside our control, specifically market conditions that impact revenue growth assumptions, could significantly impact the fair value calculated. Management considers historical experience and all available information at the time the fair values of its reporting units are estimated. However, actual fair values that could be realized in an actual transaction may differ from those used to evaluate the impairment of goodwill.

The application of our DCF model in estimating the fair value of each reporting segment is based on the 'net asset' approach to business valuation. In using this approach for each reportable segment, we forecast segment revenues and expenses out to perpetuity and then discount the resulting cash flows to their present value using an appropriate discount rate. The forecast considers, among other items, the current and expected business environment, expected changes in the fixed and variable cost structure as the business

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grows, and a revenue growth rate that we feel is both achievable and sustainable. The discount rate used is composed of a number of identifiable risk factors, including equity risk, company size, and certain company specific risk factors such as our debt-to-equity ratio, among other factors, that when added together, results in a total return that a prudent investor would demand for an investment in our company.

In the event the estimated fair value of a reporting unit per the DCF model is less than the carrying value, additional analysis would be required. The additional analysis would compare the carrying amount of the reporting unit's goodwill with the implied fair value of that goodwill. The implied fair value of goodwill is the excess of the fair value of the reporting unit over the fair values assigned to all of the assets and liabilities of that unit as if the reporting unit was acquired in a business combination and the fair value of the reporting unit represented the purchase price.

In January 2017, the FASB issued ASU 2017-04, Intangibles-Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment. This ASU is meant to simplify how an entity is required to test goodwill for impairment by eliminating Step 2 from the goodwill impairment test. Step 2 measures a goodwill impairment loss by comparing the implied fair value of a reporting unit's goodwill with the carrying amount of that goodwill. The Company early adopted ASU 2017-04 on October 1, 2018 for the annual goodwill impairment test completed during the fourth quarter which simplified the test by comparing the implied fair value of the reporting unit's goodwill with the carrying amount of goodwill and eliminating Step 2.

Fuel Tech performed its annual goodwill impairment analysis for each of its reporting units as of October 1, 2018 and determined that no impairment of goodwill existed within the FUEL CHEM technology segment.

Building Impairment

During the second quarter of 2017, we experienced a decrease in our stock price that caused our market capitalization to fall below the equity value on our consolidated balance sheet, which resulted in an indicator of impairment. This, along with an overall slowdown in APC technology and corresponding downward adjustments to our financial forecasts, was considered during a detailed evaluation of the fair value of our reporting units. As a result of these triggering events, Fuel Tech performed a long-lived asset impairment analysis for each of the reporting units as of April 1, 2017. Based on this evaluation, we determined that our APC segment failed the first step of our impairment analysis because the estimated gross cash flows and fair value of the reporting unit was less than its carrying value, thus requiring additional analysis of the segment. However, no impairment resulted as the fair values of the underlying patents and equipment equaled or exceeded their carrying values. We evaluated the corporate asset group, which contains our corporate headquarters office building and land in Warrenville, Illinois, using the residual method and management determined that there was not adequate gross cash flows to support the carrying value. After obtaining an appraisal from a third-party appraiser, management determined that the carrying value of the office building and land exceeded the fair value and recorded an impairment charge of \$2,965 for the year ended December 31, 2017.

Impairment of Long-Lived Assets and Amortizable Intangible Assets

Long-lived assets, including property, plant and equipment (PP&E) and intangible assets, are reviewed for impairment when events and circumstances indicate that the carrying amount of the assets (or asset group) may not be recoverable. If impairment indicators exist, we perform a more detailed analysis and an impairment loss is recognized when estimated future undiscounted cash flows expected to result from the use of the asset (or asset group) and its eventual disposition are less than the carrying amount. This process of analyzing impairment involves examining the operating condition of individual assets (or asset group) and estimating a fair value based upon current condition, relevant market factors and remaining estimated operational life compared to the asset's remaining depreciable life. Quoted market prices and other valuation techniques are used to determine expected cash flows. Due to the existence of impairment indicators as more fully described in Note 1 to our consolidated financial statements, we performed a more detailed analysis of potential long-lived and intangible asset impairment in the APC technology asset group

during the fourth quarter of 2018 using the aforementioned undiscounted cash flows analysis.

In the second quarter of 2018, the Company recorded an abandonment charge of \$317 associated with certain international patent assets which the Company elected to not maintain and abandon in certain international locations due to limited business opportunities in those regions. The abandonment charge was calculated by determining the net book values of the abandoned patent assets by deducting the accumulated amortization from the acquisition cost. The abandonment charge of \$317 is included in “Intangible assets abandonment and building impairment” line in the accompanying Consolidated Statements of Operations for the year ended December 31, 2018.

In the fourth quarter of 2016, the Company performed an impairment test of the carrying value of our intangible assets to determine whether any impairment existed. The Company determined that the sum of the expected undiscounted cash flows attributable to certain intangible assets was less than its carrying value and that an impairment write-down was required. The impairment loss

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primarily related to the developed technology, customer relationships and trademarks acquired in the 2014 acquisition of PECO and FGC. The Company calculated the estimated fair value of the intangible asset by summing the present value of the expected cash flows over its life. The impairment was calculated by deducting the present value of the expected cash flows from the carrying value. This assessment resulted in an impairment charge of \$2,074, which was included in "Goodwill and intangible assets impairment" line in the accompanying Consolidated Statements of Operations for the year ended December 31, 2016.

A significant portion of our property and equipment is comprised of assets deployed at customer locations relating to our FUEL CHEM technology asset group, and due to the shorter-term duration over which this equipment is depreciated, the likelihood of impairment is mitigated. The discontinuation of a FUEL CHEM program at a customer site would most likely result in the re-deployment of all or most of the affected assets to another customer location rather than an impairment.

Valuation Allowance for Deferred Income Taxes

Deferred tax assets represent deductible temporary differences and net operating loss and tax credit carryforwards. A valuation allowance is recognized if it is more likely than not that some portion of the deferred tax asset will not be realized. At the end of each reporting period, management reviews the realizability of the deferred tax assets. As part of this review, we consider if there are taxable temporary differences that could generate taxable income in the future, if there is the ability to carry back the net operating losses or credits, if there is a projection of future taxable income, and if there are any tax planning strategies that can be readily implemented. As required by ASC 740 "Income Taxes", a valuation allowance must be established when it is more likely than not that all or a portion of a deferred tax asset will not be realized. This assessment resulted in a valuation allowance on our deferred tax assets of \$13,044, \$12,234 and \$13,179 for the years ended December 31, 2018, 2017 and 2016 respectively.

Stock-Based Compensation

We recognize compensation expense for employee equity awards ratably over the requisite service period of the award, adjusted for estimated forfeitures.

We utilize the Black-Scholes option-pricing model to estimate the fair value of stock option awards. Determining the fair value of stock options using the Black-Scholes model requires judgment, including estimates for (1) risk-free interest rate - an estimate based on the yield of zero-coupon treasury securities with a maturity equal to the expected life of the option; (2) expected volatility - an estimate based on the historical volatility of our Common Shares for a period equal to the expected life of the option; and (3) expected life of the option - an estimate based on historical experience including the effect of employee terminations.

In addition, we utilize a Monte Carlo valuation pricing model to determine the fair value of certain restricted stock units (RSUs) that contain market conditions. Determining the fair value of these RSUs requires judgment and involves simulating potential future stock prices based on estimates for the risk-free interest rate, stock volatility, and correlations between our stock price and the stock prices of a peer group of companies. If any of these assumptions differ significantly from actual results, stock-based compensation expense could be impacted. There were no stock options or RSUs granted during the year ended December 31, 2018.

Recently Adopted Accounting Standards

In May 2014, the Financial Accounting Standards Board (FASB) issued ASU 2014-09 "Revenue from Contracts with Customers" (ASC 606). These changes created a comprehensive framework for all entities in all industries to apply in the determination of when to recognize revenue, and, therefore, supersede virtually all existing revenue recognition requirements and guidance. This framework is expected to result in less complex guidance in application while providing a consistent and comparable methodology for revenue recognition. 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. To achieve this principle, an entity should apply the following steps: (i) identify the contract(s) with a customer, (ii) identify the performance obligations in the contract(s), (iii) determine the transaction price, (iv) allocate the transaction price to the performance obligations in the contract(s), and (v) recognize revenue when, or as, the entity satisfies a performance obligation. The new standard also requires additional financial statement disclosures that will enable users to understand the nature, amount, timing and uncertainty of revenue and cash flows relating to customer contracts. In August 2015, the FASB approved a one-year deferral to January 1, 2018. The Company adopted the standard on January 1, 2018 using the modified retrospective transition method. See Note 3, Revenue Recognition, for further discussion.

In November 2016, the FASB issued ASU 2016-18, Statement of Cash Flows (Topic 230): Restricted Cash (a consensus of the FASB Emerging Issues Task Force). The amendments in this Update require 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

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equivalents. Accordingly, restricted cash will be included with cash and cash equivalents when reconciling the beginning-of period and end-of-period total amounts shown on the Consolidated Statement of Cash Flows. The Company adopted ASU 2016-18 beginning on January 1, 2018 and adopted the standard using a retrospective approach.

In January 2017, the FASB issued ASU 2017-04, Intangibles-Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment. This ASU is meant to simplify how an entity is required to test goodwill for impairment by eliminating Step 2 from the goodwill impairment test. Step 2 measures a goodwill impairment loss by comparing the implied fair value of a reporting unit's goodwill with the carrying amount of that goodwill. ASU 2017-04 is effective for fiscal years beginning after December 15, 2019, with early adoption permitted for interim or annual goodwill impairment tests performed on testing dates after January 1, 2017. The Company early adopted ASU 2017-04 on October 1, 2018 for the annual goodwill impairment test completed during the fourth quarter which simplified the test by comparing the implied fair value of the reporting unit's goodwill with the carrying amount of goodwill and eliminating Step 2. The adoption did not have a material impact on the Company's consolidated financial statements. Recently Issued Accounting Pronouncements

In February 2016, the FASB issued ASU 2016-02, Leases (Topic 842). The amendments in this Update increase transparency and comparability among organizations by recognizing lease assets and lease liabilities on the balance sheet and disclosing key information about leasing arrangements. The liability recorded for a lease is meant to recognize the lease payments and the asset as a right to use the underlying asset for the lease, including optional periods if it reasonably certain the option will be exercised. Recording of the liability should be based on the present value of the lease payments. If a lease term is less than twelve months, a company is allowed to elect not to record the asset and liability. Expense related to these leases are to be amortized on a straightline basis over the expected term of the lease. Additionally, the provisions of Topic 842 provide additional guidance on separating lease terms from maintenance and other type of provisions that provide a good or service, accounting for sale-leaseback provisions, and leveraged leases. Reporting in the cash flow statement remains virtually unchanged. Additional qualitative and quantitative disclosures are required.

ASU 2016-02 will be effective for the Company beginning on January 1, 2019. We expect that this standard will have a material effect on our financial statements. While we continue to assess all of the effects of adoption, we currently believe the most significant effects relate to the recognition of new right-of-use assets and lease liabilities on our balance sheet for our office and equipment operating leases and providing significant new disclosures about our leasing activities. We do not expect a significant change in our leasing activities between now and adoption. On adoption, we currently expect to recognize additional operating liabilities of approximately \$756, with corresponding right-of-use assets of the same amount based on the present value of the remaining minimum rental payments under current leasing standards for existing operating leases. The new standard also provides practical expedients for an entity's ongoing accounting. We currently expect to elect the short-term lease recognition exemption for all leases that qualify. This means, for those leases that qualify, we will not recognize right-of-use assets or lease liabilities, and this includes not recognizing right-of-use assets or lease liabilities for existing short-term leases of those assets in transitions. We also currently expect to elect the practical expedient to not separate lease and non-lease components for all of our leases.

In July 2018, the FASB issued ASU 2018-11 "Leases (Topic 842) Targeted Improvements." This amendment allows companies to elect to record a cumulative effect adjustment to beginning retained earnings on the date of adoption. We expect to elect the provisions of ASU 2018-11 as of the date of adoption on January 1, 2019.

2018 versus 2017

Revenues for the years ended December 31, 2018 and 2017 were \$56,535 and \$45,166, respectively. The year-over-year increase of \$11,369 or 25%, was driven by increased revenue in both APC and FUEL CHEM technology segments in our United States (U.S.) operations. Our U.S. revenues increased by \$14,377 or 49% from \$29,510 to \$43,887, and our international revenues decreased by \$3,008 or 19% from \$15,656 to \$12,648.

Revenues for the APC technology segment were \$38,417 for the year ended December 31, 2018, an increase of \$10,609, or 38%, versus fiscal 2017. The increase in APC revenue for the twelve month period ending December 31, 2018 in comparison to prior year amount is related to the timing of project execution as a result of conversion of new orders announced during 2017 and 2018. Backlog for the years ended December 31, 2018 and 2017 was \$12.4 million and \$22.1 million, respectively.

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Revenues for the FUEL CHEM technology segment for the year ended December 31, 2018 were \$18,118, an increase of \$760, or 4% versus fiscal 2017. We remain focused on attracting new customers in our FUEL CHEM business, for both coal and non-coal applications, but our ability to attract new coal customers continues to be affected by the soft electric demand market and fuel switching as a result of low natural gas prices.

Consolidated cost of sales for the years ended December 31, 2018 and 2017 were \$36,471 and \$27,144, respectively. Consolidated gross margin percentages for the years ended December 31, 2018 and 2017 were 35% and 40%, respectively. The gross margins for the APC technology segment decreased to 29% in 2018 from 34% in 2017. The overall decrease in gross margin in the APC technology segment from 2017 to 2018 is primarily due to project mix, timing of project execution and margin erosion on lower-margin projects being executed in foreign geographies, which will not recur. Gross margin percentage for the FUEL CHEM technology segment remained consistent at 50% for the years ended December 31, 2018 and 2017.

Selling, general and administrative (SG&A) expenses for the years ended December 31, 2018 and 2017 were \$18,564 and \$20,933, respectively. The decrease of \$2,369 or 11%, is primarily attributed to the following:

- ▲ decrease in employee related costs of \$1,004
- ▲ decrease in professional fees and consulting services of \$438
 - A decrease in office and administrative costs relating to our foreign subsidiaries of \$809
- ▲ decrease in other administrative costs, including depreciation and amortization of \$118

Restructuring costs were \$0 and \$119 in connection with the workforce reduction for the years ended December 31, 2018 and 2017. See Note 15, Restructuring Activities, for further discussion.

Research and development (“R&D”) expenses were \$1,073 and \$1,070 for the years ended December 31, 2018 and 2017, respectively.

In the second quarter of 2018, Fuel Tech recorded an abandonment charge of \$317 associated with certain international patent assets which the Company elected to not maintain and abandon in certain international locations due to limited business opportunities in those regions. The abandonment charge was calculated by determining the net book values of the abandoned patent assets by deducting the accumulated amortization from the acquisition cost. The abandonment charge of \$317 is included in “Intangible assets abandonment and building impairment” line in the accompanying Consolidated Statements of Operations for the twelve months ended December 31, 2018.

During the second quarter of 2017, the Company suspended all operations associated with the Fuel Conversion business segment. The activity of the Fuel Conversion discontinued operations consisted of Research and Development, severance and other costs for the for the year ended December 31, 2018 and 2017 of \$113 and \$3,914, respectively. The loss f