FUELCELL ENERGY INC
Form 10-K
January 11, 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 October 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 number: 1-14204

FUELCELL ENERGY, INC.

(Exact name of registrant as specified in its charter)

Delaware	06-0853042
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
3 Great Pasture Road Danbury, Connecticut	06810
(Address of principal executive offices)	(Zip Code)

Registrant’s telephone number, including area code: (203) 825-6000

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

Title of each class	Name of each exchange on which registered
Common Stock, $0.0001 par value per share	The Nasdaq Stock Market LLC (Nasdaq Global Market)

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 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 Exchange Act). Yes No

As of April 28, 2017, the aggregate market value of the registrant's common stock held by non-affiliates of the registrant was $54,054,838 based on the closing sale price of $1.15 as reported on the NASDAQ Global Market.

Indicate the number of shares outstanding of each of the registrant's classes of common stock, as of the latest practicable date.

Class	Outstanding at January 2, 2018

Common Stock, $0.0001 par value per share	75,678,919

DOCUMENT INCORPORATED BY REFERENCE

Document	Parts Into Which Incorporated
Proxy Statement for the Annual Meeting of Stockholders to be held April 5, 2018	Part III

FUELCELL ENERGY, INC.

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PART I

Item 1. BUSINESS

Forward-Looking Statement Disclaimer

This Annual Report on Form 10-K contains statements that the Company believes to be "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995. All statements other than statements of historical fact included in this Form 10-K, including statements regarding the Company's future financial condition, results of operations, business operations and business prospects, are forward-looking statements. Words such as "expects," "anticipates," "estimates," "projects," "intends," "plans," "believes," "predicts," "should," "will," "could," "would," and similar expressions and variations of such words are intended to identify forward-looking statements. Such statements relate to, among other things, the following:

- the development and commercialization by FuelCell Energy, Inc. and its subsidiaries ("FuelCell Energy," "Company," "we," "us" and "our") of fuel cell technology and products and the market for such products,
- expected operating results such as revenue growth and earnings,
- our belief that we have sufficient liquidity to fund our business operations for the next 12 months,
- future funding under Advanced Technologies contracts,
- future financing for projects including publicly issued bonds, equity and debt investments by investors and commercial bank financing,
- the expected cost competitiveness of our technology, and
- our ability to achieve our sales plans and cost reduction targets.

The forward-looking statements contained in this report are subject to risks and uncertainties, known and unknown, that could cause actual results to differ materially from those forward-looking statements, including, without limitation, the risks contained under Item 1A - Risk Factors of this report and the following:

- general risks associated with product development and manufacturing,
- general economic conditions,
- changes in the utility regulatory environment,
- changes in the utility industry and the markets for distributed generation, distributed hydrogen, and carbon capture configured fuel cell power plants for coal and gas-fired central generation,
- potential volatility of energy prices,
- availability of government subsidies and economic incentives for alternative energy technologies,
- rapid technological change,
- competition,
- market acceptance of our products,
- changes in accounting policies or practices adopted voluntarily or as required by accounting principles generally accepted in the United States,
- factors affecting our liquidity position and financial condition,
- government appropriations,
- the ability of the government to terminate its development contracts at any time,
- the ability of the government to exercise "march-in" rights with respect to certain of our patents,
- our changing relationship with POSCO Energy, which may affect our ability to develop the market in Asia and deploy SureSource power plants,
- our ability to implement our strategy,

- our ability to reduce our levelized cost of energy and cost reduction strategy generally,
- our ability to protect our intellectual property,
- the risk that commercialization of our products will not occur when anticipated,
- our ability to generate positive cash flow from operations,
- our ability to service our long-term debt,
- our ability to increase the output and longevity of our power plants, and
- our ability to expand our customer base and maintain relationships with our largest customers and strategic business allies.

We cannot assure you that:

- we will be able to meet any of our development or commercialization schedules,
  - any of our new products or technology, once developed, will be commercially successful,
  - our existing SureSource power plants will remain commercially successful,
- the government will appropriate the funds anticipated by us under our government contracts,
- the government will not exercise its right to terminate any or all of our government contracts, or
- we will be able to achieve any other result anticipated in any other forward-looking statement contained herein.

The forward-looking statements contained herein speak only as of the date of this report. Except for ongoing obligations to disclose material information under the federal securities laws, we expressly disclaim any obligation or undertaking to release publicly any updates or revisions to any such statement to reflect any change in our expectations or any change in events, conditions or circumstances on which any such statement is based.

Background

Information contained in this report concerning the electric power supply industry and the distributed generation market, our general expectations concerning this industry and this market, and our position within this industry are based on market research, industry publications, other publicly available information and assumptions made by us based on this information and our knowledge of this industry and this market, which we believe to be reasonable. Although we believe that the market research, industry publications and other publicly available information, including the sources that we cite in this report, are reliable, they have not been independently verified by us and, accordingly, we cannot assure you that such information is accurate in all material respects. Our estimates, particularly as they relate to our general expectations concerning the electric power supply industry and the distributed generation market, involve risks and uncertainties and are subject to change based on various factors, including those discussed under Item 1A - Risk Factors of this report.

As used in this report, all degrees refer to Fahrenheit (“F”); kilowatt (“kW”) and megawatt (“MW”) numbers designate nominal or rated capacity of the referenced power plant; “efficiency” or “electrical efficiency” means the ratio of the electrical energy generated in the conversion of a fuel to the total energy contained in the fuel (lower heating value, the standard for power plant generation, assumes the water in the product is in vapor form; as opposed to higher heating value, which assumes the water in the product is in liquid form, net of parasitic load); kW means 1,000 watts; MW means 1,000,000 watts; “kilowatt hour” (“kWh”) is equal to 1kW of power supplied to or taken from an electric circuit steadily for one hour; and one British Thermal Unit (“Btu”) is equal to the amount of heat necessary to raise one pound of pure water from 59^{o}F to 60^{o}F at a specified constant pressure.

All dollar amounts are in U.S. dollars unless otherwise noted.

Additional Technical Terms and Definitions

Advanced Technologies - Advanced Technologies projects involve the development of new products or applications based on existing carbonate technology or new electrochemical technologies. Examples are carbon capture, distributed hydrogen, solid oxide fuel cells and solid oxide electrolysis cell technologies. Advanced Technologies projects are typically externally funded by government or private sources and executed by our Advanced Technologies Group.

Availability - A measure of the amount of time a system is available to operate, as a fraction of total calendar time. For power generation equipment, an industry standard (IEEE (The Institute of Electrical and Electronics Engineers) 762, "Definitions for Use in Reporting Electric Generating Unit Reliability, Availability and Productivity") is used to compute availability. "Availability percentage" is calculated as total period hours since Commercial Operations Date less hours not producing electricity due to planned and unplanned maintenance divided by total period hours. Grid disturbances, force majeure events and site specific issues such as a lack of available fuel supply or customer infrastructure repair do not penalize the calculation of availability according to this standard.

Carbonate Fuel Cell ("CFC") - Carbonate fuel cells, such as the fuel cell power plants produced and sold by FuelCell Energy, are high-temperature fuel cells that use an electrolyte composed of a carbonate salt mixture suspended in a porous, chemically inert ceramic-based matrix. CFCs operate at high temperatures, enabling the use of a nickel-based catalyst, a lower cost alternative to precious metal catalysts used in some other fuel cell technologies.

Combined Heat & Power ("CHP") - A power plant configuration or mode of operation featuring simultaneous on-site generation from the same unit of fuel of both electricity and heat with the heat used to produce steam, hot water or heated air for both heating and cooling applications.

Commercial Operations Date ("COD") - The date that testing and commissioning of a fuel cell project is completed and the fuel cell power plant is operational with power being generated and sold to the end-user.

Distributed Generation - Electric power that is generated where it is needed (distributed throughout the power grid) rather than from a central location. Centrally generated power requires extensive transmission networks that require maintenance and experience efficiency losses during transmission while distributed generation does not. Distributed generation is small to mid-size power plants, typically generating 75 MW or less. Central generation is large power plants generating hundreds or even thousands of MW.

Micro-grids - Micro-grids are localized electric grids that can disconnect from the traditional electric grid to operate autonomously and strengthen grid resiliency. Micro-grids can be composed only of SureSource power plants due to their continual power output or combine a variety of power generation types such as fuel cells and solar arrays.

Nitrogen Oxides ("NOx") - Generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Many of the NOx are colorless and odorless; however, they are a major precursor to smog production and acid rain. One common pollutant, Nitrogen Dioxide, along with particles in the air, can often be seen as a reddish-brown layer over many urban areas. NOx form when fuel is burned at high temperatures, as in a combustion process. The primary manmade sources of NOx are motor vehicles, traditional fossil-fuel fired electric utility generation, and other industrial, commercial and residential sources that burn fuels.

Particulate Matter ("PM") - Solid or liquid particles emitted into the air that are generally caused by the combustion of materials or dust generating activities. Particulate matter caused by combustion can be harmful to humans as the fine particles of chemicals, acids and metals may get lodged in lung tissue.

Power Purchase Agreement (“PPA”) - A Power Purchase Agreement is a contract that enables a power user to purchase energy under a long-term contract where the user agrees to pay a predetermined rate for the kilowatt-hours delivered from a power generating asset while avoiding the need to own the equipment and pay the upfront capital cost. The PPA rate is typically fixed (with an escalation clause tied to a consumer price index or similar index), or pegged to a floating index that is on par with or below the current electricity rate being charged by the local utility company for a term of 10 to 20 years.

Renewable Biogas - Renewable biogas is fuel produced by biological breakdown of organic material. Biogas is commonly produced in biomass digesters employing bacteria in a heated and controlled oxygen environment. These digesters are typically used at wastewater treatment facilities or food processors to break down solid waste and the biogas produced is a byproduct of the waste digestion. Biogas can be used as a renewable fuel source for SureSource fuel cell plants located on site where the biogas is produced with gas cleanup, or it can be processed further to meet pipeline fuel standards and injected into a gas pipeline network, which is termed Directed Biogas.

Solid Oxide Electrolysis Cell ("SOEC") - Solid Oxide Electrolysis Cells are electrochemical cells with the same cell and stack structure as Solid Oxide Fuel Cells, but are operated in reverse – instead of producing power from fuel and oxygen, SOEC cells produce hydrogen and oxygen from steam when supplied with power. The Solid Oxide Fuel Cell platform can be operated in fuel cell mode (producing power from fuel) or electrolysis mode (producing hydrogen from power) and can alternate between the two.

Solid Oxide Fuel Cell ("SOFC") - Solid Oxide Fuel Cells are electrochemical cells with a non-porous ceramic material as the electrolyte. SOFCs operate at high temperatures (slightly higher than carbonate) eliminating the need for costly precious-metal catalysts, thereby reducing cost. Like carbonate, the high operating temperature enables internal reforming of the hydrogen rich fuel source.

Sulfur Oxide ("SOx") - Sulfur oxide refers to any one of the following: sulfur monoxide, sulfur dioxide ("SO_2") and sulfur trioxide. SO_2 is a byproduct of various industrial processes. Coal and petroleum contain sulfur compounds, and generate SO_2 when burned. SOx compounds are particulate and acid rain precursors.

Overview

We deliver proprietary fuel cell power solutions for the clean and affordable supply, recovery and storage of energy. We serve utilities and industry and municipal power users on three continents with megawatt-class scalable solutions that include utility-scale and on-site power generation, carbon capture, local hydrogen production for transportation and industry, and energy storage. With more than 7.0 million megawatt hours of ultra-clean power produced, FuelCell Energy is a global leader in designing, manufacturing, installing, operating and maintaining environmentally responsible fuel cell power solutions.

We provide comprehensive turn-key power generation solutions to our customers, including power plant installation, operations and maintenance under multi-year service agreements. We develop projects and also sell direct to customers, providing either a complete solution of developing, installing and servicing the fuel cell power plant, or selling the power plant equipment only. For projects that we develop, the end user of the power typically enters into a PPA and we either identify a project investor to purchase the power plant and assume the PPA, or we retain the project and recognize electricity revenue ratably over the term of the PPA. We target large-scale power users with our megawatt-class installations. To provide a frame of reference, one megawatt is adequate to continually power approximately 1,000 average sized U.S. homes. Our customer base includes utility companies, municipalities, universities, government entities and a variety of industrial and commercial enterprises. Our leading geographic markets are the United States and South Korea. We are pursuing expanding opportunities in other countries.

Our value proposition is to enable economic value with clean and affordable fuel cell power plants that supply power where consumed. Our products can also be configured for recovery and storage applications. Our solutions are easy-to-site in populated areas as they are clean, operate quietly and without vibrations, and have only modest space requirements. Fuel cells use an electrochemical process to convert a fuel source into electricity and heat in a highly efficient process that emits virtually no pollutants as the fuel is not burned, generating power that is almost wholly absent of criteria pollutants such as NOx that causes smog, SOx that contributes to acid rain, and particulate matter that can aggravate asthma. Locating power generation near the point of use reduces reliance on the transmission grid,

leading to enhanced energy security and power reliability. Utilities can minimize or even avoid the cost of transmission or other infrastructure by adopting distributed generation, which saves their customers the cost of installing and maintaining transmission and also avoids the losses associated with transmitting electricity over great distances. Our power plants provide electricity priced competitively to grid-delivered electricity in certain high cost regions and our strategy is to continue to reduce costs, which we believe will lead to wider adoption.

FuelCell Energy was founded as a Connecticut corporation in 1969 as an applied research organization, providing contract research and development. The Company went public in 1992 and reincorporated in Delaware in 1999. We began selling stationary fuel cell power plants commercially in 2003. Today, we develop turn-key distributed power generation solutions, operating and providing comprehensive service for the life of the asset.

Business Strategy

Our business model is to address power generation challenges with versatile, efficient and economical fuel cell solutions. We are leveraging our common core fuel cell technology and products to target global markets including on-site and utility-scale projects for the supply, recovery and storage of energy. We selectively utilize strategic business alliances and collaboration agreements for market development, financing and cost reductions. Our extensive intellectual property portfolio consists of patents, trade secrets and collective experience, which acts as a foundation for expanding and maximizing our solutions portfolio. Our business model is based on multiple revenue streams, including power plant and component sales; engineering, procurement and construction ("EPC") revenue; royalty and license revenue; recurring service revenue, including long term service agreements; recurring electricity sales under PPAs and tariffs for projects we retain in our generation portfolio; and revenue from public and private industry research contracts under Advanced Technologies.

Market adoption

We target vertical markets and geographic regions that value clean distributed generation, are located where there are high energy costs, and are aligned with regulatory frameworks that harmonize energy, economic and environmental policies. Our business model addresses all three of these policy areas with highly efficient and affordable distributed generation that delivers de-centralized power in a low-carbon, virtually pollutant-free manner. Geographic markets that meet these criteria and where we are already well established include South Korea, the Northeast U.S. and California. We have also installed and are operating plants in the United Kingdom, Germany, and Switzerland, have contracts and awards to install and operate plants in New York, and are pursuing further opportunities in Western Europe and certain other states in the United States as well as certain countries in Asia. We selectively develop strategic business relationships with some of the leading energy and power generation companies in our target markets to facilitate demand and deploy our projects.

While the Company has made significant progress with reducing costs and creating markets since the commercialization of our products in 2003, we face two primary challenges in growing the adoption of our distributed power generation solutions, which are (1) the need to further reduce the total cost of ownership, and (2) the continued education and acknowledgment of the value that our solutions provide. The business model for the generation and delivery of electricity for over a century has been central generation, which is large scale power generation in distant locations away from urban areas with transmission and distribution to the end users. Distributed generation enhances existing utility models and it is being embraced in an increasing number of markets to improve grid operations.

We work with utilities and power generators to demonstrate how our solutions complement central generation by incrementally adding clean power generation when and where needed. One example of this is a 40 megawatt fuel-cell only program by Long Island Power Authority ("LIPA") to address load pockets or power needs in specific areas of its service territory. LIPA operates in an area with high population density, scarce and expensive land, the need for resiliency to ensure power during storms, and vocal citizens that may not welcome new transmission lines in their neighborhoods. The structure of the program reflected the unique value drivers of fuel cells to cleanly, efficiently and economically supply power where it is needed, which for LIPA is near existing electrical substations. LIPA awarded the entire 40 MW program to FuelCell Energy through a competitive bidding process after a review of more than 375

MW of proposals from multiple developers.

Fuel cell power plant ownership structures

In the United States, historically, customers generally purchased our fuel cell power plants outright. As the size of our fuel cell projects has grown and availability of project capital improved, project structures have transitioned to predominantly PPAs. Under a PPA, the end-user of the power commits to purchase power as it is produced for an

extended period of time, typically 10 to 20 years. End-users may be a university, pharmaceutical company, hospital or utility. A primary advantage for the end-user is that it does not need to commit its own capital to own a power generating asset, yet it enjoys the multiple benefits of fuel cell power generation.

Once the PPA is executed, construction of the fuel cell project can begin. At or around the COD, the project may be sold to a project investor or retained by the Company. If the project is sold, revenue from the product sale is recognized. If the project is retained, electricity sales are recognized monthly over the term of the PPA.

Our business model is continuing to evolve to meet the needs and opportunities of the market and to best situate ourselves for success. In 2016, we began to retain ownership of certain projects through sale-leasebacks and retaining the related PPAs, thus keeping them on our balance sheet instead of selling them to an end-user customer, investor, or utility. Our decision to retain certain projects is based in part on the strong cash flows these projects can offer to us, the proliferation of power purchase agreements in the industry and the potential access to capital. Retaining PPAs affords the Company with the full benefit of future cash flows under the PPAs, which is higher than if we sell the projects. As of October 31, 2017, our operating portfolio of retained projects totaled 11.2 MW with an additional 19.5 MW under construction. The Company plans to continue to grow this portfolio in a balanced manner while also selling projects to investors when that presents the best opportunity.

Levelized Cost of Energy

Our fuel cell projects deliver power at a rate comparable to pricing from the grid in our targeted markets. Policy programs that help to support adoption of clean distributed power generation lead to below-grid pricing. We measure power costs by calculating the Levelized Cost of Energy (“LCOE”) over the life of the project.

We innovate, design and own our proprietary fuel cell technology. We develop and execute comprehensive fuel cell turn-key projects or sell direct. We manufacture and install the fuel cell power plants and we then operate and maintain the plants for our customers under long term service agreements, or selectively retain projects in our generation portfolio. Given this level of integration, there are multiple areas and opportunities for cost reductions. There are several primary elements to LCOE for our fuel cell projects, including (1) Capital Cost, (2) Operations and Maintenance, (3) Fuel, and (4) Cost of Capital. We are actively managing and reducing costs in all four areas as follows:

- Capital Cost - Capital costs of our projects include cost to manufacture, install, interconnect, and any on-site application requirements such as configuring for a micro-grid and/or heating and cooling applications. We have reduced the product cost of our megawatt-class power plants by more than 60% from the first commercial installation in 2003 through our ongoing product cost reduction program, which involves every aspect of our business including engineering, procurement and manufacturing. Further cost reductions will be primarily obtained from higher production volumes which will lead to reductions in the per-unit cost of materials purchased, supported by continued actions with engineering and manufacturing cost reductions. On-site, our experienced EPC team has substantial experience in working with contractors and local utilities to safely and efficiently execute our projects and we expect continued cost reduction in this area with experience and continued transition to multi-MW fuel cell parks. Larger projects offer scale and the opportunity to consolidate systems and reduce costs. In addition to these cost reduction efforts, our technology roadmap includes plans to increase the output of our power plants which will add further value for our customers and reduce LCOE.
- Operations and Maintenance - We remotely monitor, operate, and maintain the fuel cell power plants to optimize performance and meet or exceed expected operating parameters throughout the plant’s operational life. Operations and maintenance (“O&M”) is a key driver for power plants to deliver on projected electrical output and revenue. Many of

our service agreements include guarantees for system performance levels, including electrical output. Customers benefit from predictable savings and financial returns over the life of the contract, while minimizing risk. While the electrical and mechanical balance of plant ("BOP") in our power plants is designed to last 25 years, the fuel cell modules are currently scheduled for replacement every five years, the price of which is included in our service agreements. We expect to continually drive down the cost of O&M with an expanding fleet which will leverage our investments in this area. Additionally, we have completed the development of fuel cells that have a longer life, which will reduce O&M costs by increasing our scheduled module replacement period to seven years.

- Fuel - Our fuel cells directly convert chemical energy (fuel) into electricity, heat, water, and in certain configurations, other value streams such as high purity hydrogen. Because fuel cells generate power electrochemically rather than by combusting (burning) fuels, they are more efficient in extracting energy from fuels and produce less carbon dioxide ("CO_2") and only trace levels of pollutants compared to combustion-type power generation. Our power plants can operate on a variety of existing and readily available fuels, including natural gas, renewable biogas, directed biogas and propane. Our core SureSource power plants deliver electrical efficiencies of 47%, and in 2017, the Company introduced a power plant which operates at 60% efficiency targeted at electric-only applications such as grid support and data centers. In a CHP configuration, our plants can deliver even higher system efficiency, depending on the application. Increasing electrical efficiency and reducing fuel costs is a key element of our operating cost reduction efforts.
- Cost of Capital - Most of our MW-scale projects are financed either by the energy user/off-taker that owns the asset or a project investor that owns the asset and sells energy to the off-taker. We have responded to an evolving market with greater interest in the pay-as-you-go PPA approach by end users of the power that prefer to avoid the up-front investment in power generation assets. Our projects create predictable recurring revenue that is not dependent on weather or time of the day, investment tax credits, accelerated tax depreciation or other incentives. Credit risk is mitigated by contracting with customers with strong credit. In addition, we offer meaningful system-level output performance guarantees over the life of our projects. As a result, cost of capital for our projects has declined over time, partially due to our operating experience. With continued execution, we expect to continue to attract project finance capital, and with financial and project performance credibility continuing to improve, we expect continued reductions in risk premiums leading to lower financing costs.

An additional factor that benefits fuel cells when comparing LCOE to other forms of power generation is that our solutions provide delivered electricity that minimizes or even avoids the costs of transmission.

Our distributed generation solutions minimize or entirely avoid the need for transmission. When comparing LCOE across different forms of power generation, transmission needs to be considered in the evaluation. Power generation far from where the power is used requires transmission, which is a cost to ratepayers and is inefficient due to line losses of power in the transmission process.

We believe that our strong business model and strategy, demonstrated project development execution, plant operating performance, and strategic relationships will support accelerated adoption of our fuel cell solutions.

Markets

Vertical Markets

Access to clean, affordable and reliable power defines modern lifestyles. The ability to provide power cleanly and efficiently is taking on greater importance and urgency in many regions of the world. Central generation and its associated transmission and distribution grid are difficult to site, costly, and generally take many years to permit and build. Some types of power generation that were widely adopted in the past, such as nuclear power, are no longer welcome in certain regions. The cost and impact to public health and the environment of pollutants and greenhouse gas emissions impact the siting of new power generation. The attributes of SureSource power plants address these challenges by providing virtually particulate emission-free power and heat at the point of use in a highly efficient process that is affordable to consumers.

Our solutions are installed on both sides of the electric meter, meaning that we serve on-site markets supplying power directly to the end user, as well as utility-scale projects that supply the power to the electric grid. We target seven distinct markets including:

(1) Utilities and Independent Power Producers,

(2) Industrial and Process applications,
(3) Education and Health care,
(4) Data Centers and Communication,
(5) Wastewater treatment,

(6) Government, and
(7) Commercial and Hospitality.

The Utilities and Independent Power Producers segment is our largest vertical market with customers that include utilities on the East and West coast of the United States such as Dominion (NYSE: D), one of the largest utilities in the United States: Avangrid Holdings (NYSE: AGR), Long Island Power & Light and NRG Energy (NYSE: NRG), one of the largest Independent Power Producers ("IPP") in the United States. Our carbon capture demonstration installation will be located at a power plant owned by a subsidiary of Southern Company (NYSE: SO). In Europe, utility customers include E.ON Connecting Energies (DAX: EOAN), one of the largest utilities in the world, and Switzerland-based ewz. The greatest number of installed fuel cell plants is in South Korea, primarily supplying that nation's electric grid, with the fuel cells' heat typically used in district heating systems to heat and cool nearby facilities. Our technology licensee in South Korea is POSCO Energy Co., Ltd. ("POSCO Energy"), a subsidiary of South Korean-based POSCO (NYSE: PKX), one of the world's largest steel manufacturers.

Our SureSource power plants are producing power for a variety of industrial, commercial, municipal and government customers, including manufacturing facilities, pharmaceutical processing facilities, universities, healthcare facilities and wastewater treatment facilities. These institutions desire efficient, ultra-clean continuous power to reduce operating expenses, reduce greenhouse gas emissions and avoid pollutant emissions to meet their sustainability goals, while achieving secure and reliable on-site power. Combined heat and power fuel cell applications further support economic and sustainability initiatives by minimizing or avoiding use of combustion based boilers for heat.

Our products are fuel flexible, utilizing clean natural gas and renewable biogas generated by the customer on-site or directed biogas generated at a distant location and transported via the existing gas network. In addition, we have demonstrated other fuel sources including coal syngas and propane.

As renewable technologies such as wind and solar power are deployed more widely, the need for a clean, continuous power generation that complements and balances these intermittent sources becomes greater to maintain grid stability and consistent power supply for on-site applications. Our installed base includes a number of locations where our customers use SureSource plants for meeting power needs that complements intermittent wind and/or solar power generation.

Our fuel cell solutions are well suited for micro-grid applications, either as the sole source of power, or integrated with other forms of power generation. We can model, install and operate the micro-grid, which is a differentiator in the power industry. We have fuel cells operating as micro-grids at universities and municipalities, including one university micro-grid owned by a wholly owned subsidiary of NRG Yield (NYSE: NYLD) and a town-based micro-grid owned by Avangrid. Under normal operation, the fuel cells supply power to the grid. If the grid is disrupted, the fuel cell plant will automatically disconnect from the grid and power a number of critical buildings.

Wastewater treatment facilities, food and beverage processors, and agricultural operations produce biogas as a byproduct of their operations. Disposing of this greenhouse gas can be harmful to the environment if released into the atmosphere or flared. Our SureSource power plants convert this biogas into electricity and heat efficiently and economically. Wastewater facilities with anaerobic digesters are an attractive market for our SureSource solution including the power plant as well as treatment of the biogas. Since our fuel cells operate on the renewable biogas produced by the wastewater treatment process and the heat is used to support daily operations at the wastewater treatment facility, the overall thermal efficiency of these installations is high, supporting economics and sustainability.

We estimate that the addressable distributed generation market and geographies in which we compete for the supply of energy, including distributed hydrogen production, is approximately a $22 billion opportunity, with approximately 40-45% consisting of power plant sales and the remainder representing associated service agreements. We estimate that the addressable market for the recovery of energy, including our fuel cell carbon capture solution and our gas

pipeline application, is approximately $28 billion, assuming only a 1% penetration rate of addressable coal and gas-fired central generation power plant facilities within the geographies where we do business, and only 25% carbon capture at these coal or gas-fired plants. We believe there are additional market opportunities for capture from

industrial thermal sources, such as boilers, in industries like steel and cement production. The addressable energy storage market is still developing as different technologies are beginning to come to market with different approaches to storage and different storage durations. We estimate that the addressable market for long duration storage may be in the range of tens of billions of dollars.

Strategic Alliances

We leverage our core capabilities by forging strategic alliances with carefully selected third parties that bring power generation experience, financial resources, and market access. Our strategic allies typically have extensive experience in developing and selling power generation products. We believe our strength in the development of fuel cell products, coupled with our strategic allies' understanding of a broad range of markets and customers, products and services, enhances the sales and development of our products, as well as provides endorsement of our power generation solutions. Our global business alliances include:

NRG Energy: NRG Energy ("NRG") owns approximately 1.4 million shares of our common stock (or approximately 2% of our outstanding common stock), extends a $40.0 million revolving construction and term financing facility to FuelCell Energy Finance, LLC ("FuelCell Finance"), our wholly-owned subsidiary, and is represented on the FuelCell Energy Board of Directors by the CEO of NRG Yield (NYSE: NYLD). NRG is one of the largest IPPs in the U.S. with approximately 50,000 MW of generation capacity and almost three million retail and commercial customers.

POSCO Energy: We entered into manufacturing and technology transfer agreements in 2007, 2009 and 2012 with POSCO Energy, which provide POSCO Energy with the technology rights to manufacture SureSource power plants in South Korea and the right to sell power plants throughout Asia. POSCO Energy owns 2.6 million shares of our common stock (or approximately 4% of our outstanding shares of common stock). POSCO Energy is one of the largest IPPs in South Korea.

In March 2017, we entered into a memorandum of understanding ("2017 MOU") with POSCO Energy to permit us to directly develop the Asian fuel cell business, including the right for us to sell SureSource solutions in South Korea and the broader Asian market. We and POSCO Energy also agreed to undertake to amend certain technology transfer and other agreements by a target date of September 30, 2017 to reflect our new relationship. Although these agreements have not yet been amended, we continue to engage in discussions with POSCO Energy regarding our relationship and the direction of the fuel cell business in the South Korean and Asian markets.

Pursuant to the 2017 MOU, we have commenced marketing the entire suite of SureSource solutions in South Korea. In June 2017, an EPC contractor was awarded a 20 megawatt project utilizing our SureSource technology by a Korean utility after a competitive bidding process. On August 29, 2017, we entered into a definitive agreement for this 20 MW project with the EPC contractor, Hanyang Industrial Development Co., Ltd ("HYD"), pursuant to which we provided equipment to HYD for the fuel cell project with Korea Southern Power Co., Ltd. ("KOSPO"). The SureSource 3000™ power plants will cleanly produce electricity and thermal energy to supply the electric grid and support a district heating system. Construction began in 2017 and the installation is expected to be operational in 2018. The value of the equipment sale contract to the Company is in excess of $60 million.

In accordance with the 2017 MOU, we are collaborating with POSCO Energy to pursue investor opportunities in the Korean fuel cell business to further develop and advance the Korean market for fuel cells.

E.ON Connecting Energies GmbH: E.ON Connecting Energies ("E.ON") specializes in integrated energy solutions for industrial, commercial and public sector customers. E.ON has purchased two SureSource fuel cell power plants to serve E.ON end user customers. The first sale announced was a CHP-configured megawatt-class fuel cell plant installation at a German manufacturing company and the second sale was a CHP-configured fuel cell power plant for a

German hotel owned by an international hotel chain.

ExxonMobil: We entered into a joint development agreement in 2016 with ExxonMobil for advancing fuel cell carbon capture with applications for gas-fired power stations. ExxonMobil is supporting a demonstration fuel cell carbon capture plant to be installed at the Plant Barry power station, owned by an affiliate of Southern Company.

Products

Our core fuel cell products offer ultra-clean, highly efficient power generation for customers, including the 1.4 MW SureSource 1500™, the 2.8 MW SureSource 3000™, and the recently introduced 3.7 MW SureSource 4000™. The plants are scalable for multi-megawatt utility scale applications or on-site CHP generation for a broad range of applications. We provide a comprehensive and complete turn-key fuel cell project that includes project development, EPC services, O&M, and project finance.

Our proprietary carbonate fuel cell technology generates electricity directly from a fuel, such as natural gas or renewable biogas, by reforming the fuel inside the fuel cell to produce hydrogen. This internal "one-step" reforming process results in a simpler, more efficient, and cost-effective energy conversion system compared with external reforming fuel cells. Additionally, natural gas has an established infrastructure and is readily available in our existing and target markets compared to some types of fuel cells that require high purity hydrogen. The fuel cells operate at approximately 1,100° F. An advantage of high temperature fuel cells is that they do not require the use of precious metal electrodes required by lower temperature fuel cells, such as proton-exchange membrane ("PEM") fuel cells. As a result, we are able to use less expensive and readily available industrial metals as catalysts for our fuel cell components.

The SureSource product line is a global platform based on carbonate fuel cell technology. Using a standard design globally enables volume-based cost reduction and optimal resource utilization. Our power plants utilize a variety of available fuels to produce electricity electrochemically, in a process that is highly efficient, quiet, and due to the avoidance of combustion, produces virtually no particulate pollutants. Thus, our plants generate more power and fewer emissions for a given unit of fuel than combustion-based power generation of a similar size, making them economical and environmentally responsible power generation solutions. In addition to electricity, our standard configuration produces high quality heat (approximately 700° F), suitable for heating facilities or water, or steam for industrial processes or absorption cooling. Our system's efficiencies can reach up to 90%, depending on the application, when configured for CHP.

We market different configurations of the SureSource plants to meet specific market needs for the supply, recovery and storage of energy, including:

Energy Supply

- On-Site Power (Behind the Meter): Customers benefit from improved power reliability and energy security from on-site power that reduces reliance on the electric grid. Utilization of the high quality heat produced by the fuel cell in a CHP configuration supports economics and sustainability goals by lessening or even avoiding the need for combustion-based boilers for heat and its associated cost, pollutants and carbon emissions. On-site CHP power projects generally range in size from an individual SureSource 1500 to combining multiple SureSource 3000 or SureSource 4000 power plants for larger on-site projects. For example, an installation at a pharmaceutical company uses two SureSource 3000 power plants for 5.6 MW of power and heat production while an installation currently contracted for a U.S. Navy base will use two SureSource 4000 power plants for 7.4 MW of power.
- Utility Grid Support: The SureSource power plants are scalable, which enables siting multiple fuel cell power plants together in a fuel cell park. Fuel cell parks enable utilities to add clean and continuous multi-megawatt power generation when and where needed and enhance the resiliency of the electric grid by reducing reliance on large central generation plants and the associated transmission grid. Consolidating certain steps for multiple plants, such as fuel processing, reduces the cost per megawatt hour for fuel cell parks compared to individual fuel cell power plants. Fuel cell park examples include a five plant, 14.9 MW fuel cell park in Bridgeport, Connecticut that is supplying the electric grid, and multiple fuel cell parks in South Korea in excess of 10 MW each that supply power to the electric grid and high quality heat to district heating systems, such as a 59 MW installation which consists of 21

power plants, the world's largest fuel cell park. By producing power near the point of use, our fuel cells help to ease congestion of the electric grid and can also enable the smart grid via distributed generation combined with continuous monitoring and operation by our service organization. Thus, our solutions can avoid or reduce investment in new central generation and transmission infrastructure which is

costly, difficult to site and expensive to maintain. Deploying our SureSource power plants throughout a utility service territory can also help utilities comply with government-mandated clean energy regulations and meet air quality standards. Our products can be part of a total on-site power generation solution with our high efficiency products providing continuous power, and can be combined with intermittent power generation, such as solar or wind, or less efficient combustion-based equipment that provides peaking or load following power.

- Higher Electrical Efficiency - Multi-megawatt applications: The SureSource 4000 is designed to extract more electrical power from each unit of fuel with electrical efficiency of approximately 60% and targets applications with large load requirements and limited waste heat utilization such as utility/grid support or data centers. This 3.7 megawatt plant is configured with a series of three fuel cell modules that operate in sequence, yielding a higher electrical efficiency than the standard SureSource 3000 configuration of two fuel cell modules operating in parallel. The heat energy and unused hydrogen from two fuel cell modules is supplied to the third module, enhancing overall electrical efficiency.
- Distributed Hydrogen: The SureSource fuel cells internally reform the fuel source (i.e. natural gas or biogas) to obtain hydrogen. The SureSource plants can be configured for tri-generation, supplying power, heat and high purity hydrogen. Power output is modestly reduced to support hydrogen generation, which can then be used for industrial applications such as metal or glass processing, or petrochemical, or transportation applications. Siting the tri-generation fuel cell plant at a source of biogas, such as a wastewater treatment facility, enables the generation of renewable hydrogen for transportation, an attractive proposition to regulatory and legislative officials and auto companies. We have announced the first commercial MW-scale application of this product configuration at the Port of Long Beach, California which will support Toyota's logistical support facility.
- Micro-grid: The SureSource plants can also be configured as a micro-grid, either independently or with other forms of power generation. We possess the capabilities to model, design and operate the micro grid and have multiple examples of our solutions operating within micro-grids, some individually and some with other forms of power generation.

Energy Recovery

- Gas Pipeline Applications: SureSource Recovery™ power plants are used in natural gas pipeline applications, harnessing energy that is otherwise lost during the natural gas pressure-reduction ("letdown") process. Also, thermal energy produced as a byproduct of the fuel cell's operation supports the letdown process, improving the letdown station's carbon footprint and enhancing the project's economics. Depending on the specific gas flows and application, the SureSource Recovery configuration is capable of achieving electrical efficiencies of up to 70%. A 3.4 megawatt system is owned by a subsidiary of Avangrid and operating at a gas letdown station owned by its regulated gas utility subsidiary.

- Carbon Capture: The SureSource Capture™ system separates CO_2 from the flue gases of natural gas or coal-fired power plants or industrial facilities while producing ultra-clean power. Exhaust flue gas from the coal/gas plant is supplied to the cathode side of the fuel cell, instead of ambient air. The CO_2 in the exhaust is transferred to the anode side of the fuel cell, where it is much more concentrated and easy to separate. The CO_2 from the anode exhaust stream is liquefied using common chilling equipment. The purified CO_2 is then available for enhanced oil recovery, industrial applications or sequestration. Carbon concentration and capture within the carbonate fuel cell is a side reaction of the natural gas-fueled power generation process. Carbon capture systems can be implemented in increments, starting with as little as 5% capture with no appreciable change in the cost of power and with minimum capital outlay. Our solution generates a return on capital resulting from the fuel cell's production of electricity rather than an increase in operating expense required by other carbon capture technologies, and can extend the life of existing coal-fired power plants, enabling low carbon utilization of domestic coal and gas resources. During 2018, we will be installing the first carbon capture configured SureSource 3000 power plant, which will be located at a mixed coal/gas fired power station owned by a subsidiary of Southern Company. The project is partially funded by the U.S. Department of Energy and ExxonMobil is also participating in portions of the project.

Energy Storage

We are developing our long-duration SureSource Storage™ solution, creating a system that utilizes both SOFC and SOEC technology and using hydrogen as the energy storage medium. Our solid oxide stacks are capable of alternating between electrolysis and power generation mode. Instead of producing power from fuel and air, a solid oxide fuel cell stack in electrolysis mode splits water into hydrogen and oxygen using supplied electricity. Hydrogen is an energy carrier that can be compressed and stored for long durations in storage tubes or underground.

This allows us to configure efficient and cost effective energy storage solutions where hydrogen is produced from electricity in electrolysis mode and stored until power is needed, at which point the stored hydrogen is used in the same stacks to produce electricity. Storage capacity is easily expanded by adding additional storage tanks, a low cost approach for storage applications requiring many hours or days of storage capacity. The need for long duration energy storage behind the meter and on the utility grid will increase as the penetration of intermittent renewable sources on the grid expands. This solution can be sited adjacent to an electric substation, avoiding the need for transmission.

In summary, our solutions offer many advantages:

- Distributed generation: Generating power near the point of use improves power reliability and energy security and lessens the need for costly and difficult-to-site generation and transmission infrastructure, enhancing the resiliency of the grid.
- Ultra-clean: Our SureSource solutions produce electricity electrochemically – without combustion – directly from readily available fuels such as natural gas and renewable biogas in a highly efficient process. The virtual absence of pollutants facilitates siting the power plants in regions with clean air permitting regulations and is an important public health benefit.
- High efficiency: Fuel cells are the most efficient power generation option in their size class, providing the most power from a given unit of fuel, reducing fuel costs. This high electrical efficiency also reduces carbon emissions compared to less efficient combustion-based power generation.
- Combined heat and power: Our power plants provide both electricity and usable high quality heat/steam from the same unit of fuel. The heat can be used for facility heating and cooling or further enhancing the electrical efficiency of the power plant in a combined cycle configuration. When used in CHP configurations, system efficiencies can potentially reach up to 90%, depending on the application.
- Reliability / continuous operation: Our SureSource power plants improve power reliability and energy security by lessening reliance on transmission and distribution infrastructure of the electric grid. Unlike solar and wind power, fuel cells are able to operate continuously regardless of weather or time of day.
- Fuel flexibility: Our SureSource power plants can operate on a variety of existing and readily available fuels, including natural gas, renewable biogas, directed biogas and propane.
- Scalability: Our solutions are scalable, providing a cost-effective solution to adding power incrementally as demand grows, such as multi-megawatt fuel cell parks supporting the electric grid.
- Quiet operation: Because they produce power without combustion and contain very few moving parts, our SureSource solutions operate quietly and without vibrations.
- Easy to site: Our SureSource power plants are relatively easy to site by virtue of their ultra-clean emissions profile, modest space requirements and quiet operation. These characteristics facilitate the installation of the power plants in urban locations with scarce and expensive land. A 10 MW fuel cell park only requires about one acre of land whereas an equivalent size solar array requires up to seven to ten times as much land, illustrating how fuel cell parks are easy to site in high density areas with constrained land resources, and adjacent to the demand source thereby avoiding costly transmission construction.

SureSource Emissions Profile

Fuel cells are devices that directly convert chemical energy (fuel) into electricity, heat and water. Because fuel cells generate power electrochemically rather than by combusting (burning) fuels, they are more efficient in extracting energy from fuels, and produce less CO_2 and only trace levels of pollutants compared to combustion-type power generation. The following table illustrates the favorable emission profile of our SureSource power plants:

	Emissions (Lbs. Per MWh)				
	NO_X	SO_2	PM	CO_2	CO_2 with CHP
Average U.S. Fossil Fuel Plant	5.06	11.6	0.27	2,031	NA
Microturbine (60 kW)	0.44	0.008	0.09	1,596	520 - 680
Small Natural Gas Turbine	1.15	0.008	0.08	1,494	520 - 680
SureSource - natural gas	0.01	0.0001	0.00002	940	520 - 680
SureSource 4000 High Efficiency Plant	0.01	0.0001	0.00002	740	520 - 680
SureSource - utility scale carbon capture	0.01	0.0001	0.00002	80	n/a
SureSource - renewable biogas	0.01	0.0001	0.00002	< 0	< 0

For power plants operating on natural gas, higher electrical efficiency results in lower CO_2, and also results in less fuel needed per kWh of electricity generated and Btu of heat produced. The high efficiency of our products results in significantly less CO_2 per unit of power production compared to the average U.S. fossil fuel power plant, and the carbon emissions are reduced even further when configured for combined heat and power. When operating on renewable biogas, government agencies and regulatory bodies generally classify our power plants as carbon neutral due to the renewable nature of the fuel source.

High electrical efficiency reduces customers' exposure to volatile fuel costs, minimizes operating costs, and provides maximum electrical output from a finite fuel source. Our power plants achieve electrical efficiencies of 47% to 60% or higher depending on configuration, location, and application, and even higher total efficiency in a CHP configuration, depending on the application. This represents delivered efficiency as our distributed solutions generate power near the point of use, avoiding the line losses inherent in transmission. The electric grid in the United States is only approximately 35% electrically efficient and typically does not support CHP configurations.

Manufacturing

We design and manufacture the core SureSource fuel cell components that are stacked on top of each other to build a fuel cell stack. For MW-size power plants, four fuel cell stacks are combined to build a fuel cell module. To complete the power plant, the fuel cell module or modules are combined with the BOP. The mechanical BOP processes the incoming fuel such as natural gas or renewable biogas and includes various fuel handling and processing equipment such as pipes and blowers. The electrical BOP processes the power generated for use by the customer and includes electrical interface equipment such as an inverter. The BOP components are either purchased directly from suppliers or the manufacturing is outsourced based on our designs and specifications. This strategy allows us to leverage our manufacturing capacity, focusing on the critical aspects of the power plant where we have specialized knowledge, expertise and possess extensive intellectual property. BOP components are shipped directly to a customer's site and are then assembled with the fuel cell module into a complete power plant.

North America: We operate a 167,000 square-foot manufacturing facility in Torrington, Connecticut where we produce the individual cell packages and assemble the fuel cell modules. The completed modules are then conditioned at our facility in Danbury, Connecticut for the final step in the manufacturing process and shipped to customer sites. Annual capacity (module manufacturing, final assembly, testing and conditioning) is 100 MW per year, with full utilization under its current configuration. The building is sized to accommodate annual production capacity of 200 MW per year.

The expansion of the facility was recently completed, representing the first phase of a two phase capacity expansion. This expansion has enabled the consolidation of warehousing and service facilities, which will lead to reduced leasing expenses. The additional space is also expected to lead to additional manufacturing efficiencies by providing the needed space to re-configure the manufacturing lines without interrupting production. As demand

supports, the second phase will be undertaken to add manufacturing equipment to increase annual capacity to 200 MW. The State of Connecticut is extending two low interest long term loans to us (one for each of the two phases) and up to $10.0 million of tax credits. Each loan is $10.0 million, with an interest rate of 2.0% and a term of 15 years. Up to 50% of the principal is forgivable if certain job creation and retention targets are met. We previously received the proceeds of the first $10 million loan to support the first phase of the expansion and have received an extension from the State of Connecticut to meet the required job targets.

The Torrington production facility, the Danbury corporate headquarters and research and development facility, and our Field Service Operations (which maintains the installed fleet for our plants) are ISO 9001:2015 certified, reinforcing the tenets of the FuelCell Energy Quality Management System and our core values of continual improvement and commitment to quality.

South Korea: To meet Asian demand, POSCO Energy built a cell manufacturing facility in Pohang, Korea which became operational in late 2015. Annual production capability is 100 MW and the building is sized to accommodate up to 200 MW of annual production to support future growth in the Asian market. We collaborate with POSCO Energy to manage the supply chain and production volumes between the U.S. and South Korean facilities.

Europe: We have a manufacturing facility in Taufkirchen, Germany that has the capability to perform final module assembly for up to 20 MW per year of sub-megawatt fuel cell power plants for the European market. Our operations in Europe are certified under both ISO 9001:2015 and ISO 14001:2015.

Raw Materials and Supplier Relationships

We use various commercially available raw materials and components to construct a fuel cell module, including nickel and stainless steel, which are key inputs to our manufacturing process. Our fuel cell stack raw materials are sourced from multiple vendors and are not considered precious metals. We have a global integrated supply chain that serves North American, European, and the POSCO Energy-owned Asian production facilities. In addition to manufacturing the fuel cell module in our Torrington facility, the electrical and mechanical BOPs are assembled by and procured from several suppliers. All of our suppliers must undergo a qualification process. We continually evaluate and qualify new suppliers as we diversify our supplier base in our pursuit of lower costs and consistent quality. We purchase mechanical and electrical BOP componentry from third party vendors, based on our own proprietary designs.

Engineering, Procurement and Construction

We provide customers with complete turn-key solutions, including the development, engineering, procurement, construction, interconnection and operations for our fuel cell projects. From an EPC standpoint, we have an extensive history of safe and timely delivery of turn-key projects. We have developed relationships with many design firms and licensed general contractors and have a repeatable, safe, and efficient execution philosophy that has been successfully demonstrated in numerous jurisdictions, both domestically and abroad, all with an exemplary safety record. The ability to rapidly and safely execute installations minimizes high cost construction period financing and can assist customers in certain situations when the commercial operating date is time sensitive.

Services and Warranty Agreements

We offer a comprehensive portfolio of services, including engineering, project management and installation, and long-term operating and maintenance programs, including trained technicians that remotely monitor and operate the plants around the world, 24 hours a day and 365 days a year. We employ field technicians to service the power plants and maintain service centers near our customers to ensure high availability of our plants. All of our customers

purchase service agreements, some of which have terms of up to 20 years. Pricing for service contracts is based upon the markets in which we compete and includes all future maintenance and fuel cell module exchanges. While the electrical and mechanical BOP in our power plants is designed to last about 25 years, the current fuel cell modules must be replaced approximately every five years.

Under the typical provisions of our service agreements, we provide services to monitor, operate and maintain customer power plants to meet specified performance levels. Operations and maintenance is a key driver for power plants to deliver their projected revenue and cash flows. Many of our service agreements include guarantees for system performance, including electrical output and heat rate. Should the power plant not meet the minimum performance levels, we may be required to replace the fuel cell module with a new or used replacement and/or pay performance penalties. The service aspects of our business model provide a recurring and predictable revenue stream for the Company. We have committed future production for scheduled fuel cell module exchanges under service agreements through the year 2038. The pricing structure of the service agreements incorporates these scheduled fuel cell module exchanges and the committed nature of this production facilitates our production planning. Our goal is to optimize our customers' power plants to meet expected operating parameters throughout their contracted project term.

In addition to our service agreements, we provide a warranty for our products for a specific period of time against manufacturing or performance defects. The warranty term in the U.S. is typically 15 months after shipment or 12 months after acceptance of our products. We accrue for estimated future warranty costs based on historical experience.

Retained projects in the generation portfolio do not have service agreements with the off-takers but we maintain the power plants through long-term service agreements with our project level subsidiaries. Under the PPAs for these retained projects, we are obligated to deliver a certain contractual level of power. We operate and maintain the plants in our generation portfolio in a manner intended to maximize power output, just as we do for our customers who own their plants.

License Agreements and Royalty Income

We are entitled to receive license fees and royalty income from POSCO Energy related to manufacturing and technology transfer agreements entered into in 2007, 2009 and 2012. The Cell Technology Transfer Agreement ("CTTA"), executed in October 2012, provides POSCO Energy with the technology rights to manufacture SureSource power plants in South Korea and the right to sell power plants throughout Asia. In October 2016, the Company and POSCO Energy extended the terms of the 2007 and 2009 license agreements to be consistent with the term of the CTTA, which expires on October 31, 2027. The term of these agreements may be extended beyond 2027 through future extensions by mutual agreement of the Company and POSCO Energy. In conjunction with the CTTA, the Company is entitled to receive a 3.0% royalty on POSCO Energy net product sales as well as a royalty on each scheduled fuel cell module replacement under service agreements for modules that were built by POSCO Energy and installed at any plant in Asia under the terms of the Master Service Agreement between the Company and POSCO Energy. The Company has contracted directly with POSCO Energy for equipment and services for its first direct order in the Korean market.

Advanced Technologies Programs (Third Party Funded Research and Development)

We undertake both privately-funded and public research and development to expand the markets for our power plants, reduce costs, and expand our technology portfolio in complementary high-temperature fuel cell systems. This research builds on our expertise and the versatility of our fuel cell power plants and contributes to the development of potentially new end markets for our commercial product solution portfolio. Our power plants can be configured to provide a number of value streams including clean electricity, high quality usable heat, hydrogen suitable for vehicle fueling or industrial purposes as well as configuration to concentrate CO_2 from coal and natural gas fired power plants. Our Advanced Technologies Programs are focused on commercializing solutions within three strategic areas: (1) carbon capture for emissions reduction and power generation; (2) distributed hydrogen production, compression, and recovery; and (3) SOFC/SOEC for stationary power generation and energy storage. The revenue and associated costs from government and third party sponsored research and development is classified as "Advanced

Technologies contract revenues" and "Cost of Advanced Technologies contract revenues", respectively, in our consolidated financial statements.

We have historically worked on technology development with various U.S. government departments and agencies, including the Department of Energy (DOE), the Department of Defense (DOD), the Environmental Protection Agency (EPA), the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR),

and the National Aeronautics and Space Administration (NASA). Government funding, principally from the DOE, provided 9%, 8% and 6% of our revenue for the fiscal years ended 2017, 2016, and 2015, respectively.

Significant commercialization programs on which we are currently working include:

Carbon Capture - Coal and natural gas are abundant, low cost resources that are widely used to generate electricity in developed and developing countries, but burning these fuels results in the emission of criteria pollutants and CO_2. Cost effective and efficient carbon capture from coal-fired and gas-fired power plants potentially represents a large global market because it could enable clean use of these fuels. Our carbonate fuel cell technology separates and concentrates CO_2 as a side reaction during the power generation process. Capturing CO_2 as a side reaction while generating additional valuable power is an approach that could be more cost effective than other systems which are being considered for carbon capture.

We announced an agreement with ExxonMobil (NYSE: XOM) in 2016 to pursue fuel cell carbon capture for central generation gas-fired power plants. We are working on the installation of a megawatt-class fuel cell power plant at a mixed coal/gas-fired power station owned by Alabama Power, a subsidiary of Southern Company. This project is being supported by an award from the U.S. Department of Energy to design and build the first MW-scale carbon capture system for coal fired power, and by ExxonMobil through a joint development agreement for evaluating carbon capture from gas-fired power generation. Successful demonstration may then lead to additional fuel cell power plant installations at this site and/or other central generation coal or gas-fired sites globally. In addition, in 2017, we conducted two engineering studies: one with Alberta Innovates, a consortium of Canadian oil sands producers, and one with Cenovus Energy, as lead partner of a joint industry project, to evaluate the feasibility of fuel cell carbon capture for gas-fired boilers used in oil sands processing. These oil and gas and power producers are interested in the fuel cell carbon capture value proposition, and these studies are evaluating the application of our carbon capture system at specific sites, which could be future MW-scale carbon capture project opportunities.

Distributed Hydrogen production, compression, and recovery - On-site or distributed hydrogen generation, produced cleanly, represents an attractive market. Our high temperature fuel cells generate electricity directly from a fuel by reforming the fuel inside the fuel cell to supply hydrogen for the electrical generation process. Gas separation technology can be added to capture hydrogen that is not used by the electrical generation process, and we term this configuration SureSource Hydrogen. This value-added proposition may be compelling for industrial users of hydrogen and transportation applications, further summarized as follows:

Fueling Applications: We recently announced a renewable hydrogen generation project under a hydrogen power purchase agreement with Toyota. The multi-megawatt SureSource Hydrogen plant will be located at the Port of Long Beach, California and will use renewable directed biogas for fuel. Toyota will purchase the hydrogen output of approximately 1,200 kg per day to fuel its fuel cell cars that arrive at the Port from overseas as well as fuel a Class 8 fuel cell truck located at the Port. Toyota will also purchase a portion of the renewable electricity generated with the remainder of the electricity to be sold to the local utility under the California BioMAT program.

We previously demonstrated renewable hydrogen generation under a three year project at the Orange County Wastewater Treatment Facility in Irvine, California, utilizing renewable biogas to supply hydrogen for use in fuel cell vehicle fueling and produce clean renewable electricity. The demonstration was performed under a sub-contract to Air Products (NYSE: APD), with funding provided by the DOE, California Air Resources Board, South Coast Air Quality Management District, Orange County Sanitation District, and Southern California Gas Company.

SOFC/SOEC development and commercialization: We are working towards commercialization of solid oxide fuel cell technology to target long-duration storage applications utilizing hydrogen as an energy carrier and storage medium. SOFC power plant design and manufacturing is complementary to our carbonate technology-based MW

scale product line and affords us the opportunity to leverage our field operating history, existing expertise in power plant design, fuel processing and high volume manufacturing capabilities, and our existing installation and service infrastructure. Additionally, the target market for storage application is electric utilities, which is a market in which we are already active.

We perform SOFC/SOEC research and development at our Danbury facility as well as at our dedicated SOFC/SOEC facility in Calgary, Canada. We are working under a variety of awards from the DOE for development and commercialization of both SOFC and SOEC. We are currently installing a demonstration SOFC power plant at the NRG Energy Center in Pittsburgh, Pennsylvania.

We believe there are significant market opportunities for distributed hydrogen production, carbon capture, solid oxide fuel cell solutions and energy storage. The demonstration projects described above are steps on the commercialization road map as we leverage third-party resources and funding to accelerate the commercialization and realize the market potential for each of these solutions.

Company Funded Research and Development

In addition to research and development performed under research contracts, we also fund our own research and development projects including extending module life, increasing the power output of our modules and reducing the cost of our products. Current initiatives include increasing the net power output of the fuel cell stacks to 375 kW from 350 kW, and extending the stack life to seven years from five-year life modules produced in fiscal 2017. The Company's seven-year module design will enter production in fiscal 2018. Greater power output and improved longevity are expected to lead to improved gross margin profitability on a per-unit basis for each power plant sold and improved profitability of service contracts, which will support expanding gross margins for the Company.

In addition to output and life enhancements, we designed and are now introducing the 3.7 megawatt SureSource 4000 configuration with increased electrical efficiency, and we invest in cost reduction and improving the performance, quality and serviceability of our plants. These efforts continually improve our value proposition.

Company-funded research and development is included in Research and development expenses (operating expenses) in our consolidated financial statements. The total research and development expenditures in the consolidated statement of operations, including third party and Company-funded expenditures, are as follows:

	Years Ended October 31,		
	2017	2016	2015
Cost of Advanced Technologies contract revenues	$12,728	$11,879	$13,470
Research and development expenses	20,398	20,846	17,442
Total research and development	$33,126	$32,725	$30,912

Backlog

The Company had a contract backlog totaling approximately $554.2 million as of October 31, 2017 compared to $432.3 million as of October 31, 2016. At October 31, 2017 and 2016, backlog included approximately $182.3 million and $204.8 million, respectively, of service agreements. Service backlog as of October 31, 2017 had an average term of approximately 17 years weighted based on dollar backlog and utility service contracts up to twenty years in duration. Generation backlog as of October 31, 2017 and 2016 was $296.3 million and $142.5 million, respectively. As of October 31, 2017, product sales backlog totaled approximately $31.3 million compared to $24.9 million as of October 31, 2016. As of October 31, 2017, Advanced Technologies contracts backlog totaled $44.3 million, of which $24.5 million was funded compared to $60.1 million as of October 31, 2016, of which $39.6 million

was funded.

Our backlog amount outstanding is not indicative of amounts to be earned in the upcoming fiscal year. The specific elements of backlog may vary in terms of timing and revenue recognition from less than one year to up to twenty years. In addition, the Company may retain operating power plants on the balance sheet rather than selling them, thus creating variability in timing of revenue recognition. Accordingly, the timing and the nature of our business makes it difficult to predict what portion of our backlog will be filled in the next fiscal year.

Backlog represents firm definitive agreements executed by the Company and our customers. As of October 31, 2017, we also had project awards totaling between $600.0 million and $1.0 billion, with the range based on whether the projects are sold or retained as part of our Generation portfolio. Project awards referenced by the Company are

notifications that the Company has been selected, typically through a competitive bidding process, to enter into definitive agreements. These awards have been publicly disclosed. Negotiations are in process and if successfully completed, project awards will become backlog.

Fuel Cell Technologies

Fuel cell technologies are classified according to the electrolyte used by each fuel cell type. Our SureSource technology utilizes a carbonate electrolyte. Carbonate-based fuel cells are well-suited for megawatt-class applications, offering a number of advantages over other types of fuel cells in the markets we are pursuing. These advantages include carbonate fuel cells' ability to generate electricity directly from readily available fuels such as natural gas or renewable biogas, lower raw material costs as the high temperature of the fuel cell enables the use of commodity metals rather than precious metals, and high-quality heat suitable for CHP applications. We are also actively developing SOFC technology, as discussed in the prior “Advanced Technologies Programs” section. Other fuel cell types that may be used for commercial applications include phosphoric acid and PEM.

The following table illustrates the four principal types of fuel cells, highlighting typical market applications, industry estimates of the electrical efficiency, expected capacity range, and versatility for applications in addition to power generation:

	MW- Class	Sub-MW-Class	Micro CHP	Mobi