

U.S. Manufacturers among Leading Suppliers in Growing Stationary Fuel Cell Market

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Global demand for stationary fuel cells (a low emission, power generation technology)¹ is increasing, with shipments almost doubling during 2012–18. The United States was the largest manufacturer of stationary fuel cells in 2018, and a significant exporter. U.S. manufacturers are likely to benefit from continued global market growth, though there is significant foreign competition and many firms are not yet profitable

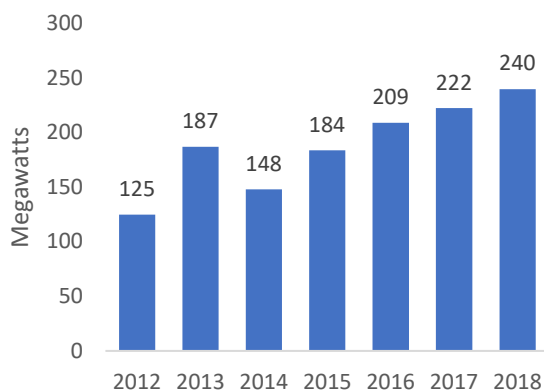
Stationary fuel cells

Fuel cells convert the chemical energy in hydrogen or a hydrogen-rich fuel (such as natural gas) to electricity via an electrolytic process. Stationary fuel cells are immobile units that generate electricity for use at a particular site. They include: (1) units that produce primary power, such as for continuous use in a building; (2) backup units that supply electricity during a power outage; and (3) units for providing electricity at remote sites (e.g., telecom towers). Primary power applications include combined heat and power (CHP) in which the waste heat from electricity generation provides space or water heating.

Growing global demand

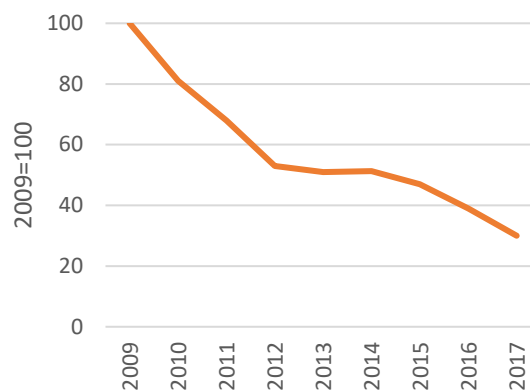
Global stationary fuel cell shipments increased from 125 megawatts (MW) in 2012 to 240 MW in 2018, an increase of 92 percent (figure 1). This demand growth was driven by supportive government policies, an increasing corporate focus on electric reliability and resiliency, and declining costs (due to factors such as growing economies of scale and technology improvements) (figure 2). Korea was the largest market in 2018 (measured by MW), followed by the United States and Japan.² The estimated value of the global stationary fuel cell market was \$1.8 billion in 2018, and is projected to increase to \$2.2 billion in 2019.³

Figure 1: Global stationary fuel cell shipments



Source: E4tech, [The Fuel Cell Industry Review 2018](#), December 2018, 45; E4tech, [The Fuel Cell Industry Review 2017](#), December 2017, 47.

Figure 2: Stationary fuel cell installed cost per MW



Source: National Fuel Cell Research Center (NFCRC), [Stationary Fuel Cell Cost Trends](#), May 2018, 3.

¹ Fuel cells emit low levels of pollutants such as sulfur oxides (SOx) and nitrogen oxides (NOx). Fuel cell greenhouse gas emissions vary depending on the source of hydrogen and their efficiency. U.S. Environmental Protection Agency, [Catalog of CHP Technologies](#), March 2015, 6–19; Fuel Cell Today [Website](#).

² The three largest markets all have policies to encourage fuel cell installations. E4tech, [The Fuel Cell Industry Review 2018](#), December 2018, 4, 13, 32–34, 45; NFCRC, [Stationary Fuel Cell Cost Trends](#), May 2018, 3; Keneflick, Michael, [U.S. Fuel Cell Vendors Weather 2017 for Brighter 2018](#), BloombergNEF, May 10, 2018, 2; BloombergNEF, [2019 Sustainable Energy in America Factbook](#), 2019, 92.

³ Fact.MR, [“Stationary Fuel Cell Systems Market will Surpass US\\$ 2 Billion by 2019,”](#) December 17, 2018.

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U.S. industry continues to develop

The U.S. stationary fuel cell industry generated around \$1 billion in goods and services revenue in 2018, including more than \$600 million from fuel cell product sales.⁴ The U.S. stationary fuel cell manufacturing industry comprises a diverse group of companies, including subsidiaries of large multinationals, publicly traded firms, and small start-up companies (table 1). Some companies focus entirely on stationary fuel cells, while other companies produce fuel cells for both stationary and mobile applications. Companies also produce different sizes and types of fuel cells.⁵ Firms continue to lower fuel cell prices, increase sales, and adapt their business models, but publicly available data indicates that firms have struggled to achieve profitability (due to factors such as limited production volumes).⁶ A number of firms have filed for bankruptcy or exited the industry.⁷

Table 1: Select U.S. stationary fuel cell manufacturers with commercial production, May 2019

Company	Revenue (billion \$)			Employees	Applications	Type	Manufacturing locations
	2016	2017	2018				
Adaptive Energy	a	a	a	20	Mobile and stationary	SOFC ^b	Ann Arbor, MI
Alteryx	a	a	a	<200	Stationary	PEMFC ^c	Folsom, CA
Atrex Energy	a	a	a	<50	Stationary	SOFC	Walpole, MA
Bloom Energy	208.5	376.0	742.0	1,524	Stationary	SOFC	Mountain View and Sunnyvale, CA; Newark, DE
Doosan Fuel Cell America	169.9	213.5	183.1	300	Stationary	PAFC ^d	South Windsor, CT ^e
FuelCell Energy	108.3	95.7	89.4	345	Stationary	MCFC ^f	Torrington, CT ^g
Plug Power	82.8	100.2	174.6	685	Mobile and stationary	PEMFC	Clifton Park, Latham, and Rochester, NY; Spokane, WA
Watt Fuel Cell	a	a	a	24	Mobile and stationary	SOFC	Mount Pleasant, PA

Source: Compiled from company financial reports, websites, documents, and media reports.

^a Not available; ^b SOFC: Solid oxide fuel cell; ^c PEMFC: Proton exchange membrane fuel cell; ^d PAFC: phosphoric acid fuel cell; ^e Doosan opened a Korean plant in 2017; data are U.S. employment and global revenue; ^f MCFC: molten carbonate fuel cell; ^g The firm also has German manufacturing, and previously licensed technology to POSCO Energy for Korean production.

U.S. manufacturers capture a significant share of the global market

The United States was the largest global manufacturer of fuel cells (by MW) in 2018, and a leading global exporter.⁸ The U.S. fuel cell industry generated between \$160 and \$250 million in fuel cell goods and services exports in 2018, with exports representing less than 25 percent of revenue. Korea was the largest U.S. export destination, accounting for a majority of 2018 exports.⁹ The U.S. industry will likely continue to benefit from U.S. and global market growth. There is, however, significant competition in foreign markets, with companies in Canada, Europe, Japan, Korea, Taiwan and other locations producing a range of stationary fuel cell types, and new companies planning to enter the market.¹⁰ Further, the industry landscape will continue to change as the market expands and the technology evolves and matures.

⁴ Staff estimates based on company information and trade data. This does not include revenue from production for mobile applications or production at Doosan's plant in Korea. In addition to product sales, companies generate revenue from installations, operations and maintenance, electricity sales, and other sources.

⁵ Fuel cells contain positive and negative electrodes, with an electrolyte in the middle. The form of electrolyte differentiates the types of fuel cells. Fuel Cell Today [Website](#); Department of Energy [Website](#).

⁶ Wesoff, Eric, "[Fuel Cell Industry Financials in 2018](#)," *Greentech Media*, December 26, 2018.

⁷ For example, Shulman Rogers [Website](#); Cleveland.com, "[LG Fuel Cell Systems Quitting Ohio](#)," December 12, 2018.

⁸ Staff estimates and E4tech, [The Fuel Cell Industry Review 2018](#), December 2018, 45.

⁹ Staff estimates based on company information and trade data. The range of estimated 2018 exports primarily reflects differences between U.S. export and Korean import data.

¹⁰ Based on company information and E4tech, [The Fuel Cell Industry Review 2018](#), December 2018, 32–37.