Stationary Fuel Cell Cost Trends

An assessment produced by the National Fuel Cell Research Center

Introduction. A fuel cell converts the chemical energy in a fuel directly into electricity, via electrochemical (non-combustion) reactions that are similar to those occurring in batteries. The key difference between fuel cells and batteries is that fuel cells operate on an external fuel source rather than stored chemical reactants. Thus, fuel cells do not run down or require charging, and will continuously provide electricity as long as fuel is provided in the same manner as combustion heat engines. In contrast to heat engines, fuel cells provide clean, efficient energy conversion, and supply many different industries and applications with a wide range of energy, environmental, and economic benefits.

Fuel cells scale with high efficiency, providing power from kilowatts for individual buildings to multi-megawatts for supporting the grid, all with virtually zero emission of criteria pollutants and virtually zero water consumption [1]. The flexibility, modularity, and scalability of fuel cell systems yield many options for potential customers to meet primary, backup, emergency, and auxiliary load demands. For primary load demands, fuel cells provide continuous clean, reliable, and load-following power and, in the case of a utility grid outage, seamless transition to serve critical loads. Fuel cells also support combined cooling, heat, and power (CCHP) operations [1, 2]. Additionally, tri-generation fuel cell systems can produce electricity, heat, and hydrogen to provide not only high quality electricity and heat, but hydrogen as well for fueling fuel cell electric vehicles (e.g., light-, medium-, and heavy-duty vehicles, and cargo and materials handling equipment). Fuel cells are fuel flexible and can be effectively operated on a diverse range of gaseous fuels including natural gas, and renewable fuels such as biogas and renewable hydrogen [3].

A key driver associated with increased commercialization of stationary fuel cells is cost. Costs for stationary fuel cell systems vary by type and application and include capital cost (equipment and installation), operating and maintenance (O & M) costs, and cost for fuel. Installed costs range depending on factors such as the scope of plant equipment, geographical deployment area, competitive market condition, existence of specialized site requirements, and current rates of labor [1]. Traditionally, incentive programs and other funding opportunities have been made available at state and federal levels due to the environmental benefits associated with their use, making fuel cell costs competitive with other technologies and support their deployment. For example, In California, the Self-Generation Incentive Program (SGIP) has led to the deployment of over 300 MW of stationary fuel cell systems operating on renewable biogas and natural gas [4]. With recent growth in the market, the cost of fuel cells is decreasing and a variety of financing mechanisms are now available to achieve competitive price options in the absence of incentives. The following document presents an assessment of historical fuel cell cost trends to demonstrate the improvement of stationary fuel cell economics.

Approach. Three leading stationary fuel cell manufacturers were surveyed to obtain data for their respective systems on total installed cost (excluding incentives), annual O&M cost, and total annual installed capacities for the period of 2009 to 2017. The real-world data provided were used to determine the historical cost trends (total installed and O&M) over the period, weighted by the annual installed capacities of each manufacturer. The results provide insight into the historical performance of stationary fuel cell costs and informs expected trends in coming years.

Results. Figure 1 presents the results for total installed cost per megawatt (MW) installed for stationary fuel cell systems. The results are reported relative to 2009 costs and weighted according to installed capacities for each manufacturer. Total installed costs significantly decrease from 2009 to present with an inverse relationship to installed capacity. In 2017, average installed costs are over 70% lower than those for 2009. The significant improvements in cost are a result of technical and manufacturing improvements, economies of scale, increasing annual production, and performance gains. The trend of decreasing installed costs is expected to continue going forward.

Figure 2 presents the results for annual O&M costs per megawatt (MW) installed for stationary fuel cell systems relative to 2009 O&M costs. Similar to installed costs, annual O&M costs have experienced significant reductions as installed capacities increase. In particular, costs in 2016 are approximately 57% lower than those for 2009. As with installed costs, the decline in O&M costs are expected to continue.

References

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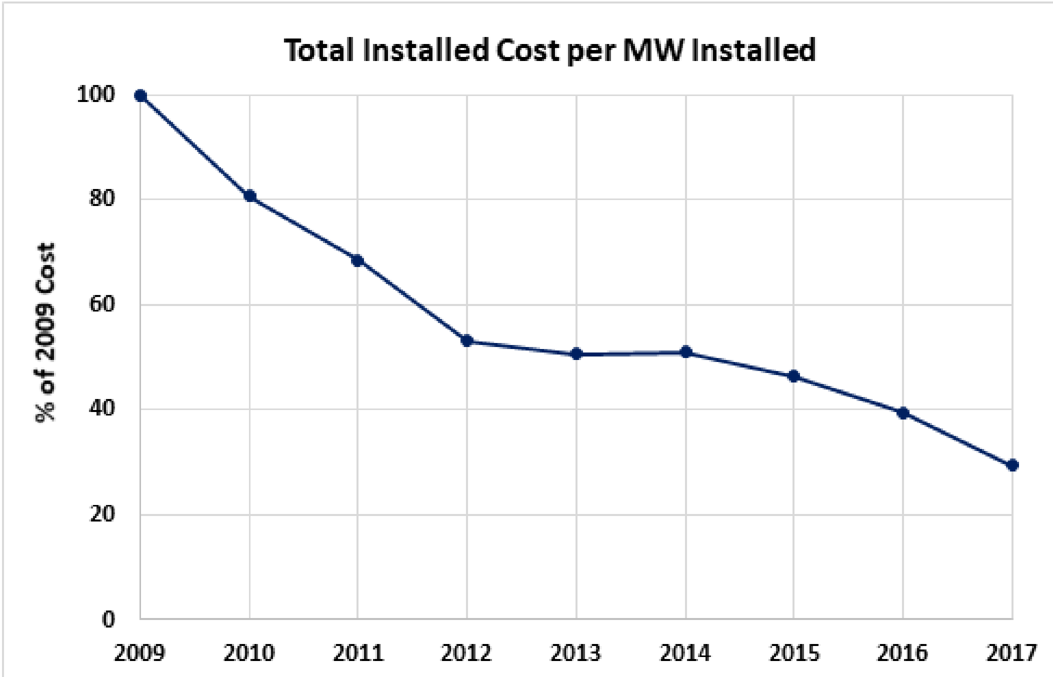

Figure 1. Total Installed stationary fuel cell costs as a function of 2009 costs from manufacturer data

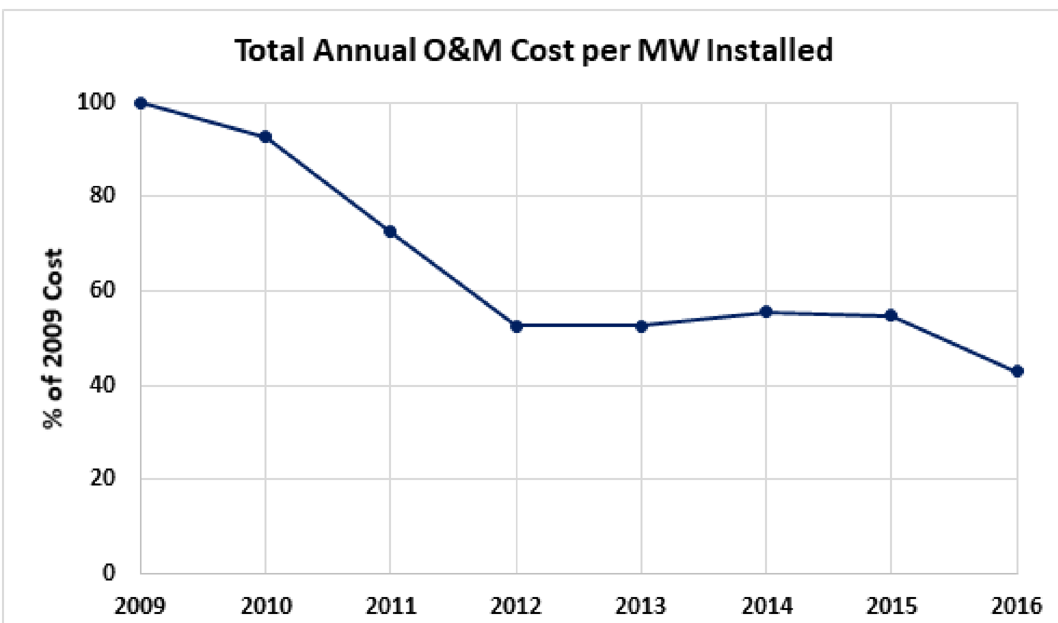

Figure 2. Annual O&M stationary fuel cell costs as a function of 2009 costs from manufacturer data