REVEALING THE "HIDDEN" BENEFITS OF DISTRIBUTED GENERATION

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OVERVIEW

As a result of established Renewable Portfolio Standard requirements, many states in the U.S. are faced with requests to commit ratepayer funding to the development of renewable generation. Traditional evaluation of resource costs and benefits has typically been limited to an identification of those avoided costs that can be readily quantified in monetary terms. Such an evaluation, however, overlooks the myriad of "distributed value elements" that each distributed generation technology offers. Examples include the benefits of blackout avoidance, and reduced emissions (with resultant health benefits), modularity and responsiveness to load growth, and reduced time for decision making and project installation. This paper describes the methodology used by the author to quantify a number of traditional and non-traditional distributed value elements in separate analyses undertaken in California for fuel cell and solar photovoltaic manufacturers.

METHODS

Fuel cells can be categorized into three general market sectors, with each sector having a different value proposition. Stationary fuel cells tend to be distributed energy resources that capture waste heat from electricity generation for combined cooling, heating, and power applications. Portable fuel cells tend to be fuel cells that are, for instance, built into laptop computers and cell phones. Fuel cells in the transportation sector are those that are built into cars and trucks for improved fuel efficiency.

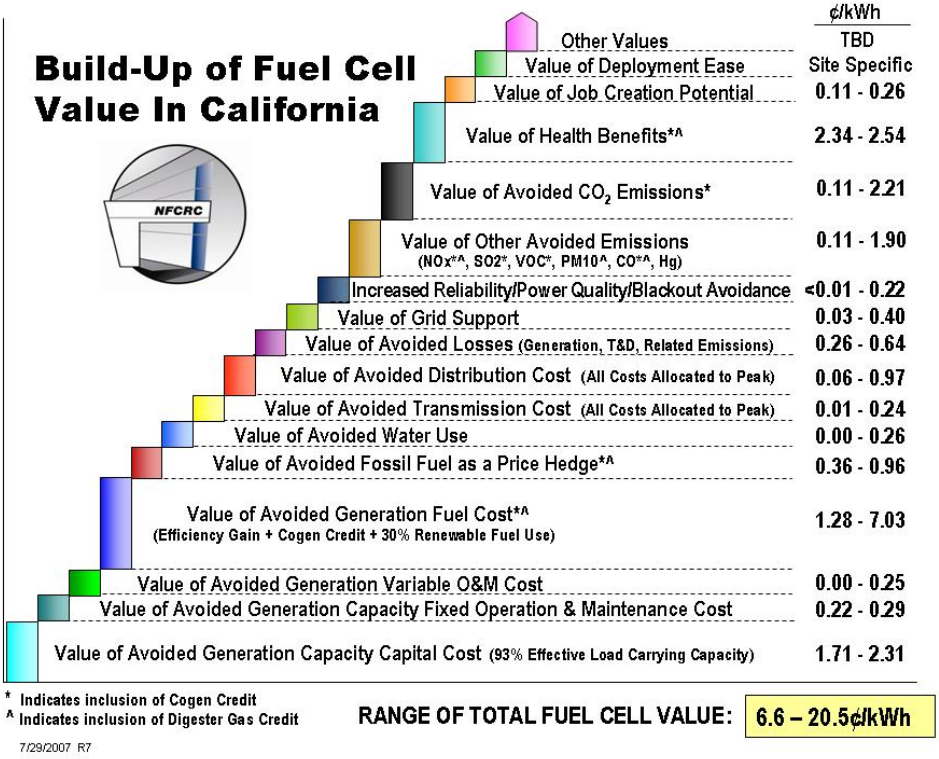
The fuel cells considered in this paper are stationary fuel cells that operate as a baseload distributed generation technology, with an annual capacity factor in excess of 90 percent. Most fuel cells operate on natural gas, though many operate on renewable digester gas from landfills and wastewater treatment plants. As is the case for all fuel cells, the fuel cells considered here generate electricity through an electrochemical process rather than through combustion. This technological difference results in greater efficiency of natural gas use and lower emissions than the avoided baseload central station generating technology.

As a baseload technology, valuing the avoided costs associated with the deployment of stationary fuel cells must be based on a comparison with the avoided baseload central station electricity generation technology serving California customers. These avoided baseload technologies include in-state natural gas-fired generation and out-of-state coal-fired generation.

In contrast to fuel cells, solar photovoltaics ("PV") represent a peaking technology that requires no fuel input other than sunlight. The avoided technology for solar PV in California is, therefore, baseload and peaking natural-gas fired capacity. The solar PV capacity underlying the results presented in this paper includes residential and commercial installations without battery back-up. As a result, the estimated 20 percent annual capacity factor for solar PV is relatively low when compared to baseload fuel cell operations.

RESULTS

Avoided costs related to the relevant avoided generating capacity for fuel cells and solar PV in California are used to quantify the range of values for a number of distributed value elements. The cumulative range of value for fuel cells is calculated to be 6.6-20.5 cents/kWh for fuel cells currently installed in California, as illustrated below in the "Build-Up of Distributed Fuel Cell Value in California." This value expected to increase significantly over time as the penetration of fuel cells throughout the state increases.



Results for solar PV calculated in 2005 indicated a range of total value of 7.8-22.4 cents/kWh, but this range of value included fewer distributed value elements than are included in the range of value for fuel cells. Updating natural gas costs to reflect the enormous run-up in natural gas prices over the past two years and including the quantification of additional avoided emissions and related health benefits increases the current range of total value for solar PV in California to approximately 8.7-31.0 cents/kWh.

The paper discusses in greater detail the derivation of: (i) The Value of Increased Reliability and Blackout Avoidance; and, (ii) the Value of Avoided Emissions (and related Health Benefits).

CONCLUSIONS

Both fuel cells and solar PV provide significant "hidden" value to California's ratepayers in terms of avoided generation-related costs, avoided grid-related costs, and avoided emissions and related health benefits, among others. Because it requires no fossil fuel input, solar PV has greater *avoided* emissions per kWh generated. However, on an annual basis, fuel cells have greater avoided emissions per installed kW because of their significantly higher capacity factor. Combined, the two complementary technologies have the potential to make a significant contribution to achieving the reduced greenhouse gases emissions goals under the California Global Warming Solutions Act of 2006 ("AB32").