Pricing Retail Electricity in a Distributed Energy Resources World

The traditional electric utility is threatened by developments triggered by public policy support for renewable energy and its improving cost-competitiveness. We describe the elements of retail pricing that can be applied to electricity consumers regardless of DER ownership, based on the principle that costs incurred by a utility depend solely upon the power flows that a consumer imposes on the utility's system.

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I. Drivers of Change

Change in the traditional regulated utility business model is being driven by the falling costs of DER and of the information technologies that promise to allow DER to be inexpensively integrated with the power system's other resources. This technological progress has been abetted by public policies in support of DER. Consequently, there has been growing worldwide use of on-site distributed generation, particularly solar photovoltaic (PV) systems. The prospect of further cost reductions promises continuation or acceleration of these trends in DER development.

A. Distributed energy resources

Investment in DER has historically been driven primarily by tax incentives and other public

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policies in support of renewable energy. Increasingly, however, such investment is being driven by the falling costs of DER relative to both conventional resources and retail electricity prices. In addition, DER investment is increasingly driven by some customers' needs for highly reliable electricity service and for exceptionally high power quality.

Solar power has enjoyed remarkable growth over the past decade, with capacity in the U.S. more than doubling every two years since 2006.[1] This rapid growth has been partly or largely driven by the dramatic downward trend in the cost of PV over the past decade (Figure 1).

Demand response has grown substantially over the past few decades. As shown in Figure 2, reported potential peak load reductions have more than doubled during the 2006 to 2012 period.

Microturbines are small fossil-fuel-fired electricity generators ranging in size from about 30 to 250 kW. They generally run on fossil fuels, but can also burn waste gases. Microturbines generally serve commercial customers, and can be incorporated into combined heat and power (CHP) systems for such customers.

Fuel cells generate electricity through chemical reactions that move electrons from a positive electrode to a negative electrode. Fuel cells generally run on hydrogen (or hydrogen-rich molecules) and oxygen gases, which provide environmentally benign energy. The efficiency and cost of this energy production depend upon the electrolytes and catalysts of the various fuel cell technologies. At the present time, these technologies are not yet cost-competitive with conventional generation.[4]

Electrical energy storage has historically been provided, on a fairly large scale, by hydroelectric facilities. Prospectively, it can also be provided, on a smaller scale, by batteries and innovative technologies such as flywheels. Storage can be useful for facilitating integration into power systems of intermittent resources such as wind and solar, and for balancing electric supply and demand in small areas such as those served by microgrids. The gross value of the services provided by an energy storage facility primarily depends upon the differences in the values of electricity at those off-peak times when the facility is charged (that is, when it ''buys'' power) and those on-peak times when the facility is discharged (that is, when

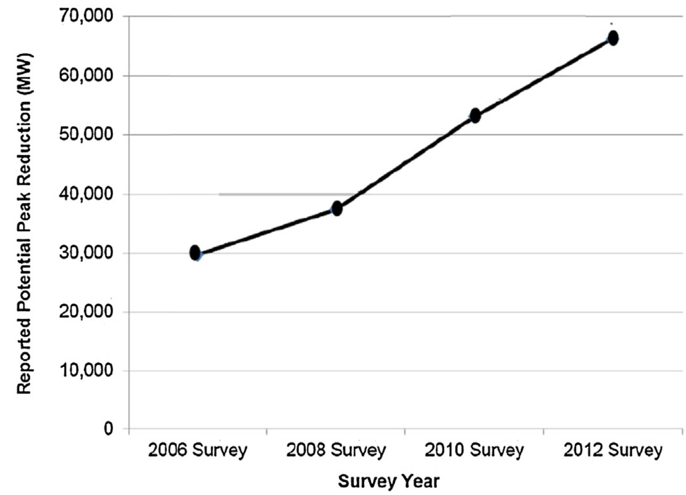

Figure 2: Total Reported Potential Peak Reduction Due to Demand Response, 2006 through 2012[3]

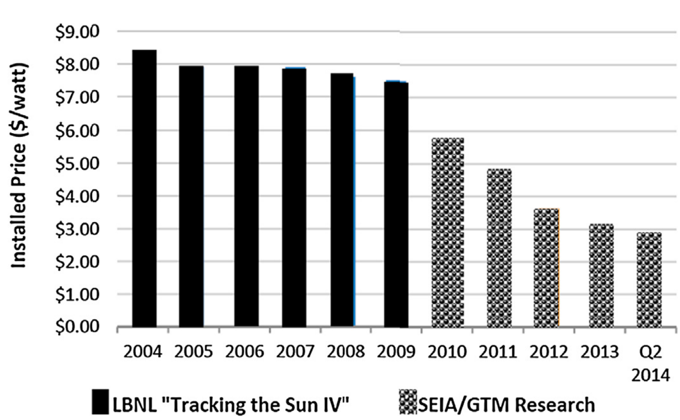

Figure 1: Average PV System Prices, 2004–2014 (nominal $)[2]

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