DEMAND RESPONSE

OVERVIEW OF A HIGH-IMPACT DRAWDOWN SOLUTION

Demand response programs serve to "adjust the timing and amount of electricity use" and can help utility companies reduce peak load, shift load, or reduce overall usage. This can include changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.

TECHNOLOGY AND MARKET READINESS

Demand response (DR) is in a technology demonstration phase. DR has been used extensively in industrial and commercial sectors since the 1970s, but today's DR is being transformed by technology and market innovations. Wholesale markets are incentivizing DR to participate in markets, smart grid technologies and dynamic pricing are enabling faster and better control of DR resources, and increasingly system aggregators are enabling smaller entities to participate. Many agree that DR can, on the one hand, reduce daily peak loads and contribute to system reliability, and on the other hand, reduce the cost of electricity supply. DR's impact on carbon emissions, by contrast, is less well understood (Smith and Brown, 2015).

LOCAL EXPERIENCE AND DATA AVAILABILITY

Georgia Power operates DR programs with industrial customers, and it has used direct load control of water heaters in the residential and commercial sectors. Georgia Power's Integrated Resource Plan proposes two new residential programs (demand response and low-income qualified energy efficiency) and one new "behavioral" commercial program. By 2022 its energy efficiency programs "are designed to help reduce peak demand approximately 1,600 MW, which is 10% of the company's current peak demand." DR is also an aspect of its microgrid smart community in Atlanta called "Altus at the Quarter" by load shifting demand for electricity from heat pump water heaters. This is a first-of-a-kind demonstration project for Georgia.

We assume that DR can shift one hour of electricity from an on-peak hour that is served by natural gas to 30 minutes that is served by solar (perhaps via home storage) and 30 minutes of curtailment through appliance cycling (i.e., reduction in consumption). That reflects the goals of some DR programs such as the Microgrid Pulte Homes community in Atlanta. We also assume that the peak load for each family is 4.39 kW (Georgia Power, 2019) [1].

TECHNICALLY ACHIEVABLE CO2 REDUCTION POTENTIAL

We used GT-NEMS to model DR as an increase from 3% to 20% maximum peak load shift in 2030. This produced a total reduction of 3.6 MtCO2 in the SERC SE region, which equates to 1.63 Mt CO2 in Georgia. This peak load shift produced a reduction of summer peak demand of 365 MW. This would result in an estimated reduction of 164 MW summer peak load in Georgia. Based on shifting 20% of the 4.4 KW peak load of an average household in Georgia, this reduction in summer peak is equivalent to 187,000 households in Georgia participating in a demand response program.

COST COMPETITIVENESS

Smith and Brown (2015) found that DR is likely to defer significant amounts of expensive, aging peak capacity such as single-cycle natural gas. Georgia Power conducts EE education initiatives as a pillar demand side management (DSM) and DR program and as a way of achieving flexibility and clean energy goals. One form of digitally connected 'smart' energy technology such as NEST thermostats and home energy management systems (HEMS), can enable consumers to visualize, monitor and manage electricity consumption within their household. Smith and Brown (2015) provide evidence that "suggests that demand response can serve as a long-term, low-cost alternative for peak-hour load balancing without increasing carbon emissions."

BEYOND CARBON ATTRIBUTES

Together with microgrids, grid flexibility solutions, and distributed energy resources, DR can improve resiliency and flexibility to mitigate climate change impacts on the grid (resulting from extreme weather temperatures, intense storms, etc.) [2,3].

From an environmental and public health standpoint, adoption of demand response solutions can lead to air quality improvements over existing alternatives. For example, simple cycle gas turbines or coal power plants that run during peak hours, tend to be inefficient and higher emitting. Offsetting these peaking plants with demand response can significantly reduce environmentally-harmful emissions. The degree of air quality benefit should, however, be assessed on a case-by-case basis because results vary significantly depending on the energy source utilized.

The social and economic benefits of demand response include affordability and potentially greater accessibility by low-income households (versus for example rooftop solar). Besides moderate upfront costs, some studies found that residential demand response technologies generate overall energy savings in addition to shifting demand to low rate off-peak hours [4].

DR solutions requiring high adoption rates of lithium-ion batteries may impose environmental risks regarding their end-of life disposability (EPA, 2013).

References:

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Endnotes:

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