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Demand response: what can we learn from California?

Initial findings from a meeting of experts supported by the Transatlantic Climate Bridge

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Abstract

The growing share of photovoltaics and wind power requires additional flexibility options to ensure the reliability of power supply and integrate excess energy. Demand response can be an inexpensive, environmentally friendly option. Various ways of further developing regulatory frameworks were discussed among stakeholders at two workshops in San Francisco and Sacramento. The primary goal should be to create a level playing field for flexibility options so that demand response can compete on equal terms with other flexibility options, such as power storage and flexible power plants. To this end, the regulatory frameworks should be tailored to the characteristics of flexible loads.

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1. The energy market in California

In transforming its energy supply, California faces **challenges** similar to those in Germany. California has adopted ambitious targets for renewables, energy efficiency and demand response. At the same time, surplus capacity on the power market puts pressure on contribution margins for existing generation capacity, and local bottlenecks on the transmission grid are a threat to supply security in some regions.

On the other hand, there are great differences in the regulatory frameworks, partly as a result of California's energy crisis in 2001. As a result, the state's energy market is not fully deregulated, and electric utilities are obligated to ensure the provision of 115 percent of their annual peak load in bilateral contracts. There are also a number of small, but important differences in market operations. For instance, power on a real-time market is sold as five-minute products, which greatly reduces the dispatch of ancillary services (spinning and non-spinning reserves).

California's Energy Roadmap specifies that demand response is a focal point. The resulting challenges and proposed solutions are therefore currently being intensely discussed.

2. The role of demand response in California

Demand response means that flexible loads are actively controlled to react to price signals (such as on the day-ahead market) or as required by grid operators (to maintain frequency, serve as an emergency reserve, etc.). California focuses on the market integration of loads that can be curtailed. In contrast, policies have not yet focused on loads that can be switched on or shifted, such as processes with thermal and physical storage.

California has defined special programs for curtailable loads that serve as **emergency reserves**. The basic design is similar to Germany's *ordinance governing industrial loads*. These programs are common in a number of other US energy markets, such as New England and PJM (Pennsylvania, New Jersey and Maryland). The capacity payment for curtailable loads is set at 60,000 euros/MW per year, three times as much as conventional power plants receive through the aforementioned bilateral contracts with the utilities and roughly twice as much as compensation in Germany's *ordinance governing industrial loads*. The volume of 1,000 MW (two percent of the maximum annual load) has already been contracted by the utilities. In theory, this approach should cover the extreme peak loads that rarely occur.

One desired side effect of this emergency reserve was an indirect subsidy for domestic industry, which was to be kept from leaving the state. The system benefits sometimes played a minor role, and the design of the emergency reserve meant that loads were practically never curtailed. Grid operators also cannot curtail specific loads because they do not know what loads can be curtailed at what node on the transmission grid.

For reasons like those in Germany, demand response is just starting to take part in other market niches, such as the **spot market** and the **ancillary services market** . In California, prices also do not fluctuate much on the spot market, and the prices offered on the ancillary services market are relatively low because there is so much on offer. Furthermore, a number of prequalification requirements (such as for measurement technology) hamper new technologies to enter the market.

The main **target groups** in demand response programs are industrial and large commercial firms. Generally, 100 kW is required to take part. SMUD, the municipal utility in Sacramento, is entering new territory here. Air-conditioning units in homes and small businesses are clustered, and these clusters are switched off one after the other. Individual air-conditioners then only have to be switched off for very short times (such as 15 minutes), so the comfort effects are hard to notice. The result is greater acceptance and participation among households and small firms.

3. Findings from the discussion

The participants at the demand response workshops presented a number of challenges and proposed solutions for the market integration of flexible loads.

Emergency reserve: The participants recommended that the criteria for the emergency reserve be designed so that transmission grid operators can actually use the loads in practice. In other words, the emergency reserve should focus on the loads that can be switched off without costly production downtime – and can therefore be used often. The result would be a smaller reserve capacity overall, but one that can actually be used.

Balancing power: Various projects have shown that flexible loads are useful on the ancillary services market, but prices are sometimes too low to make this option lucrative. In addition, such market barriers as excessively strict prequalification requirements and limitations on independent aggregators prevent flexible loads from taking part on the market. The participants agreed that these market barriers can be taken down quickly, and they were also confident that flexible loads will be able to compete in terms of price in the midterm.

Energy roadmap: The participants reiterated that the goal is to make flexible loads competitive on a level playing field with other technologies. The market entry barriers for flexible loads are therefore to be done away with soon in all market segments. Other support mechanisms for demand management, such as premium prices and minimum quotas, were not found to be necessary because of the wide range of other flexibility options.

Non-electric storage: The participants agreed that shiftable loads based on thermal and physical storage will become more important as photovol-

taics and wind power grow. Unlike loads that can be curtailed, which is only done at times of peak loads, there is no experience for regulatory frame - works here.

Support mechanisms: The participants point - ed out that the near-term market integration of de - mand response can be a political goal. In this case, an exit strategy should be defined for the end of the subsidy phase so that these loads can continue to take part on the market when the subsidies expire. In addition, the participants recommended that the actual problem first be defined without refer - ence to a technology (such as the extent, duration, and frequency of the required response); only af - terwards should suitability for demand response be investigated.

Technical details: The discussions also showed that the devil is in the details, as is so often the case. For instance, it is not generally easy to mea - sure what load was actually switched off ("how great would consumption otherwise have been?"), and there is a lack of proper standards.

Conclusion

Germany and California should attempt to create a level playing field for flexibility options so that de - mand response can compete on equal terms with other flexibility options, such as power storage and flexible power plants. The regulatory obstacles on the German power market are largely known; on the **ancillary services market**, for instance, they mainly concern prequalification criteria, terms for requests for proposals, grid fee regula - tion and the role of independent aggregators. Grid fee regulation should also be redesigned so that flexible loads can take part on the spot market; then, overall power supply could be optimized, not just an individual consumer's consumption.

If a **capacity instrument** is launched in the next few years, demand response mechanisms have to be able to participate as equals to allow for compe - tition between demand and supply options. A dis - tinction needs to be made between loads that can be shifted and those that can be curtailed. If cur - tailable loads have limited availability (such as 20 or 100 hours), check the extent to which they can contribute to supply security. Also find out which compensation mechanism is suitable for curtailable loads – and whether the compensation mechanism can be adapted to the cost structure of such loads (low fixed costs, high variable costs). In contrast, shiftable loads have higher fixed costs (deprecia - tion, capital costs, etc.) due to the installation of additional production and storage capacity. Up to now, California's government has not focused on this kind of demand response. Here, Germany has to find ways to provide appropriate compensation as a part of capacity instruments.

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