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ESG Economist

Responsive demand for grid balancing

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- **Demand response is a needed solution to optimize grid capacity and reliability to avoid blackouts or curtailments**
- **Energy efficiency, load shedding, bidirectional charging, and virtual power plants are some of the prominent measures for demand flexibility**
- **Demand response measures represent a cornerstone for aligning with Net-zero scenario with more than 500 GW of required demand savings by 2030**
- **To unlock the full potential for demand flexibility on a larger scale in Europe, European interconnectivity needs improving, where real time data collection and sharing becoming an essential catalyser for this**
- **Finally, the optimal application of demand response measures require the development of supporting regulation for pricing, permitting, designs, and cost recovery that would reduce uncertainty and help in boosting investments in VPPs and other supporting measures**

Introduction

The rapid increase of the share of intermittent renewable sources in the power mix, combined with high growth in electrification and limited grid capacity, amplify the need for solutions for balancing the electricity market and increase the reliability of grid. A conventional solution that would provide flexibility to the grid is the use of natural gas, which has been promoted as a transition fuel that helps in smoothing out the intermittency of renewable resources. However, the associated emissions with natural gas reduce its attractiveness as a sustainable solution. Grid scale storage and smart grids are more sustainable solutions that provide sufficient flexibility. We have covered these topics in previous notes (see **here** and **here**). Another complementary promising solution is to rely on demand flexibility measures.

Demand flexibility, or demand response, refers to managing the balance in the power market by encouraging industrial and final consumers to shift their demand away from peak hours to times with excessive electricity supply or lower demand through various incentive schemes. Thus, flexible demand is a way to optimize grid capacity and management.
In this ESG Economist, we dive into the opportunities that could arise by the implementation of demand response measures, the various approaches to achieve it, and the incentives and ways to unlock its full potential.

Why do we need demand response?

Balancing the demand and supply of power at all times becomes a challenging objective with higher share of intermittent resources in the power mix and the need to accommodate the impacts of more electrification, the expansion of distributed power sources, all associated with a limited grid capacity. The main idea of demand flexibility is to switch demand profiles away from peak times. That is, the power made available through such measures could save on investments in additional peak capacity, reduce energy bills for consumers, and the speeding up of the transition by the reallocation of resources to reinforce infrastructural capacity, for instance.

Measures for demand flexibility

There are several measures for demand response that can be implemented, with multiple programmes around the world testing their viability and possible expansion, such as in India (see more **here**) and the United States (see more **here)**. In this section, we highlight some of these measures where each has its advantages and challenges.

Energy efficiency

Different sectors have different appropriate measures for demand flexibility. A more general structural measure would be the increase in energy efficiency. This solution is appropriate for the building sector with a high potential for non-residential buildings where coordination and implementation is easy. Demand response in the residential sector can be achieved by simple actions such as the rescheduling of energy intensive tasks (doing the laundry or running dishwashers) to off-peak times. Furthermore, controlling the loads of different appliances by measuring their power consumption - so-called submetering is an effective flexibility measure for residential buildings.

Bidirectional charging

The idea is to use EV batteries as a source of electricity in times of high demand. These batteries can be used to store power generated through renewable energy sources such as solar PV or wind turbines in times of high supply. This power can be fed back to the grid, so-called Vehicle-to-Grid (V2G), or be used for any other purpose that require electricity, so-called Vehicle-to-X (V2X) in times of peak demand, relieving the pressure on the grid. Noting that software requirements differ between V2G and V2X.

Still, challenges to bidirectional charging exist. For example, the lack of standardization for bi-directional charging. Also, bi-directional charging could increase battery cost as it induce a faster degradation of the battery. Furthermore, bidirectional charging is most efficient using specific type of batteries (Chemical LFP batteries) that are not widely embedded in EV yet. See more on bi-directional charging in one of our previous research notes **here**.
The technical and safety feasibility of bidirectional charging is being tested through different pilots and initiatives across several countries such as the Netherlands where more than 1000 bi-directional charging stations have been deployed (see more **here**), and France (see more **here**).

Smart appliances and facilitating platforms

The use of smart meters and smart connected appliances that can be remotely controlled could also be used for enabling demand switching. Moreover, there are now many match-making platforms that facilitate the trade of conserved power through demand flexibility measures. These platforms bring together different organizations and stakeholders and help to expand collaboration in demand flexibility programs such as the flexibility innovation programme launched in 2022 in the UK (see more **here**). GOPACS is another platform in the Netherlands that was created to exchange and trade flexibility (see more **here**).

Virtual Power Plants (VPPs)

VPPs represent an aggregation of many distributed energy sources, storage systems (battery storage for households or group of households), and flexible demand, that are digitally linked and remotely controlled in a central manner, which allows for optimizing their use (see more **here**). VPPs provide flexibility to the grid by facilitating the planning and scheduling of energy sourced by distributed sources. VVPs help prosumers (consumers who act as producers) take a proactive part in the electricity market. That is, it gives prosumers access to a market that until now has only been accessible to large utilities and retailers.
VPPs are still at an early stage for commercial use. One of the major obstacles to VPPs is the absence of appropriate regulation and rules, along with the upfront costs to build software aggregation platforms or the deployment of any needed hardware, which make their profit margins only attractive if the fleet of Distributed Energy Resources (DER) large enough (see more **here**).

Load shedding

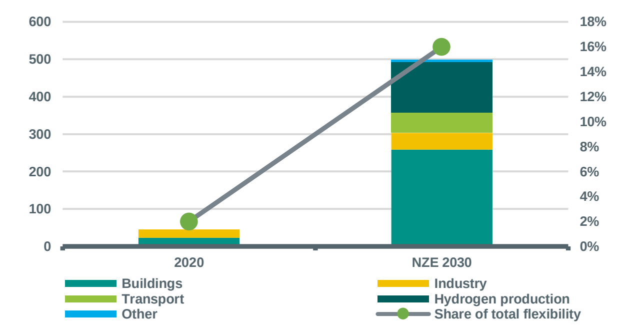
Power demand for industrial purposes constitutes a big chunk of total electricity demand especially for energy-intensive manufacturing industries. These industries can reduce output in peak times to relieve the grid and be paid certain amount in compensation, also known as load shedding.

Demand flexibility needs and potential

Demand flexibility saves on the needed additional supply capacity to meet peak loads. Countries' needs for demand flexibility varies as their future power mix is likely to evolve differently. The need will be higher for those countries with higher share of intermittent sources such as wind and solar.

Demand flexibility (response) is considered one of the cornerstones to achieve net zero targets. For instance, the IEA's Net-Zero Scenario for 2030 has 500 GW of demand flexibility needs – defined as the hour-to-hour change in output required from dispatchable resources – see chart below. The IEA acknowledges the role of digital technologies in automating demand response and facilitating the implementation of VVPs. However, it notes that the supporting policies and deployment of supporting technologies need to accelerate in order to align with Net-Zero scenario (see more **here**).

Demand response availability needs to be scaled up to reach Net Zero Scenario targets



Source: IEA, ABN AMRO Group Economics

Selected global technology deployment to reach Net Zero Scenario milestones (2020 vs. 2030)

Technology	2020 deployment	2030 milestone
Commercial and residential energy storage systems (capacity)	3.7 GW	510 GW
Smart thermostats (million units)	30.4	231.5
Home energy management systems (million units)	4	32.7
Residential air conditioners (billion units)	1.9	2.6
Heat pumps (million units)	180	600
Residential electric vehicle smart chargers (units)	117 000	28 700 000

Source: IEA

To unlock the full potential for demand flexibility on a larger scale in Europe, European interconnectivity needs improving, where real time data collection and sharing becoming an essential catalyser for this. In that regard, the European Union brought together an action plan that support the digitalization of energy system and facilitate data access and sharing to support demand response measures. It noted that the market for demand side flexibility is growing across different parts of Europe. In France, this flexibility accounted for 2.4GW in 2022 and was anticipated to increase by 12% in 2023 (see more **here**).

There are issues that limit the full potential of demand response measures. For instance, reliability of demand response outcome is low especially in the absence of binding contracts. That is, even with the appropriate incentives in place, changes in the timing of demand could not materialize as needed. Also, grid stability can be compromised as the power collected from distributed energy sources can increase local voltage levels. The reinforcement of the power grid can be used as remedy to these challenges but that would need both time and money.

Instruments to support demand response measures

Financial incentives are the main instrument for demand flexibility. The IEA distinguishes between price-based programs that indirectly encourage consumers to shift their consumption (implicit demand response), and incentive-based programmes which explicitly pay consumers to shift their demand to off-peak hours(explicit demand response) (see more **here**). For instance, the availability of flexible contracts for final consumers could encourage demand switching. In that direction, the European Commission has ongoing discussions on developing a viable remuneration system to reform the EU electricity market.

The proliferation of smart grids supported by digital technologies can help to better exchange of information and energy and improve the visibility of distribution networks. Advanced inverters help prosumers to better manage their loads and production remotely. Meanwhile, digital management systems can support can enable the spread of VPPs. Furthermore, digitalisation can facilitate the optimal setting of power prices that encourage flexibility by consumers and producers alike.

In cases of limited grid capacity where peak loads could lead to acute damages or overloading of the grid, authorities could resort to “throttling” energy intensive devices such as heat pumps and EVs. Throttling guarantees the functioning of heat-pumps and the charging of EVs but with lower voltage which means a longer than usual time to heat or charge. Such measures are going to be used in Germany in 2024 where devices will receive a trickle of 4.2 kilowatts per hour in peak times.

Finally, the optimal application of demand response measures requires the development of supporting regulation for pricing, permitting, designs, and cost recovery that would reduce uncertainty and help to boost investments in VPPs and other supporting measures.