The flexibility imperative: tapping demand-side flexibility in decarbonized energy systems

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Introduction:

The recent reports by Mario Draghi[1] and Enrico Letta[2] have drawn attention to the lack of competitiveness of the European economy. One of the reasons is the lack of investment in innovation. This is not due to a lack of public funding of R&D. In the US and the EU, public funds invested in R&D is roughly the same, about 0.7% of GNP. However, private investment in R&D is twice as high in the US as in the EU. Furthermore, public funding in the EU is invested more in industries and companies of the past (e.g. automobiles) than in industries of the future (e.g. artificial intelligence). Several things are lacking, including a regulatory and market framework to foster innovation. The electricity sector has an opportunity to adopt a new approach to public and private investment by developing a regulatory framework that promotes cutting-edge industrial innovation that takes advantage of the flexibility of distributed energy resources (DER) in the electricity sector. This paper has four parts.

- The first underlines the importance of flexibility in the electricity system and the potential role of DER.
- The second emphasizes the need to reduce regulatory barriers to the development of new technologies and business models for demand-side flexibility through aggregation. It draws on the UK experience with respect to the conditions for enabling the development of independent aggregators.
- The third makes the case for creating new markets, including local platforms to manage congestion on the distribution network. This part also draws on UK experience in supporting the development of privately owned trading platforms.
- The fourth concludes.

1. The importance of flexibility grows with penetration of renewables.

For over a century, almost all electricity systems use fossil generation to manage a system where demand was uncertain and uncontrollable. With the retirement of fossil plants, there are several decarbonized resources that can offer flexibility (pumped storage, large-scale batteries and

[1] https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?filename=The%20future%20of%20European%20competitiveness%20_%20A%20competitiveness%20strategy%20for%20Europe.pdf
[2] https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf

others), but I want to draw attention to the need for flexibility using distributed energy resources, i.e. generation, storage and demand management, near to consumers and often behind their meters.

- First, the need for flexibility is increasingly local, for example, due to excess renewable generation, or heavy use of electric heating, in an area.
- Second, electrification introduces flexible distributed energy resources at the local level – electric vehicles, heat pumps, electrical devices – most of which are connected to the internet; communication and control systems allow remote control and aggregation of those resources for sale in electricity markets.
- Third, these distributed resources are very competitive compared to large-scale resources. This is because the investment in these resources has been for consumer use and the incremental cost to aggregate them to provide flexibility to the system is relatively low, provided the regulatory framework facilitates business models that enable their participation in the markets. Moreover, these resources are available now, whereas new central system resources take years to build.
- Fourth, selling these flexibility services benefits active consumers and, as they reduce sysem costs, these services benefit everyone.

Distributed resources do not offer long duration services that the system requires but they can contribute substantially to balancing the system over shorter periods (from seconds up to a week) and to lowering system costs. It is reasonable to say that the system of the past required supply-side (generation) flexibility to respond to uncontrollable and unpredictable demand and that the future system is going to require flexible demand to respond to intermittent generation supply. It is also correct to say that the future is now here, as renewable generation and electrification gather pace.

2. Overcoming barriers to new aggregation business models

Demand-side flexibility (DSF) aggregators are market agents that combine the distributed energy resources of many consumers for sale in electricity markets, in competition with large-scale generation and storage facilities. There are many different business models of aggregation, including the following.

- *Retail companies with aggregation services*. Some electricity retail supply companies are also aggregators. For instance, Octopus now offers a special tariff for EV charging[3] that guarantees a zero price for charging in return for allowing Octopus to decide when to charge the vehicle and to discharge the battery (i.e. sell the output in different markets or use it to balance its own system). By aggregating charging and discharging of many batteries, and remotely managing other sources of flexibility (e.g. generation, batteries and heat pumps), Octopus is

[3] https://octopus.energy/power-pack/ There are various restrictions on the offer.

developing a new business model that uses Software as a Service (SaaS) to optimize the use of these resources.

- *Software as a Service*. Another business model involves an agreement between a conventional retail company (or an energy community) and a SaaS provider. Retail companies and energy communities usually do not have the technology and experience to be DSF aggregators. Facing the competitive pressure from companies that do have that experience, like Octopus, conventional retailers may team up with firms that have SaaS capabilities. Emulate[4], for instance, provides its SaaS service to retail companies in Sweden. Lumenaza is another company offering SaaS, notably to energy communities in Germany.
- *Independent aggregators.* These are aggregators that have no links with retail companies in the markets where they operate. Examples include Voltalis, a French company whose business model involves aggregation of demand turn down in wholesale markets, and Sympower, a Netherlands-based company whose model is the provision of flexibility in balancing markets.
- *Virtual Power Plants.* All aggregators offer services that compete with conventional generation and in that respect, they are sometimes referred to as Virtual Power Plants (VPP). The wider the range of services provided, the more these VPP really do resemble a power plant. Next Kraftwerke, now owned by Shell, is an example of a VPP which includes a full range of distributed energy resources, including different kinds of generation, storage and demand-side assets.

All these new business models involving aggregation face barriers to DSF that have been summarized in an ACER report[5]. These include:

- *The lack of a proper legal framework to allow market access*. This category of barriers refers to the absence of clear definitions of the roles and responsibilities of new agents, such as independent aggregators; restricted access to markets due to lack of eligibility; lack of access to consumer data; and restrictions on trade in day ahead and intraday markets.
- *The lack of incentives to provide flexibility*. This includes lack of smart metering with the required functionality, absence of price signals and the absence of policies to mobilize flexibility.
- *Restrictive requirements to provide balancing or other services*. For instance, ACER identifies non-market based balancing services (requiring generators to provide the service without explicit compensation); restrictions in market-based balancing services, such as product designs (e.g. only generation) that rule out participation of demand-side resources; restrictive conditions for providing congestion management services; and restrictive conditions to participate in capacity markets.

[4] https://emulate.energy

[5] https://www.acer.europa.eu/sites/default/files/documents/Publications/ACER_MMR_2023_Barriers_to_demand_response.pdf

- *Intervention in retail markets that discourage demand-side flexibility.* For instance, consumers facing fixed tariffs have no incentive to time shift their demand to periods when prices are lower; and price caps discourage investment to reduce demand when costs are high.

Of all the barriers, the most important are related to the lack of an adequate legal framework that enables aggregation in all its commercial forms to participate in electricity markets or that discourages aggregation by raising its costs. Throughout the European Union, there has been a debate about the legal framework that defines the rights and obligations of independent aggregators, which have no relationship with retail companies in the areas where they offer aggregation services. The controversial issue has to do with the effect of independent aggregation on retail supply companies, when the activation of turn-down aggregation reduces a retail company's sales to its consumers.

In the EU and the UK, all market participants, from producers to large consumers like supply companies and aggregators, are responsible for maintaining a balance between quantities sold or bought in markets and quantities finally produced or consumed at the time of delivery (real-time). The TSO balances supply and demand in real-time and economically settles imbalances or deviations for each market participant responsible for maintaining the balance. The concern of retail companies is that activation of turn-down demand response by an independent aggregator will leave the retail company with an imbalance – it bought more than it sold – and that it will be required to pay the difference. The retail companies argue that the aggregator should compensate them. The aggregators argue that their activation of demand response is lowering the costs of the system and so they should not be responsible for compensating the affected retail company.

Let me summarize what has happened in the UK to address this problem.

- First, the energy regulator Ofgem decided that all consumers should be able to participate in the (daily) wholesale market, either individually or through aggregators.
- Second, Ofgem recognizes that retailers may be financially harmed by the activation of demand flexibility (i.e. reduced demand) if the retailer's sales to consumers result less than its purchase commitment in the day-ahead market. Ofgem recognizes the need to compensate them.
- Third, Ofgem accepts that aggregation benefits all consumers because the aggregated flexibility replaces fossil plants, supports renewables and reduces wholesale prices. In other words, there is a net benefit to the system.
- It concludes that the cost of compensating the affected retailers should be shared by all retailers and that the aggregators should not be responsible for compensation because that would have the effect of increasing their costs and limiting their interest in entering the market. Ofgem recognizes that this may imposes a cost on retailers but that the benefits overall for the system in terms of efficiency, cost reduction and integration of renewables outweigh costs.

3. New markets are needed to tap demand-side flexibility

The development of DER introduces new challenges to balance the system, especially on the distribution network. Until recently, the distribution network moved electricity from the transmission network to final consumers, in one direction. Today, the flow is bidirectional and changes frequently. This creates a need for local flexibility services and markets to tap flexibility, including from consumers and their representatives.

One option is to introduce local markets organized by the electricity market operator, for instance OMIE in Spain. A second possibility is to allow the creation of privately managed market platforms that allow distribution system operators (DSOs) to buy flexibility to manage their networks. This is what has happened in the UK, where a private company (Piclo) creates and manages markets that enable the DSO to buy flexibility services, provided either directly from the consumer or through an aggregator. For this to be a successful model, at least three regulatory reforms are needed.

- First, the regulator must allow a private market platform to manage such a marketplace and define the products that can be included in this marketplace.
- Second, the regulator must allow consumers and their representatives to participate in the market and must eliminate barriers to that.
- Third, the Distribution System Operator must have a regulatory framework that encourages reducing investment and operating costs and the use of distributed energy resources.

Conclusion:

The EU requires innovation in technologies and business models that use advanced digital technology to respond to environmental challenges and that benefit consumers. Technologies and business models that make it possible to take advantage of the flexibility of distributed energy resources combine these characteristics. This article draws attention to the importance of creating a regulatory and institutional framework that encourages the development of innovative technologies and business models and the freedom to create new privately managed markets. Finally, the prize of a framework that fosters innovation and competition is not only to benefit consumers in the EU but to create regulatory and business models to support decarbonization at the global level.