Capgemini invent

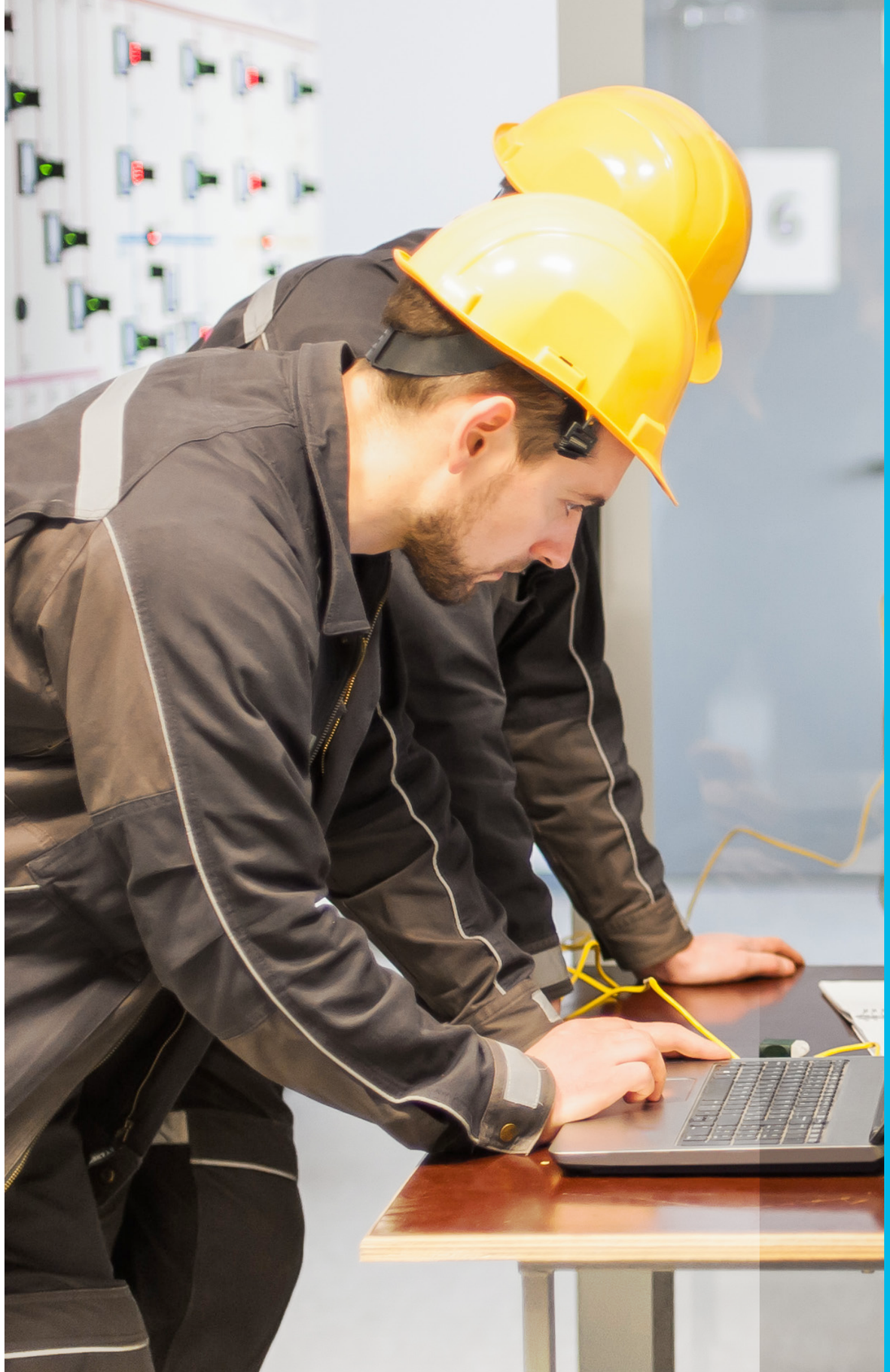
FLEXIBILITY **AGGREGATORS** IN THE **FUTURE ENERGY** SYSTEM

AGGREGATORS

THE NEED FOR AGGREGATORS IN THE ELECTRICITY NETWORK

Truly a feat of engineering and human capacity, the electricity grid is the largest machine in the world. The sheer size of the grid makes regulating it complex and requires skilled engineers, well-built systems, and well-thought-through regulations to avoid catastrophic failure. In the developed world, we have managed to continuously keep this gigantic system in near-perfect sync with millisecond precision with few interruptions. Even more impressive is that this system is regulated with physical balancing mechanisms developed generations ago.

Although the fundamental technology is old, the machine has evolved due to necessity from environmental, economic, technical, and regulatory reasons. Some of the developments bring new challenges, and the current market and systems are yet to solve them. Especially challenging is managing distributed and intermittent renewable energy generation capabilities that are being deployed coupled with a rapidly increasing electricity demand. The transition of society – away from dependence on fossil fuels – throughout the network further increases the technical complexity and risks of interruptions. An emerging solution to this challenge is a new category of energy market players that has been introduced alongside the generators, distributors, and traders of electricity: the Aggregators.



WHAT IS AN AGGREGATOR?

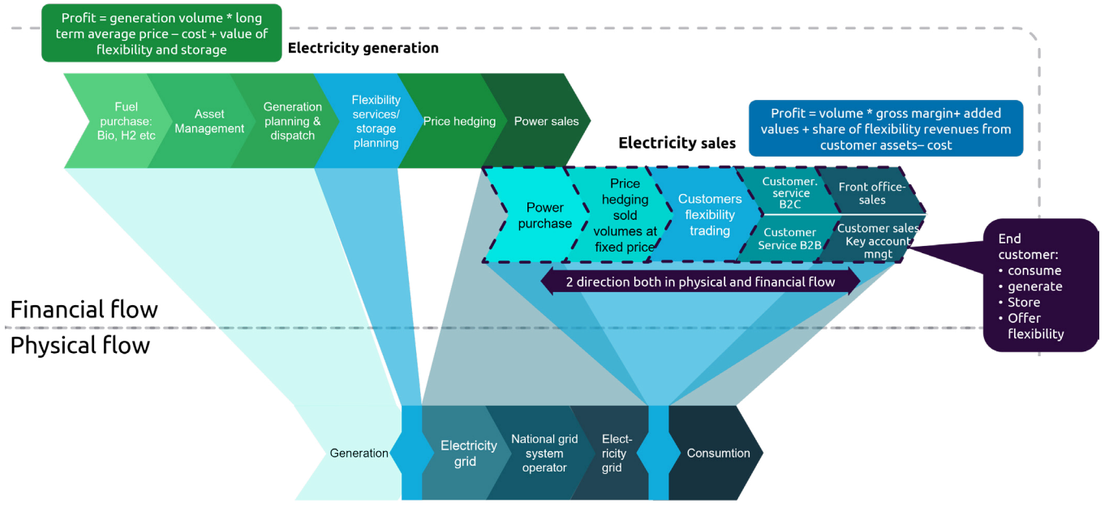
An aggregator groups numerous energy consumption or generation assets and bundles them into manageable sizes for the energy system. The grouped assets can then balance the energy system by up or down-regulating power generation or consumption on demand. Some of the more considerable challenges relating to aggregators are from the many small generation assets, such as rooftop solar panels, characterized by small capacity and low ability to change the load or generation output remotely with the current installation specs and digital capabilities.

The need for more efficient solutions is growing at an accelerating pace due to the very quick growth of distributed, intermittent power generation like wind and solar and first movers within aggregation services are likely to capture significant shares of the expanding business opportunity.

Aggregators bundle generation and/or battery systems (BESS) using IT solutions to manage many individual assets together and make offers to the grid or system operator as a packaged asset to the market similar to a conventional power plant. Depending on market rules, aggregators can also work in reverse, aggregating and steering electricity demand. In times of shortage, aggregators can down-regulate demand through centrally steered IT systems. At the same time, driving electricity demand from high-priced peak hours to other hours can be profitable even when there is no real need or signal from the system operator. An example already being commercialized is to move the start of BEV charging from the evening peak when plugging in the BEV to the 3-4 lowest priced hours during the night.

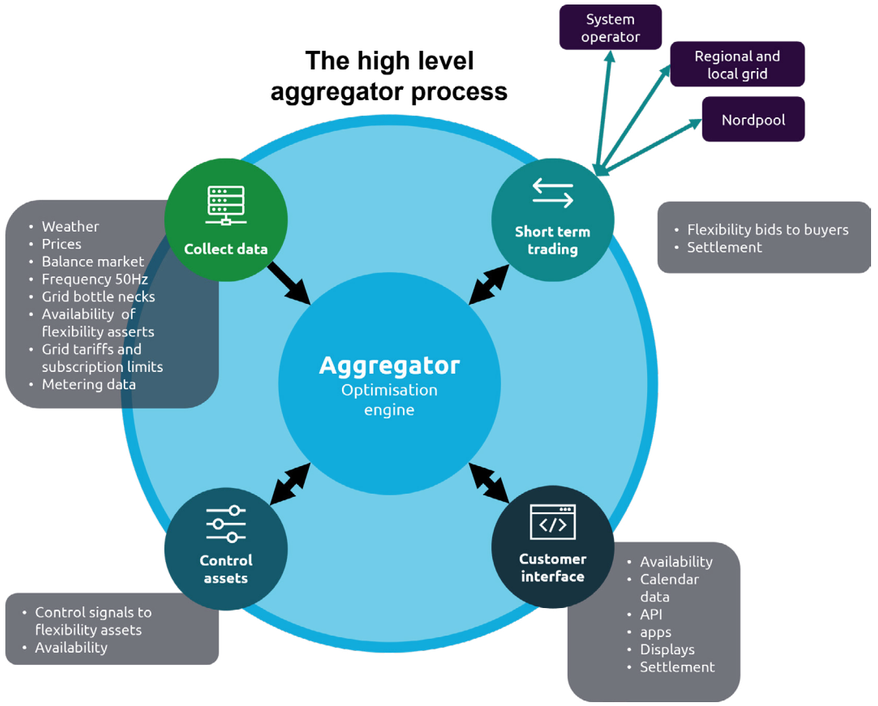
IF we look at the traditional value chain, the aggregator breaks up the value chain on both the generation and the consumption side.

THE NEW VALUE CHAIN



Before going to the market, either day-ahead or intra-day, the trader has much to win by considering the aggregate flexibility option. This process replaces the old and simple customer interface, which only contains information regarding consumption, prices, and costs, with a new, more complex interface. In this new interface, the aggregator control assets behind the meter interface in real-time. Depending on the customer's interest, this can be interactive or fully automatic, where the aggregator reports the activity, financial result, and, if relevant, saved CO2 emissions.

THE ROLE AND FUNCTION OF AN AGGREGATOR



A market study conducted by Capgemini Invent among energy companies in the fall of 2022 revealed that almost all the interviewees consider flexibility from both small-generation assets and the demand side to be a necessity for a well-functioning market and to avoid blackouts. In practice, they all see the need to aggregate assets into controllable units. If the aggregator is a role in itself or a natural development of the role of the balance provider is questioned.

It also becomes evident in the interviews that many see algorithms and IT solutions controlling and bidding in flexibility markets as necessary to handle complex and rapidly changing market situations. Ideally, the tools should be able to foresee the use of subcontractors and partners so that the balance and electricity providers can exchange the right information to enable the electricity provider to tailor the offers to the customer to make it profitable for them while mitigating challenges related to intermittent energy.

WHAT IS CURRENTLY HAPPENING WITH RESPECT TO AGGREGATORS

In European markets, there are limited examples of independent aggregators engaging with residential consumers. In the Nordics, new entrants are gaining market shares by providing new ways of bundling deals to consumers by nudging consumer behavior and providing flexibility services to the market. But until now, we see very few standalone aggregators, as almost everyone simultaneously acts as the customers' energy supplier.

WHAT ROLE WILL AGGREGATORS PLAY IN THE FUTURE?

The role aggregators or aggregation services will play in the future energy system depends on a large number of variables. Most relevant is price volatility, local and regional grid bottlenecks as well as the need for ancillary services to keep frequency and voltage levels between accepted levels. Geostrategic factors influence how quickly the changes occur; the war in Ukraine significantly impacts global energy markets and the type of favored production, price, and where to source raw materials. If the result is larger price volatility and a faster road to more renewables like wind and solar in the energy mix, then the need for aggregators will rise. Further, the responsibility for potential liabilities connected to energy generation, transmission, and cost to serve affects the assumed role of future aggregators. Together, these underlying pressures create a heavy incentive for change and accelerate the adoption of aggregators in the market.

In the Nordics, generation companies are responsible for delivering the electricity sold ahead on the spot market and face potentially high costs if they can't deliver on the sold quantity. The same consequences apply to aggregation services, and risks significantly increase for actors without available backup power generation, skewing aggregation heavily in favor of established electricity generation companies. Positioning companies with excellent data-handling capabilities – which are more prone to make accurate estimations – to capture large market shares, incentivizing partnerships between technology giants and utilities.

There are few concluded projects as the market is developing. In one of the earliest reports, the International Renewable Energy Agency (IRENA) analyzed an early initiative in South Australia where distributed power from private and commercial solar power systems was connected to a network of 50 000 households through an aggregator. Interestingly, the report shows a trend of reduced costs of 3 USD per MWh for every 50 MW of power capacity installed into the network. With an installed capacity of 250 MW, the system is estimated to reduce wholesale electricity prices by 8 USD/MWh. Whether the findings are generalizable and applicable independent of geographic factors or type of energy production remains to be investigated. Still, the potential first-mover advantage when establishing large networks of aggregated and flexible resources in a specific region can be significant.

By designing the regulations to favor a certain type of organization, major impacts on the power dynamics of the energy market are likely to materialize. A possible scenario is that the companies best positioned to benefit from an open platform for trading flexibility, without major liability assumptions for physical infrastructure, are those that are leading in machine learning in other fields with large datasets. With requirements on backup power more akin to current energy providers, the risks of providing the services without the necessary physical infrastructure might be too large. Also, in so-called black swan scenarios, when the electricity system is under extreme stress, the cost of not being able to fulfill the bid given to the system operator can be extremely high. In that case, financial strengths must be a requirement that goes together with the license to bid in capacity on the flexibility market.

INSIGHTS

Key criteria for a successful aggregator:

- Thorough understanding of the electricity market and what mechanisms and external factors impact generation and consumption in the short term
- IT systems in place as well as AI and Machine learning capability to be able to forecast, aggregate, control, and measure the results of activated flexibility
- Access to a large customer base. One comment from one of the interviews in our study was, "Flexibility is not the customer need; it's a need for the market." reflecting that there will be issues making flexibility and aggregation services something desirable for the customer
- Process for innovating, testing, developing, and launching new flexibility offerings in a fast and agile way

Obstacles for incumbent utilities to successfully take the role as aggregator

- Old investments in IT systems that make it impossible or costly to develop new services
- Invoicing systems that can't handle the settlement of flexibility services
- Lack of knowledge and processes for fast and agile development of new offerings
- Difficult to hire staff with the right skills
- New offerings to customers might erode the value of old cash cows and create internal conflict with the existing business units

On the other hand, as mentioned by one of the interviewees, there is an opportunity for the electricity retailer to combine an energy contract on fixed price but with the ability to reduce the billed amount for the customer through flexibility elements in the contract.

The future energy system will require flexibility not only from hydro generation – several other assets will have to act in the flexibility market. The understanding is already there. As one comment from a generator. ***"Batteries will be a part of a standard installation in a windmill or solar park. Intelligent control of flexibility assets and aggregation of those assets will be a natural and necessary part of the future energy system".***

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