Capturing business opportunities in emerging power system flexibility services

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Interview Alain MALOT

It is commonly agreed that the shift to a low-carbon energy mix will require the electrification of our economy, the development of variable renewable energies, and the phase-out of dispatchable thermal power plants. This shift will dramatically impact our electricity grid, thus developing the need to make it more flexible.

However, flexibility is a complex topic that is often mistreated if not forgotten. It is considered in some form in long-term scenarios. Public reports and corporate communication tend to focus only on some of the possibilities (e.g., battery storage, hydrogen, demand response, etc.). Most importantly, it is a key driver of our transition to a sustainable future and needs to be considered holistically.

To clarify this topic and its various aspects, we interviewed Alain MALOT, a passionate expert on the topic of flexibility. Mr. Malot capitalises on over 30 years of utility industry experience.

To begin with, how do you define flexibility?

Power system flexibility is an umbrella term that can be seen as a subset of the even broader term "smart grid." I identified at least a dozen different definitions which say different things. While it has become a popular term in Europe, mainly due to the policy mandates for demand-side flexibility, it is increasingly gaining traction in other regions.

A simple, yet restrictive definition would be "The ability to provide upward and downward power adjustments to the electricity grid."

But "flexibility" covers a wide portfolio of practices and technologies, both mature and nascent. Its ultimate goal is to optimise the overall system costs while increasing grid asset usage and efficiency, its resilience, and (but not only) the ability to integrate variable renewable energy sources (e.g., solar and wind).

So far, the flexibility topic was debated among electricity stakeholders only. New non-electricity resources are now coming into play, under a concept known as "energy system integration" (formerly called "sector coupling" in Europe). That includes heat (Power-to-Heat) and clean gases

(Power-to-gas) as storage buffers for instance. Electric mobility is another recent extension, given the predicted large capacity of "batteries on wheels."

Vocabulary around flexibility is far from being standardised. For instance, Californians and Europeans usually face significant difficulties in understanding each other while discussing their mutual experience. As an illustration, terms like Distributed Energy Resources (DER), Virtual Power Plant (VPP), or aggregator are subject to different interpretations and can be a source of confusion.

What are the enabling technologies for flexibility?

There are opportunities all along the electricity value chain. It is a combination of emerging technologies (e.g., V2G/vehicle-to-grid, advanced grid control software) and mature ones (e.g., upgrade of thermal power plant). It can be done using grid assets owned by utilities or using grid-connected assets (generation units, storage, or customer demand). Those resources can also be centralised or decentralised.

The use of digital technologies (Internet of Things, artificial intelligence, cybersecurity to name a few) is central in developing flexibility solutions.

Non-exhaustive list of flexibility resources

FLEXIBILITY RESOURCES	UTILITY GRID ASSETS	ASSETS CONNECTED TO THE GRID	
		SUPPLY-SIDE (GENERATION & STORAGE)	DEMAND-SIDE (CONSUMERS)
TRANSMISSION CONNECTED ASSETS (CENTRALISED)	• Optimisation of connections (e.g. Ringo Project[1]) • Advanced Energy Management Systems • Interconnections	• Large power plants • Stationary batteries	• Large industries & infrastructures
DISTRIBUTION CONNECTED (DECENTRALISED)	• Advanced distribution management systems	• Community-scale renewables • Urban CHP • Batteries	• Industrial • Commercial • Residential • (processes, heating & cooling, behind the meter batteries) • Advanced Building Management Systems • EV smart charging

Historically, flexibility has been provided by traditional centralised power generation assets (e.g., large-scale power plants, nuclear, coal, hydro), grid interconnections, and extended to demand response in electro-intensive industries from large process loads.

It is now moving increasingly to decentralised assets. For instance, demand-side flexibility from smaller commercial and residential loads, microgrids, and innovative electricity tariff structures are now gaining traction in a growing number of countries.

[1] Virtual power lines using batteries (https://www.rte-france.com/en/accelerate-energy-transition/rationalised-use-grid)

Lesser-known methods (but important ones) are the development of advanced grid management systems (e.g., Dynamic Line Rating, Distribution grid Active Network Management) that are alternatives to the transmission and distribution grid reinforcement through the use of innovative control software. Utility-owned hardware solutions like large-scale stationary batteries are also part of the portfolio of solutions. Those projects are managed by transmission and distribution utilities.

One should not forget that solar and wind assets are part of the flexibility portfolio as well. For instance, in California, solar PV assets must be curtailed at times of low consumption and high generation.

How does flexibility create value, who benefits from it?

Before creating value for the asset owners or grid operators, flexibility benefits society.

In a world where we want to quickly replace dispatchable fossil power plants with renewable assets, using all the enablers of the vast flexibility portfolio of resources is the best way to lower the overall transition cost and to make greater use of renewable generation capacities. It is a necessity to meet the objectives of energy transition in line with the national and international pledges.

The value of flexibility is historically tied to transmission grid balancing, which is too restrictive. In fact, three main flexibility value streams can be identified:

- Grid services at transmission and distribution levels: system balancing, congestion management, Non-Wire Alternatives…
- Market participant services in deregulated markets: portfolio optimisation, hedging…
- Prosumers[2] services, at individual prosumer level or community level: energy cost optimisation, resilience…

A large ecosystem of grid stakeholders participates and conducts transactions via organised markets at national or international levels (like the European Single Electricity Market), or simply self-monetise the value of flexibility they generate. However, the type of services that can be provided varies a lot across regions.

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[2] A prosumer is a portmanteau word describing an individual, a group of individuals, or a company both producing and consuming energy.

But what makes a country economically interesting for one of those players?

It is overly complex and depends on a large variety of situations. We can summarise it in three layers that are complementary.

- First and foremost, the market design of the country. A vertically integrated electricity market will be very different from a fully unbundled one.[3] The existence of dedicated markets (e.g., capacity markets) is a key driver.
- Then comes regulation. In France, for instance, flexibility service providers called "aggregators" can act as an intermediary between flexibility assets and the grid operators. So far this does not exist in other neighbouring countries like Spain.
- Finally comes the robustness of the grid that depends on both the structure of the physical copper plate (e.g., Chile's grid poses a particular challenge), the historical investments made in the infrastructure, and on the pace of the energy transition (e.g., the need to connect a large number of renewable energy assets in a short time frame).

Many players tend to answer to the flexibility need of a country through a technological approach (techno-push). Technology is an enabler but makes limited sense if it is not included in a holistic approach. The institutional part (e.g., defining roles and responsibilities) and economic (market design, regulations, frameworks…) approaches are just as fundamental.

Furthermore, the complexity of flexibility management makes it almost impossible for a country with no former knowledge to create the relevant market design and regulations alone.

If you take the example of new economies already moving quickly on energy transition, such as India and parts of Africa, the development of the institutional and regulatory framework is being made with the strong support of international thinktanks, energy agencies, consultants, and industrial players. It is an opportunity for those players to promote their technological solutions adapted to this framework!

What are the most promising countries for monetising flexibility?

The ones that answer to the criteria mentioned above! The U.K, Australia, California, are very good candidates for the title today. We expect that many countries will follow soon.

Islanded regions or countries can be particularly good fields of experimentation (e.g., Hawaii in the U.S, Jeju in South Korea, overseas non-interconnected territories "ZNI" in France, Astypalea island in Greece[4]…). However, if they facilitate the development of advanced flexibility technologies, there are some limitations to scale up those technologies in larger interconnected grids.

France has a unique DNA in that space, it has always been a pioneer in flexibility implementation (flexible nuclear power plants[5], flexible time-of-use electricity tariffs, industrial demand response, pumped hydro storage…) but still has a lower inherent need for flexibility versus other countries, mainly due to the structure of its existing grid and generation mix, and its central position in the interconnected European grid. Hence it cannot be considered the most dynamic market in the world.

[3] Unbundled = a market where the electricity generation, supply, and grid operators are separated into different companies.

[4] Model island with very high EV penetration https://www.volkswagen-newsroom.com/en/press-releases/volkswagen-group-and-greece-to-create-model-island-for-climate-neutral-mobility-6583

[5] Which is not the case in most other countries. https://hal-edf.archives-ouvertes.fr/hal-01977209/document

Then how do technology providers adapt themselves to this complex framework?

The vendor ecosystem around flexibility is a combination of new and traditional players.

Traditional players can have the necessary holistic view and the international presence but often lack the specific expertise and the technological knowledge. Agility may also be a challenge.

On the other hand, many new players (start-ups) tend to be technologically focused with an important level of agility. They lack the capacity to assess the institutional and economic layers and do not have the ability to focus on more than one national market.

In order to scale up internationally, those innovating small companies either adopt partnering strategies (e.g., Autogrid, Octopus Energy, Kiwi Power) with large, international, traditional players, or find their future via an acquisition by a larger group. (e.g., Wärtsilä's with Greensmith, Enel X with Enernoc…)

Developing winning flexibility technologies requires a deep understanding of the current status of various flexibility options and monetisation schemes and monitoring the changes that potentially favour or kill business models. This is a complex and resource-intensive task, given the lack of a common flexibility framework across most electricity markets. A Dutch industry think tank named USEF[6] has done an excellent job in producing a European, open-source framework for demand-side flexibility. Could this valuable foundation be used to build a more international framework and map the variety of country situations? This would help clarify the existing complexity for many stakeholders willing to expand in multiple regions.

Can flexibility technologies be an answer to the recent price spikes in the European energy market?

Many European wholesale markets are strongly affected by the surge in natural gas prices, which in turn affect electricity prices. Wholesale market participants are exposed to day-ahead and intra-day prices with increasing volatility. The value of incentivising customers to shift their consumption to lower price periods using demand-side flexibility is stronger than ever and is still rather untapped. The recent development of smart EV charging options with dynamic pricing in some European countries is a good example of an emerging possibility.

We would like to warmly thank Alain Malot for the time he dedicated to this interview and for its valuable insights.

[6] Universal Smart Energy Framework, https://www.usef.energy/