

GEOTHERMAL POWER PLANTS IN THE ELECTRICITY MARKET

The evolution of the **European electricity market**

Europe can largely be considered as a single electricity market. While electricity grids that transport electricity generated from one part of Europe to another are still largely heirs of the aggregated national electricity networks built up by national monopolies, the massive build-up of interconnection makes it very easy to move electricity from one end of Europe to another. The successive European legislations introduced over the years have all strove to transform 27 national electricity networks into one European one. In practice, some distinctions exist between European electricity markets, for instance between the EPEX Spot area (France, Benelux, Germany, Austria, Switzerland, Denmark, Sweden, Norway, Finland, and Poland) and OMIE (Spain and Portugal).

The European electricity industry evolved with the progressive integration of national energy markets and the transformation of the rules according to which electricity is sold. The European Commission promoted the unbundling of infrastructure and generation (the same company cannot own the transmission lines and the power plants), and the electricity market became dominated by hourly pricing determined by the marginal bidder.

Increased reliance on natural gas to generate electricity and notably provide flexibility to the electricity system has been one of the consequences of this evolution. Gas power plants indeed have the advantage of having low CAPEX, being quite flexible, and depending on gas price for most of their costs.

Aggregated national markets

- National monopolies
- Low rates of interconnections
- Central planning of investments and resource adequacy

Beginning of privatisation

- Unbundling of infrastructure
- Privatisation of state owned monopolies
- Arrival of new actors
- Build up of interconnections
- Marginal cost pricing transforms investments

Beginning of decarbonisation

- Variable renewables become an important force in some national markets
- Systems markets by lack of interconnection
- Subsidies awarded to maintain flexibility resources open

Integrated decarbonised energy system

- Abundance of flexibility resources
- Renewable technologies as the default energy producers
- Higher rate of decentralisation of generation flexibility

Coal, oil & nuclear

Gas CCGT

PV, Wind

Geothermal energy

From the adoption of the Renewable Energy Directive 2009 onwards, the structure of the European electricity market evolved with the rapid deployment of variable renewable electricity generation in several European countries. Photovoltaics and wind power plants change the economics of the European electricity market. Because they can generate electricity somewhat randomly (wind) or on the contrary, in clearly defined moments of the day (solar), these renewable sources change the dynamics of the electricity market, significantly increasing the value of flexible and dispatchable electricity generation.

In 2018, the European Union adopted a new set of legislations on the electricity market to make it function while mainstreaming renewable power generation. This legislative update entailed a major focus on mechanisms to incentivize flexibility in the electricity market while exposing renewable electricity producers to market signals to a larger extent.

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Operating a **geothermal power plant** in the **electricity market: today and tomorrow**

For geothermal power plant operators, the evolution of the electricity market rules means that their market behaviors will also have to change. Geothermal power plants built in Europe to this day operate as baseload producers in the European electricity markets.

The capacity to reach capacity factors well above 90% throughout the year, very low operational costs, and the high CAPEX of geothermal plants naturally incentivize baseload production. The availability of priority of dispatch rules for geothermal and other renewable power plants, as well as feed-in tariffs or, more recently feed-in premiums means that geothermal power plants are strongly incentivized by market rules to focus on baseload generation.

From 2018 onwards, we see the emergence of an electricity market that puts much more value on flexibility and renewable supply when attributing value to electricity generated, two features that geothermal power plants can put forwards. The 2018 Electricity Regulation suppresses the priority of dispatch for renewable plants, introduces balancing responsibility for all actors in the electricity sector and new mechanisms to reward flexibility or dispatchability such as strengthened balancing markets and capacity remuneration mechanisms. Newly commissioned geothermal plants will have to operate in an increasingly different manner than they traditionally did to adapt to the new incentive structure in the electricity market.

Electricity market features for a successful geothermal power plant development

1. Prioritising flexibility from renewable generation: Capacity remuneration mechanisms, balancing markets, and other similar mechanisms that incentivize plant operators to provide flexibility to the electricity market are not clearly promoting renewable flexibility. CRM, balancing markets and other schemes to incentivise investments in flexibility must be balanced around promoting additional investment investments in renewable solutions, not merely keeping existing fossil plants to the grid.

2. Business models that allow geothermal plants to profit from the value they create in the grid: as renewable producers, including geothermal plants, are increasingly confronted to market incentives, business models and regulatory frameworks need to emerge to allow geothermal power plant operators to reap the benefits they provide the electricity system. Baseload capacity and flexibility reduce the need for redundancy or infrastructure build-up; however thus far geothermal power plants have not always been able to market this benefit.

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