New State aid rules and market design in the European Union: What impact on geothermal electricity projects?

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ABSTRACT

This paper presents a number of exogenous factors which can influence the development of new geothermal power projects in the European Union (EU), including in terms of business model.

The revised European Union's State aid rules are drastically changing operating aid for renewable electricity. While the shift from feed-in tariffs to premiums is by now a reality, the obligation for geothermal power operators to participate in the market will be inevitable even in countries which have hitherto chosen a softer transition.

Meanwhile, geothermal power technology is ready to adapt to the new electricity system, revolutionised by a significant penetration of fluctuating electricity generation from solar photovoltaic (PV) and wind. New binary technology can be flexible and provide ancillary services products. But this will be possible at a large extent only if tailor-made support continues to be provided for at least the next decade and electricity markets are deeply reformed to adapt to the new reality.

The author finds that it is very likely that the above factors will affect business models of geothermal power operators. However, any detailed forecast maybe be premature. Future business models will depend on the regulatory evolution in different countries, on the size and nature of the economic actors involved as well as on future technological developments.

1. INTRODUCTION

The electricity system in Europe is currently undergoing a revolution. The centralised conventional system, based on fossil fuels and nuclear and built under monopolistic market conditions, is being transformed by market liberalisation and the recent large penetration of renewable energy sources (RES) such as wind and solar PV, whose output varies according to resource availability.

In many EU countries, such growth was greatly facilitated by the availability of feed-in tariffs, the most secure and attractive financial incentive for a project developer. Feed-in tariffs have generated a fast deployment of these technologies and contributed to significant costs reductions. A larger share of fluctuating RES has been the cause of the following interconnected and on-going developments:

- A call for reducing the financial support allocated to renewables and for exposing their operators to market signals;
- Concerns over grid management and security of supply and the need for more flexibility through interconnections, storage, demand side management, and flexible generation;
- The need to reform electricity markets to make them "fit for renewables", thus more flexible and open to a broader range of players, both on the supply and demand side (European Commission, 2015).

This paper will briefly present the above issues and the potential implications for new geothermal power projects in the European Union.

2. SUPPORT SCHEMES AND EU STATE AID RULES

Instruments of environmental policies such as a carbon tax or a carbon cap-and-trade system, aim to internalise negative externalities of energy resources extraction, transportation, transformation, and consumption. Those policies, however, may not be sufficient alone to deliver the wide range of alternative and newer technologies at the necessary scale needed to decarbonise the economy. This is because, beyond pollution and other negative externalities, there exist other market failures in the energy industry. Examples of these market failures are non-competitive markets, knowledge spillovers and learning-by-doing (Linares et.al., 2013: 560). Where technologies are not yet competitive, specific technology policies are therefore justified. Given its current limited market uptake and its significant potential, effective financial support can change for the better the perspectives for geothermal technologies.

Since the early 2000s, the engagement under the Kyoto Protocol, translated among other things in indicative targets for renewable electricity (Directive 2001/77/EC), led member states to establish a number of financial incentives in support of emerging renewable energy technologies. In the European Union, however, financial aid from the public sector can be allocated only provided it is considered compatible with the EU internal market and State aid rules. And, in general, the Commission tends to take a strict approach to the granting of State aid by member states. However, the existence of common climate and renewable energy objectives, meanwhile extended and strengthened until 2020, suggested an initial soft approach (Thieffry, 2015: p.1125); in 2008, therefore, both the Block Exemption Regulation [1] and the State aid guidelines on environmental protection[2] provided broad discretion to member states as to how support renewable energy projects.

As for other renewable electricity technologies, the main support available for geothermal power in the main EU markets (France, Germany, Italy, etc.) has been through feed-in tariffs. A feed-in tariff is a fixed and guaranteed price paid for each kWh produced. It is considered the most attractive financial incentive for project developers and operators which in practice can operate without major risks for future returns on investments and outside the market. Yet, the establishment of feed-in tariffs has not triggered significant growth in terms of installed capacity[3]. As explained below this is probably due to the very nature of the technology.

In the meantime, on the contrary, fluctuating wind and solar PV had experienced a real boom[4], with dramatic cost reductions. Their large deployment caused a call for reducing financial support and for increasing their market exposure, notably through a shift from feed in tariffs to feed-in premiums (i.e. a fixed or variable[5] bonus on top of the electricity price).

[1] Regulation 800/2008 declaring certain categories of aid compatible with the common market in application of Articles 87 and 88 of the Treaty.

[2] Community guidelines on State aid for environmental protection (2008/C 82/01).

[3] Over the period 2005–2013, the annual growth rate for geothermal power was 1% (EEA, 2016: 27)

[4] Over the period 2005–2013, the compound annual growth rate was 65 percent for solar photovoltaic, 27% for offshore wind, and 15 percent for onshore wind (Ibid.).

[5] Variable premiums can take different forms depending on whether they are adjusted on an hourly, monthly, or yearly basis and whether they have a cap and/or floor price.

The first strong signal in that direction came from the European Commission in its 2013 guidance for the design of renewables support schemes. In that document,

> ‘[t]he Commission consider[ed], on the basis of its analysis of support schemes, that premium systems have several advantages compared to other instruments: they oblige renewable energy producers to find a seller for their production on the market and make sure that market signals reach the renewable energy operators through varying degrees of market exposure. A well designed premium scheme will also limit costs and drive innovation by granting support based on a competitive allocation process or including automatic and predictable adjustments on cost calculations, giving investors market signals coupled with foresight and the necessary confidence to invest’ (European Commission, 2013: 9).

On top of the concern for the stability of the grid, the main reason for such new approach was a risk of new fragmentation of the internal market by heterogeneous national support mechanisms (Thieffry, 2015: p.1126).

Only one year later, in 2014, the Commission used its exclusive competence in terms of state aid rules to translate its considerations into law. As a matter of fact, the new guidelines on State aid for environmental protection and energy (EEAG) 2014-2020 tend to drastically change the way operating aid for renewable electricity is allocated. In that respect, it is worth underlying that operating aid is considered to have a more distorting effect than investment aid, which is a one-off measure not requiring readjustments at a later stage.

The new standard rule is therefore as follows:

a) As of 2016, operating aid for renewable installations above 0.5 MW is granted by way of a premium or certificates to operators which sell the electricity directly in the market and bear standard balancing costs. No support is given in case of negative prices.

b) As of 2017, feed-in premium is allocated via a technology-neutral bidding process open to all technologies regardless of their maturity.

However, the EEAG provide some flexibility for their application through the following opt-out provisions which could be requested, yet duly justified, by member states:

a) Feed in tariffs are still possible for demonstration projects;

b) Member states can set-up technology-specific auctions to ensure diversification, and take into account different levels of maturity of new technologies;

c) Support can be granted without bidding if this would result in underbidding or in low project realisation rates (European Commission, 2014).

The new rules are therefore characterised by two new elements: a) an emphasis on technology-neutrality; and b) a trend to oblige renewable energy operators to sell the electricity in the market and to receive a bonus (premium) on top of the market price.

Regarding the principle of technology-neutrality, the renewable energy industry has heavily contested this approach on the basis that no single support model could properly factor in the different technology profiles of renewable energy sources. Additionally, applying a single system across the board would require technologies with significantly different technical characteristics and costs to compete. All in all, this risks stifling innovation and slowing technology cost reduction. To assess the stake for geothermal power projects, it is worth briefly recalling the basic nature of this technology. Most of the investment of a deep geothermal project falls into the initial, high-risk, phase. While the project is being developed, the required budget changes successively (see Fig.1 below). Therefore, the bottleneck of many geothermal projects is that in most cases debt financing by banks is possible only following the completion of the long-term flow tests. Furthermore, due to the limited practical geological knowledge in some regions, private insurers consider the operation to be too risky. Under those conditions, tailor-made instruments (including some form of risk insurance) are crucial for the successful financing of a project.

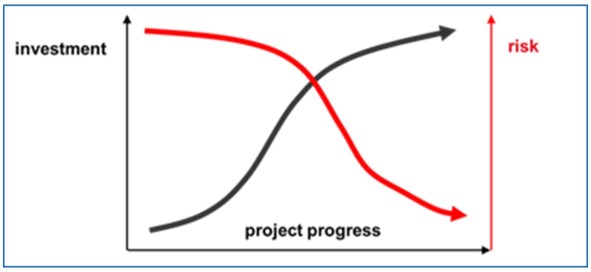

Figure 1: Risk and cumulative investment during the project progress. Source GEOELEC (2013).

Additionally, it is worth stressing that often geothermal exploration and development licenses are often issued through competitive concessions/tenders and that technology-specific auctions take place in Italy, but only for plants above 20 MW. In any case, what is certain is that a second stage of auctions against other renewable technologies may fatally undermine investments, especially in emerging markets. Therefore, considering the current levels of maturity and the deployment speed, the application of a technology-neutral approach does not seem to be appropriate for geothermal electricity.

It is now interesting to see how member states will apply the new EU state aid guidelines. In that regard, France and Germany have already reformed their support schemes. Yet, these countries opted for exempting geothermal projects from multi-technology auctions. This is certainly due to the slow development of geothermal projects. As regards the shift from feed-in tariff to premium, Table 1 provides an overview of operating aid systems available. More specifically concerning the obligation to sell the electricity on the market, France and Germany have so far adopted hybrid systems in which the geothermal project developer has the choice between

- selling the electricity on the market and therewith receiving a variable or floating premium automatically falling when electricity prices go up; and
- selling the electricity to the grid operator at a lower price compared with the sum of the feed-in premium and the electricity price.

Despite these interim provisions, and awaiting the reform in other countries, participation in the market seems, at least in the long-run, an inevitable evolution.

Table 1: Operating aid for geothermal power in selected EU countries (2016)

Country	Type	Eligibility period (years)
Belgium (Flanders)	Quota system	10
Croatia	Feed-in tariff	14
France	Feed-in Premium	15
Germany	Feed-in Premium	20
Hungary	Feed-in Tariff	-
Italy	Feed-in premium/ Tenders	25
Portugal (Azores)	Feed-in tariff / Feed-in premium	12
Romania	Quota system	-
UK	Feed-in premium (contract for difference)	15

2. GEOTHERMAL POWER: A VALUABLE OPTION FOR GRID STABILITY?

I have already mentioned in the foregoing sections that the growing share of solar PV and wind has generated growing concern over grid stability in some regions of the EU. As a result, there is a serious need for more flexibility. Against this background, the question of this section is the following: Can new geothermal power plants be operated in a flexible mode, thereby contributing to increase the flexibility of the system?

Traditionally, geothermal power plants have been built to operate continuously at maximum output (baseload). However, they could indeed be designed to be operated flexibly, meaning capable of responding to system operators' needs.

Firstly, a geothermal power plant can be used in partial load operation and, especially with new binary technology, can quickly ramp their output down on demand. Even changes in the range of 30 to 100% in 15 seconds could be achieved by means of simultaneous adjustment of both admission and by-pass valves, as has already been implemented following to the requirements of German regulation[6]. Two other examples of flexible geothermal power plants are found in the United States, where part of the 38 MW Puna geothermal plant in Hawaii provides regulation and ramping services to the local utility and where some plant operators at the Geysers geothermal field in California provide peaking capacity and are remunerated through capacity payments (Edmunds and Sotorrio, 2015).

Secondly, geothermal resources can be used for the combined generation of heat and power, and be connected to local district heating systems. Extra flexibility stems from the fact that the respective shares of heat and power from the geothermal resource can be adjusted, and from the possibility to convert a surplus of renewable electricity to heat- including the option of heat storage.

That said, the reply to the question is yes, geothermal plants can be operated in a flexible mode. Geothermal operators can therefore offer several types of ancillary services (AS)[7] to system operators and provide valuable short and long-term flexibility. This is one of the benefits of geothermal energy, which is being explored not only in Europe, but also in other regions of the world.

[6] Altieri et al. (2016) provide details of the latest developments in Organic Rankine Cycle binary technology, including in terms of Low Voltage Ride Through (LVRT), the capability of electric generators to stay connected in short periods of voltage dip.

[7] Battle (2013) highlights that ʽterminology and subdivisions into different [ancillary] services may differ from one country to another'. The author presents a European-oriented way to classify these services as follows: a) Frequency control (primary reserve in which time response is measured in seconds, secondary reserve in which response time ranges from 5 to 15 minutes, and tertiary in which the response time is more than 15 minutes); b) Reactive power for voltage regulation and; c) Black-start capability (power restoration).

3. CAN FLEXIBILITY AFFECT BUSINESS MODELS?

While geothermal power plants can technically be operated in a more flexible mode to provide AS and mitigate uncertainty and variability in grid operations, this will be done only if adequate regulation and economic incentives are in place (International Energy Agency, 2011). Edmunds and Sotorrio (2015) have assessed the situation in California, where a renewable portfolio standard mechanism[8] will increase the share of renewable electricity generation to 33 percent by the year 2020. In their study, the authors found that AS prices were too low to provide sufficient economic incentive to geothermal plant operators to provide flexibility. Moreover, power purchase agreements (PPA) were configured to provide only energy sales at significantly higher prices than average AS prices. Yet, AS in 2020 are expected to periodically receive higher remuneration levels; as a consequence, geothermal plant operators who secure flexible contracts that allow them to provide AS could add additional revenue streams (Ibid).

In Europe, one could expect a similar situation. Where geothermal plant operators benefit from guaranteed operating aid such as feed-in tariffs for a fixed number of years, they will have no economic incentives to reduce their output (yet, this can be mandatory in certain cases by regulation). In the next years, however, as electricity from new geothermal plants will definitely have to be sold in the market (see the switch from feed-in tariffs to feed-in premiums) and as priority dispatch will no longer be guaranteed, geothermal power operators may need to reconsider their business models.

This is particularly true, especially given the risk that increasing share of wind and solar PV may displace other types of plants with higher marginal costs, including geothermal plants. As explained by the IEA,

> ʽat first, only mid-merit plants will be affected, but as [PV and wind] penetration increases, even base-load plants (e.g. nuclear, geothermal, some coal) risk falling revenues and higher cycling costs as they, too, are displaced. If a base-load plant is built in the expectation that it will operate for 7,800 hours per year (90% of the time), the loss of a small part of this operating time could seriously reduce profitability.

In consideration of the above, it is very likely that the above-mentioned factors will affect business models of geothermal power operators. Today, however, there are too many uncertainties for any more detailed forecasts on new business models. Many options could be be explored, from PPA limited to the supply of firm energy only, to flexible PPA in which

[8] A renewable portfolio standard is a mechanism placing an obligation on electricity supply companies to produce a specified fraction of their electricity from renewable energy sources.

geothermal operators decide to moderate output and reserve some capacity for AS and provide when it is advantageous to do so. Eventual new business models will depend on many factors, including further technological developments and the size and nature of the operator. Regarding the latter, while a large electric utility may just want to integrate a flexible power plant into their portfolio so as to handle its own imbalances, an independent producer could decide to reserve part of the capacity to traders and aggregators which can play in balancing markets.

Additionally, one must consider that regulation varies from one country to another, and that balancing markets are currently not always open to all operators and power plants. In this regard, the forthcoming EU package for a new market design, excepted in November 2016, may deeply reform the day-ahead, intraday, and, more importantly for our discussion, balancing markets. Within the framework of that reform, it is expected that shortening gate closure times, clearer, transparent, non-discriminatory pre-qualification requirements for balancing markets, and more dynamic prices reflecting scarcity, will be features expected in all of the European national electricity markets.

4. CONCLUSIONS

This paper has presented the following developments: a) the phasing-out of feed-in tariffs and the upcoming obligation to sell power in the market foreseen by the new EU State aid rules; b) the growing need for flexibility due to the increasing deployment of fluctuating renewables; c) the possibility for geothermal power plants to modulate production and provide AS; d) the forthcoming reform of electricity markets to make them more flexible and fit for renewable energy.

It is very likely that the above factors will affect the business models of new geothermal power projects. Indeed, the current business models based on the expectation that the geothermal plant will operate around the clock may soon be obsolete. But it may be premature to forecast in detail the type of business models suitable to geothermal plants operated in a flexible mode, and in a power system dominated by fluctuating RES in which renewable operators are integrated into the market. Future business models will depend on many factors, amongst which the evolution of the electricity markets in different countries, the size and nature of the economic actors involved as well as the future technological developments.

In future analyses, the evolution of the interplay between all of the above factors should be further assessed, including through more detailed assessments at national and regional levels.

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