Modernising the EU's batteries legislation - Public consultation response

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EGEC is the voice of the European geothermal industry. It is a not-for-profit organisation representing over 120 members across the entire value-chain located across 28 countries. Geothermal energy provides renewable heating, cooling, baseload electricity and sustainably sourced raw materials everywhere. It is included on the European Transparency Register number: 11458103335-07 Further information can be found at www.egec.org.

The sustainable finance regulation is a key opportunity to unlock the access to public and private finance for key renewable energy technologies, allowing the EU to implement its decarbonisation objectives. The implementation of the sustainable finance regulation, the establishment of a sustainable finance framework and the financing of sustainable investment however requires stakeholders to understand the needs of specific technologies that actively contribute to these objectives.

The financing of a geothermal energy project depends on many factors, chiefly technology, type of production and scale. The first takeaway of this publication should be that the right scheme is crucial for the success of geothermal project development. This is true for all geothermal technologies. **Geothermal projects do not require more public support than other renewable technologies, they merely require support to be provided at a level that is aligned with technology and market maturity.** Besides, the financial instruments available to geothermal projects for private or public finance must also be adapted to the specific requirements of geothermal projects.

Due to the cost structure and the requirements of project developments**, geothermal energy project deployment benefits hugely from financing frameworks that emphasise derisking CAPEX.** This derisking framework can take many forms, from grant money in emerging markets for innovative technologies, to private insurance schemes in mature and liquid markets. Here again, tailoring the scheme to market maturity is crucial to ensure it is able to deliver.

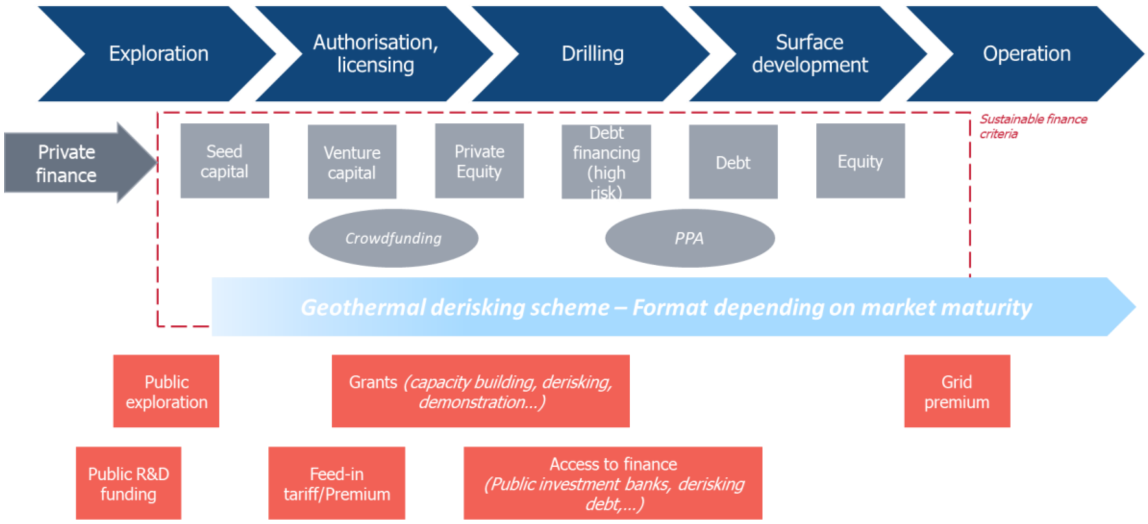
Geothermal energy projects are in general looking at financial instruments that contribute to a reduced financial uncertainty. While this means on one hand derisking CAPEX, it also means securing income. In that regard, **operational support or long-term contracts are crucial.** For geothermal electricity projects, the framework is already well established for securing income on the sale of baseload electricity production. **For heating and cooling, the availability of infrastructure is crucial for the geothermal project** operator to ensure an outlet for the renewable heat or cold produced.

Finally, as the energy sector is increasingly competitive while fossil energy sources continue to benefit from massive and systemic subsidies, **geothermal energy developers are looking to new income streams to increase the profitability of**

projects. These include the provision of flexibility services to the energy system, where schemes for the remuneration of this service need to be put in place. It also includes developing entirely new geothermal products, such as the extraction of strategic minerals like lithium from geothermal brines and signing long term supply contracts with battery factories.

To facilitate geothermal project financing, decision makers need looking at:

- Derisking capital expenditures through schemes tailored to market maturity;
- Reducing income uncertainty through public (FiT, FiP…) or private (enabling corporate PPAs…) instruments;
- Ensure the infrastructure is ready for the deployment of geothermal projects, notably for heating and cooling;
- Schemes to enable marketing the value of providing flexibility to the system by geothermal operators (for power production, storage, demand response…);
- Readiness of the regulatory environment for geothermal operators to propose new services such as mineral extraction from brine;
- New business models are key for the market uptake of geothermal energy technologies, as their cost structure differs greatly from the prevalent ones in the current fossil technology dominated energy system which relies on not including externalities such as carbon costs, and discounting future costs (e.g. OPEX) compared to investments (CAPEX) when assessing the value of an investment.



Comparability: the need for indicators that reflect the value provided by geothermal technologies

At the policy level, a strong emphasis is put on the levelized cost of electricity (LCoE). However, this measure of the cost of electricity is only a partial representation of the value of an electricity project. Typically, the LCoE does not reflect the need for

electricity to be produced at exactly the same time it is needed, and therefore the specific value of flexible and dispatchable plants.
The LCOE is defined as follow:

$$LCOE = \frac{total\ lifetime\ expenses}{total\ expected\ output} = \frac{\sum_t^n \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^n \frac{E_t}{(1+r)^t}}$$

Where:

- LCOE = average lifetime levelized cost of electricity;
- It = investment expenditures in the year “t”;
- Mt = O&M expenditures in the year “t”;
- Ft = fuel expenditures in the year “t”;
- Et = Electricity generation in the year “t”;
- R = Discount rate

Moreover, the sole focus on LCoE tends to ignore the possibility to extract value from heat production in thermal renewable plants (such as geothermal), which may represent a significant amount of heat able to meet the needs of whole neighborhoods. The value of this cogeneration should be reflected when comparing two projects – as well as the quantity of fossil energy displaced not only by the addition of electrical capacity, but by the substitution of fossil heating by renewable heat such as geothermal.
Missing in the above equations are factors that are therefore much more difficult to approximate within a single value, and are therefore often left aside when considering the LCOE of two different technologies:

- Value of the production of heat (compared to alternative when the heat is needed);
- Value of dispatchability and flexibility;
- Externalities (from carbon, air pollution, other environmental impacts).

European funded projects such as GEOENVI and GEOSMART are working to propose indicators that are more relevant to reflect the needs of the evolving energy sector.

Externalities and carbon price: the blind spot of LCOE

Externalities are notably emissions of GHG such as Carbon dioxide (CO2), Sulphur dioxide (SO2) and Nitrogen Dioxide (NO2), but also subsidies to fossil fuels and nuclear, electricity and gas regulated prices. They must be counted and ideally also the security of energy supply should be taken into account;

- Carbon emissions are counted through ETS (but only for the large energy plants)
- SO2 and NO2 emissions are not (except the example of the Swedish pool for No2)
- Gas price for heating: open market

The EU Emission Trading Scheme (ETS) has a conflicting objective of CO2 emissions reduction and promoting low carbon technologies. The current incertitude on its main goal creates the conditions of its ineffectiveness with a CO2 price that is not reflective of the targeted decarbonization trajectory.

The introduction of a system to reflect the price of carbon emissions, or more generally the lifetime carbon impact of alternative projects can also contribute to a better information on the benefits of different investment options in renewable projects. The inclusion of system costs in the pricing of these projects could also reflect their real-world value more accurately. While geothermal projects remain more expensive on an LCoE basis, their value in terms of system services and supply of heat is usually not reflected in this indicator.

Another major distortion in the perceived cost of an energy source linked to LCOE – but also to similar methodologies for "levelized cost" – is linked to the discount rate. With the discount rate, a lower value is put on a cost in the future that in the present. The higher the discount rate, and the further away in the future the cost, the lower it is perceived in the present. This seriously minimizes the perceived cost of operating or cost expenditures in the future, such as the cost of carbon regardless of the price.

As illustrated above regarding the value of flexibility from geothermal technologies to the energy sytems, this service from geothermal energy can represent a very significant part of the LCOE of a project (from 5-100%+). Relevant indicators must include this dimension of geothermal technologies, especially as significant amount of capital are being mobilized to invest in both renewable energy production and flexibility resources. Geothermal projects should be compared with technologies than can provide the same services (this is also true regarding the possible supply of combined heat and power).

Toward innovative schemes

a) grid premium for geothermal electricity?

Capacity and flexibility payments for geothermal power plants

Electricity production from geothermal energy is a renewable, dispatchable and flexible resource. The high capacity factor of existing geothermal plant show that they are currently able to meet the demand of baseload production. Tests on German plants also show that geothermal capacity can be ramped or down in a matter of seconds. These characteristics open the opportunity for geothermal power to benefit from support in the form of a grid premium or capacity remuneration.

In a system where there is an increasingly high share of intermittent electricity production (namely PV and wind power), policy makers are challenged to developed incentives to support technologies that are at the same time compliant with climate imperatives and contribute to ensuring the continuous supply of electricity to consumers. Some options such as capacity remuneration mechanisms (CRM) are being debated as part of the proposal for an electricity market regulation. The purpose of CRM is to provide a payment to a producer of electricity for its capacity to supply power at a given time, to meet imbalances that may arise between production and demand. Grid premium is a more general idea for remunerating flexible and dispatchable – and ideally prioritising renewable - capacity if it has to be displaced by intermittent renewable production.

CRM or grid premium are an interesting support scheme perspective for geothermal energy, as it highlights the specific benefits that geothermal electricity production provides in addition to the simple "capacity" figure. Able to provide baseload power, or to meet sharp ramp or down requirements, the capabilities of geothermal power plants

have a value for the stability of the system. A framework that captures this value and fairly distributes it to the geothermal plants can incentivize the development of a more robust electricity network and spur the development of flexible and dispatchable renewable capacity, notably geothermal electricity.
The value of the flexibility provided by geothermal power plants is difficult to estimate considering the current market structure where this service is not usually rewarded, and the abundance of publicly subsidized fossil flexibility resources (gas, oil power plants), in the price of which carbon externalities are not suitably included. However, some studies allow a conservative estimate of the value of flexibility of geothermal power plants between 15-50 €/MWh1.
For a geothermal power plant selling its output at 40€/MWh, as can be the case in Tuscany considering costs, this may entail an average 10€/MWh net subsidy from the geothermal operator in flexibility costs to the rest of the system.

Market flexibility through system integration

On the other side, geothermal heating and cooling technologies can also derive financing from the provision of flexibility service. First, geothermal heat pump systems can contribute to demand response schemes, where the electricity consumption of appliances is adapted to the grid (i.e. run the heat pump when there is plentiful renewable supply from intermittent source and electricity is cheap, and not when there is more scarcity). Demand response is increasingly considered to reduce the cost of energy for consumers, while being one of the answers to the need for flexibility resources in a decarbonised electricity sector. Geothermal heat pumps are a valuable instrument in that regard, because they allow an interconnection between the electricity and heating and cooling sector, while minimizing the impact on the grid. Indeed, geothermal heat pumps being the most efficient, heating the same area will require between 10-85% less electricity than any other alternative equipment2. The deployment at scale of geothermal heat pumps allows to benefit from demand response for flexibility, while not minimizing the increase in the absolute quantity of electricity needed.

Value Metric	Residential Cooling	Residential Water Heating
Revenue per peak capacity	$5/kW-year	$45/kW-year
Revenue per annual availability	$15/MW-h	$31/MW-h
Revenue per enabled capacity	$3.1/kW-year	$0.7/kW-year
Revenue per unit	$7.4/unit-year	$3.3/unit-year

Table 1. Value to load of demand response options (Source: NREL, analyzing the Arizona power grid)

[1] Approximated value based on the Committee on Climate Change study "Value of Flexibility in a Decarbonised Grid and System Externalities of Low-Carbon Generation Technologies", 2015.
[2] Alternative electrically driven heating and cooling equipment including air heat pumps (which are 10 to 50% less efficient in using electricity to produce heat than geothermal ones) and direct electric heating which uses at least 5 times as must electricity to produce the same amount of heat as a geothermal heat pump would.

The above table highlights the value that can be extracted from the provision of demand response services by shallow geothermal systems – although these figures cannot be translated as such to the European framework considering the greater use of cooling in Arizona and the much lower heating needs that in Europe. They however allow to approximate a range for the value of demand response from individual shallow geothermal systems ranging from 10 – 100+ €/month per household.
Simultaneously, geothermal technologies for heating and cooling also represent opportunities to store energy. This can be done over a few hours (typically what is done with demand response in geothermal heat pumps). But geothermal technologies also have a huge potential for seasonal storage of thermal energy. This is particularly relevant as heat represents about half of the European energy consumption, and winter heat demand may be up to 10 times the electricity peak load. Seasonal storage could therefore enable the European economy to avoid multiplying the size of its electricity capacity (including production and distribution networks) by several order or magnitudes. The right business models can enable seasonal storage from geothermal, for instance UTES or ATES technologies, to provide this service, for instance by storing solar thermal energy in summer, or even excess intermittent renewable electricity production, to deliver heat in winter.

b) Geothermal in a fair competitive market

The structure of the heat market impacts the deployment prospects for geothermal energy projects. A market defined by subsidised fossil fuels will be closed to geothermal energy projects, as there will be huge incentives for actors to reward low investment costs compared to operational costs. On the contrary, in energy markets built around fair competition, which implies including environmental externalities (carbon price) and the value of various services provided such as flexibility, energy storage and so on, geothermal is much more competitive.

- **Fair competition**

Currently, the European heat market is designed around a privileged place for fossil gas, which benefits from a heavily subsidized and extremely granular infrastructure (transmission and distribution networks, publicly funded import infrastructure such as LNG terminals, pipelines), and economic rules and business models that benefit the low CAPEX high OPEX cost structure of fossil fuels (once the huge investment costs and risks for the infrastructure have been socialized through programmes such as the Connecting Europe Facility). For geothermal energy technologies, a restructuration of the heat market design allows to compete through a better access to the heat market via fair competition and the availability of the needed infrastructure for consumers to be able to access geothermal energy.
Gas is the only fossil fuel included in multiple EU regulations. Because of this privileged position it is able to continue to benefit from numerous public subsidies for infrastructure, appliances and consumption. Article 176 of TEFU calls for an internal energy market that ensures security of supply, interconnectivity as well as the promotion of energy efficiency, energy savings and renewable energies. The focus on an internal market for fossil gas goes against these requirements. It prevents the heat sector from delivering cost-effective, reliable and renewable heating, cooling and electricity services in Member States.

- **Heat market design**

The design of a heat market needs to shift the focus from the provision of a commodity to considering the heat market as a competition of service providers. Geothermal heating and cooling technologies can compete with fossil fuel alternatives in many cases, especially for uses with low (e.g. ~50-60°C for space heating) or medium temperatures (80-150°C for business processes). However there can only be fair competition if the comparison of the costs of the two energy sources includes all parameters, notably the cost of carbon and air emissions, the cost of subsidies embedded in the gas infrastructure and discounted from the cost.
Across the European Union, the consolidation of a fair heat market supposes the deployment of a suitable infrastructure to enable the competition of renewable solutions such as geothermal with incumbent fossil fuels that abuse their dominant position. Pricing of the carbon externality is a first factor to contribute aligning the dynamics of the heat market with the principles of fair competition. Mapping available renewable heating and cooling resources is another key requirement of fair competition. For geothermal energy for instance, this may mean a European financing of geothermal exploration campaign.
The heat market, beyond the need for fair competition in line with the European climate and energy objectives, goes beyond the sole comparison of the price of energy services. The value provided to the community is a factor that needs to be reflected by the heat market as well. Geothermal district heating systems are a factor of resilience and mitigation of energy poverty, locking in a fixed price for renewable heating and cooling, with no additional expenses for the community. Geothermal projects are also responsible for important direct, indirect, and induced job creation, notably when they enable new businesses with the provision of renewable heat. Geothermal heat pumps can also contribute to increasing the value of buildings, ensuring low operational costs (i.e. heating and cooling bills).

- **Heat grid & infrastructure**

To enable a fair and competitive European heat market, which allows the market uptake of renewable heating and cooling technologies such as geothermal energy, infrastructure is a crucial factor. The fossil gas market is enabled by decades of public investments in an expensive infrastructure, from transmission pipelines to distribution networks. In recent years the Transadriatic Pipeline, the NordStream and the tremendous buildup of subsidized LNG terminals are examples of the huge amount of public resources into fossil assets. They are also a testament of the vulnerability of the European Union to geopolitical disruption in fossil fuel supply. Renewable heating and cooling prevents these issues.
To be able to compete, renewable heating and cooling solutions such as geothermal require the availability the relevant infrastructure. This includes soft infrastructure such as the knowledge of resources available (e.g. financing geothermal exploration across Europe), and hard infrastructure such as the availability of heating and cooling grids and equipment to deploy geothermal energy projects (e.g. drilling rigs). There needs to be a shift at the European level on the understand of what consititutes an investment in the completion of the internal energy market (enabling the market uptake of renewable solutions, notably in heating and cooling), compared to what is undue state aid (financing any project that may lock-in fossil fuel consumption.

Contact:
Thomas Garabetian // Senior Policy Advisor
t.garabetian@egec.org // T. +32 2 318 40 62