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Strategic Planning for Geothermal Utilization at the Eurometropolis of Strasbourg

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ABSTRACT

There are currently several geothermal projects under various stages of development on the territory of the "Eurometropolis of Strasbourg"[1] (the "EMS"). Although the high tariff for electricity from geothermal has been an important factor for encouraging investment in these projects, it also appears to be a barrier for direct use of the resource at local level. Overseeing the organization of energy related matters and facing various challenges related to the energy transition, the EMS has been seeking ways to integrate these projects to enable the territory to benefit from this local renewable source of energy. Various players could potentially be involved in the direct use opportunities, which makes the development of a strategy at the community level even more complex. This paper proposes an overview of the strategic planning study conducted in 2018-2019 to find ways to integrate the geothermal power projects for direct use purposes at local level.

As part of the "Strategic study and assistance to the community on the exploitation of geothermal energy on the territory of the Eurometropolis of Strasbourg" carried out between May and October 2018, Verkís, cabinet of Icelandic consulting engineers, and its partners BBA, Intellecon and Public Strategies had as their mission to assist the Eurometropole in the planning of the exploitation of geothermal energy in the short, medium and long term. The paper presents the main findings of the study and how strategic planning was developed to better integrate geothermal projects on the territory.

1. INTRODUCTION

While today many elements indicate that the deep geothermal resource is available and could be exploited profitably on the territory "EMS", the question remains with regards to benefit to the local population through direct use of the geothermal resource to contribute to EMS's environmental targets: 100% renewable energy target for 2050, 40 % GHG emissions reduction in 2030 and a radical improvement in local air quality.

France has committed to a 2050 carbon neutral target in line with the 2015 Paris climate agreement. The use of renewable energy should reach at least 32% in 2030. These 2050 goals have been endorsed and even challenged at local level by the city and its urban area. Geothermal energy has been harnessed in France for production of electricity at Bouillante in the Caribbean and for district heating in Paris for some time now. The country has however not yet seen cases where geothermal resources could be exploited for multipurpose, i.e. both for production of electricity and heat or other purposes. In this sense, the territory of Strasbourg is a unique case in France with potential projects located at the heart of a densely populated area in a context of continental climate, i.e. with a heating period of up to 200 days.

Until now, public policy has focused on the use of geothermal for electricity production with tools such as feed-in tariffs and risk funds. This political will at the national level is opposed by the reality of local conditions. Residential and tertiary buildings in the Strasbourg area have annual heat requirements of around 4,700 GWh (reference 2017). Although the current trajectory of local policies suggests a positive impact and a decrease in these needs in the long term, especially through the objectives of the local sustainable energy action plan (Climate Change, Air Quality and Energy Plan, PCAET), of 30% energy reduction from 2012-2030 and the target of 100 % EnR in 2050, the heat needs of the community will remain substantial by 2050.

The energy transition will obviously require a mix of renewable energies. The capacity of the geothermal resource is not yet proven but a first draft of Strasbourg's Energy Masterplan estimates that up to 20% of the 2050 heat needs of the territory could be covered by geothermal energy, if accompanied of a 50% energy consumption reduction. However, the EMS seems ill-equipped to promote the massive use of geothermal energy in heat mode, mainly because of the conditions in which heat networks have developed and are now exploited. Firstly, the heat networks of the territory are numerous, resulting in multiple actors operating these systems, some private other semi-public. Secondly, although presenting consumer prices quite in line with the national average, existing heat prices offer very little room for manoeuvre to integrate the thermal use of geothermal energy in the face of very high-yield electricity production. Finally, the fragmentation of networks and their distribution can in some cases make it difficult to create ideal conditions for a market at the local level that is adequate for the promotion of thermal renewable energies. This last point is however mitigated by the fact that the EMS has the authority to organize the energy matters on the territory of Strasbourg and can take part in the organization and operation of the main existing networks and can influence their development. Therefore, the EMS has in this context a margin of manoeuvre which, although relatively limited, could favour the creation of favourable conditions for the use of geothermal

[1] Strasbourg's urban area local government

energy locally. As an authority organizing energy on the territory, it could effectively contribute to making the link between geothermal operators and users.

What follows is a description of the context of the geothermal projects under development on the territory of the EMS and a preliminary estimate of the potential uses for various cases. The paper concludes on how geothermal could be better integrated on the territory for the benefit of all.

2. CONTEXT

2.1 Energy Strategy of the EMS

In 2017, the EMS (500 000 inhabitants, 340 km²) consumed up to 12,000 GWh of final energy. This figure falls in the ballpark of the average energy consumption of European cities, however overall trend shows little signs of improvement. As a result of this, curbing energy consumption and accelerating the implementation of renewable energies has become a top priority of EMS's energy strategy.

As part of France's national climate strategy, the EMS has developed a "Territorial Climate Change, Air Quality and Energy Plan" (PCAET) for 2030 with the following targets:

- To reduce energy consumption by 30% by 2030 (compared to 2012 baseline)
- To reduce greenhouse gas (GHG) emissions by 40% by 2030 (compared to 1990 baseline)
- To increase the share of renewable energy to 40% in gross final consumption by 2030.

Additionally, the EMS voluntarily committed in 2018 to achieving and exceeding these national climate and energy targets: the local government's council voted unanimously a proposition to become a "100% renewable energy" territory by 2050. This includes reducing energy consumption by 55% (compared to 2012 baseline) and reducing GHG emissions by 90% (compared to 1990 baseline).

The cornerstone of this strategy is Strasbourg's Energy Masterplan (*Schéma Directeur des Energies*, SDE). This strategic roadmap was under preparation in 2019 when this article was written and aims at proposing tools to achieve massive reductions in energy consumption, a large development of renewable energy sources as well as a revamp of all energy grids (electric, gas and district heating).

In this framework, the SDE estimates that deep geothermal energy should account for at least 20% of the city's energy demand in 2050, which equates to an exploitable potential of around 1000 $GWh_{,th}$ / year (the equivalent of approximately 8 geothermal power plants connected to a single geothermal doublet in a similar conditions as the projects under development on the territory)

For the time being, three geothermal projects are under development in the territory:

- The GeoVen project in Vendenheim;
- The GeoEck project in Eckbolsheim; and
- The "ES Geothermal - Illkirch-Graffenstaden" project.

These projects are currently in various stages of development and have different characteristics not only according to the resource but also because of various local components. However, they prove to be key projects for the realization of the energy transition of the EMS. Section 3 of this paper gives an overview of the potential production modes that could be achieved on these projects.

2.2 District Heating in the Territory of Strasbourg

When planning for district heating it is important to make sure that there is a sufficient density of potential users in the immediate vicinity of the project, among other things, in order to limit the costs associated with the transmission of energy to users. Other factors are also important such as energy density or the distribution of annual demand. These are all factors that need to be considered in detail and case by case in the detailed evaluation of a project.

For the projects currently being developed in the EMS and given the thermal powers involved in each doublet, the development of a heat network capable of distributing energy to potential users would be the most practical solution. The other solution would be to encourage the establishment of an industry that could benefit from the use of geothermal energy nearby with a stable year-round demand. The case of the Rittershoffen geothermal power plant (60 km north from Strasbourg) developed by ÉS Géothermie with the main purpose of supplying heat to the "Roquette Frères" biorefinery is an example of this type of developer / industry synergy. A similar approach could be considered on a site such as the Ecopark Rhénan if the project is developed. In general, it is ideal to obtain a high thermal demand density in order to make the development of such a system as profitable as possible and ultimately as economical as possible for the users.

The distance between direct use projects of geothermal energy and their potential market could be an obstacle as it may not be economical to transport hot water over long distances. The economic radius will depend on the parameters affecting the investment costs, i.e. the pipelines and equipment, and the operating costs related to heat loss, pumping costs and others.

Finally, the direct use of geothermal resources is highly dependent on the local climate, the characteristics of the geothermal resource and the local market. However, the efficiency of geothermal direct-use applications can be quite high, especially when different uses are combined in an integrated or cascaded arrangement. It should also be taken into account that in the case of existing heat networks the heat use regime may not be fully compatible with the recommended regime for geothermal energy, and that the direct use may require modifications of existing user-level networks or system engineering to combine high-temperature users with low-temperature cascading users.

Various entities currently provide heat to the various users of the territory, among others:

- Gas (and fuel-oil) boilers for decentralised solutions,
- Various small renewable solutions (geothermal heat pump and wood boiler <3 MW) scattered throughout the territory for decentralised solutions,
- Gas boilers and cogeneration for district heating,
- The biomass cogeneration "Strasbourg Biomasse" in the east for “Elsau” and “Esplanade” district heating,
- The biomass boiler for “Waken” district heating,
- The waste-to-energy plant.

A few factors will have to be considered to eventually supplant the use of heat from the non-renewable entities and boost the use of geothermal heating. The competitiveness of the energy in question is obviously a factor, but also the legal aspects in the context of concessions, as well as technical aspects such as temperature regimes or the ease of adaptation of existing systems to new parameters.

The district heating operators are other important players. The "Master Plan for Heat Networks" document (Naldéo, 2017) provides an overview of these actors, who appear to be numerous and varied in size, energy supply and type of clients.

There are semi-public or public operators under public service concession including:

- Three EMS-owned networks in: Hautepierre, Elsau - Esplanade (to be merged in 1 network “Strasbourg Centre” in 2021-2022) and Waken
- Waste-to-energy: cogeneration from the incineration of household waste, managed by the Eurométropole in the framework of a waste management public service concession. This concession includes a 10 km feeder towards Elsau district heating that also feeds two boilers of a public housing company.

There are heat networks managed by private operators, among them:

- Three fairly large networks: The Ried, Cité de l'Ill and Tanneries;
- Other island-type networks with various profiles, for example, public housing companies (SIBAR, Habitation Moderne) or systems intended to serve only a few buildings.

Last but not least are the potential users of geothermal energy who are key to the success of any project. Their interests are diverse, ranging from the financial aspects of purchasing and using energy to environmental considerations. When developing heat networks, public or private entities with a large potential number of users are important players. The following entities can be cited: CUS Habitat, SERS, University of Strasbourg, Trade Union Association of the Esplanade Residential Complex, Elsau Residents' Association, Strasbourg Hospitals, Habitation Moderne, etc.

In conclusion, the context for the development of district heating in Strasbourg is fairly complex due to the number of stakeholders and due to the lack of interconnection between existing systems enabling a massive connection to geothermal.

Other considerations play a heavy part for the development of geothermal utilization for local purpose as is presented in the next section on the economic context.

2.3 Economic Context

2.3.1 Electricity Tariffs

Compensation for geothermal electricity is governed by the tariff decree of 13 December 2016 published in the Official Gazette of 14 December 2016 setting the conditions for additional remuneration for electricity produced by installations primarily using energy extracted from geothermal deposits as referred to in paragraph 5 of Article D. 314-23 of the Energy Code. According to the formula for remuneration, the value of geothermal electricity should range from € 354 / MWh to € 147 / MWh over the first 20 years of any project, see Figure 1 below.

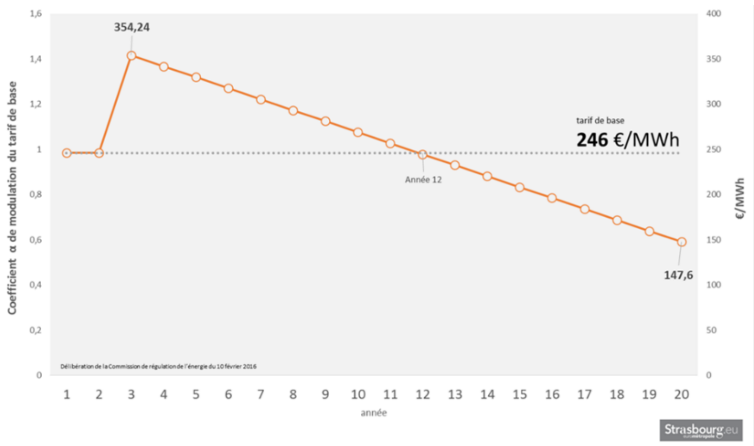

Figure 1: Electricity tariffs according to the 2016 tariff decree.

It should be noted that these pricing conditions are particularly advantageous compared to those proposed in other countries where the rates are currently between 80 and 200 € / MWh (World Energy Council, 2016).

These last figures are to be looked at in the context of the installation costs of geothermal power projects, which generally vary between 2,000 and 10,000 € / MW of installed electrical power. Projects involving binary technology and / or requiring drilling at great depths -as is the case in Strasbourg- are often in the high range of installation costs. In this context, the advantageous tariffs proposed at national level play a key role in the development of such projects.

In this context, the priority of developers of geothermal projects is therefore to produce electricity, the remuneration of electricity allowing a quick return on investment.

2.3.2 Heat price

With regard to the prices of thermal energy, the price of heat paid by the subscriber to the network operator takes into account several variables such as the cost of energy, the costs of operation and maintenance and the depreciation of equipment. The bill to subscribers generally includes a variable part related to the cost of energy and a fixed part related to the fixed costs of development and operation of the network.

In general, geothermal projects are different from conventional projects due to the fact that investment costs are relatively high while energy and operating costs are relatively low. Indeed, a geothermal project requires drilling that weighs heavily on investment while a conventional project will require only investments related to energy production technology. On the other hand, once the drilling is completed, a geothermal project will have very few costs related to the purchase of fuel or energy for its operation compared to a conventional project.

Being inherently linked to the characteristics and the energy mix of each network, the rates of thermal energy can be very different from one heat network to another. For the Strasbourg region, the order of magnitude of the price of thermal energy is 70 to 100 € / MWh, varying according to networks and years. Although only indicative, this order of magnitude is significantly lower than the purchase price of the megawatt-hour of geothermal electricity.

The operators of heat networks have thus little room to include geothermal energy because of low heat rates. In this context, geothermal heat generation competes with high-cost electricity generation and heat generation from conventional sources, making its integration for the benefit of the local population even more complex.

2.4 Legal aspects

Several legal obstacles to the use of geothermal energy in heat networks have been identified, both in terms of supply and demand.

On the supply side, the main obstacle remains competition from the high remuneration for electricity from the exploitation of geothermal resources as discussed above. This high remuneration, set by ministerial decree to encourage the non-existent deep geothermal sector, has prompted project promoters to focus exclusively on electricity generation. Yet, thanks to its mandate, the EMS has the legal authority required to better integrate geothermal for the benefit of the local population. Various ways to overcome this problem are being investigated as illustrated by the “Memorandum of Understanding” on the Illkirch project concluded between Electricité de Strasbourg and the EMS that proposes the implementation of various heat removal obligations from geothermal sources at the expense of future operators of the heat networks concerned. Despite this, the current situation remains complex, with no real incentive to promote the utilisation of geothermal at local level.

For instance, the EMS has no control over the conditions under which the so-called “exclusive research permits” and concessions are granted, the latter being issued by the State pursuant to the Mining Code. The EMS has therefore no leverage to impose heat production as a condition for issuing the mining permit. In addition, the difference in treatment between high temperature and low temperature geothermal energy, in the context of issuing mining permits, can make it difficult to develop geothermal projects for heat production. Project promoters also face a legal and financial problem specific to geothermal projects. Banks are very reluctant to finance the first exploration well. In some cases, however, they agree to refinance the equity invested for the realization of this first well. Project promoters must therefore be able to provide significant capital at the start of the project and bear the risk that arises. They may also, in some cases, benefit from public funding provided by ADEME (French agency for the implementation of public policy in the areas of the environment, energy and sustainable development) or the “Grand Est” regional government either for promoting renewable energy or for mitigation of risk in the drilling phase.

It also appears that the use of geothermal energy in heat networks was not mandatory in 2018 in the specifications of the existing public service concessions. The EMS has however the tools necessary to give way to integration of geothermal energy when renewing concessions as such entities could be key to the integration of geothermal at local level. As for the end users, the EMS seems to be able to use the urban code (*PLU, Plan Local d’Urbanisme*) as a lever. As it stands, the local urban code provides only for an obligation to favour connection to a heating network. Changes to the exiting code are under consideration to create better incentives for systematic connection to district heating.

3. POTENTIAL UTILISATION

Several modes of exploitation of geothermal energy can be envisaged on the territory of the EMS to produce electricity and / or heat. In a general manner, the use of geothermal energy will be done in a closed loop through geothermal doublets. The information currently available on the geothermal resource of the territory indicates that the binary cycle would be the most profitable technology to exploit the resource for electricity production.

Another application of geothermal energy is the direct production of heat to supply local heat networks. Since heat production does not require enthalpy levels as high as power generation, it is possible to consider producing heat in cascade to recover waste heat simultaneously on the cold end of the power cycle. However, based on preliminary estimates of the recovery of the waste heat from the electrical project which would be carried out mainly on the cold part of the electricity production, it was concluded that such a cogeneration scheme would not be viable because of its impact on the electricity generation cycle. In fact, losses on the cycle would lead to loss of revenue that could hardly be replaced by compensation at an equivalent level by producing heat given the current heat market on the territory. Furthermore, the heat cogenerated would also be a low-temperature energy, at about 45°C, which is difficult to exploit on current heating networks and with the heating mode of existing users.

In this context, it was concluded that the mode of heat production that should be favoured is co-production, that is, heat production in parallel with electricity production and not in cascade as in the case of cogeneration. This model seems, as far as the resource is currently identified in Strasbourg, to allow for the production of heat with a smaller impact on electricity production than in the cascade model.

On the basis of these observations and the information collected for the purpose of the study, four scenarios were assessed with regard to various conditions and production modes:

- Scenario 1 - 100% electricity: this scenario considers the production of electricity from a doublet drawing from a geothermal resource at 5 km depth at a temperature of 200 ° C.

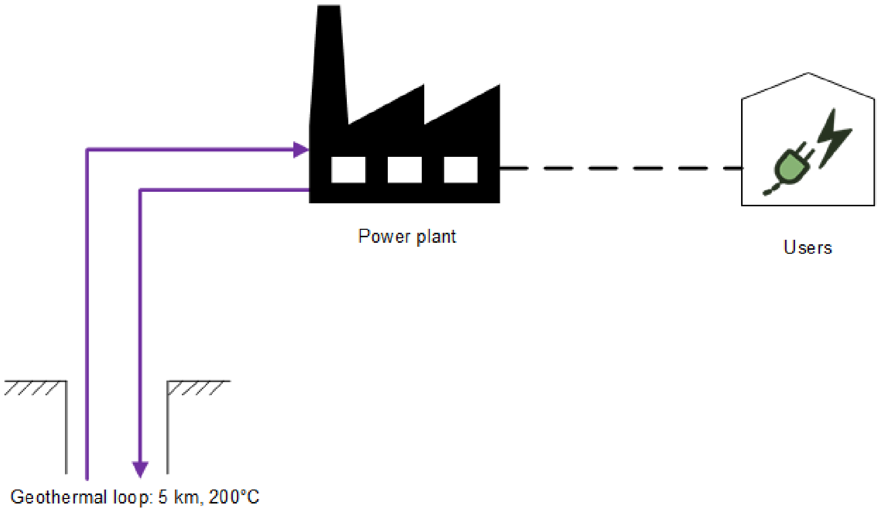

Figure 2: Scenario 1 – 100% electricity: Simplified production schematic

- Scenario 2 - 100% heat, deep well: this scenario considers the production of heat from a doublet drawing from a geothermal resource at 5 km depth at a temperature of 200 ° C.

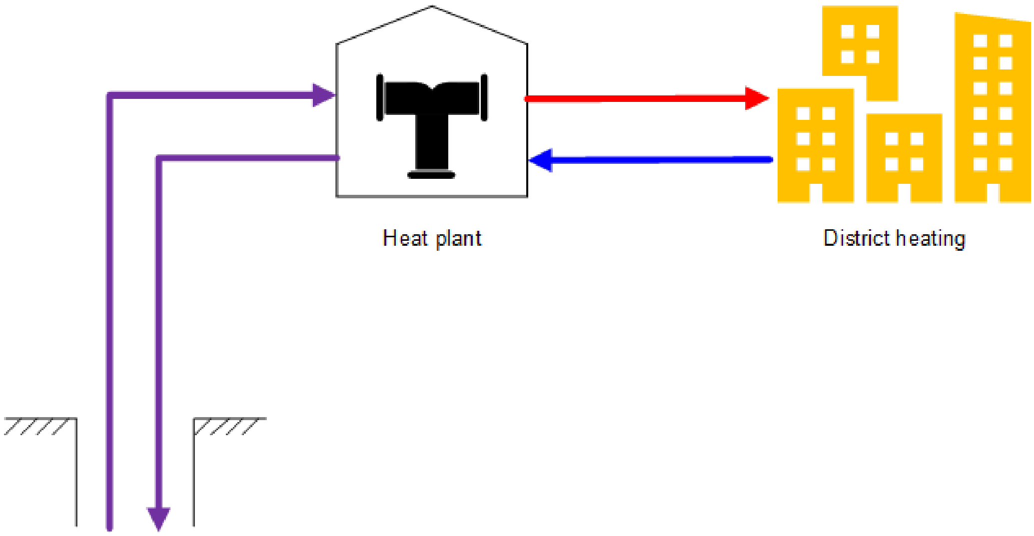

Figure 3: Scenario 2 - 100% heat, deep well: Simplified production schematic

- Scenario 3 - 100% heat, shallow well: this scenario considers the production of heat from a doublet drawing from a geothermal resource at 3 km depth at a temperature of 120 ° C. Such a scenario seems likely given the studies already conducted in the territory indicating the possibility of such a resource accessible at this depth.

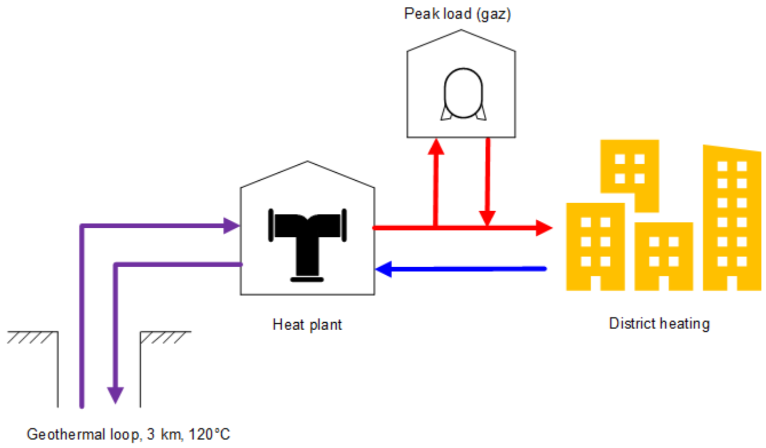

Figure 4: Scenario 3 - 100% heat, shallow well: Simplified production schematic

- Scenario 4 - Co-production heat / electricity: this scenario considers the production of electricity and heat a mode of co-production, ie in parallel on the geothermal doublet drawing in a geothermal resource at 5 km depth at a temperature of 200 ° C.

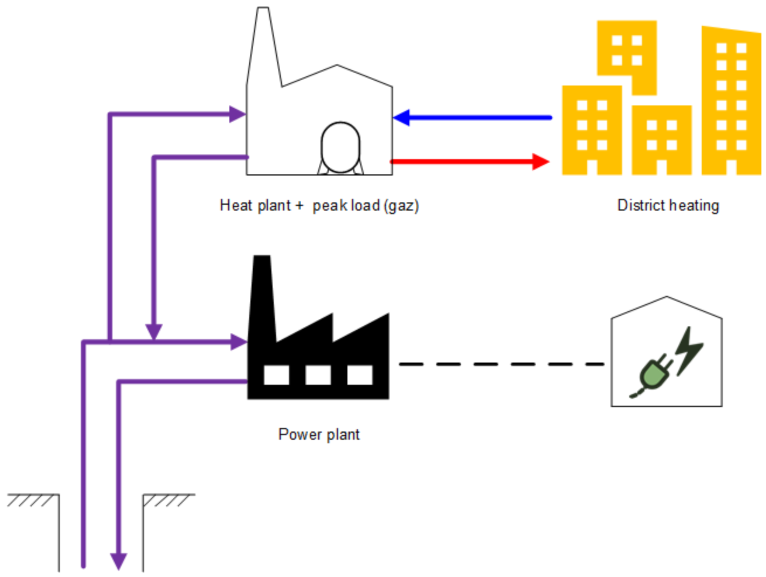

Figure 5: Scenario 4 - Co-production heat / electricity: Simplified production schematic

Table 1: Comparison of the energy extraction and production for various production cases

Case/scenario		**1 - 100% electricity**	**2 - 100% heating, deep wells**	**3 - 100% heating, shallower wells**	**4 - Co-production of heat and electricity**
Annual heat production	GWh_{th}/yr	-	108	61,8	76
Annual heat for electricity production	GWh_{e}/yr	331	-	-	255
Annual heat extraction from resource	GWh_{th}/yr	331	108	61,8	331
Annual heat production, geothermal energy	GWh_{th}/yr	-	108	61,8	75,8
Annual heat production, peak load	GWh_{th}/yr	-	-	3,3	4,0
Heat production, 1st year	GWh_{th}/yr	-	108	65,0	79,8
Electricity production , 1st year	GWh_{e}/yr	48,0	-	-	37,0

Among other things, the study concluded that projects only aimed at producing heat were unlikely to become competitive in the near future in light of the current heat market. The so-called co-production schemes are on the other hand interesting options that appear to be worth investigating further, not only because they enable developers to diversify their source of income while ensuring a high return on interest on their investment with heat and electricity prices that remain fairly competitive on the renewable energy market. For the EMS, such scheme would present the advantage of providing heat from local renewable energy resources and contributing to the energy transition of the territory. A rough comparison of the various production schemes investigated it presented in the table below.

As shown in the table above, the co-production scheme also enables to optimize the energy extraction from the resource.

4. STRATEGIC PLANNING FOR BETTER INTEGRATION OF GEOTHERMAL PROJECTS IN STRASBOURG

The study demonstrates that geothermal energy has a real interest for the territory. However, as outlined previously, there are several obstacles to massive development of geothermal heat networks. A first estimate, based on unconfirmed data for the geothermal resource, indicates that the projects under development could provide approximately 300-400 GWh with a coproduction scheme.

Geothermal energy also seems ideal because of its low carbon footprint compared to other renewable energies already used in the territory and the fact that the other renewable resources for the supply of heat networks are already under tension. Finally, considering that the current estimates of the SDE for geothermal energy indicate that 20% of the heat needs of the territory could be covered by geothermal energy, the 100% EnR objectives of the EMS by 2050 are impossible to achieve without the planning of the use of geothermal energy in a perspective of collective heat distribution.

Nevertheless, the fact that developers are private and support mechanism for deep geothermal sector are poorly adapted to the needs of the territory are real drawbacks. Indeed, the sector's feed-in tariff makes it impossible for the territory to buy heat at a competitive price for the first 10-15 years of a ORC-equipped power plant. Additionally, the widespread public-private montage used to build and run district heating (DSP, or public service concession) is not adapted to the integration of deep geothermal energy in its actual configuration.

The development of an economic strategy seems essential to create the necessary conditions for the deployment of geothermal energy for the benefit of the territory. This approach could be focused on preliminary negotiations between the local government and the geothermal producers regarding heat withdrawal. These framework agreements could facilitate the adoption by the industrial stakeholders of coproduction schemes.

Negotiations should be framed in a context where local government has been empowered as the main local energy stakeholder. This empowerment includes financial capacities that allows the local government to build energy infrastructure. For instance, a public financial engineering to build connections between private producers and users can provide several benefits for the territory. Various possibilities that would enable the EMS to implement a massive use of geothermal energy adapted to the needs of the territory were assessed. These possibilities are listed below with the aim of clarifying the possible approaches even if all were not retained:

- Urban Code (PLU) and other regulatory tools: Article 15 of the PLU only incentives the connection of new buildings to neighbouring district heating but does not mandate it. Therefore, ideal economic conditions for the massive development of district heating networks are not created. A revision of this PLU article is planned for 2019 and a new approach regarding DH connection as well as tougher requirements for multi-storey buildings (i.e. banning individual boiler solutions) is under study. This could benefit heating networks in general and geothermal energy in particular.
- Subsidies: In the absence of financial leverage to make geothermal energy competitive with other sources of energy on the heat market, one could consider the creation of a fund to subsidize the infrastructure needed to connect users to geothermal power plants. The EMS cannot in the present context provide subsidies. However, it would be possible to consider a heat subsidy application, such as the Fonds Chaleur promoted by the Ademe, to connect heat networks to geothermal power plants.
- Mutualisation of heating networks: In the absence of the possibility of setting up specific taxes that could be implemented for the energy transition, the EMS could make the investment between the projects and the distribution networks, as well as connecting existing networks in order to provide inter-networks heat exchange. This would provide the EMS control over a key element of the supply of energies to the heating networks and a new role as a heat distribution watchdog. It would be possible for this to be inspired by the models of various local public services with a depreciation over 50 years (as for example the sewage networks) in order to curb the impact of the infrastructure on final energy price. This calls for a reorganisation of the local government's services as well as budget management.
- Finally, it seems important to promote the use of geothermal energy (and district heating) for purposes other than the heating of buildings, with industrial applications. The EMS has set up an ambitious program in relation to the green economy and it seems obvious that the dialogue on geothermal energy also has its place at this level.

More concretely, the following tracks have been evaluated and were under consideration at the EMS when this article was written:

1. Negotiate and create favourable conditions for the production and sale of heat for all stakeholders;
2. Public financial engineering specific to the EMS for the construction of connexion feeders;
3. Development of heat recovery and interconnection between existing district heating systems;

Empowering the local government as a major financial actor in the local ER sector. A specific tool (publicly-owned company, dedicated budget, etc.) with an exclusive dedication to the renewable energies sector could facilitate the construction of new networks or access the equity capital of project's SPV.

5. CONCLUSION

Strasbourg is the frontrunner in the development of deep geothermal power in France and its case study has revealed the limits of some existing national and local energy policies. This study's main purpose was to find ways to integrate this local resource to a local reality, but its conclusions could be useful to fine-tune the approach to deep geothermal power at a national level.

The analysis of the geothermal projects under development in the EMS perimeter has highlighted the importance of this renewable resource for the territory's local energy transition. The EMS estimates that deep geothermal energy should account for at least 20% of the city's energy demand in 2050.

The exploitation of Alsatian geothermal resource, however, requires very high upfront investments (deep wells, ORC turbines). To promote the industrial development of the deep geothermal sector, the French national government proposed a generous feed-in tariff scheme for electric production that regrettably backfired on local heat demands. Effectively, local district-heating systems cannot compete financially with electricity prices during the duration of the feed-in tariff agreement.

This study highlighted the fact that there is a way of satisfying both industrial and territorial needs: coproduction. The model of heat production directly from the geothermal resource, in parallel to the production of electricity, seems the most favourable scheme from an economic point of view. Nevertheless, this alternative mode of exploitation asks for a series of adaptations from a multi-level perspective :

- Central government, as deep geothermal projects and feed-in tariffs regulations should be coordinated with host territory's local government,
- Industrial stakeholders, as their exploitation schemes should be compatible with the energy transition strategy of the host territory,
- Local governments, who should be empowered as a major energy transition stakeholder and provided with financial capacity to make strategic investments (such as heat feeders connecting geothermal power plants and existing district heating). This bottom-up governance could assist national governments in drafting more accurate policies to effectively deploy Energy Transition measures such as the promotion of deep geothermal energy;
- Local energy planning, as all of these geothermal projects share fact that potential direct users of geothermal energy are essentially users connected to an existing or potential heat network. Stakeholders are numerous and the missing link to allow the implementation of a local use of geothermal energy is the connection between geothermal projects and distribution heat networks via feeders. The establishment of an interconnection system between all heat networks as well as with the geothermal power plants could help to overcome this problem but calls for changes of governance in many levels.

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