Regulatory frameworks for geothermal district heating: A review of existing practices

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ABSTRACT

The potential of geothermal district heating is significant. Yet, regulatory and financial barriers hamper its large-scale deployment. This paper will present part of the work carried out during the IEE project 'GeoDH'.

Through case-studies from Hungary, Italy, and Denmark, the objective is to identify what are the very favourable regulatory conditions for the development of geothermal district heating technology in Europe and what is considered to be a barrier. Finally, a number of general recommendations are proposed for national, regional, and local policy-makers.

1. INTRODUCTION

'Geothermal district heating or district cooling' (hereinafter geo-DH) is defined as the use of one or more geothermal production fields as source for the supply of thermal energy through a network to multiple buildings or sites. The methodology used for the EGEC Geothermal Market Report includes greenhouses and geothermal heat projects above 500 kWth in this definition. It also includes geothermal systems supported by heat pumps as long as the heat produced is distributed via a pipe network to more than one building or site.

District heating is the geothermal market segment with the most dynamic development and the most interesting perspective in Europe in the coming years. In 2015 there were 257 geo-DH plants (including cogeneration systems), 177 of which were located in the European Union. The total installed capacity in the EU-28 amounted to around 1.5 GWth, producing some 4,300 GWh of thermal energy (European Geothermal Energy Council, 2016). However, based on the identified potential, some 25% of the EU population lives in an area where geo-DH is an option for the future heat supply (Connolly et al, 2012).

A geo-DH system is composed of three major components (Fig. 1). The first part is the heat production, which includes the geothermal wells, the heat exchanger and/or heat pumps (elements marked 1-2-3-4-5 on Fig. 1). The second part is the transmission/distribution system, which delivers the heated water to the consumers (element 7). The third part includes central pumping stations and in-building equipment. Geothermal fluids may be pumped to a central pumping station/heat exchanger or to individual heat exchangers in each building, depending among others on the water chemistry. Thermal storage tanks may be used to meet variations in demand.

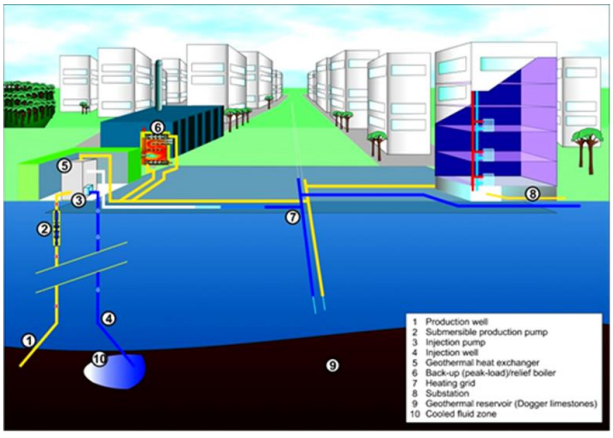

Fig. 1: Main components of geothermal district heating system. Source: GEODH (2014). Copyright: GPC IP (France).

As a typical deep geothermal project, a geo-DH system is developed in several phases, such as a) exploration; b) resource development; c) construction of plant and network; d) commissioning and operation. Each of these phases requires one or more permits and the compliance with a range of national and local rules. The whole regulatory set-up should be as transparent and balanced as possible in order to ensure, simultaneously, the sustainable use of the resource, confidence in the technology, and investment security.

This paper presents the regulatory framework in Hungary, Italy, and Denmark, with the objective to identify favourable and unfavourable regulatory conditions for the development of geo-DH in Europe. Based on these case studies, a number of key recommendations for policy-makers are put forward. Such assessments were carried out during the project 'Developing Geothermal District Heating in Europe' (in short, 'GEODH'). The project was co-funded by the European Union through the Intelligent Energy Europe programme.

2. REGULATIONS FOR GEOTHERMAL AND THE DISTRICT HEATING SECTORS

Public intervention is often perceived as a way to control and restrict behaviour, but in several cases it is an essential enabler. The mere existence of a licencing or authorisation procedure is an example of how governments can enable an economic activity. In the geothermal sector, a true license provides exclusive rights within a certain area and for a given time period, thereby ensuring investment security. Additionally, a licencing regime tends to clarify issues such as who is eligible to obtain a permit, who are the licencing authorities, how many steps and the time the process involves, the exact time period for which a license can be obtained and extended, if royalties are required, and under what parameters, etc.

The type of permits a project developer must obtain and the respective procedures to follow depend primarily on the definition and classification of geothermal resources. Being an underground resource, the administrative procedures relevant for geothermal stem from a long history in mining and are in many cases part of a wider legal framework intended for coal, hydrocarbons, etc. A licencing regime for deep geothermal usually consists of a two-step process requiring an exploration and a production license. In addition, a number of other permits could be required during these two phases. These permits allow the public authorities to ensure that the project is performed in a safe and environmentally sound way and fulfils all public participation and consultation requirements.

As for every industrial activity, some potential adverse effects from a geothermal project exist (such as gaseous emissions, induced seismicity, ground subsidence, noise during the construction phase, and/or temperature anomalies in the subsurface and/or the groundwater). These potential impacts vary depending on the geological settings, size and type of resources and applications, etc. and can be minimised by sound practice, technology developments, the need for environmental permits, and the compliance with all environmental regulations.

In the European Union, the body of environmental legislation is very comprehensive. The most relevant EU directives for geo-DH are the following:

- Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive);
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (SEA Directive); and
- Directive 2000/60/EC on establishing a framework for Community action in the field of water policy (Water Framework Directive).

The environmental impact assessment (EIA) is a process aiming to ensure that the environmental implications of decisions are taken into account before decisions are made and executed. It is acknowledged universally as a crucial instrument for the protection of the environment and the application of appropriate preventive measures [Thieffry, 2015: p.639].

A full EIA must comply with the minimum requirements set out in articles 5-10 and Annex IV of the EIA Directive. In a nutshell, an EIA report must demonstrate in an appropriate manner that the project does not have, directly and indirectly, significant negative effects on the following factors:

- population and human health;
- biodiversity;
- land, soil, water, air and climate;
- material assets, cultural heritage; and
- the landscape.

In addition, a minimum 30-day public consultation must take place, which is a key part of the process. The competent authorities examine the report and the relevant information received in the framework of the consultation and issue a reasoned conclusion which is integrated in the development consent decision. Only following these procedures, the developer can be entitled to proceed with the project.

This is, in general, a very demanding exercise, especially for small and medium-sized enterprises. However, not all deep geothermal projects are required to go through such a strict process. Indeed, according to the EIA Directive the national authorities have the choice to determine which deep geothermal drilling projects are subject to a full EIA process (Art.

4(2) and Annex II). Such determination is done on the basis of thresholds/criteria or on a case-by-case examination (screening). This is why, despite a common EU framework, the rules in the 28 member states may differ.

An energy plan including a geothermal district heating project can also be subject to an impact assessment. As a matter of fact, the SEA Directive extends the evaluation of the environmental impact to certain plans and programmes adopted by a national, regional or local authority. This takes place, however, only when such plan or programme is required by legislative, regulatory or administrative provisions.

As far as the protection of water quality and quantity is concerned, the Water Framework Directive represents the main piece of legislation on the matter in Europe. It requires member states to implement the necessary measures to prevent the deterioration of the status of all bodies of surface and groundwater. Concerning the latter, for which pollution prevention and quality monitoring and restoration are more difficult mostly due to its inaccessibility, the directive takes the precautionary approach and establishes a general prohibition on direct discharges to groundwater. An important exemption is however provided for geothermal energy: in this case member states are given the option to authorise reinjection into the same aquifer, provided it does not compromise the environmental objectives of the directive (Art. 11). It is therefore within the competence of the national governments to decide as to whether reinjection of the geothermal fluids is allowed or even required.

Regarding the district heating sector, the existence of common EU rules is not as developed, most likely due to the fact that the current and historic use of district heating varies greatly from a member state to another. District heating is generally an infrastructure, which allows for the use of different heat sources (including from geothermal reservoirs) that would otherwise not be used and that can save primary energy and contribute to replacing fossil fuels. For this reason, this sector is mainly covered by Directive 2012/27/EU on energy efficiency (Energy Efficiency Directive).

The Energy Efficiency Directive requires accurate metering reflecting actual energy consumption for all new buildings, buildings undergoing major renovations, and all buildings supplied by district heating when this is cost efficient and technically feasible (Art.9). More importantly for the development of geo-DH systems, the directive has established an EU-wide definition of ‘efficient district heating and cooling’, which is ‘[a district heating or cooling system] using at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat’ (Art.2).

This definition should be considered in the framework of the new State aid rules for projects in the field of environmental protection and energy (EEAG) for the period 2014-20, which limit public support to ‘efficient’ systems only.

The same directive also promotes the inclusion of this type of infrastructure into national and regional plans. To this end, national authorities were requested to carry out comprehensive assessments and cost-benefit analyses of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling as a basis for sound planning (Art. 14). When a potential for the construction of the related infrastructure is identified and its benefits exceed the costs, adequate measures to accommodate its realisation should be put in place. This provision should be read in combination with the recommendation from Directive 2009/28/EC (RES Directive) for national governments to encourage local and regional administrative bodies to include heating and cooling from RES in the planning of city infrastructure (Art. 13).

3. REGULATORY FRAMEWORK IN HUNGARY

During the past few years the Hungarian government has significantly reorganised the public administration in order to make the system more efficient. Through the establishment of the so-called “regional governmental offices” (altogether 20, one for each county equivalent to a NUTS-3 region, and one for the capital, Budapest) all thematic authorities (e.g. environmental and water protection, construction, mining inspectorates, etc.) were integrated into these regional offices in 2015, so the “one-stop-shop” concept (i.e. applying and getting all necessary permits at one place) was realised.

Although this made the acquisition of necessary licences easier (in theory less time consuming due to the integrated management of the different permits for the same project), it did not reduce the number of permits, which are quite numerous for a geothermal project. Furthermore, the permits for district heating are issued by the Hungarian Energy and Public Utility Regulatory Authority, being independent of these regional offices.

Regarding exploration, typical Hungarian geo-DH projects abstract thermal groundwater from a depth of ca. 1,000-2,500m, where the wells are licensed according to the provisions of the relevant environmental and water management legislation. A special attention is paid to the requirements of the National River Basin Management Plans (in accordance with the Water Framework Directive), i.e. to maintain/achieve the good quality and quantity status of the groundwater aquifers, i.e. to avoid overexploitation (quantity) and pollution (quality).

Hungarian geo-DH projects try to avoid drilling targets deeper than 2,500m, because in this case exploration and project development takes place in the frame of a concession (Art. 49 of the Mining Act XVVIII of 1993), for which a costly and fairly complex procedure is foreseen, including a more

complex vulnerability and EIA. The concession works as follows:

- The Ministry of National Development announces a public tender published in the Official Journal of the EU;
- The tender is evaluated within 90 days, after which a contract is signed with the winner and a concession fee has to be paid.
- The exploration cannot be longer than 4 years within the concession period and can be extended twice.
- The concession is granted for a period up to 35 years and may be extended once by not more than half of the term.

So far only four tenders have been published for deep geothermal (the majority of concessions is for hydrocarbons), of which only 2 contracts have been signed, one for an EGS project and one for a deep hydrothermal CHP project.

Reinjection - an essential part of a geo-DH project - witnessed many regulatory changes and heated debates within the geothermal and water management sector over the last 10 years in Hungary: from being compulsory (with exemptions till a certain deadline) to non-compulsory. At the moment reinjection is not mandatory, and is assessed on a case-by-case basis (depending on the local reservoir conditions). Nevertheless, the largest Hungarian geo-DH projects recently realised (e.g. Szentlőrinc, Miskolc, Győr) are all designed and operate with full reinjection, while existing systems have been complemented with reinjection wells (e.g. Veresegyház, Hódmezővásárhely, Szeged).

Licencing procedures are different within the major phases of project development. Firstly, in the preparation phase the most important is the EIA, which is compulsory in case groundwater abstraction exceeds 5 million m³/year, reinjection exceeds 3 million m³/year and in all cases where groundwater extraction from karstic aquifers exceeds 500 m³/day or 2,000 m³/day from porous aquifers (these are typically in the range of water demand of larger geo-DH projects). This licence is a pre-requisite to start all construction/drilling operations. Secondly, in the phase of project development, the wells (in case they are shallower than 2,500 m) require a water construction licence (issued now by the competent department of the respective regional governmental office). The plant, the network as well as the district heating supply need separate licences from the Hungarian Energy and Public Utility Regulatory Authority. If the production is less than 5 MWth a so called "simplified" district heating licence is sufficient. Thirdly, during the phase of operation, the water operation licence, and operation licence for the district heating supply and power plant are necessary to be obtained from the above-mentioned authority.

Hungary's untapped potential in geo-DH has been recognised by the Government. As part of the National Energy Strategy, a so called District Heating Development Action Plan has been elaborated. This emphasises the role of biomass and geothermal. A preliminary list has been published in the Action Plan of those settlements (~30) which already have a district heating infrastructure, fed by gas, although favourable geothermal conditions would make it possible to (at least partly) replace it with geothermal energy. In addition to these primary development targets, the Action Plan also provides a draft list of those settlements, where a DH infrastructure does not exist yet, although the heat demand and the geological conditions would make them candidates for geo-DH developments (~22 towns). Presently a governmental decision is under preparation about the execution of this Action Plan (expected to be launched in June 2016). A separate paragraph of this decision (Act 4) deals with the above listed geothermal development possibilities, which is expected to boost geo-DH developments in Hungary.

In summary, although the regulatory framework for geo-DH is still complex in Hungary, the centralized public administration (regional governmental offices) is expected to shorten the time of licencing to some extent, although the lack of skilled workforce in these bureaus is a concern. A major positive impact is expected when the District Heating Development Action Plan will enter into force.

4. REGULATORY FRAMEWORK IN DENMARK

Denmark has a well-established licensing system covering all activities in the underground, be it production of oil, natural gas, geothermal energy, salt, the storage of natural gas, heat or CO_2[1]. The licenses are approved by the parliamentary committee on energy, climate and buildings and signed be the Minister for energy, climate and buildings. The administration of the licenses is handled by the Danish Energy Agency, which also oversees that the duties of the licensees (exploration, production and decommissioning) are carried out in a safe and sound way. The exploration license is normally issued for 6 years, which can be transformed in a 30-year production license.

EIAs are routinely carried out by the local municipalities; however, with the limited number of geo-DH plants in operation, it is a challenge for the local politicians and civil servants to comprehend the special conditions and potential environmental issues related to deep geothermal. A strategic environmental assessment was carried out by the Danish Energy Agency in 2012. Even though this is a general assessment, it does provide some guidance to the local municipalities.

[1] Underground storage of heat and CO, however, have not been applied yet.

Denmark has a long tradition for district heating stretching back to the beginning of the 20th century, and today district heating is supplying more than 60 % of the households. The sector consists of many small, some medium and a few large companies, almost all owned by the consumers, either directly or indirectly through the local municipalities. The Danish heating sector is heavily regulated with a strong focus on planning and consumer protection. All district heating projects have to be approved by the local municipality mainly on the basis of socio-economic considerations, but also with a view to develop a consumer-based and environmentally friendly economy.

The two main legal acts – the Subsoil Act and the Heating Act – provide a strong regulatory basis for geo-DH in Denmark. The administrative systems are in place and have solid experience with handling the regulatory matters related to geo-DH in a fair and efficient way.

Still, the use of geo-DH has so far been very limited with only three plants in operation since 1984, 2005 and 2013, respectively. This is quite disappointing in the view of the fine geological conditions in most parts of Denmark and the very high number of district heating systems already in operation. The main barrier is the lack of an operational national risk mitigation system. As most companies will have only one geo-DH project and as the companies are owned and financed entirely by the consumers, a national guarantee fund like the ones in France and the Netherlands seems to be the obvious answer. The Danish parliament decided to set up such a fund in November 2014, removed it from the national budget in November 2015, only for it to re-emerge with new funding in December 2015. So far, the necessary administrative and organisational setup has not been put in place though, so the current prediction is, that the fund will not be operational before the beginning of 2017. This political uncertainty has greatly reduced the confidence and patience of the district heating companies.

Even with a national guarantee fund in place, the road to further geo-DH expansion in Denmark will not be easy. Despite the fact that the technology is competitive with fossil fuels (taxes on fossil fuels are quite substantial), geothermal face a fierce competition from biomass. Biomass combustion is more widely used with a lot of technical and operational experience, and most importantly, the construction of a biomass plant is less risky. As a consequence, many district heating plants are currently being converted from fossil fuels to biomass, most of which is already being imported. All in all, the competitiveness of geo-DH must be improved, if geo-DH is to play a role in avoiding that the Danish district heating sector becomes too dependent on imported biomass in the future.

5. REGULATORY FRAMEWORK IN ITALY

A dedicated framework for geothermal energy was established in Italy in 1986 and has been reshaped in 2010. Deep geothermal energy is defined as a mineral resource distinguished between high enthalpy resources (over 150°C), medium enthalpy resources (between 150°C and 90°C) and low enthalpy resources (below 90°C). High enthalpy resources are of national interest together with areas able to provide plants with a capacity of at least 20 MW. Other types of resources belong to the regions (Legislative decree No 22/2010).

Additionally, the Italian regulation further does not define ‘small local uses’ of geothermal resources as mineral resources and they belong to the regions as follows:

- All closed-loop systems;
- Open loop systems with a thermal capacity of maximum 2 MW and with wells located up to 400 metres depth. These resources are considered as “water resources”.

In order to make use of the geothermal resources of national interest an exploration and a production license are required. The exploration license gives the holder the exclusive right for exploration within a defined area and a specified time period. The area cannot exceed 300 km² and the term can be set up to 4 years and can be extended up to 2 years. The development license is granted up to 20 years and extendible for 10 more years. Production permits may be automatically considered as variation to urban plans.

Legislative Decree 28/2011 imposes on municipalities with more than 50,000 inhabitants the requirement to draft district heating development plans. The same decree also considers district heating as strategic; therefore, district heating networks are considered primary infrastructure works.

The licencing process for a geo-DH project utilising national or local resources can be summarised as follows:

1. The developer applies for the exploration license for geothermal resources through:

- A request to be presented to the region or any authority authorised by the region;
- Information for the EIA screening to be presented to the region or the authority authorised by the region.

2. The exploration license is released through a simplified procedure following the favourable opinion of the authority in charge of the EIA. Depending on the result of the screening, a full EIA can be necessary.

3. If the exploration phase is successful, the following permits must be requested individually:

- Environmental permit to be requested to the region or institution authorised by the region for the geothermal project and the construction of the district heating network when this exceeds 20 km;
- Permit for the exploitation of the geothermal resources (mining lease) and the construction of the geothermal project, to be requested to the region or an authority authorised by the region.
- Eventual modification to the urban plan(s), to be submitted to the municipality (or municipalities) involved;
- Eventual regional authorisation concerning the modification of regional plans;
- Eventual authorisation for the demolition and subsequent restoration of cultural heritage;
- Eventual authorisation to carry out works affecting wooded areas in protected landscape areas;
- Eventual hydrogeological authorisations, to be requested to the municipality;
- Eventual authorisations for works in areas affected by the presence of waterways;
- Eventual authorisations and agreements of the competent authority for the renovation of water supply and sewerage networks.

4. A mining lease and the authorisation for construction of the entire geothermal project (including the district heating network) are released via a simplified procedure. This is subject to a positive opinion of the authority in charge of the EIA. Depending on the result of the screening, a full EIA can be necessary.

Quite similar procedures apply for resources of small local uses. In this case, however, the EIA screening is only required for plants above 1 MWth, with a groundwater flow greater than 50 l/s, and for networks longer than 20 km.

Beyond the licencing procedures, it is worth mentioning that the utility supplying the heat is free to establish the tariff. The only exception is for new networks, and if the connection is mandatory. In that case, tariffs are set by the regulator (AEEGSI). The same authority identifies the ways in which prices are made public.

As far the incentives to develop a geo-DH are concerned, these are currently limited to the additional revenues stemming from the white certificate system (average value amounting to €100/toe) and to a reduction of the VAT additionally, some fragmented investment aid may be available in some regions. Regarding the end-user, he/she can benefit from tax deductions for the investment related to the grid connection. Households can also benefit from reduced VAT.

Positive elements of the regulatory framework in Italy are the availability of incentives for end users, the existence of specific legislation for the geothermal sector and the regulations in place promoting energy efficiency measures and district heating and cooling. However, there is still room for improvement. Firstly, policy-makers consider direct uses less relevant compared to the production of electricity from geothermal resources; secondly, administrative procedures are complex and very long; furthermore, there are too many authorities involved and only the license is issued jointly by the various authorities involved; thirdly, there are poor national incentives for district heating networks targeted to investors; fourthly, there is a lack of national or regional strategies for the development of district heating; lastly, in some cases the regional authorities competent for the licencing procedures in the field of geothermal energy do not have the sufficient number of qualified staff.

6. ASSESSMENT OF THE CASE STUDIES

Despite the significant potential of deep geothermal energy in several countries, geo-DH systems have been poorly developed so far. This is mainly due to the lack of adequate national and regional policies and legislation concerning geothermal district heating systems creating a proper long-term environment for the development of projects.

From the case studied three elements emerge as key successful factors. Firstly, as shown in the Hungarian case, national and regional plans are a pre-requisite for developing the technology on the local level. Secondly, tailor-made and targeted incentives, notably the reduction of the risk stemming from limited geological information, are vital. This can in some cases be an impossible barrier to overcome, especially if the investment is made by local authorities or the district heating consumers. Governments can help through geological exploration (drilling, seismic profiles, etc.), repayable grants for drilling the first well in very emerging markets, or more complex public-private risk mitigation facilities (as those in place for example in France, The Netherlands, and Switzerland). Thirdly, in line with Article 13 of the RES Directive, there is a need for streamlining and rationalising the administrative procedures. In spite of this, complex/time consuming administrative procedures are still observed in the cases studied (especially in Hungary and Italy). This is a significant barrier because long procedures and delays can result in additional costs for investors. It is therefore crucial to work more for establishing a fair, transparent and not too burdensome regulatory framework for geothermal and district heating.

7. RECOMMENDATIONS

The GeoDH project has made proposals for the removal of regulatory barriers in order to promote the best environment for geothermal district heating system operators and policy makers. The report "Regulatory Framework for Geothermal District Heating Systems in Europe" makes recommendations for decision makers on ways to optimise and simplify the regulations by translating the best rules into local and regional regulatory systems. Key stakeholders were consulted on the Framework and it was endorsed by relevant authorities in the 14 European countries involved in the project.

As a result, the main elements of a good regulatory framework are the following:

- National and local rules must include a definition of geothermal energy resources and related terms, in line with Directive 2009/28/EC;
- Ownership rights should be guaranteed;
- Administrative procedures for geothermal licensing have to be fit for purpose - they should be streamlined wherever possible and the burden on the applicant should reflect the complexity, cost and potential impacts of the proposed geothermal energy development;
- The rules concerning the authorisation and licensing procedures must be proportionate and simplified. Where appropriate, they should be transferred to the regional level, but only if this is prepared to handle the complexity related to geothermal energy.
- Tailor-made and targeted incentives should be established, especially taking into account the geological risk associated with the technology.
- Rules for district heating (DH) should be as decentralised as possible in order to be adaptable to the local context, and stipulate a mandatory minimum level of energy from renewable sources, in line with Article 13 §3 of Directive 2009/28/EC
- A single licensing authority should be the main contact responsible for the process;
- Information on geothermal resources suitable for geo-DH systems should be available and easily accessible;
- GeoDH should be included in national, regional and local energy planning and strategies;
- Policy-makers and civil servants should be well informed about geothermal;
- Technicians and Energy Service Companies should be trained in geothermal technologies;
- The public should be adequately informed and consulted about geo-DH project development in order to support public acceptance;
- Legislation should aim at protecting the environment and setting priorities for the use of underground resources: geothermal energy should be given priority over other uses such as for (unconventional) fossil fuels, CCS, and nuclear waste deposits.

It is worth highlighting that the presence of some good practises may be largely offset by the persistence of other barriers. It is therefore crucial to have a consistent enabling framework from start to finish.

The implementation of these recommendations will facilitate the introduction of complementary and cohesive legislation provisions essential to create a long-term stable system for geo-DH development, thereby ensuring positive benefits for the environment and the economy, including the creation of local and lasting jobs.

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