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Action Plan for promoting workers' mobility and establishing an education system

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Executive Summary

In 2013, there were 2500-3000 jobs directly related to geothermal electricity in the EU-28. Geothermal energy jobs can be broken down into different types, from engineers, drillers and workers in equipment factories to project managers. Geothermal power also generates indirect jobs, for example with suppliers of raw materials and induced jobs. The estimated total number of geothermal power jobs in 2013 is 10,000.

Based on the projects under development and under investigation as well as newly installed capacity, job creation is expected by 2020 in Italy, Hungary, Greece, Portugal, France, Germany, Spain, UK, Iceland, Turkey, Belgium, Slovakia and Switzerland. By 2030, more than 100,000 people should be employed in the sector.

Over the last few years little newly installed capacity has caused a concentration of jobs mainly in O&M, traditionally requiring only a few workers. The development of a significant number of new projects will trigger a real boom in labour-intensive activities such as exploration, drilling, construction and manufacturing.

Job opportunities are provided for people with different types and levels of skills. Scientists and engineers are needed to explore new geothermal fields, and skilled technicians are required for construction and operation of the new geothermal power plants.

Some of the main areas in which the geothermal power industry which can have an impact regarding economic activity and job creation are:

- Suppliers of mechanical equipment and raw materials;
- Consultants and contractors searching for geothermal resources;
- Drilling and well service firms;
- Environmental services managing permits and sample testing;
- Geothermal developers, regarding project development, construction, security etc.;
- Power plant operators and maintenance staff;
- Scientists for ongoing research and development.

As geothermal technologies are site specific (the geology is different all over Europe and knowledge of the local conditions is essential) and capital-intensive, the needs regarding exploration, resource development, construction and O&M are covered by the local workforce. Manufacturing jobs may be created internationally, depending on where the industries manufacturing the particular equipment are located.

Employment in the geothermal power industry is expected to increase, while skill gaps and labour shortages may occur. To address these challenges, decision-makers should ensure that there is consistency across EU Energy and industrial policy, complemented by social and education measures.

In sum, the following actions can facilitate meeting the surging demand for workforce in the geothermal sector:

- Anticipate change in employment needs and ensure consistency between public policy and industrial and social policy measures aimed at tackling employment restructuring.
- Create Networks for Geothermal Energy Education and Training involving industrial platforms, universities and research centres with competences in geothermal energy-related disciplines – geosciences, material sciences, mechanical engineering, computational sciences, economic and legal sciences.
- Develop courses on geothermal within existing university courses in fields such as engineering, bio-sciences, earth sciences, business administration and finance, and launch new courses combining Geoscience and Mechanical Engineering.
- Absorb workforce of related declining industries through retraining and employment restructuring. For example, the geothermal sector – being on the rise – can attract workers from related sectors that employ similar technology or specialists with identical core skills such as the coal mining sector.
- Promote mobility of workers through an EU-wide Internet portal and take advantage of the mutual recognition of diplomas and certificates between Member States.

Introduction

Objectives of the Employment Study on Geothermal Electricity

What is geothermal electricity?

Geothermal energy is defined in the Directive on Renewable energy sources (2009/28/EC) as energy stored in the form of heat beneath the surface of solid earth.

Geothermal power generation originated in 1913 at the Larderello dry steam field in Italy. Since then, the development of geothermal technology has been continuous and the total installed capacity currently amounts to 1.8 GWe, generating approximately 11.5 TWh of electric power every year.

*For a decade, thanks to the optimisation of the new binary system technology, geothermal electricity can be produced using lower temperatures than previously. Moreover, with Enhanced Geothermal Systems (EGS), a breakthrough technology proven since 2007, geothermal power can in theory be produced **anywhere** in Europe.*

The geothermal power sector has enormous potential to contribute to attaining the low carbon objectives of the EU in a cost-efficient manner. Geothermal electricity has many advantages in comparison with other renewable energy technologies: it produces steady output around the clock and it is a local energy source that can effectively contribute to reducing greenhouse gas emissions and energy dependency (on European level, and in particular in Central and Eastern European Countries that are mostly dependent on energy imports from Russia).

The potential of geothermal electricity is continuously being recognised by decision makers at the EU and national level which will further stimulate growth, i.e. development of an increased number of geothermal electricity projects.

Over the last years, due to little new installed capacity, the bulk of the jobs in the geothermal sector took place in the operation and maintenance phase. However, development of new geothermal projects will require a large number of highly qualified workers to carry out activities such as exploration, drilling and power plant construction.

The objective of this report is thus to assess and quantify the potential for job creation in the geothermal sector in accordance with projected market development, also taking account of local employment effects.

The report defines and evaluates the value chain in the geothermal energy sector and delineates activities associated with each of the project development phases. On this basis, the report seeks to measure direct, indirect and induced employment effects.

In the section below, we provide an overview of commonly used definitions and methodologies upon which this report relies to draw its conclusions.

Methodology

Definitions

Direct employment

According to the definitions of the World Bank and the International Labour Organization, direct employment effects stem from the extra employment created (or destroyed) within the analysed sector, resulting from the increased demand for its product.¹

Direct jobs – associated with core activities of the geothermal industry – include “jobs created in the manufacturing, delivery, construction, installation, project management and operation and maintenance of the different components of the technology, or power plant, under consideration”.²

For instance, in the geothermal sector, employment created to manufacture or operate turbines is measured as direct jobs.

Indirect employment

Indirect employment effects arise from jobs created (or destroyed) as other sectors increase their output in response to surging demand of the given sector. These sectors can in turn commission yet other sectors to produce additional input which will similarly fall within the category of indirect employment.³

Indirect employment thus refers to jobs created in industries that provide goods and services to companies involved in geothermal energy projects. For instance, manufacturing steel for the production of turbines as well as producing the energy required to manufacture the steel are indirect jobs created by the geothermal industry.⁴

The range of indirect jobs is not limited to supplying sectors but also includes activities such as policy, development, regulatory, business-related activities etc.

Induced employment

Increased demand for input in the abovementioned sectors leads to higher household incomes. The extra workers that are directly or indirectly engaged in the production process spend their incomes on a wide range of supporting sectors thus creating additional employment in these sectors.⁵

¹ The World Bank, *Issues in estimating the employment generated by energy sector activities*, June 2011; International Labour Organisation, *Methodologies for Assessing Green Jobs*, Policy Brief, available at: <http://www.uncsd2012.org/content/documents/Assessment%20Methodologies%20Policy%20brief%20March%202012%201.pdf>

² Kammen, Kapadia & Fripp, University of California, Berkley, *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?*, April 2004.

³ World Bank report, cit.

⁴ GEA, *Green Jobs Through Geothermal Energy*, October 2010 and World Bank report, cit.

⁵ ILO, *Skills and Occupational Needs in Renewable Energy report*, 2011 and World Bank report, cit.

Calculation methods

Based on the total installed capacity of geothermal power plants at EU-28 level (ca. 1000 MWe) and in Europe (ca. 1800 MWe) and current employment in the geothermal sector, we calculated the number of full-time jobs to be created per additional MWe of installed capacity.

We estimated that 20% of the jobs in the geothermal industry today are related to research and development, in particular with regard to EGS technologies. The remaining 80% of the jobs take place mainly in the operation and maintenance phase of the geothermal projects.

For 2020, we analysed capacity expected to be newly installed, projects under development and projects under investigation (mainly in Italy, Hungary, Greece, Portugal, France, Germany, Spain, UK, Iceland, Turkey, Belgium, Slovakia and Switzerland). The implementation of new geothermal projects will generate employment mainly in activities relating to the exploration, resource development and construction phase of the project.

We multiplied the additional capacity expected to be installed by the current employment factor (jobs per MWe) and reached the number of direct jobs anticipated in 2020.

For 2030, we applied the same calculation methods, i.e. we calculated the capacity expected to be installed by 2030 and multiplied it by the same employment factor.

In order to give an estimation of indirect and induced jobs created by the geothermal energy sector, we assumed a multiplier of 2.5, and multiplied the number of direct jobs by 2.5.

Chapter I: Geothermal Value Chain Description

1. Geothermal energy industry overview

The geothermal energy sector builds upon various segments, essential for the core functions of the industry, i.e. resource exploration and geothermal energy production.

These segments involve equipment suppliers, service providers (e.g. technical/ financial/legal consultants), or final energy off-takers (consumers). Another key segment for the development of the geothermal industry is the underlying research and development as well as relating training and educational activities.

Geothermal development is closely intertwined with other activities such as governmental services (e.g. for obtaining exploration permits), regulatory affairs (upon which market regulation hinges) etc.

There are also industries that are related to geothermal in that they employ similar technics or specialists with identical core skills. With sectors such as mining, oil & gas, carbon capture and storage, the geothermal industry could engage in cooperation and technology crossover.⁶ Also, the geothermal sector (being on the rise) could attract workers or subcontractors from related sectors in decline, e.g. the coal mining sector in Europe.

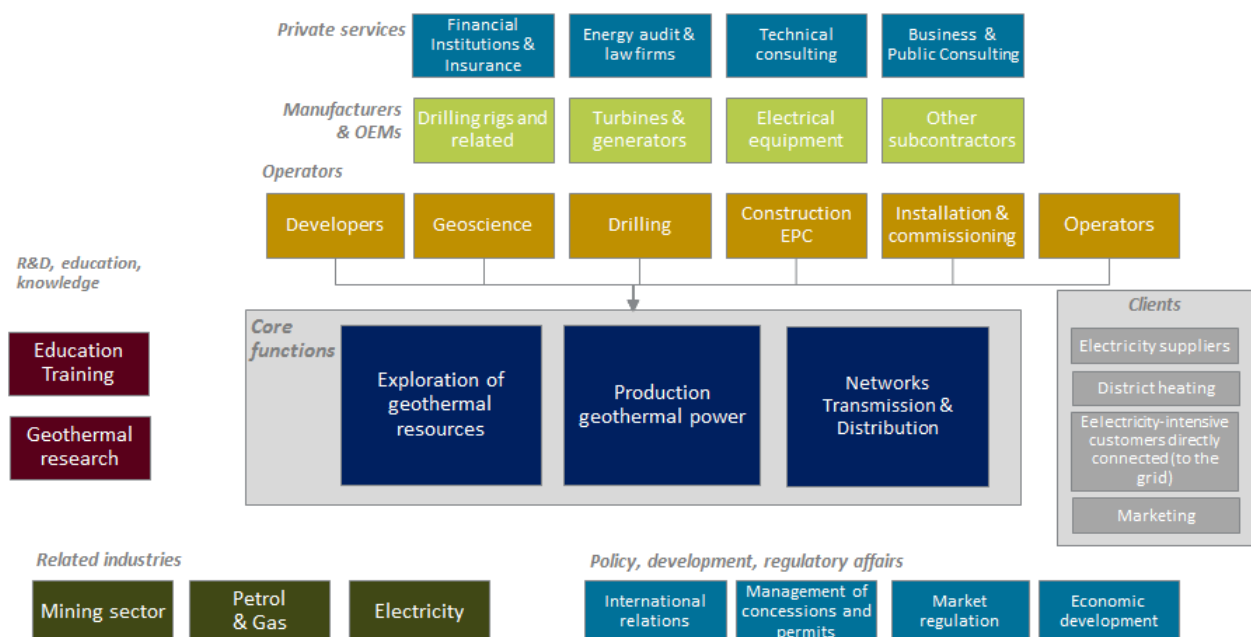


Figure 1: Geothermal industry overview

Source: Geoelec, adapted from Capgemini Consulting and CanmetEnergy

⁶ Canmet energy, "Geothermal Power & Direct Use Sector Supply Chain", March 2013

2. Geothermal project development

This Chapter will analyse the different phases of a geothermal project in order to identify core skills and occupations, both direct and indirect, needed across the value chain.

The graph below illustrates the geothermal development process and indicates activities corresponding to the separate phases.

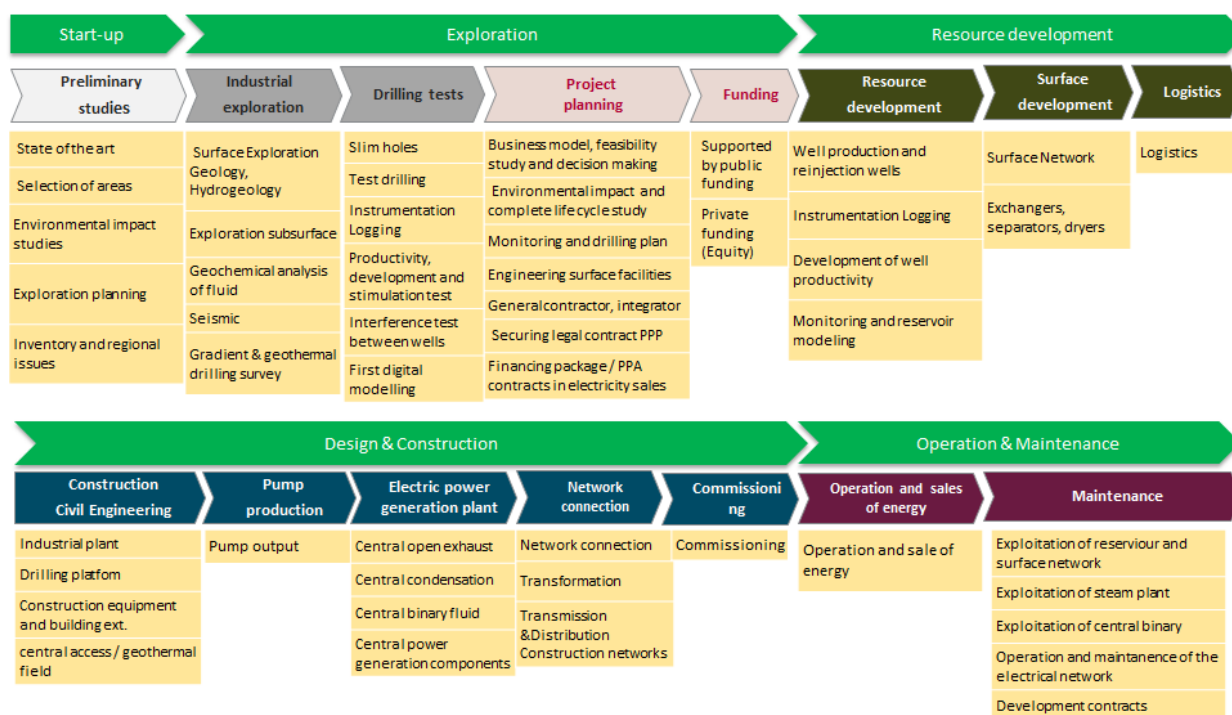


Figure 2: Core activities in the geothermal project development

Source: Geolec, adapted from Capgemini consulting, BRGM

3. Job types throughout the geothermal value chain

Project Start-up

The initial stage of the project involves activities relating to resource assessment, modelling and mapping of areas for geothermal exploration. This requires the expertise of geologists, environmental engineers, biologists, hydrologists, archaeologists etc.

During the preliminary phase, impact studies and supporting documents are needed in the course of application for an exploration permit (usually to the mining authorities). This type of work is assigned to lawyers and legal consultants, and is handled by government officials.

ACTIVITIES	DIRECT JOBS	INDIRECT JOBS
<ul style="list-style-type: none"> Preliminary studies 	<ul style="list-style-type: none"> Geologists Biologists Hydrologists Archeologists Engineers Tectonics engineers Volcanologists / petrologists Sedimentodologists Lawyers Paralegals 	<ul style="list-style-type: none"> Transporters Governmental officials

Exploration Phase

During the exploration phase of a geothermal project – and prior to developing a subsurface geothermal reservoir – a number of factors will be assessed within a “feasibility study”. These factors can be classified under two indicative groups: (i) geoscience studies and (ii) legal and market framework.

Under the first category, a series of geophysical, geological and geochemical studies will be conducted in order to improve chances of successful production wells. Test drilling is also a core element of the exploration phase.

Some of the main occupations associated with this phase include geologists, geophysicists, geochemists, reservoir / drilling engineers, geographic information systems (GIS). Additionally, surface exploration requires exploration drillers, sample analysts etc.

Expertise linked to geothermal challenges such as high temperature, geochemically aggressive fluids and high reservoir engineering⁷ is also highly valued

Experts in material science are needed from the start of the exploration phase throughout the entire life cycle of the geothermal project due to the use of aggressive chemical substances and high temperatures.

In order to facilitate geothermal exploration, a team of supporting personnel is employed that is building the roads needed to transport the drilling and exploration equipment, or testing the well pads. These activities indirectly employ experts in civil engineering, artisans, machine operators, building technicians, project engineers, and logistic officers.⁸

The second aspect of geothermal exploration, notably the project planning and funding, focuses on assessing the legal and business viability of the project. This phase involves activities such as securing funding (public or private), obtaining a PPA and EPC Agreement, acquiring transmission access etc. The workforce required to carry out the above activities includes bankers, investment consultants, insurance specialists etc.

⁷ SET Plan, p. 11

⁸ SET Plan, p.11

ACTIVITIES	DIRECT JOBS	INDIRECT JOBS
<ul style="list-style-type: none"> • Industrial exploration • Test drilling • Project planning • Funding 	<ul style="list-style-type: none"> • Geologists • Geophysicists • Geochemists • Engineers (reservoir engineers) • GIS specialists • Exploration drillers • Sample analysts • Tectonics engineers • Volcanologists • Sedimentologists • Consultants (bankers, investors, sponsors, insurance companies); 	<ul style="list-style-type: none"> • Civil engineering • Machine operators • Building technicians • Project engineers • Logistic officers

Resource development

Based on the feasibility studies, project developers can take the decision to start the active phase of “Resource Development”. This phase includes the drilling of the production and injection well(s) and the connection of the wells to a water cycle.

The drilling of a geothermal well requires professionals with expertise in engineering, welders, rig hands. Additionally, mud loggers, cementing personnel, drilling fluids personnel, and safety managers are employed during the development phase.

The resource development team (normally directly employed by the drilling company) is supported by geologists, casing crew personnel, rig and fuel transportation personnel etc.

ACTIVITIES	DIRECT JOBS	INDIRECT JOBS
<ul style="list-style-type: none"> • Resource development • Surface development • Logistics 	<ul style="list-style-type: none"> • Drilling engineers • Hydrocarbon reservoir engineers • Rig hands • Mud loggers • Drilling fluids personnel • Cementing personnel • Welders • Safety managers • Geologists • Construction personnel 	<ul style="list-style-type: none"> • Casing personnel • Directional drilling personnel • Well logging contractor • Rig transporter • Fuel transporter

Construction

The construction phase of a geothermal project can be subdivided into three segments: planning, construction and connection to the grid. The project developer shall have secured an EPC, a PPA and funding (private and public) before the actual construction works commence.

- Planning and design requires a variety of experts – engineers (electrical, civil, mechanical), plant designers, document controllers, design team supervisors etc.⁹
- Site development, construction and installation of equipment – welders, pipe fitters, plumbers, construction equipment operators, drilling equipment operators, excavators, measurement and control engineers, transportation workers.¹⁰

Business developers also play a role at this stage.

- Connection to the grid involves electrical engineers and technicians.¹¹

ACTIVITIES	DIRECT JOBS	INDIRECT JOBS
<ul style="list-style-type: none">• Construction• Civil engineering• Pump production• Electric power generation plant• Commissioning	<ul style="list-style-type: none">• Engineers (drilling and testing)• Power plant designers• Document controllers• Project managers• Construction managers• Project engineers• Field engineers• Safety managers	<ul style="list-style-type: none">• Inspection personnel• Concrete construction operator• Steel erector• General construction personnel

Operation and Maintenance

Once the construction phase had been concluded, the power plant becomes fully operational, *i.e.* can sell electricity to energy off-takers (e.g. retail market operators and indirectly to end consumers). Operation and maintenance of the plant are needed throughout the lifecycle of the project.

Day-to-day operation of the plant involves technicians operating and maintaining the equipment, e.g. turbines and grid connection. Core occupations are plant managers, measurement and control engineers, pipe fitters, welders, plumbers, electricians, construction equipment operators.

Operation & maintenance for deep geothermal projects also require the expertise of geological and geothermal engineers on recurring basis in order to ensure that the proper and reliable functioning of the plant.¹²

⁹ GEA report, cit.

¹⁰ ILO report, cit.

¹¹ ILO report, cit.

¹² GEA report, cit.

ACTIVITIES	DIRECT JOBS	INDIRECT JOBS
<ul style="list-style-type: none"> • Operation and sales of electricity • Maintenance 	<ul style="list-style-type: none"> • Plant managers • Engineers • Geochemists • Plant technicians • Site operators • Service repairmen 	<ul style="list-style-type: none"> • Suppliers of support and repair services • Suppliers of products and services that relate to transmission of energy produced

Cross-cutting / supporting activities

1. Equipment manufacture and distribution

Manufacturers and suppliers serving the geothermal energy sector develop technologies that are specific to each project. As the geological conditions differ throughout Europe and the equipment must be adapted to existing conditions, employment associated with these activities is measured as direct jobs.

For example, manufacturers of drilling rigs, drilling equipment, pipes, power plant technology, generators and related technologies fall within this category.

Additionally, manufacturers of project-tailored equipment contract suppliers of the raw materials (e.g. steel) and thus increase the number of indirect employment.

ACTIVITIES	DIRECT JOBS	INDIRECT JOBS
<ul style="list-style-type: none"> • Equipment manufacture and distribution 	<ul style="list-style-type: none"> • Mechanical engineers • Electrical engineers • Performance/systems engineers • Quality and manufacturing engineers • Maintenance engineers • Procurement specialists • Mechanist, electricians • Welders, assembly mechanics • Inspection personnel • Maintenance technicians • Site operators 	<ul style="list-style-type: none"> • Suppliers of raw materials • Shipping personnel • Sales personnel

2. Enabling activities

There are various services needed in order to ensure the successful development of a geothermal project that create indirect employment. These activities include:

- Policy-makers and government office workers

- Trade association and professional society staff
- Educators and trainers
- Management
- Administration
- Publishers and science writers
- Representatives of insurance bodies
- IT professionals
- Human resources professionals
- Other financial professionals (accountants, auditors and financiers)
- Health and safety consultants¹³

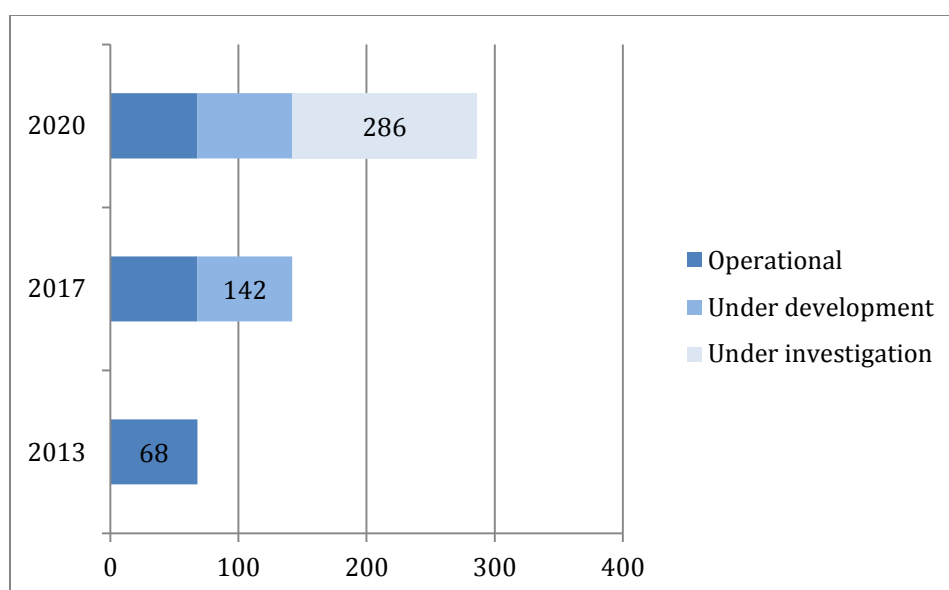
¹³ ILO report, cit.

Chapter II: Prospective Jobs in the Geothermal Sector in Europe in 2020, 2030 and 2050

1. Geothermal electricity market in Europe

In 2013, there are 68 geothermal power plants in 6 European countries (Italy, Iceland, Turkey, Portugal, France, Germany, and Austria) for a total installed capacity now amounting to around **1.8 GWe**, producing some 11 terawatt-hours (TWh) of electric power every year.

According to the EGEC Geothermal Market Report 2013, there are 74 projects currently under development in Europe, which would increase the total installed capacity to a total of **2.7 GWe** in 2017. In addition, 144 projects are now being explored. The graph below depicts the installed and projected geothermal power plants in Europe up to 2020.



Graph 1: Number of geothermal power plants in Europe

2. Geothermal job potential in Europe

Jobs in the geothermal sector in 2013

As demonstrated in Chapter 1, the development of geothermal resources requires the support of professionals with different expertise that varies during different stages of the project cycle.

We estimated that 20% of the jobs in the geothermal industry today are related to research and development, in particular with regard to EGS technologies. The remaining 80% of the jobs take place mainly in the operation and maintenance phase of the geothermal projects.

As indicated above, the total installed capacity of geothermal power plants is ca. **1000 MWe** at EU-28 level and ca. **1800 MWe** in Europe (due to the high number of installed capacity and developed geothermal electricity projects in Iceland and Turkey).

The result is that if we only consider jobs strictly pertaining to the operation or maintenance of the geothermal power plant, the direct employment generated by the industry is ca. 2500 jobs in 2013. Additionally 500 direct jobs are associated with R&D¹⁴. This leads to a total direct employment rate of ca. 3000 and an estimated employment factor of 1.5/1 MWe.

Geothermal energy also generates indirect and induced employment that is measured assuming a multiplier factor of 2.5. The result is that, in 2013, 6250 geothermal energy jobs are associated only with operation & maintenance. The total number of indirect and induced jobs, including jobs created in relation to research & development, is 7500.

The estimation of the total number of geothermal power jobs (including direct, indirect and induced employment) in **2013** is at ca. **10.000** jobs.

Employment in the geothermal power sector in 2013			
Direct employment		Indirect and induced employment	
Research & Development	Operation & Maintenance	Research & Development	Operation & Maintenance
500	2500	1250	6250
Total: 3000		Total: 7500	
Total employment in 2013: ca. 10 000			

Table 1: Employment in the geothermal power sector in 2013

Job potential towards targets for 2020/2030/2050

- **2020**

The European Geothermal Energy Council has conducted an extensive data collection with regards to geothermal projects which are currently under development and projects under investigation, i.e. which have been announced and have received funding for exploration and/or drilling. It is forecasted to have these projects under development in operation by the year 2017. This data collection was undertaken in the context of the Prospective Study within the framework of the GEOELEC project and the EGEC Market Report 2013/2014.

Based on this data, we estimate that the total installed capacity will increase from 1.8 GWe in 2013 to 2.7 GWe towards 2020.

The new capacity expected to be installed, 2.7 GWe, multiplied by the employment factor of 1.5 jobs / 1 MWe of installed capacity (as calculated based on data in 2013) translates into a total of ca. 4000 direct jobs.

¹⁴ Most of the geothermal research centres are organised in the Coordination Action ENGINE. The EERA-Joint Program on Geothermal Energy (EERA-JPGE), institutionalised the collaboration, involves a total of **354 man/year** including researchers and PhD students.

The newly created jobs will mainly concern activities relating to exploration, resource development and construction of geothermal power plants. Within this category, we have included highly-qualified as well as low-skilled workers needed throughout the project development.

Projected employment in the geothermal power sector towards 2020	
	Professions
Direct jobs	<u>Exploration:</u> <ul style="list-style-type: none"> • Geologists • Geophysicists • Geochemists • Engineers (reservoir engineers) • GIS specialists • Exploration drillers • Sample analysts • Tectonics engineers • Volcanologists • Sedimentologists • Consultants (bankers, investors, sponsors, insurance companies); •
	<u>Resource development:</u> <ul style="list-style-type: none"> • Drilling engineers • Hydrocarbon reservoir engineers • Rig hands • Mud loggers • Drilling fluids personnel • Cementing personnel • Welders • Safety managers • Geologists • Construction personnel
	<u>Construction:</u> <ul style="list-style-type: none"> • Engineers (drilling and testing) • Power plant designers • Document controllers • Project managers • Construction managers • Project engineers • Field engineers • Safety managers
Total: ca. 4000 direct jobs towards 2020	

Table 2: Direct employment in the geothermal power sector towards 2020

Out of these 4000 jobs, we can measure the number of jobs that require university education. The EERA JP on Geothermal Energy has calculated the employment factor (for 2013) at 0.5 jobs per 1 MWe of installed capacity. Thus, the number of white collar workers only is calculated

by multiplying the capacity to be installed towards 2020, 2.7 GWe, by 0.5, and equals ca. 1350.¹⁵

An increase in the installed capacity also triggers a surge in employment in related sectors. The estimated indirect and induced employment potential of the geothermal electricity sector towards 2020 is calculated using a multiplier employment factor of 2.5 (as estimated for 2013), and is more than **10,000** workers.

Projected employment in the geothermal power sector towards 2020	
	Professions
Indirect jobs	<u>Exploration:</u> <ul style="list-style-type: none"> • Civil engineering • Machine operators • Building technicians • Project engineers • Logistic officers
	<u>Resource development:</u> <ul style="list-style-type: none"> • Casing personnel • Directional drilling personnel • Well logging contractor • Rig transporter • Fuel transporter
	<u>Construction:</u> <ul style="list-style-type: none"> • Inspection personnel • Concrete construction operator • Steel erector • General construction personnel
Total: ca. 10 000 indirect jobs towards 2020	

Table 3: Indirect employment in the geothermal power sector towards 2020

• 2030

The geothermal energy sector is projected to increase to 22.3 GWe of installed capacity towards 2030. Thus, the direct employment to be created by the geothermal energy sector by 2030 is calculated at ca. 35,000 jobs.

Indirect and induced employment effects are calculated by multiplying the expected installed capacity by 2030 by an employment factor of 2.5, at ca. 60 000.

¹⁵ The difference stems from the fact that construction of new power plants requires a large number of low-skilled workers (e.g. general construction personnel, logistics officers).

Thus, the total employment expected to be generated by the geothermal energy sector by 2030 is ca. **100,000** people.

- **Skill gaps and training needs**

The anticipated pace of development of the geothermal energy sector and increased demand for highly-skilled workers with expertise in the geothermal will lead rapidly to a lack of specialists in many fields of expertise. The complexity of geothermal technology requires a wide range of experts on different levels of skills, multidisciplinary expertise and good interaction of the several disciplines.

The geothermal sector is therefore already suffering from a lack of skilled workers. For this reason, the GEOELEC project put forward some proposals on education, mobility and dissemination of information, as an action plan to overcome this barrier.

3. Local effects of geothermal energy development

As geothermal technologies are site specific (geology is different all over Europe and knowledge of the local conditions is essential) and capital-intensive, the need regarding exploration, resource development, construction and O&M are covered by local workforce, while manufacturing jobs may be created internationally, depending on where the industries manufacturing the particular equipment are located.

It is estimated that 85% of the geothermal value chain in Europe is European. In the future, this is unlikely to change as most of the geothermal-related jobs cannot be exported.

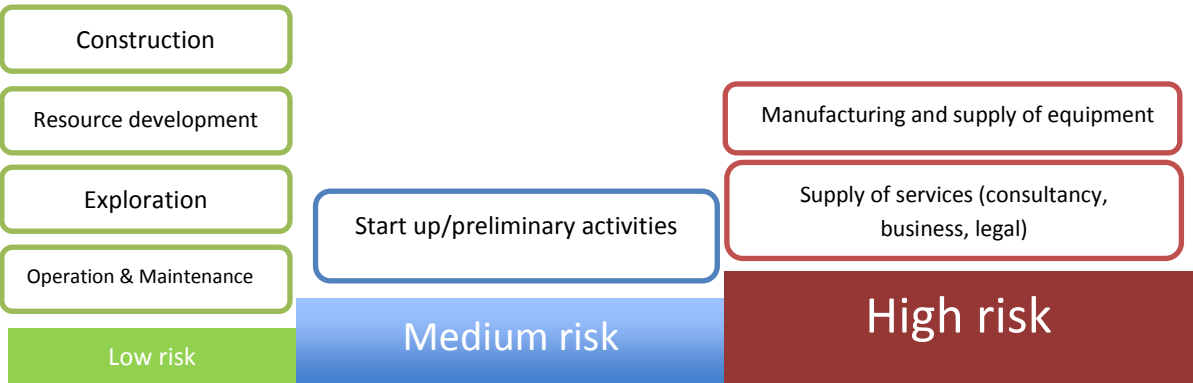


Figure 3: Risk of relocation of geothermal activities

Chapter III: Action plan for promoting workers mobility

The shift in EU Energy policy towards low-carbon technologies triggers alterations in employment structure. Anticipating change in employment needs and restructuring of employment requires decision-makers to develop a long-term strategy that builds upon various elements and ensures consistency across energy policy, industrial and social measures.

This report focuses on workers mobility (across sectors and borders) that can be encouraged through targeted measures as part of EU and national social and industrial policies.

Absorb workforce of declining industries

In light of the projected increase, the geothermal energy sector has the potential to absorb excess personnel from related sectors in decline. A good example is the coal mining sector which is currently being subsidised (especially in countries like Spain, Germany, Poland) but, according to Council decision 2010/787/EU, the aids granted to uncompetitive coal mines will be phased out by 2018.

In essence, subsidies do not provide a long-term solution for workers in sectors in decline, but merely, on a temporary basis, extend their employment by using tax payers' money in a way that does not yield the most efficient results.

Given the similarities between the mining and the geothermal sector in terms of technologies, exploration/drilling technics, and workforce skillset, the geothermal energy sector has the potential to absorb the surplus workforce, and to offer long-term employment in a sector with large potential and the possibility to play an important role in the future electricity mix.

Interplay between Energy, Industrial and Social policies

At the core of employment policy is anticipating change in employment needs and, respectively, developing a long-term strategy to tackle related challenges. It is of the utmost importance that such public policy measures are consistent with EU energy policy (triggering change in employment needs) and industrial policy, and complemented by corresponding social and educational policies.

Restructuring policy hinges upon competence and skills development, i.e. it is essential to train surplus workforce in order to ensure that existing skills are transferable to other sectors and thus employability is improved.

There is a range of EU funds available to Member States in order to effectively manage employment restructuring.

- European Social Fund (ESF)

The objective of the ESF is to *“to render the employment of workers easier and to increase their geographical and occupational mobility within the Union, and to facilitate*

their adaptation to industrial changes and to changes in production systems, in particular through vocational training and retraining”.

The ESF provides funding for restructuring and structural change at enterprise level as well as supporting individual workers to manage negative lay-off related effects. This is achieved, through developing (i) life long learning systems and strategies within companies or (ii) training and support with restructuring of whole sectors.

- European Globalisation Adjustment Fund (EGF)

The main role of the EGF is to combat short-term adverse effects on local, regional or national economies, resulting from globalisation and open trade. In particular, the EGF supports workers to find alternative employment.

Measures, eligible for co-financing are defined as ‘active labour market policy measures’, and include the following categories:

- Training and retaining, assistance with self-employment;
- Job-search assistance (and allowances), allowances for lifelong learning and training activities;

It is within the (exclusive) prerogatives of Member States, and not companies or individuals, to request co-financing for employment and restructuring measures through the EGF. Thus, Member States can absorb the financial resources available within the Globalisation Fund to steer and stimulate national industrial policy.

Action Plan

The potential of the geothermal power industry can be achieved only through the attraction, retention and renewal of the workforce.

It is within the remit of public authorities to anticipate change in employment and to take the necessary steps to address such challenges through adopting industrial or social policy measures. Companies and organisations should also adopt a range of measures which will allow them to have access to the highly skilled workforce they need.

In sum, we have identified the following actions that will facilitate meeting the surging demand for workforce in the geothermal sector:

- Anticipate change in employment needs and ensure consistency between public policy and industrial and social policy measures aimed at tackling employment restructuring.
- Create Networks for Geothermal Energy Education and Training involving industrial platforms, universities and research centres with competences in geothermal

energy-related disciplines – geosciences, material sciences, mechanical engineering, computational sciences, economic and legal sciences.

- Develop courses on geothermal with existing university courses in fields such as engineering, bio-sciences, earth sciences, business administration and finance and launch of new courses combining Geoscience and Mechanical Engineering.
- Absorb workforce of related declining industries through retraining of workers and restructuring of employment.
- Promote mobility of workers through an EU-wide Internet portal and take advantage of the mutual recognition of diplomas and certificates between Member States.

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