



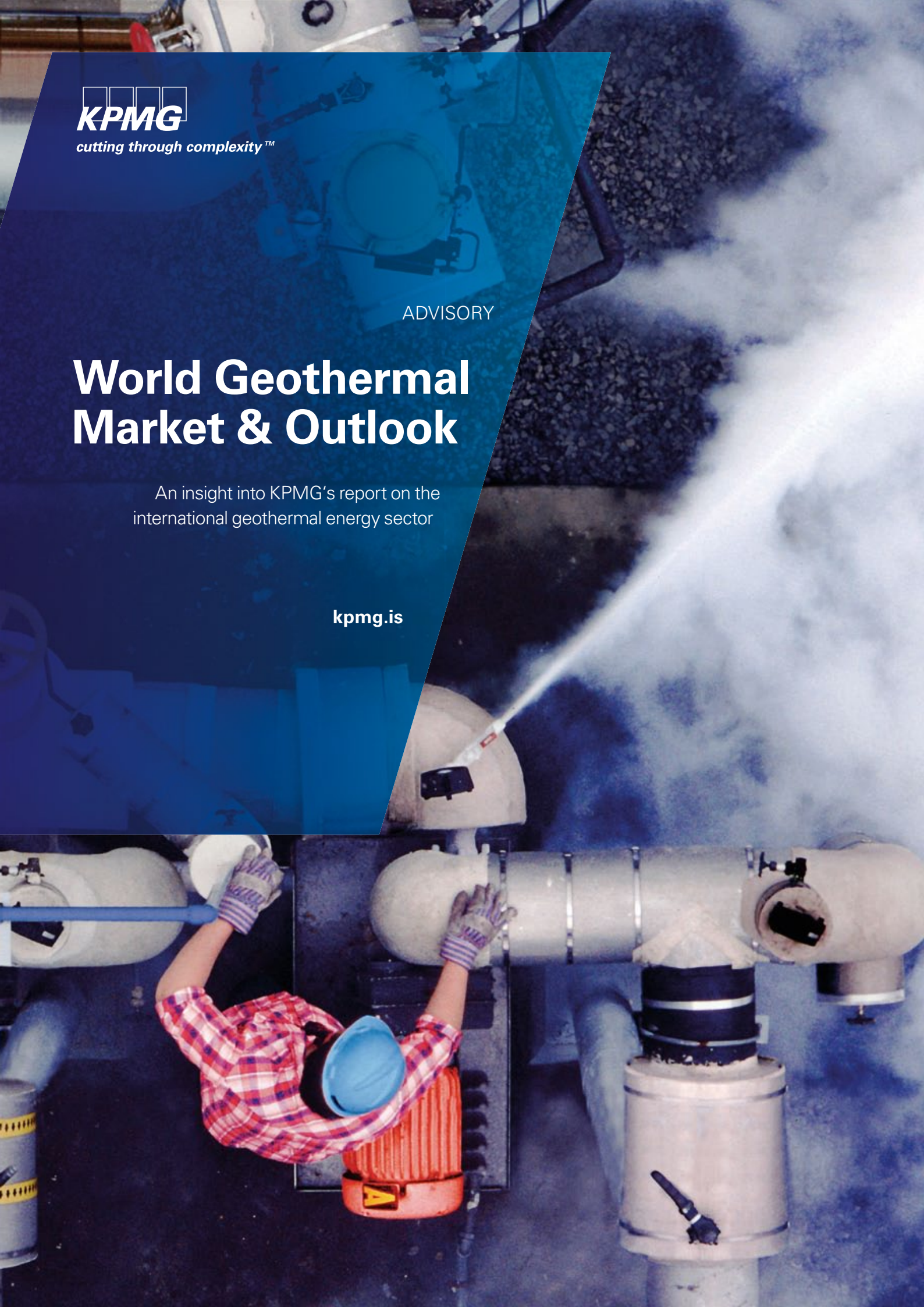
cutting through complexity™

ADVISORY

# World Geothermal Market & Outlook

An insight into KPMG's report on the international geothermal energy sector

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**KPMG's report "World Geothermal Market & Outlook" is a comprehensive analysis of the geothermal energy sector. The report analyzes key data on the industry obtained from interviews with leaders within the sector and an array of other sources. It offers an objective view of the sector's current state, its future outlook and the key drivers of new investment. To get a copy of the report, please contact KPMG Iceland.**

Growth is an imperative for any business sector to survive. Whether it is achieved through entering new markets, developing a new mix of services and products or by achieving increased efficiencies, growth is the only option businesses have in the long run.

We believe that the geothermal energy sector is about to enter a new growth phase following a decade which saw a substantial slowdown in worldwide development. There are a few reasons to be optimistic; first of all governments around the world have been moving towards a cleaner energy economy. The increased emphasis on clean energy has seen the introduction of various support mechanisms and incentives to increase investment in renewable energy like geothermal. Second, new technologies are being developed that will increase the scope of the geothermal sector opening up new opportunities for future development. Finally, high energy prices and emissions legislation on the horizon will make geothermal energy a competitive source of clean, sustainable energy in more markets.

The geothermal sector is poised for a phase of consolidation in our estimate. The rationale is clear, there are too many small players out there putting all their resources into too few, high risk projects. A phase of consolidation will create larger firms that can pool the risk of many development projects. Larger companies will also be better equipped to finance their own development projects in emerging markets where obtaining external financing can be difficult.

KPMG's interest in writing a comprehensive market report on the geothermal sector stems from two factors. First, geothermal energy is a clean source of renewable, base-load electricity. Second, technological innovation on the horizon is set to revolutionize the entire sector in the coming years.

We hope that our report will offer a fresh perspective on the geothermal sector, the sector's key drivers for investment and the current market outlook.

A handwritten signature in blue ink, appearing to read 'H. Ágúst Jóhannesson', with a stylized flourish at the end.

H. Ágúst Jóhannesson  
Head of Advisory



# Main Findings

- In 2010, 24 countries around the world were utilizing geothermal energy for electricity production. The world's total installed capacity in 2010 was 10,715 MWe, a 20% increase from 2005
- The US leads the way in terms of installed capacity with 3,074 MWe followed by the Philippines with 1,902 MWe and Indonesia with 1,187 MWe. The US also leads the world in terms of developing projects with over 150 geothermal development projects underway in 13 states
- The most common form of geothermal resource currently exploited is traditional hydro geothermal or volcanic geothermal. Experiments into enhanced geothermal systems (EGS) and hot dry rock systems (HDR) are currently underway in France, the US, Australia, Germany, Switzerland and Japan
- Japanese firms Fuji, Mitsubishi and Toshiba have a 67% market share in direct steam turbines while Ormat Technologies dominates the market for binary systems. The drilling equipment and drilling services market is dominated by Halliburton and Schlumberger
- 87% of the world's installed capacity utilizes direct steam or flash technology, binary systems account for 13%
- Geothermal energy has a lower levelized cost of electricity than all other renewable energy sources except for biomass. It also compares favorably to advanced coal and advanced gas power plants
- The latest phase of geothermal development is being driven by government support mechanisms and the liberalization of electricity markets around the world. Support mechanisms include:
  - Tax credits and grants
  - Renewable portfolio standards
  - Feed-in tariffs

**“Evaluating the cash generation from the proved reserves and the potential of the estimated resources are key issues for the geothermal investor”**

**Ásgeir Margeirsson,  
President and CEO of Magma Energy Iceland**



# The Nature of Geothermal Energy

The need for the world to switch to renewable energy sources has been at the heart of an ongoing conversation that is fueled by concerns for the environment, energy security and the sustainability of our current energy consumption. As the world heads towards a new energy economy, geothermal energy will inevitably play a larger role in the world's future energy mix.

The last two decades have seen a dramatic increase in investment in renewable energy as governments around the world have introduced various incentives to make such investments more attractive. The geothermal energy sector is in direct competition with other renewable sources when it comes to funding research and attracting investment capital.

Renewable energy sources are usually lumped together in the same category but this can be misleading. Unlike solar and wind, geothermal energy is a very reliable source of clean, base-load electricity. Geothermal power plants operate at a consistent production level twenty four hours a day. Geothermal also has very different characteristics as an investment than solar and wind. The upfront investment risk is typically higher.

KPMG's report compares geothermal energy to other sources of energy, both conventional and renewable, to provide our readers with a clear perspective on the nature of geothermal energy. We specifically look into:

- Technical aspects of various energy sources
- Financial aspects
- Government support mechanisms used to encourage investment in the sector
- The stages of geothermal development





# Geothermal Technology

Geothermal energy utilization has traditionally been very site specific, concentrated in volcanically active regions of the world. Recent technological developments like enhanced geothermal systems (EGS) could however widen the scope of the sector and make geothermal energy one of the major sources of energy in the 21<sup>st</sup> century.

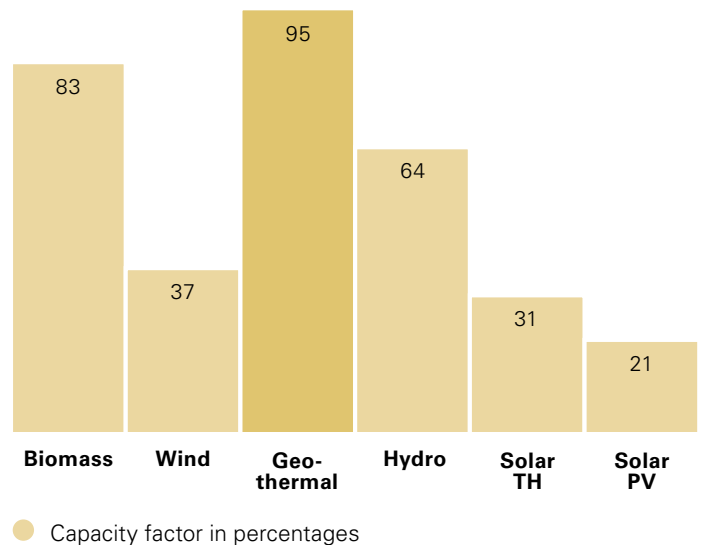
Drilling down to depths of up to 4 km to retrieve hot fluids and steam for power production is a complex endeavor. The process of locating geothermal resources and utilizing them for power production requires state of the art technology.

Developing a basic understanding of the technology involved in a sector is necessary for any interested investor as innovation and technology are key determinants of future growth. As with any evolving technology, some innovations currently being developed and tested within the geothermal sector will lead to major changes while others might never fulfill their promise.

KPMG's report provides the financial reader with a review of the current technologies currently utilized in geothermal development projects as well as emerging technologies on the horizon that could impact the sector in the near future. Our report looks into:

- Exploration and drilling technology
- Power generation technology
- Steam field technology and resource utilization
- Heating technology
- Direct use application for geothermal energy

Capacity factor for renewable technologies




Source: U.S. Energy Information Agency



**“The geothermal industry is a relatively small industry with very limited resources in terms of skilled manpower”**

**Runólfur Maack,  
CEO overseas operations, Mannvit**





**“With the constant entrance of new and small players, there is a need for fewer, bigger companies to consolidate the geothermal market”**

**José Antonio Rodríguez,  
VP operations and COO Latin America  
Polaris Energy Nicaragua S.A.**



## Main Players

Geothermal development is a very complicated process requiring a broad range of skills and specialized services. It is also a relatively small sector with knowledge and experience concentrated in a small number of companies around the world.

The first phase of geothermal development around the world was dominated by large public utilities and independent power producers (IPPs). Many of the utilities in the geothermal sector started off as government owned entities and some still are.

The liberalization of electricity markets along with increased government support mechanisms and an increased emphasis on clean energy, has seen new players emerge on the scene to compete with established geothermal developers.

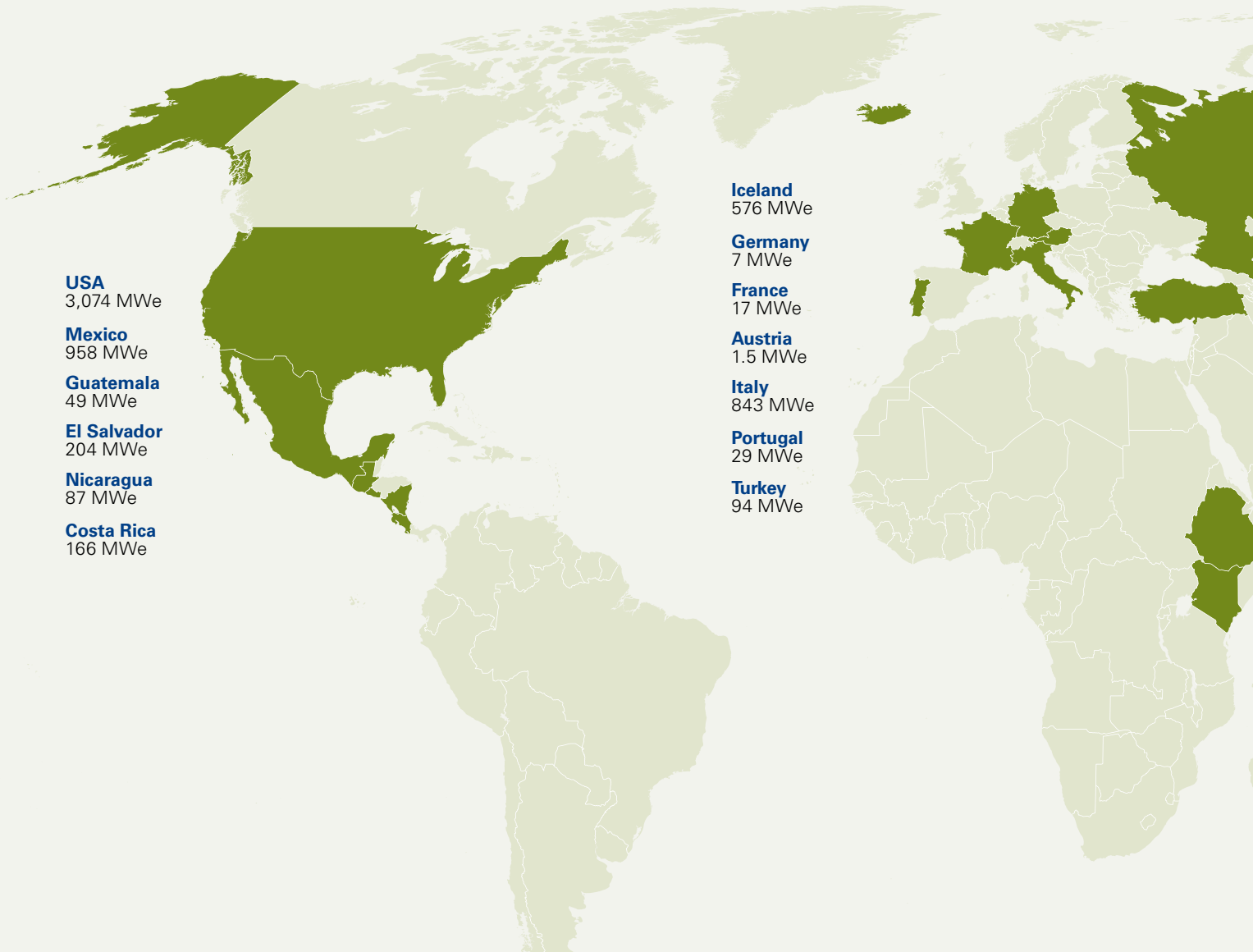
KPMG's report categorizes the companies most active in the geothermal sector into:

- Pure-Play developers
- Utilities and IPPs
- Technical consultants

- Drilling companies
- Equipment suppliers
- EPC contractors
- Financial institutions

In our report, we profile fifteen of the most active geothermal developers on the international stage in terms of current installed capacity and those that have the largest project pipeline. The company profiles provide an overview of the companies, their activities in the geothermal sector, any current operating geothermal power plants and their project pipeline.

We also look into which technical consultants, drilling companies, equipment suppliers, EPC contractors and financial institutions have been the most active internationally in the geothermal sector in recent years.



## Geothermal Countries

Electricity production from geothermal power plants using traditional hydro-geothermal technology has been concentrated near the boundaries of tectonic plates and other geological hotspots where geothermal resources are located near the surface. Advancements in the utilization of low- to mid-temperature resources have widened the scope of the sector as more and more countries have started to develop geothermal energy.

There are currently 24 countries around the world that produce electrical power from geothermal power plants. Electricity production from geothermal power totalled 67,000 GWh/year in 2009.

KPMG's report profiles the 24 countries that are currently utilizing geothermal energy for electrical power production

as well as 16 other countries that are currently developing geothermal resources for the first time. Our country profiles contain:

- Detailed information about the geothermal resources in each country and the potential for future development
- Maps that show the location of geothermal resources, any operating geothermal power plants and ongoing development sites
- Energy market and electricity market overview for each country and the current share of geothermal in electricity production
- Information on the main players that are active in the local geothermal sector
- The current state of geothermal power production and details of any operating plants, developing projects and plants currently under construction





Sources: Proceedings from World Geothermal Congress, 2010; KPMG analysis

**“No matter where you are, geothermal development should be carried out with strategic local partners”**

**Ásgeir Margeirsson,  
President and CEO of Magma Energy Iceland**

**“The financial support of local and regional entities is very important for the financing stage of geothermal plants”**

**Kerry McDonald, CEO Power West Indies**



## Geothermal Project Financials

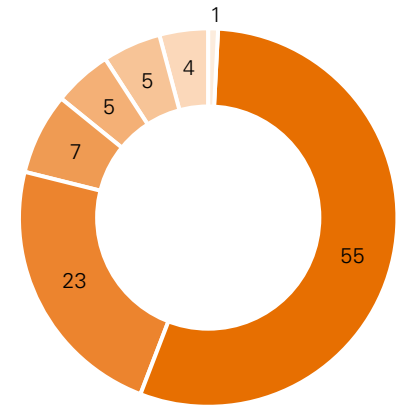
The emphasis on clean renewable energy has led governments around the world to introduce support mechanisms and incentives to increase investment in clean energy technology. Such measures are helpful in attracting new investors to the sector but at the end of the day, if geothermal development is not a profitable business, it will not develop further.

Geothermal development projects are characterized by high upfront investment and long lead times, that is to say the development of a geothermal resource from the initial exploration phase to the operational stage can take several years. Understanding the initial capital outlay required and the main cost drivers, the sources of revenue and the operating costs over the lifetime of a project are essential to any investor interested in the geothermal sector.

KPMG’s report presents a thorough analysis of:

- Capital investment and the cost of developing geothermal projects
- Geothermal power plant revenues
- Operations and maintenance costs of geothermal power plants
- Project financing geothermal development

**Cost breakdown of typical geothermal development**



- Power plant
- Drilling
- Steam gathering
- Confirmation
- Exploration
- Transmission
- Permitting

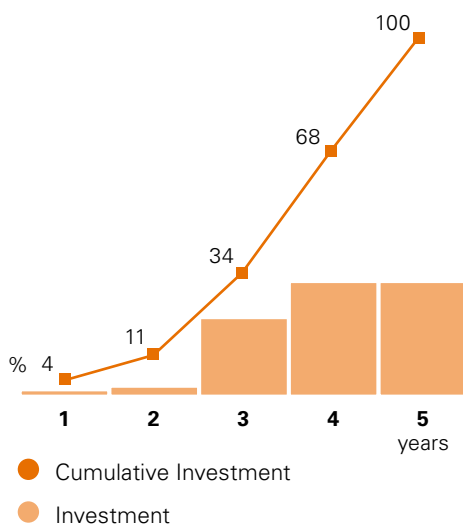
Source: Geothermal Energy Association, 2005





# Geothermal Financing

## Investment timeline for geothermal development



Source: KPMG analysis

The financing options available for any development project will reflect the risk structure of the project and the market's knowledge of the sector. The less the market knows about a specific sector, the harder it will be to attract financing.

Geothermal development has historically been a very small sector in most countries, dominated by publicly owned utilities. As a result, investors do not have the same level of knowledge about geothermal energy as they do with conventional sources of energy.

The privatization of public utilities and the emergence of pure-play geothermal developers in the last two decades has led to a dramatic increase in publicly listed geothermal developers competing in the equity markets. Early phase geothermal development is highly dependent on equity financing.

In the current economic climate, financing geothermal development has become more challenging. The financing options that were available for geothermal development before the economic crisis of 2008 are more difficult to find today, especially debt financing.

KPMG's report offers investors and geothermal developers an insight into the various sources of financing currently available for development projects. Our report highlights:

- Equity financing
- Debt financing
- Government support mechanisms
- Financing the different stages of geothermal development
- Risks involved in geothermal development
- Risk mitigation schemes

**“The dry period in geothermal development in the U.S., in the 1990’s, was down to a lack of incentives and very low gas prices”**

**Yehudit “Dita” Bronicki, CEO Ormat Technologies**

# Market Outlook

KPMG’s report indicates that the geothermal power sector is at a critical point in its evolution. For the last two decades, development has slowed down around the world but things seem to be turning around once again and the industry is bracing itself for a new growth period.

Spurred on by a global awareness of the need to move from fossil fuels, governments around the world are introducing the measures needed to increase investment. Those measures have attracted a new type of geothermal development company to the sector. Pure-play developers have emerged that are focused on resource development rather than power plant operation.

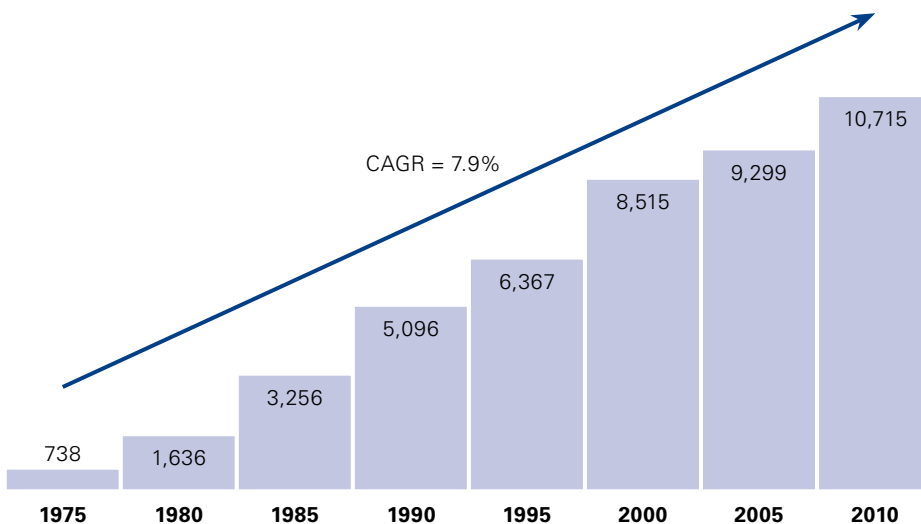
Technological advances promise to widen the scope of the geothermal sector, opening up new opportunities in markets across the globe.

KPMG’s report provides analysis of the geothermal market from different

perspectives. We take an objective look at the current situation of the sector and try to assess where it is heading. Our report looks into:

- The historical evolution of geothermal development with a regional breakdown in the last 50 years
- An assessment of the current geothermal project pipeline and estimated increase in installed capacity
- Which markets are expected to see the most growth in the near future
- The evolution of generation technology and future development
- Financing options currently available for geothermal projects

## Evolution of global installed capacity



- MWe
- Compound Annual Growth Rate

Source: KPMG analysis





**To get a copy of the World  
Geothermal Market & Outlook  
report, please contact us**

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