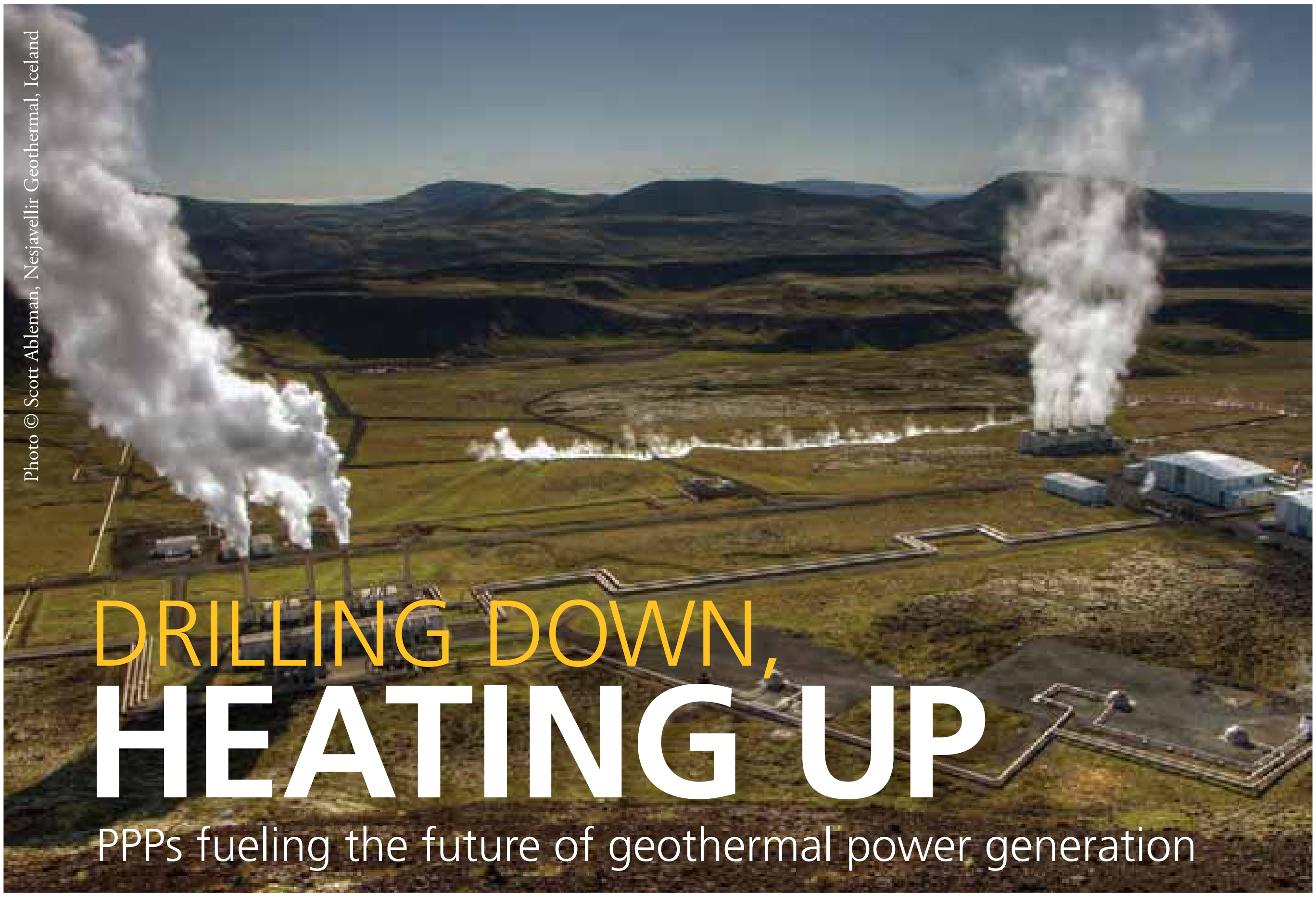

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DRILLING DOWN, HEATING UP

PPPs fueling the future of geothermal power generation

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It's hot at the center of the Earth—nearly 6,000 degrees Celsius—and the promise of public-private partnerships (PPPs) for geothermal energy, power derived from the planet's internal heat, is heating up as well. Geothermal energy has wide appeal because it is a renewable resource that produces sustainable base load power with a fraction of the greenhouse emissions of fossil fuels. Around 40 countries worldwide, including several low and middle income countries, have the potential to meet a sizeable proportion of their electricity demand through geothermal power, at a relatively low cost (around $.08 per kilowatt hour [kWh]).

As of 2012, however, global installed capacity had only reached 11.4 gigawatts (GW), about 0.3 percent of the world's total generation and only a fraction of its technical potential. What risk factors are holding back the potential of geothermal energy, and how can tailored PPPs help restore this promise?

RISKY BUSINESS

Unlike other renewable energy technologies, such as wind, solar, and hydro, it is not possible to confirm the existence of the geothermal resource with sufficient confidence for commercial development without performing at-depth drillings to assess specific geologic, chemical, and physical conditions in the field. Therefore, geothermal's risk profile is substantially more significant than the other renewable options.

While surface exploration is relatively cheap, validation of geothermal resources through exploration and confirmation drilling is expensive, often requiring $15 to $25 million per field. In other words, at least 10 percent of the capital expenditure of a new geothermal plant needs to be put at risk before it is clear whether a site has the potential to recover the costs. Although the rate of success for drillings increases with the numbers of wells drilled, production drilling is not free of resource risk. This means that project developers need to invest significant resources (up to 50 percent of the total project cost) before fully securing the geothermal fuel to meet a given power plant capacity.

Geothermal projects also have relatively long lead times from the start of exploration to power plant commissioning and the first revenues. Together with the high upfront costs and resource risk, this contributes to the high financing risk of these projects. Lack of commercial debt for resource validation and most of the production drilling stage complicates matters further.

PROMISING PATHS

Several models have the potential to mobilize capital and share the resource risk among promoters of geothermal projects, restoring the sector's promise. These models can be broadly grouped into three categories, based on the extent and nature of public and private sector participation across the phases of project development.

Public Entity: Under this model, the entire project development cycle—including risks, costs, and benefits—is undertaken by public entities. This is true whether there is a fully vertically integrated national entity (such as in Ethiopia and Kenya, KenGen at Olkaria), a group of unbundled national entities operating in the upstream phases and power sector separately (as in Indonesia), or a combination of national and municipal entities (as in Iceland). Although the purely public model has the advantage of directly benefitting the consumers through lower electricity tariffs (since no "private equity" return on investment is required), this approach has limitations. These include the insufficient level of government and other public resources that can be brought to bear on the development and execution of a country's geothermal development.

Private Developer: At the other end of the spectrum is a vertically integrated, private developer model, which is typically undertaken only by large multinational companies with strong balance sheets who are willing to take the entire project risk (Chevron in the Philippines).

PPP: In most developing countries, the private sector cannot put the required equity at risk for the riskier phases of project development, even with risk mitigation instruments in place, and the government has limited capacity to fully assume the costs of developing its geothermal potential. In these cases, a PPP model helps mobilize private developer funds and reduces overall financial risk that would be taken by either the government or private developer when operating alone. Different PPP variants can be used depending on the country risks and associated commercial, market, off-take, and other risks. Most typically, the public sector will take on part of the risk of upstream resource exploration and development, with the private sector carrying out power generation activities.

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DRILLING DOWN TO PPPs

A closer look at PPP arrangements reveals a number of different approaches within the partnership model, all of which have met with success around the world. In each case, the strategy was tailored to the specific needs of the region and the parties involved.

Tolling or energy conversion agreement: Under this approach, a geothermal steam field operator, generally a public entity, develops and operates the steam field. The steam is then converted to electricity in a power plant owned and operated by a private developer, who may or may not attain ownership of the product. The type of contractual relationship established between the steam provider and the electricity generator (and between the electricity generator and the power off-taker) will determine the specific distribution of risks. This model was used in the Leyte and Mindanao fields in the Philippines and in the Zunil I plant in Guatemala in the late 1990s, and is the model currently pursued in Kenya.

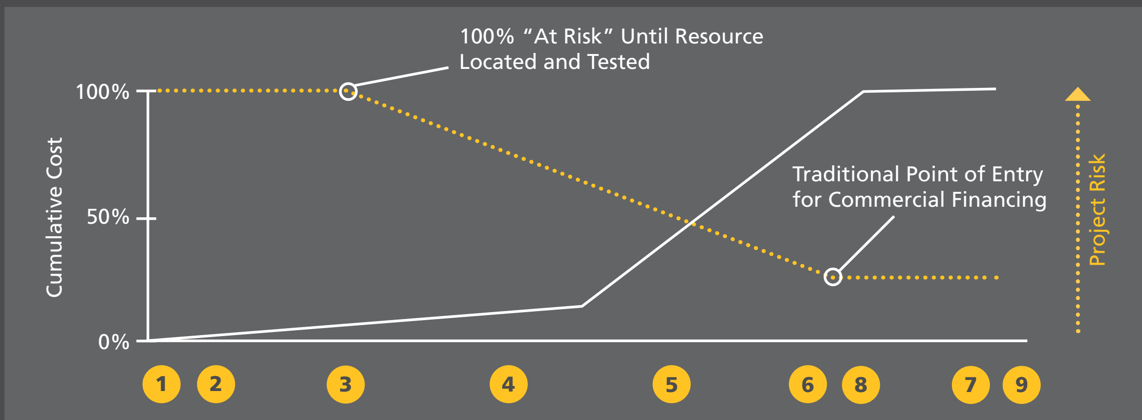
Joint venture: This entails a strategic partnership between a public entity and a competitively selected private investor. The geothermal developer is co-owned by the government and the private sector investor and all aspects of the projects are co-financed and developed (as with La-Geo, El Salvador).

Other IPP variants: Here, government may fund the surface exploration, exploratory, and confirmation drillings, offering the successful field for development and power generation. Alternatively, government performs limited exploration, then shares the risk of further exploration and power generation. The latter option is feasible only if private investors can absorb the risk associated with confirmation and production drilling.

Regardless of the approach that's used, international experience in geothermal energy shows a clear need for public-private engagement in order to exploit even a fraction of the potential of geothermal power generation. If the risks are in balance, promise can turn to potential—with power not far behind. h

This article is part of The Global Geothermal Development Plan, an initiative by the World Bank Group's Energy Sector Management Assistance Program (ESMAP) and other multilateral and bilateral development partners. More information: www.esmap.org/node/3027

KEY PHASES, RISKS, AND COST PROFILE OF GEOTHERMAL DEVELOPMENT



EXPLORATORY PHASE:

1 ***Preliminary Survey:*** includes data collection, inventory, selection of areas for exploration, and pre-feasibility studies.

2 ***Surface Exploration:*** identifies the probable location and characteristics of the geothermal reservoir and establishes exploratory drilling targets.

3 ***Exploratory Drilling:*** validates surface exploration results, locates and tests the geo-thermal resource to support preparation of a feasibility study.

4 ***Confirmation Drilling:*** confirms or serves to modify the conceptual reservoir model, updates the volumetric assessment, and establishes production drilling targets.

RESOURCE/FIELD DEVELOPMENT:

5 ***Production/Capacity Drilling:*** increases geothermal resource supply by drilling the geothermal reservoir in conformance with the model.

6 ***Steam Gathering System Development & Construction:*** detailed design, engineering, procurement, and construction of the steam gathering system and related equipment, which connects the geothermal reservoir to the power plan.

7 ***Steam Gathering System Operation:*** all operating requirements of the geothermal steam field as part of the integral operation of the power generation facility.

POWER PLANT DEVELOPMENT & OPERATIONS:

8 ***Power Plant Detailed Development & Construction:*** detailed design, engineering, procurement, and construction of the power plant and the electrical interconnect to the transmission grid.

9 ***Power Plant Operation:*** personnel training and operational requirements as part of the integral operation of the power generation facility.