U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

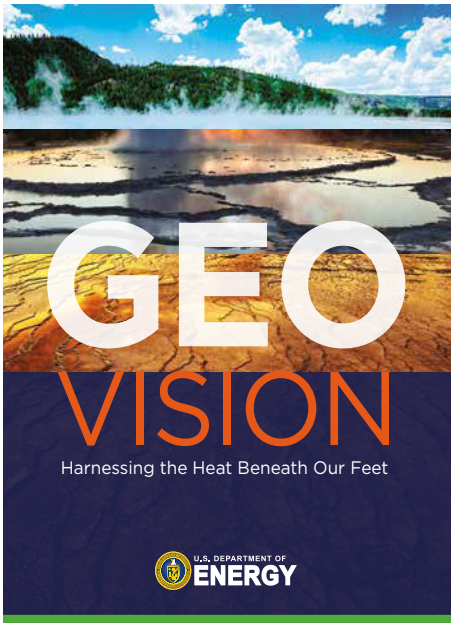
Introduction to the *GeoVision* Analysis

Geothermal energy offers abundant potential in the United States, including opportunities to increase geothermal electricity generation 26-fold by 2050. Geothermal has enormous potential as a renewable and diverse energy solution for the United States—providing constant, secure electric-power generation with flexible capabilities and delivering unique technology solutions for America's heating and cooling demands. Geothermal resources can be found nationwide, are "always on," and represent vast domestic energy potential. Only a fraction of this potential has been realized, however, because of technical and non-technical barriers that constrain industry growth. Overcoming these barriers could support increased geothermal deployment, in turn providing value to all Americans by contributing to the long-term portfolio of affordable energy options. For example, through regulatory reforms alone, geothermal capacity could double. With technology improvements that focus on exploring, discovering, developing, and managing geothermal resources, geothermal electric-power generation could increase nearly 26-fold from today. In addition, geothermal heat pumps can provide heating and cooling solutions to the equivalent of 28 million households—versus 2 million today—and geothermal district-heating systems could experience exponential growth—from 21 installations today to 17,500 installations nationwide.

About Geothermal Energy

Geothermal energy is renewable energy that originates from the heat coming from the Earth's interior to the surface. Geothermal heat flow is expressed visibly at the surface as volcanoes, hot springs, and geysers; however, the vast majority of geothermal energy exists below the surface. This subsurface energy is available everywhere and much of it can be used for productive purposes, including electricity generation, heating and cooling, and industrial processes.

The subsurface nature of geothermal resources requires some level of penetration of the Earth's surface—usually drilling wells—to characterize,



DOE released *GeoVision: Harnessing the Heat Beneath Our Feet* in May 2019. The full report is available at www.energy.gov/geovision.

Raft River geothermal power plant in Idaho. *Photo credit: Roxie Crouch*

access, and extract energy. Geothermal installations are typically low profile and have a smaller footprint than many other energy-generation technologies. Once an installation is built and operational, it will supply constant, always-available energy. Geothermal resources across a range of temperatures can be used economically for a variety of electric and non-electric applications. The use of geothermal energy can provide benefits to U.S. consumers, including diverse, affordable, and secure energy options as well as environmental benefits.

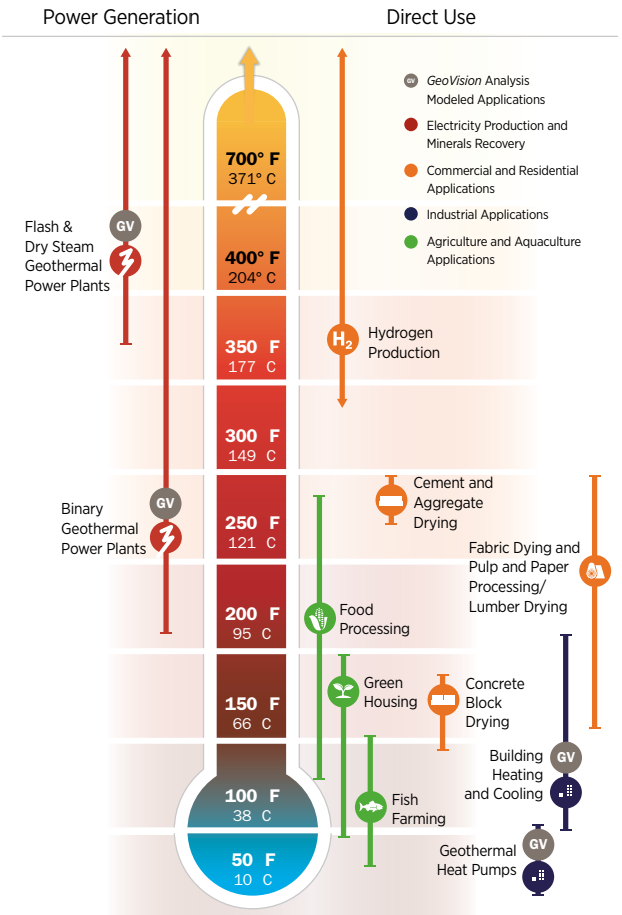
The *GeoVision* Analysis

To evaluate the potential for geothermal energy and ensure its continued contribution to America's energy future, the U.S. Department of Energy's (DOE's) Geothermal Technologies Office (GTO) initiated the *GeoVision* analysis—a detailed research effort to explore opportunities for increased geothermal deployment and the pathways to overcome technical and non-technical barriers to such deployment.

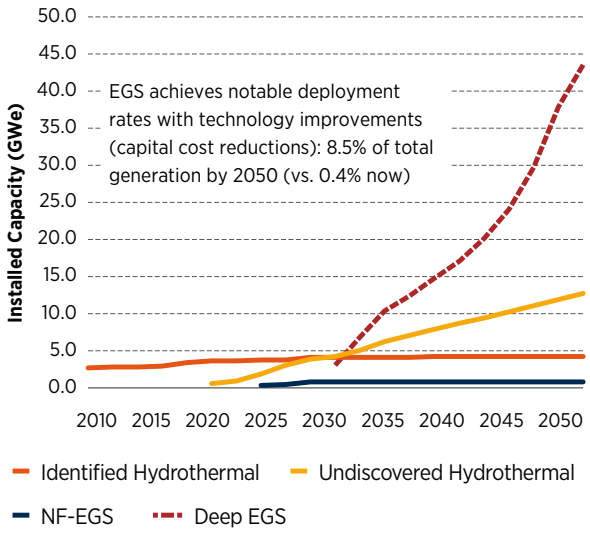
The analysis was based on three key objectives:

- Increased access to geothermal resources
- Reduced costs and improved economics for geothermal projects
- Improved education and outreach about geothermal energy.

Achieving the three key objectives can reduce risk and costs for geothermal developers, increase growth potential for geothermal energy, and provide the United States with secure, flexible energy that offers economic benefits to the geothermal industry and environmental benefits nationwide.



Geothermal energy offers a wide range of potential applications, including electricity generation, heating and cooling, and industrial and agricultural processes.



By 2050, the *GeoVision* analysis Technology Improvement scenario results in total geothermal deployment of more than 60 GW_e, with the majority of growth supplied by deep-EGS (enhanced geothermal system) resource development after 2030. *Note: NF-EGS is near-field EGS.*

The *GeoVision* analysis used quantitative models to assess geothermal deployment potential under scenarios that considered a range of technologies, market conditions, and barriers. The analysis projected that, through combined regulatory reform and technology improvements, geothermal electric generation has the potential to increase to more than 60 gigawatts-electric (GW_e) by 2050—providing 8.5% of all U.S. electricity generation.

The analysis culminated in a summary report, *GeoVision*: *Harnessing the Heat Beneath Our Feet,* published by DOE in May 2019. The full body of analytical work is detailed in the *GeoVision* Analysis Supporting Task Force Reports, which are listed in the summary report references.

The Benefits of Geothermal Energy and a Pathway Forward

The *GeoVision* analysis was a landmark effort that quantified geothermal deployment potential at a national scale and across a broad range of technology applications. The analysis examined the unique characteristics of geothermal energy and the benefits the United States can realize from increased deployment, including:

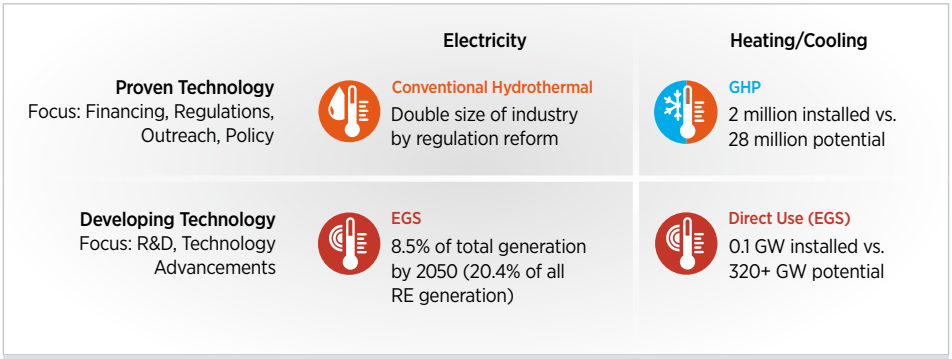
- Secure, "always-on" renewable electricity generation with flexible and load-following capabilities that provide essential services to support the grid of the future
- Nationwide, affordable solutions for electricity generation and for heating and cooling at residential, commercial, and district levels

Drilling and power-plant construction at the Blue Mountain geothermal field in Nevada. *Photo credit: John Casteel*

- Existing commercial technologies that are already proven in the market, augmented by innovative technologies with vast potential to increase electricity generation and heating and cooling solutions
- Economic benefits to the geothermal industry and environmental benefits for the nation
- Revenue potential for federal, state, and local stakeholders, as well as royalty potential for leaseholders.

The *GeoVision* analysis confirms vast deployment opportunities for proven technologies such as conventional hydrothermal and heating and cooling, as well as for developing technologies such as enhanced geothermal systems.

The analysis included a Roadmap of technical, economic, and institutional actions across the geothermal community that can help address barriers and ensure the continued and expanded contribution of geothermal energy as a renewable, reliable, and diverse energy solution for the United States. The Roadmap is intended to begin an evolving and collaborative process to inform future action across



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industry, government, academia, and other geothermal stakeholders.

The *GeoVision* Roadmap outlines a series of sub-actions under four key Action Areas:

Action Area 1: Research Related to Resource Assessments, Improved Site Characterization, and Key Technology Advancements

Action Area 2: Regulatory Process Optimization

Action Area 3: Maximizing the Full Value of Geothermal Energy

Action Area 4: Improved Stakeholder Collaboration.

The Action Areas are ultimately aimed at the three key objectives for the *GeoVision* analysis. The Roadmap is intended to be modified in regular reviews of progress toward the objectives—particularly in light of changing technologies, markets, public priorities, and policy factors. Achieving the actions in the *GeoVision* Roadmap can expand the use of geothermal energy and help the nation realize important benefits, including grid stability, greater diversity in the portfolio of affordable energy options, efficient heating and cooling, and environmental and economic benefits. ■

View to the northwest of Navy I geothermal power plants at Coso geothermal field in California. *Photo credit: Andy Sabin*

Sapphire Pool in Biscuit Basin at Yellowstone National Park, Wyoming.
Photo credit: Jim Stimac

Questions or comments? Email GeoVision@ee.doe.gov

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For more information, visit: energy.gov/geovision

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