

Geothermal Technologies Office

Connecticut DEEP Webinar
October 15, 2019

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Director



Image: Calpine



Agenda

- **Why Geothermal?**
- **About GTO**
- ***GeoVision* Analysis**
- **Geothermal in New England**

Why Geothermal?

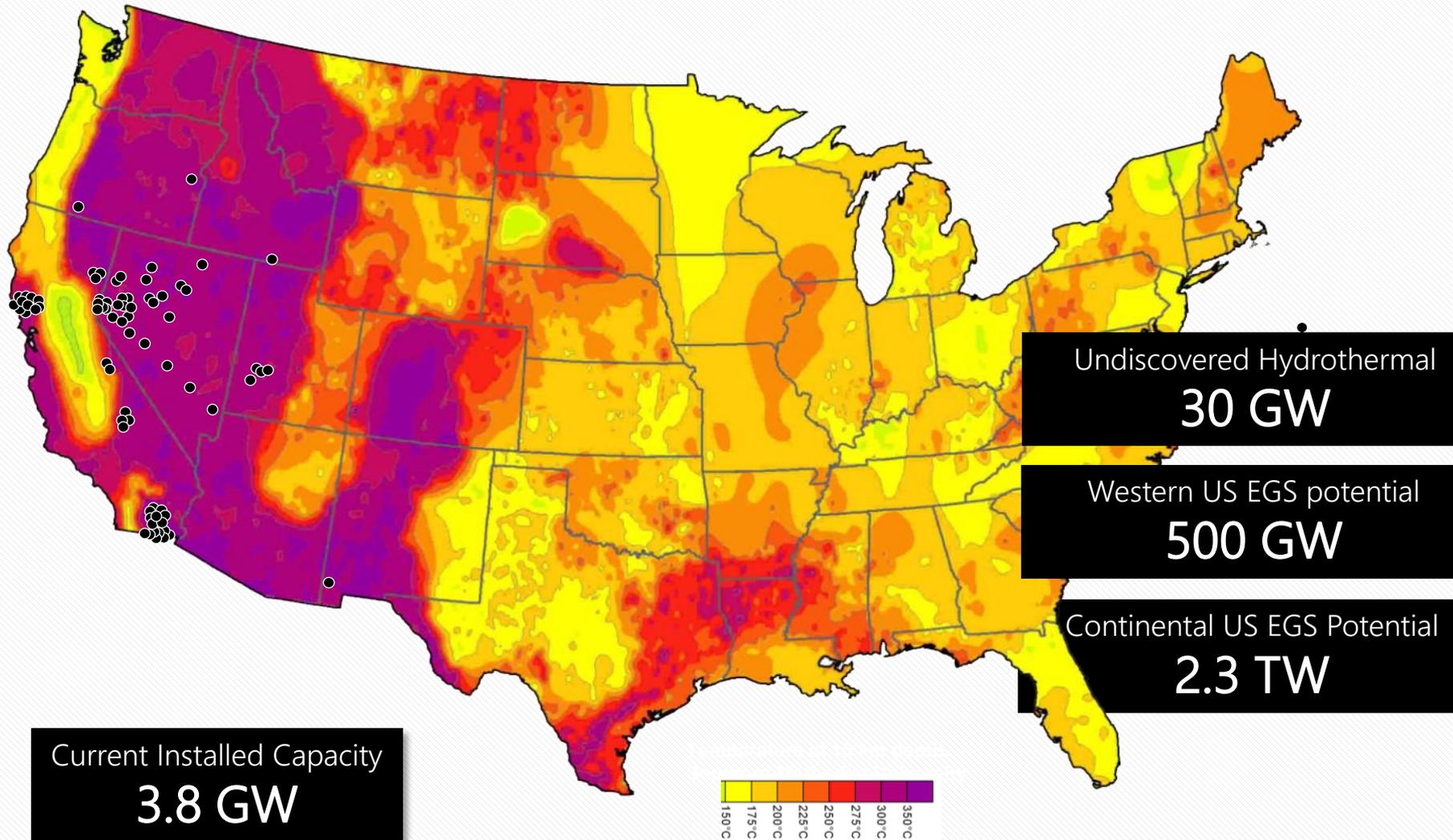
Beneath our feet lies vast, untapped energy potential.

Geothermal energy...

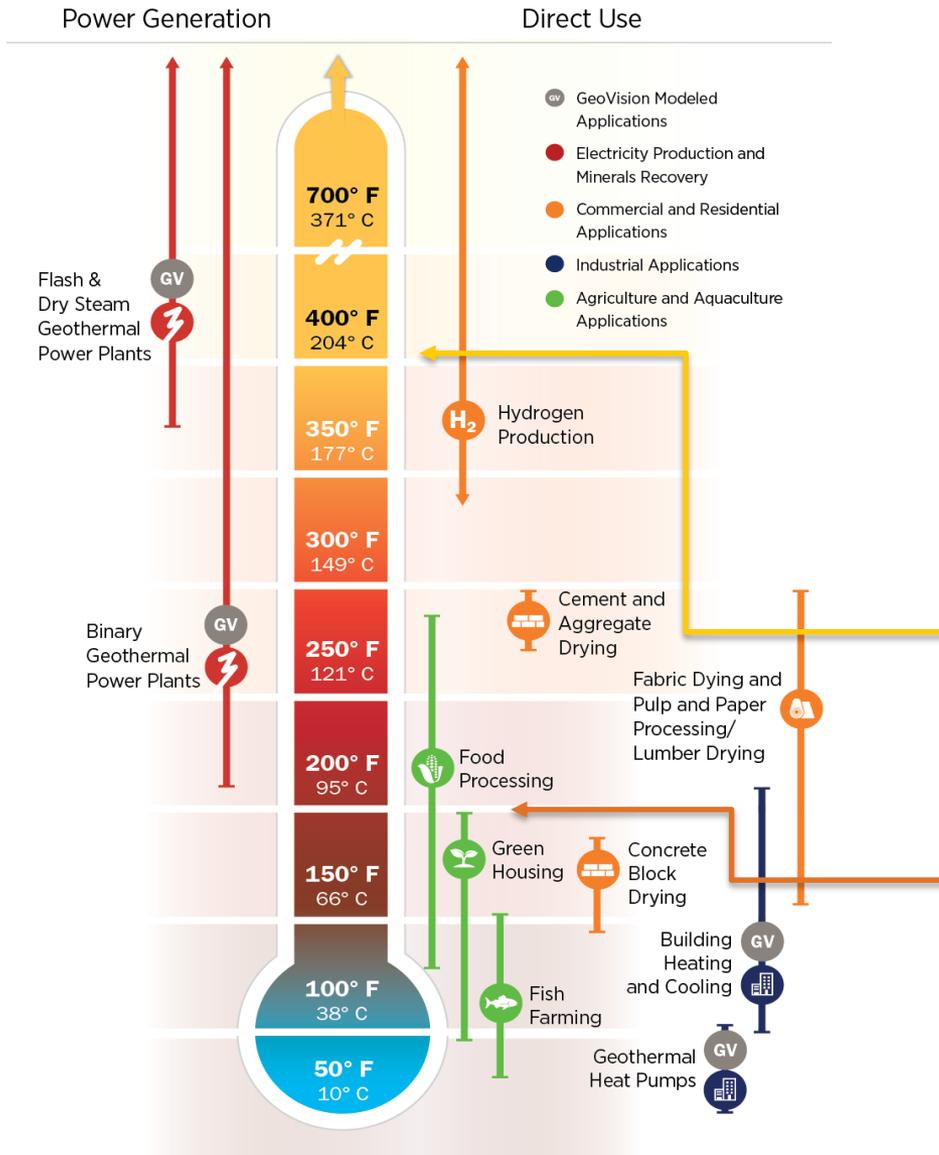
- **...is always-on.**
- **...is secure and flexible.**
- **...provides baseload power.**
- **...creates thousands of energy sector jobs.**
- **...is an everywhere solution.**



U.S. Geothermal Resources



Geothermal Diversity



Geothermal offers a broad array of technology applications for both power generation and direct use. This diversity of application is key to the geothermal industry's viability and continuous growth.

At higher temperatures, binary, flash, and dry steam power plants come into play.

At lower temperatures, direct use extends from agriculture and material production to home and commercial heating and cooling.

Types of Geothermal

Heat Pumps

- Near-ambient temperatures (40-80 °F)
- Shallow trenches to wells hundreds of feet deep
- Residential, light commercial

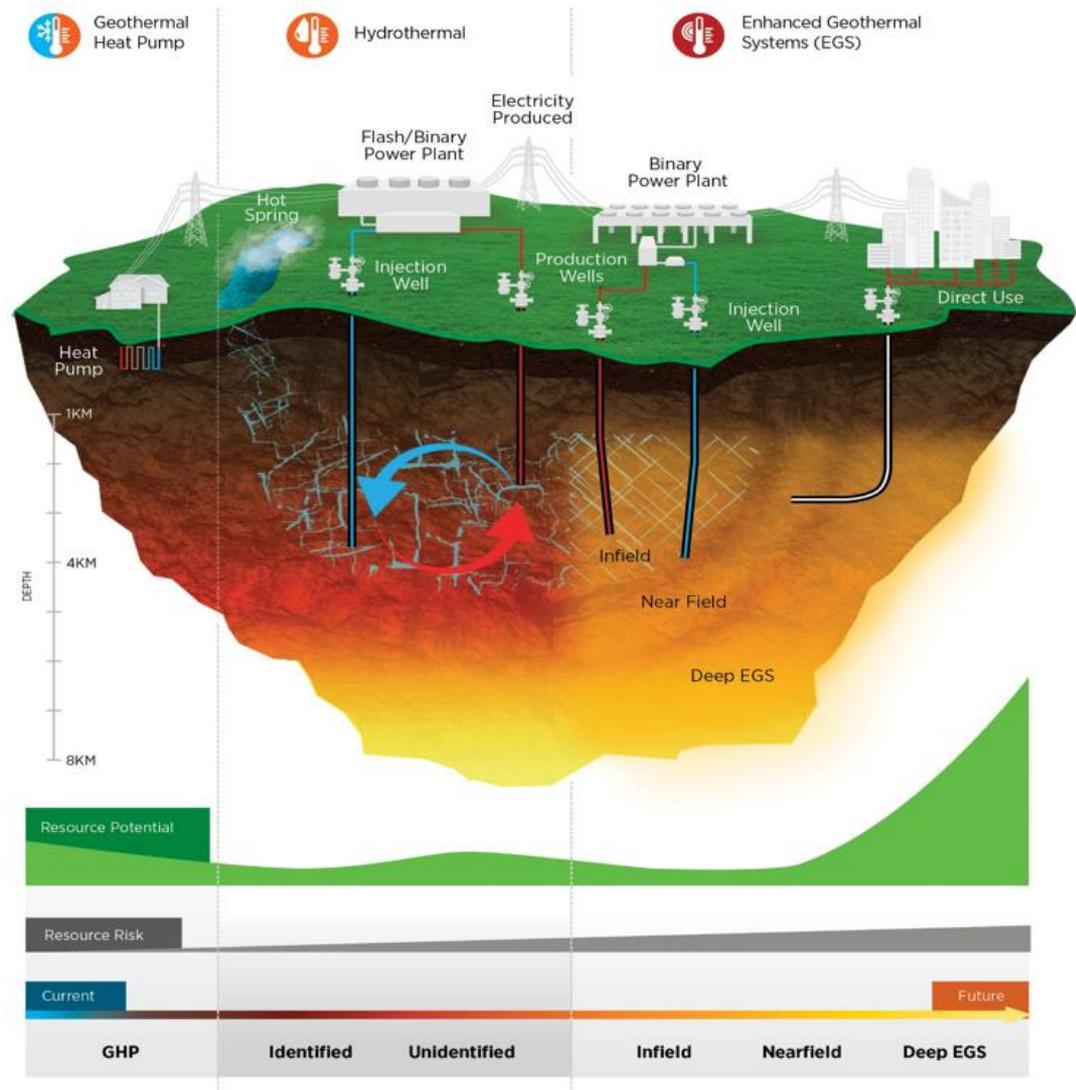
Direct Use

- Moderate temperatures (100-300 °F)
- Wells hundreds to thousands of feet deep
- Large buildings, agriculture

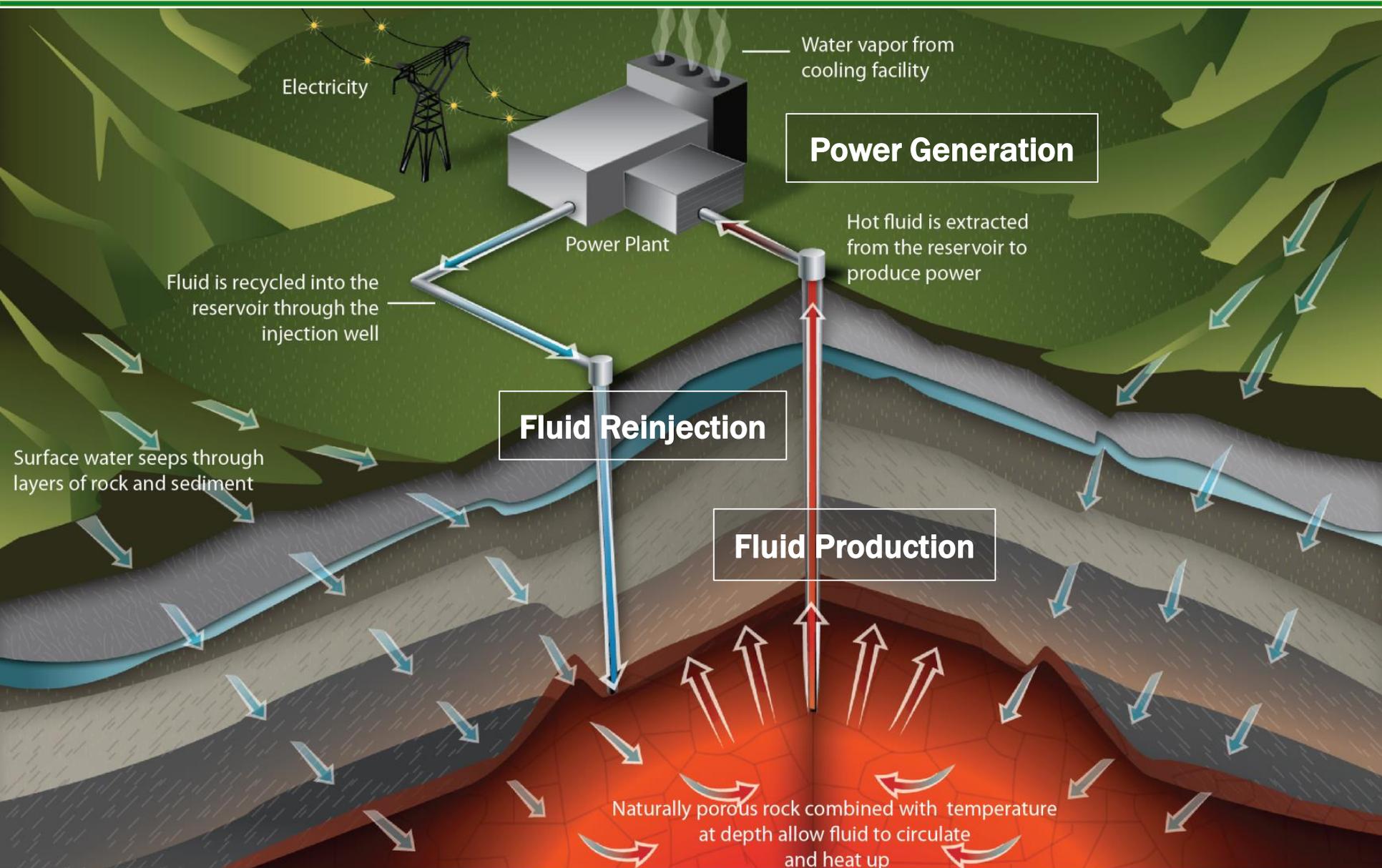
Electric Power

- Mostly high temperatures (>300 °F)
- Wells up to many thousands of feet deep
- Grid power

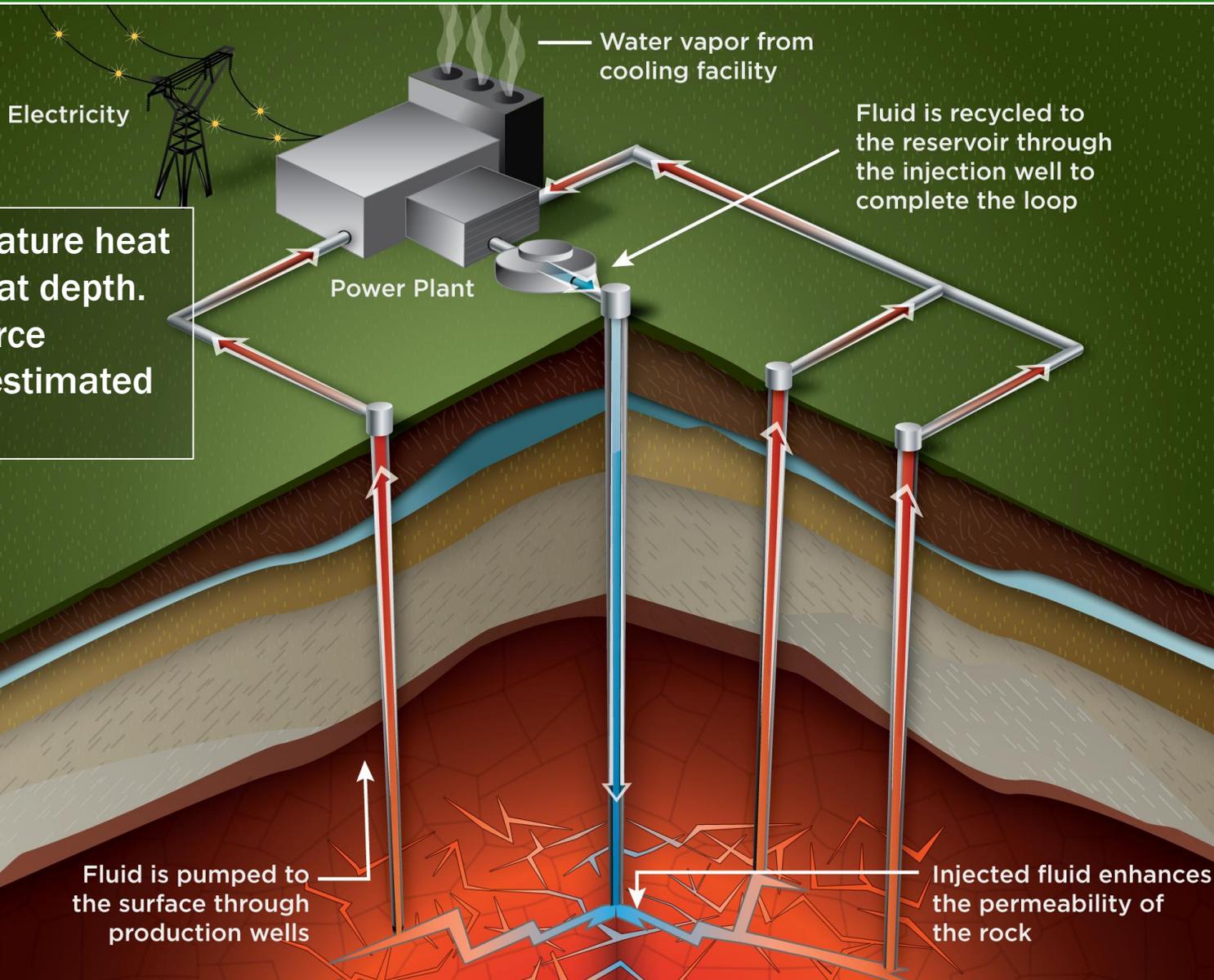
Geothermal Diversity



Geothermal Power Generation



Enhanced Geothermal Systems (EGS)



- High temperature heat is abundant at depth.
- Viable resource potential is estimated at 60+ GWe.

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Current priorities across **Renewable Energy (RE)** offices present opportunities for collaboration and innovation.

- Energy affordability
- Energy integration
- Energy storage



Solar Energy
Technologies Office



Wind Energy
Technologies Office



Geothermal Technologies Office



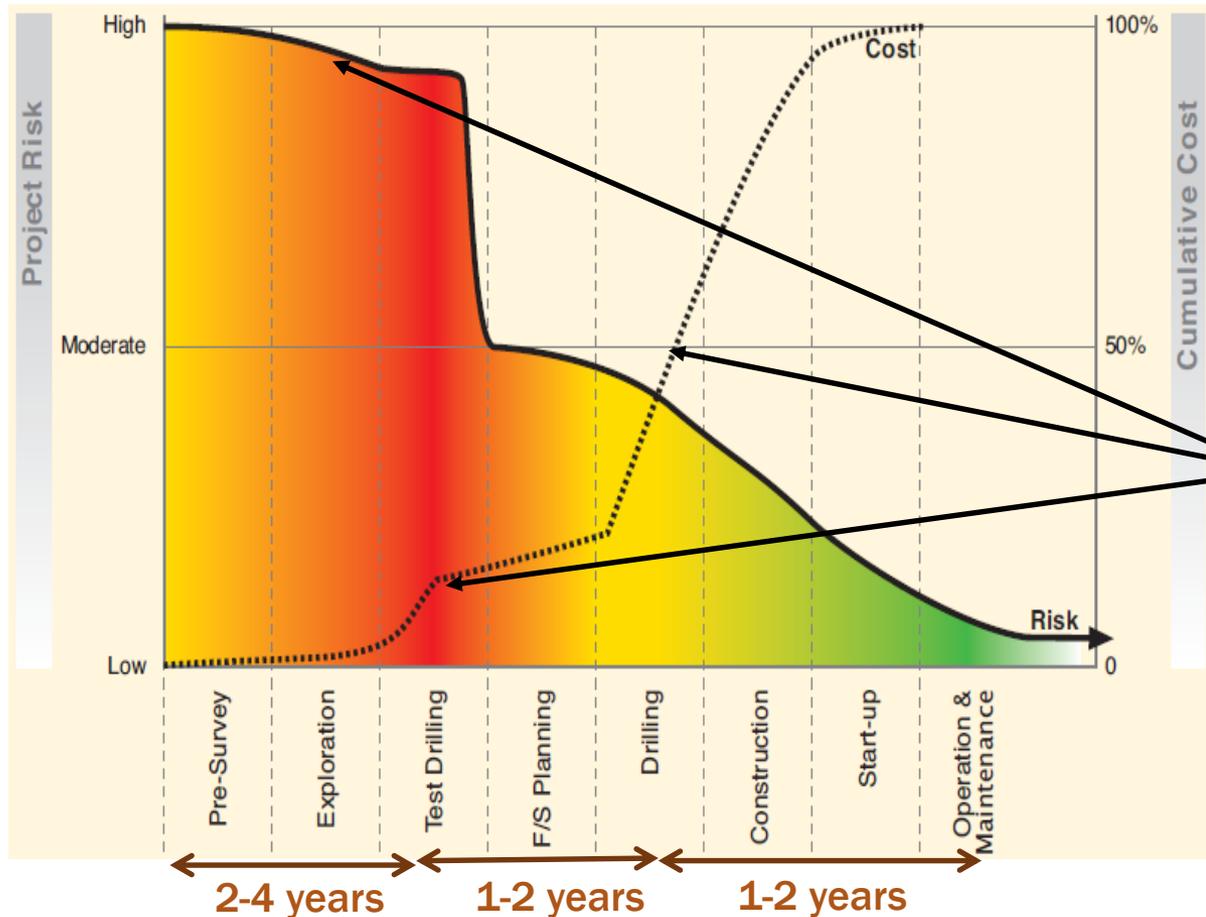
Water Power
Technologies Office



Grid Modernization
Initiative

GTO Mission

The mission of the **Geothermal Technologies Office (GTO)** is to support early-stage research and development (R&D) to strengthen the body of knowledge upon which industry can accelerate the development of innovative geothermal energy technologies.



GTO supports research in key areas such as drilling, success probability, and new technologies that help reduce early-stage risk and cost.

Research in Action: Cornell University (Ithaca, NY)



Cornell University

Cornell University's goal is to be the first major university **in a northern climate** to completely heat and cool its campus using local renewable energy sources.

Success at Cornell will demonstrate earth-source heat as an affordable, renewable, low-carbon option for district heating. The systems approach for integrating earth-source heat at Cornell **is scalable to other locations in the northern U.S.**

Geothermal end uses include:

- Building heat
- Greenhouse heating
- Aquaculture
- Biomass kiln drying
- Snow melting

Photo: Cornell University

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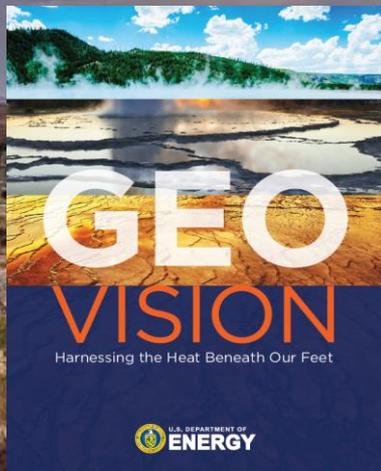
GeoVision Analysis

The *GeoVision* study addresses a **fundamental question:**

On the basis of detailed assessments of

- the geothermal industry,
- barriers to deployment,
- and both existing and improved technologies...

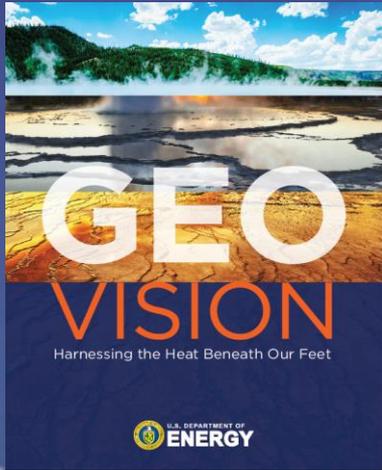
...what level of deployment would be achievable and what would be the corresponding economic benefits to industry and the environmental impacts of those deployment levels on the United States?



www.energy.gov/geovision

Image: *GeoVision* Report

GeoVision Analysis

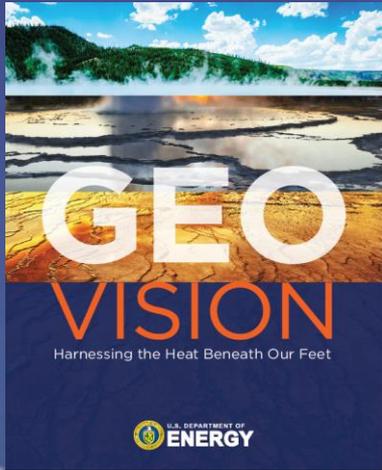


The *GeoVision* report is the product of years of rigorous research and analysis, with contributions from a broad range of participants representing industry, academia, national laboratories, and federal agencies.

Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
...and gain valuable economic and environmental benefits.

Image: *GeoVision* Report

GeoVision Report



Optimized permitting could cut development timelines in half, leading to a **doubling** of geothermal development (13 GWe by 2050) versus business-as-usual.

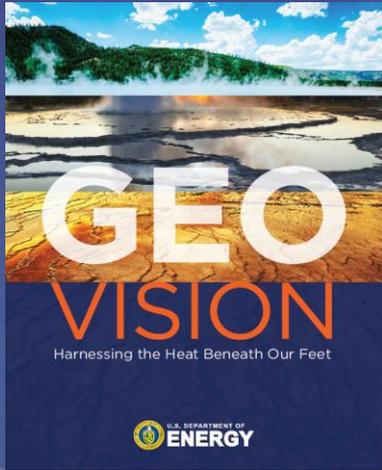
District use could increase by orders-of-magnitude, from a current total of 21 geothermal district heating installations to as many as **17,500 nationwide**. Geothermal heat pumps could increase from 2 million to **28 million**.

Deployment could reach **60 GWe by 2050** with aggressive technology improvements.

Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
...and gain valuable economic and environmental benefits.

Image: GeoVision Report

GeoVision Analysis



Technology innovation is essential – it improves our understanding of subsurface conditions, helps to reduce risk, and accelerates growth of domestic geothermal power.

Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
...and gain valuable economic and environmental benefits.

Image: GeoVision Report

The *GeoVision* Roadmap

The four Roadmap Action Areas target the three key objectives of the *GeoVision* analysis:

1. Increase access to geothermal resources
2. Reduce costs and improve economics for geothermal projects
3. Improve education and outreach about geothermal energy through stakeholder collaboration

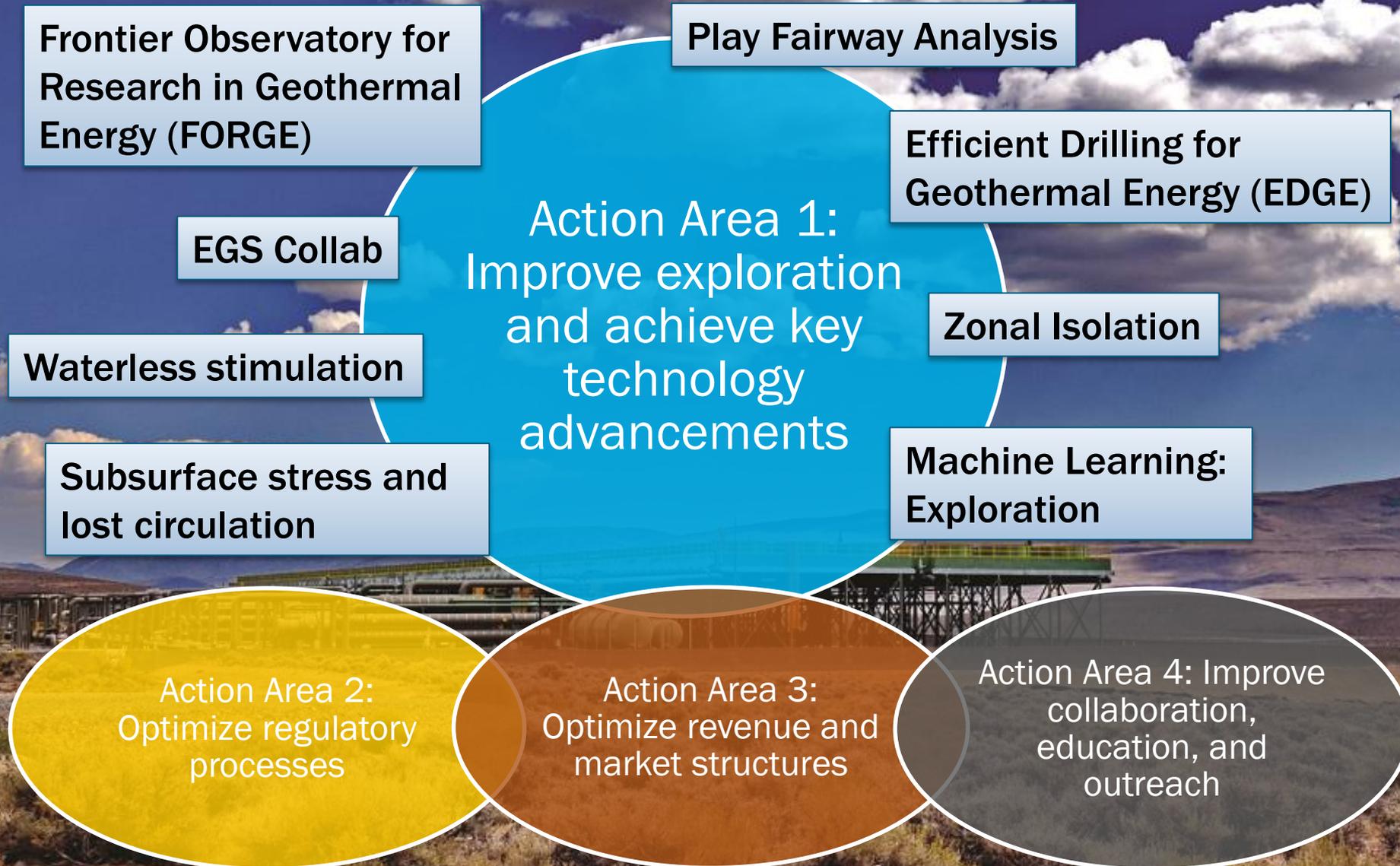
Action Area 1:
Improve exploration and achieve key technology advancements

Action Area 2:
Optimize regulatory processes

Action Area 3:
Optimize revenue and market structures

Action Area 4:
Improve collaboration, education, and outreach

GTO Research



GTO Research

**Collaboration with
Dept of Interior /
Bureau of Land Mgmt**

**Potential
collaboration with
state and local
governments**

**Action Area 2:
Optimize
regulatory
processes**

**Collaboration with
U.S. Forest Service**

**Collaboration with
Dept of Defense**

**Action Area 1: Improve
exploration and
achieve key technology
advancements**

**Action Area 3:
Optimize revenue and
market structures**

**Action Area 4: Improve
collaboration,
education, and
outreach**

GTO Research

Coordination with Strategic Priorities and Impact Analysis team

Advanced Energy Storage Initiative; improved valuation of geothermal

**Action Area 3:
Optimize revenue and market structures**

Beyond LCOE

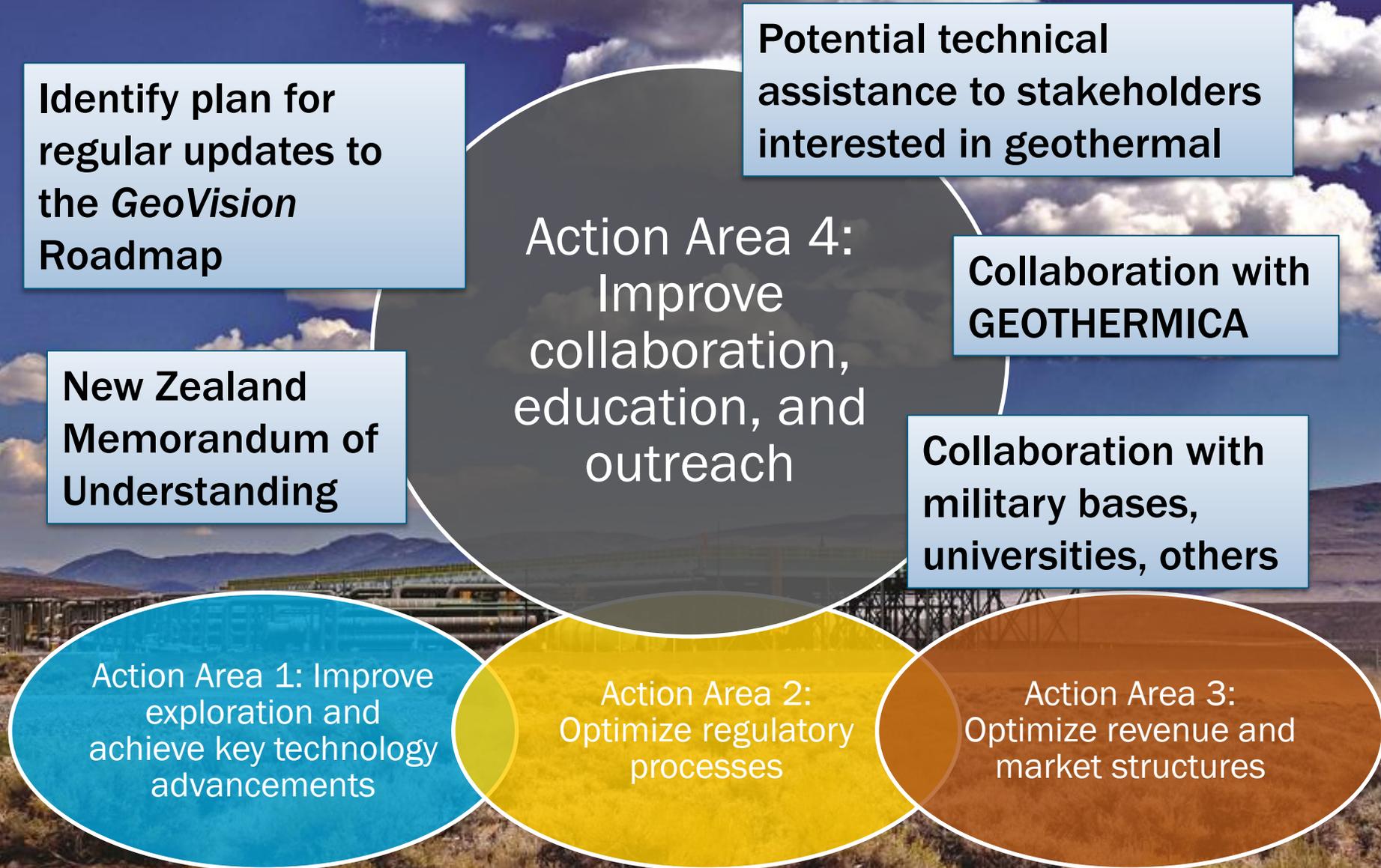
**Critical Materials /
Salton Sea**

Action Area 1: Improve exploration and achieve key technology advancements

**Action Area 2:
Optimize regulatory processes**

Action Area 4: Improve collaboration, education, and outreach

GTO Research



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Notable Geothermal Installations in New England

Kid City Museum, Middletown, CT
Children's museum that uses a GHP for heating.



Photo: Carl Verlund Photography via kidcitymuseum.com



Photo: Newport-discovery-guide.com

The Breakers, Newport, RI
70-room former Vanderbilt summer cottage, featuring a GHP system for heating and humidity control.

Notable Geothermal Installations in New England



Photo: InnatBoltwood.com

Inn at Boltwood, Amherst, MA
Historic 49-room/suite hotel with a GHP heating and cooling system featuring 50 wells, each 500' deep.

Meigs Points Nature Center, Madison, CT
Environmental education center that uses a GHP to heat and cool the building.



Photo: meigspointnaturecenter.org

How Geothermal can Help Connecticut and New England

Geothermal can help address numerous potential energy concerns in New England, especially:

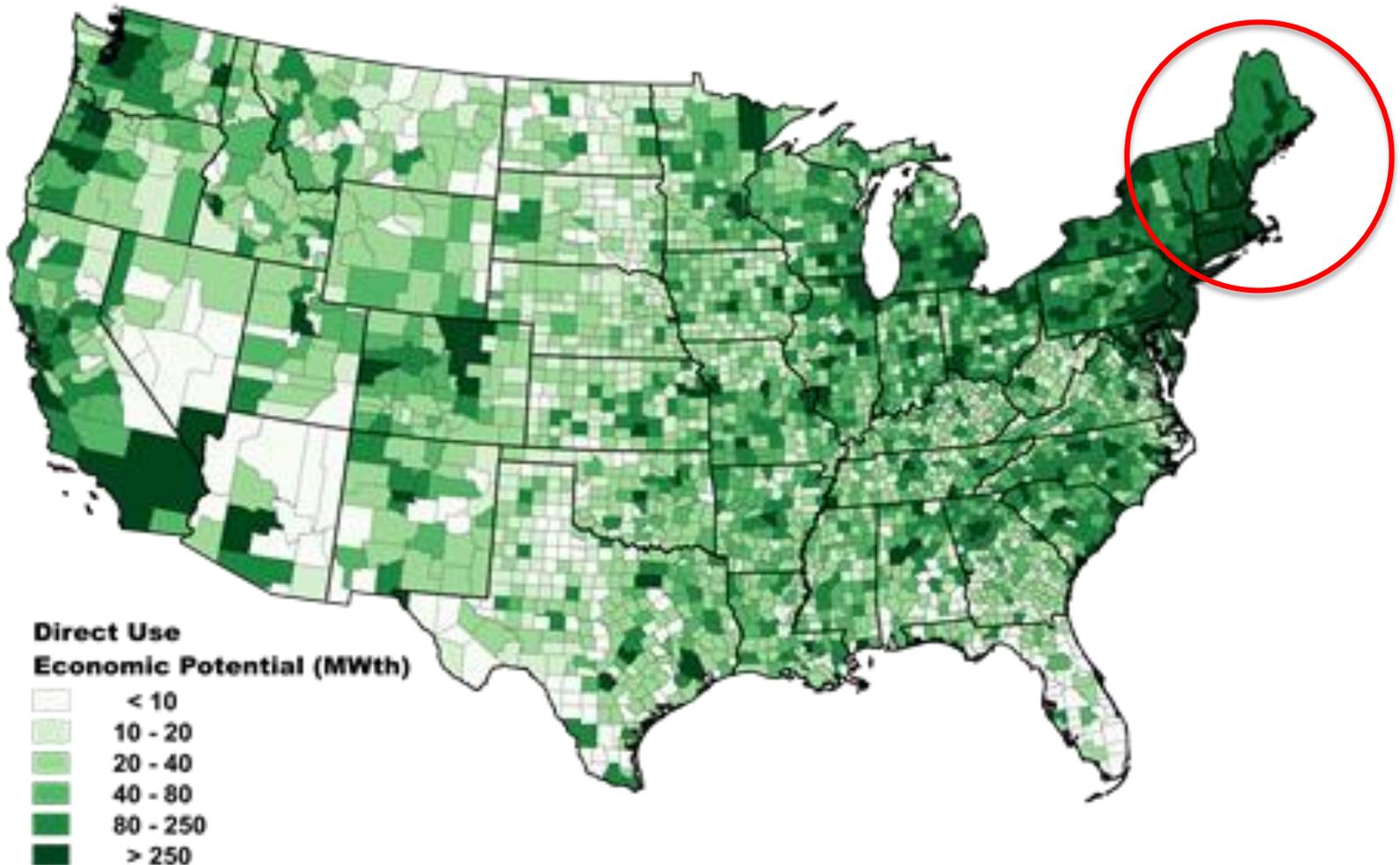
- Large heating demands
- High heating-fuel costs
- High electricity costs
- Limited natural-gas capacity
- Grid reliability and resiliency

Key challenges for geothermal in New England include high upfront costs, low consumer understanding, and general risks associated with geothermal development.

Photo: Boston Magazine

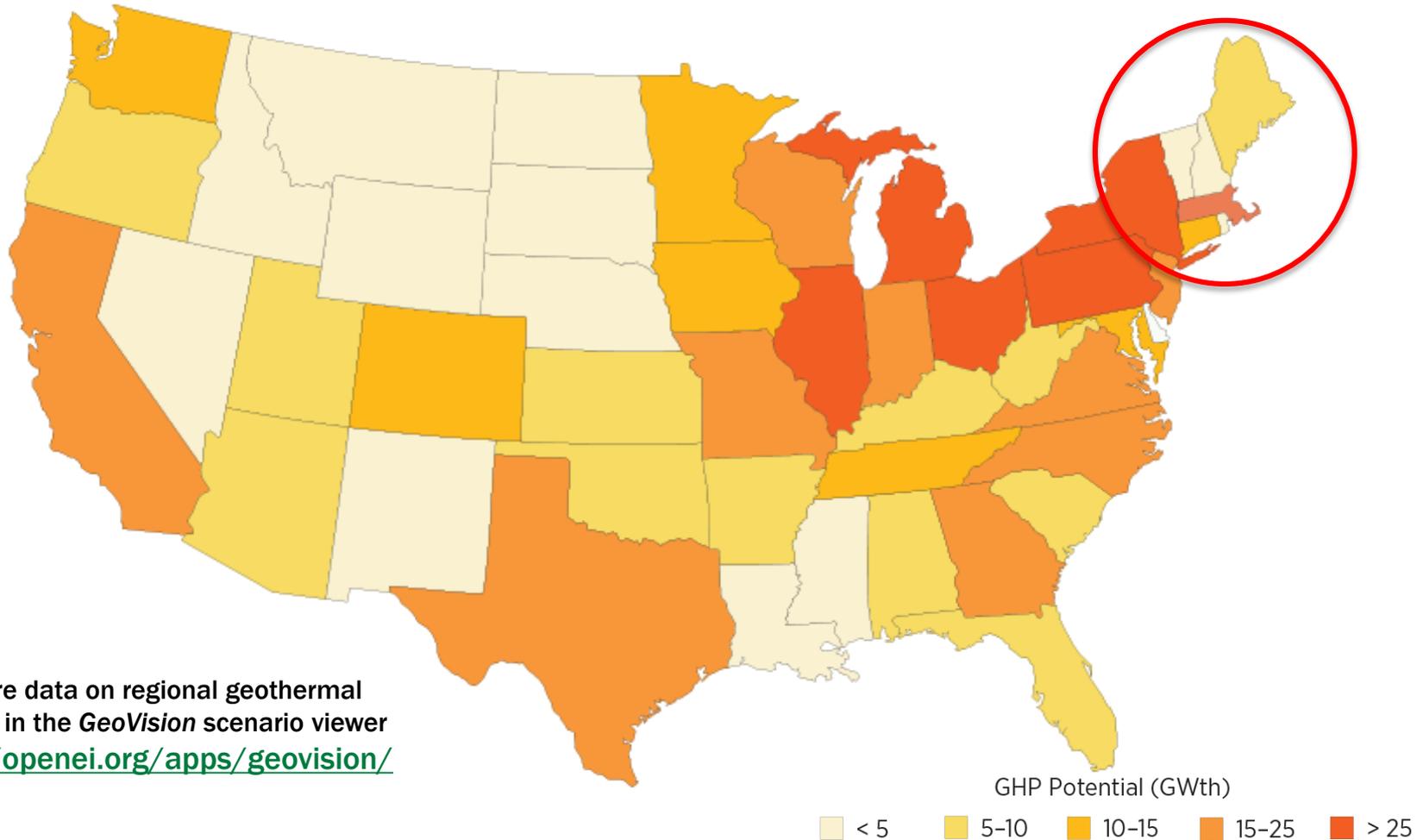
Opportunities for Geothermal in New England

The *GeoVision* Technology Improvement scenario indicates high economic potential for geothermal district heating installations in New England – more than 31,000 MW_{th} in the region by 2050, with more than 7,300 MW_{th} of that in Connecticut alone.



Opportunities for Geothermal in New England

The *GeoVision* GHP Breakthrough scenario indicates significant economic potential for **geothermal heat pumps** in New England – more than 47,000 MW_{th} for the region by 2050. **Connecticut represents ~23% of this total capacity (10,745 MW_{th}).**



Thank You!

“Making geothermal **more affordable** can increase our energy options for a more diverse electricity generation mix and for innovative heating and cooling solutions **for all Americans.**”

Rick Perry
U.S. Secretary of Energy

Visit us at: www.energy.gov/eere/geothermal

Photo: Boston Magazine

Thank You!

Want to learn more?

- ctgreenbank.com/programs/smart-e-loans
- geothermalconnecticut.org
- www.energizect.com/events-resources/energy-basics/geothermal

Visit us at: www.energy.gov/eere/geothermal

Photo: Boston Magazine

GTO Budget Overview

GTO Appropriations + FY 2020

