Enhanced Geothermal Shot Briefing

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Presenter

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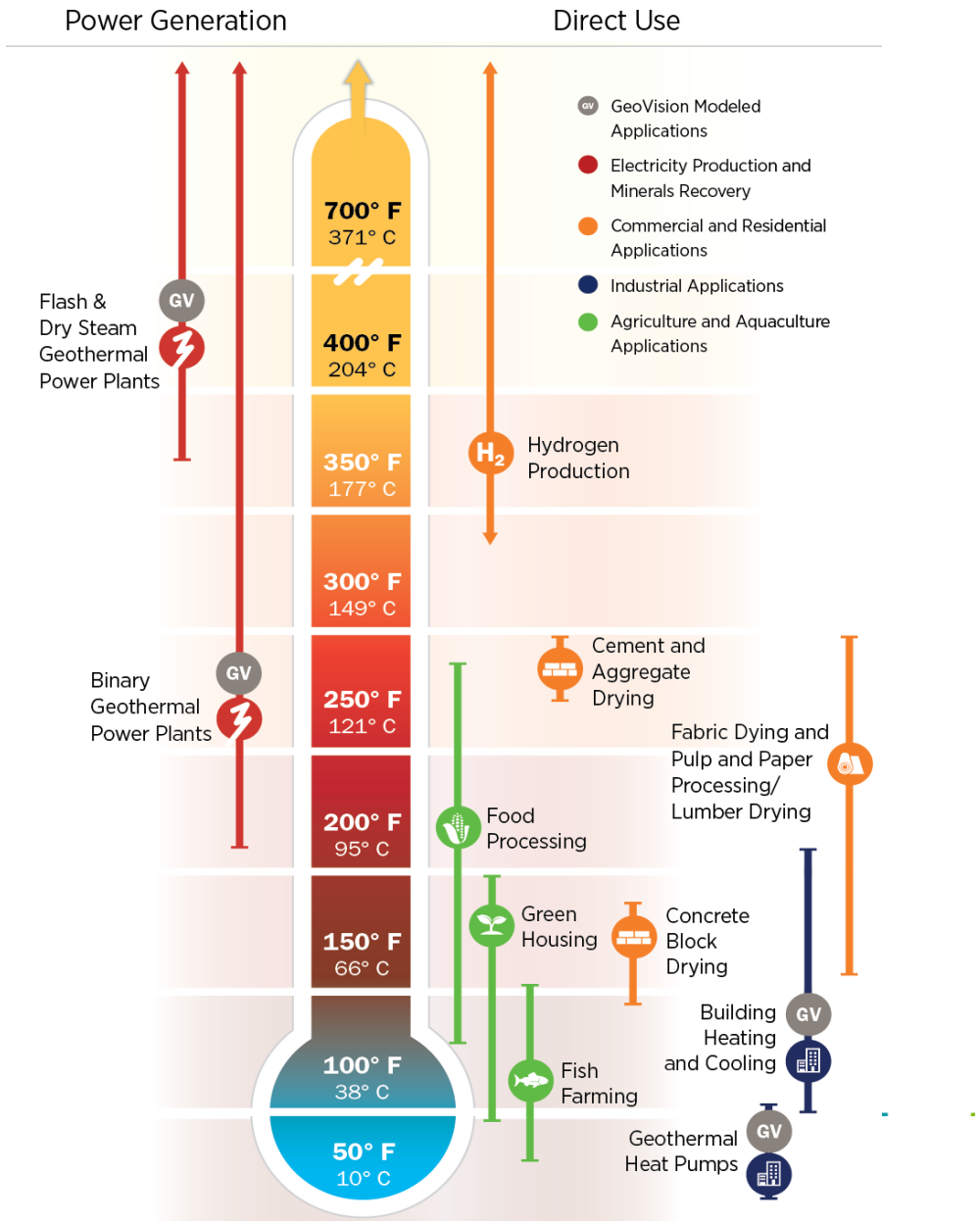
Geothermal Energy: *America's Next Renewable Powerhouse*

Electric Power	• **High temperatures (>300°F)** • **Wells up to many thousands of feet deep** • **Grid power**
Direct Use	• **Moderate temperatures (80-300°F)** • Wells hundreds to thousands of feet deep • Large buildings, agriculture
Heating & Cooling	• **Near-ambient temperatures (40-80°F)** • Shallow trenches to wells hundreds of feet deep • Residential, light commercial

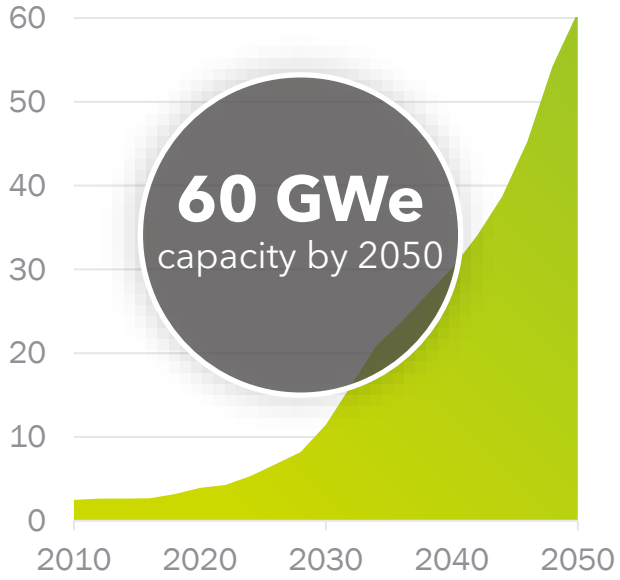


GeoVision Analysis: Geothermal Deployment Potential

ELECTRIC

8.5% of all U.S. generation by 2050

Installed Capacity (GW_e)

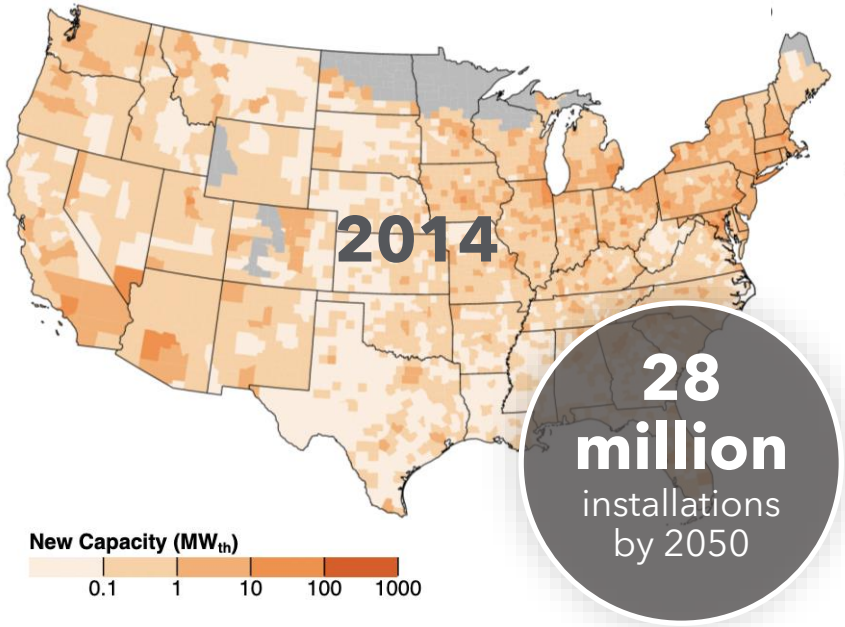


Source: Augustine et al. 2019

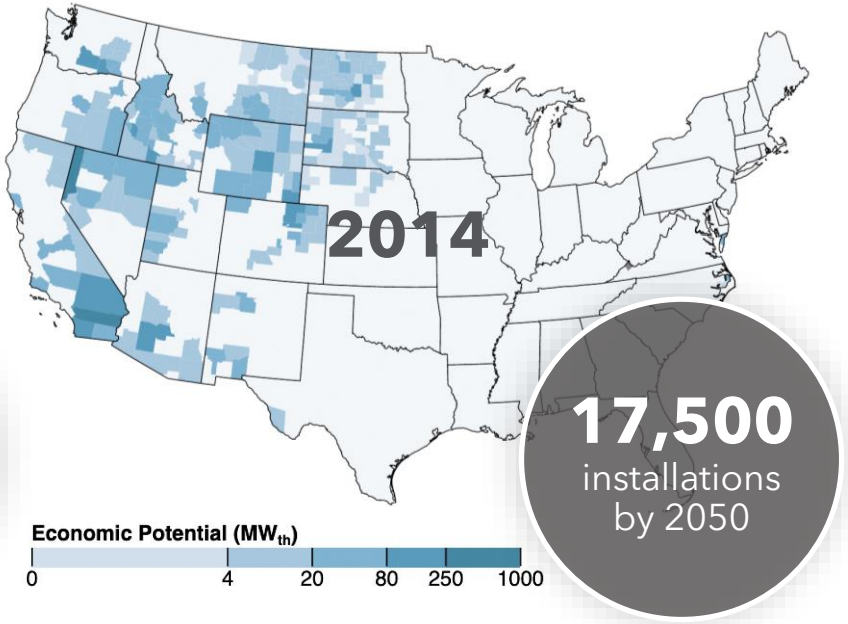
HEATING & COOLING

23% of U.S. Heating and Cooling market by 2050

Geothermal Heat Pumps



District Heating

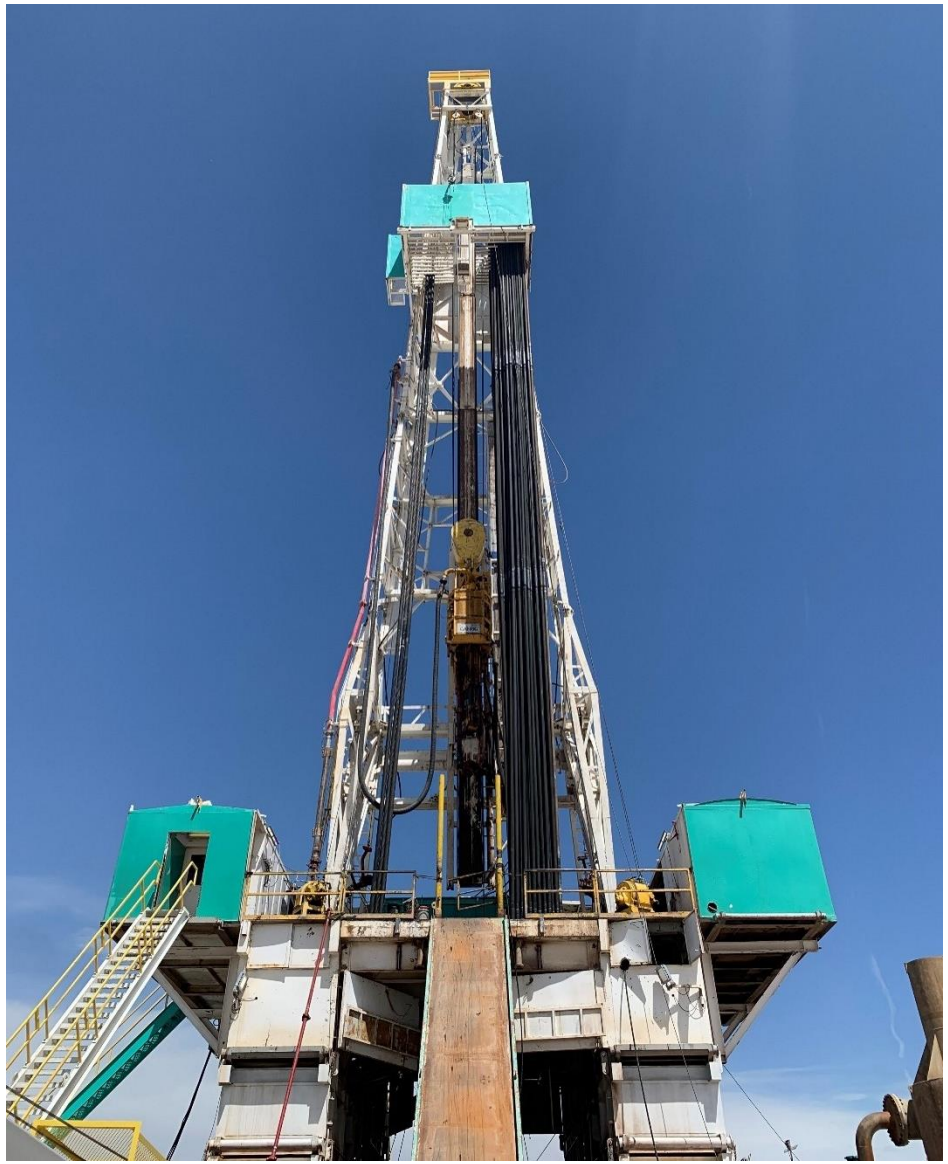


up to **516 MMT** of avoided CO2e

up to **1,281 MMT** of avoided CO2e

Total Emissions Reductions = removal of **26 million** cars per year

Benefits of Geothermal Energy



- Baseload power that can help balance intermittent generation from other renewables (solar, wind)
- Firm, flexible generation
- Space heating and cooling
- Smaller land footprint per MW than other renewables
- Combined hydrothermal and EGS industries can support up to 262,000 gross jobs by 2050
- Improved air quality, including reductions in SO_2, NO_x, $PM_{2.5}$, and greenhouse gases

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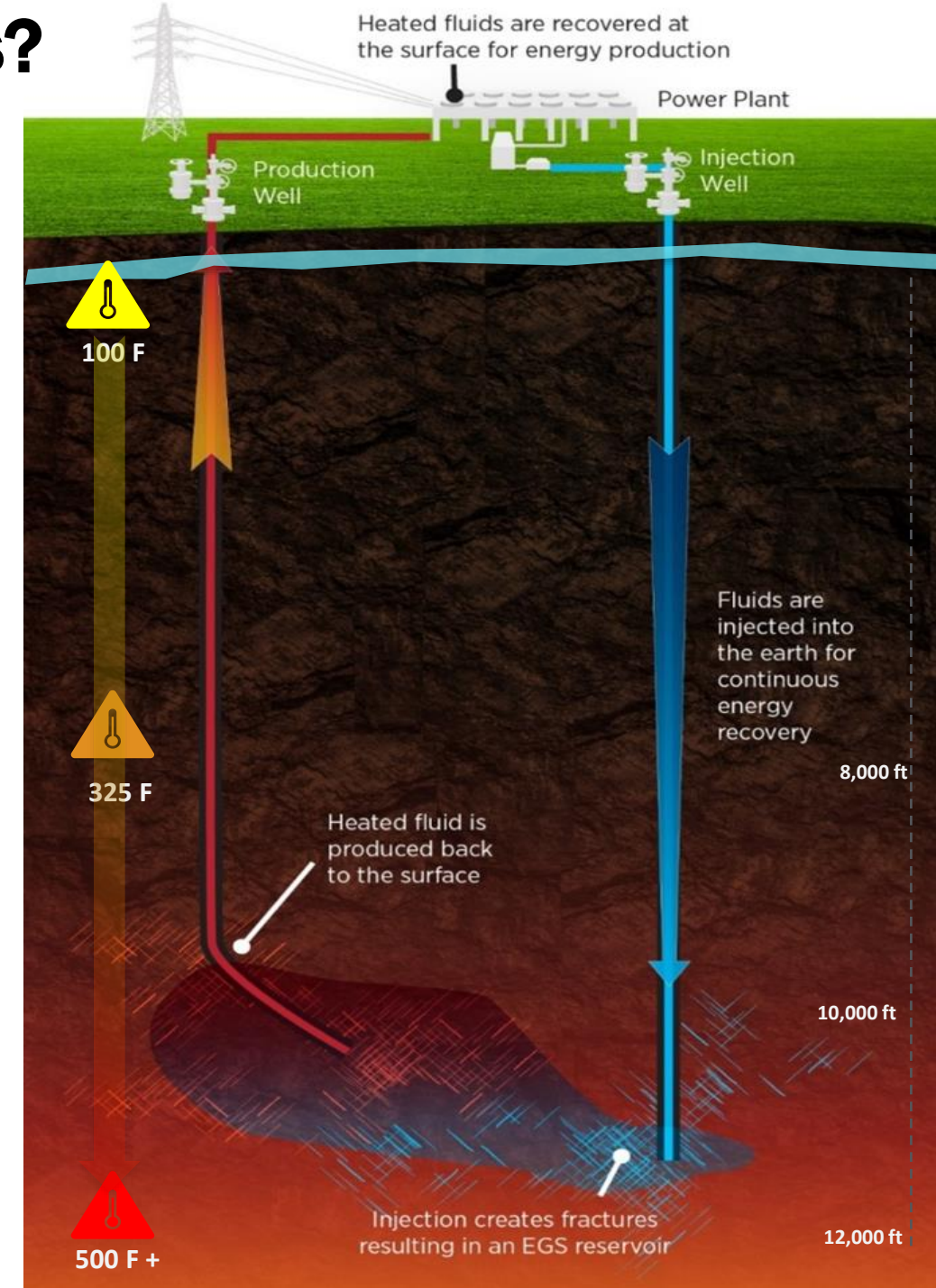
What are Enhanced Geothermal Systems?

Create pathways + Inject fluid + Heat

- **Create fractures** in hot rock deep underground
- **Inject a cool** fluid into the earth so it returns to the surface hot
- **Use the hot fluid** to generate electricity or for heating



Enhanced Geothermal Shot – The Opportunity

The Enhanced Geothermal Shot will enable access to the **five terawatts of heat resource in the United States,** driving U.S. leadership in EGS and enabling a carbon-free energy future.

Why EGS?

Nationwide potential for **CLEAN, FIRM, AND DISPATCHABLE ELECTRICITY**

+

Widespread deployment of **CARBON-FREE HEATING AND COOLING**

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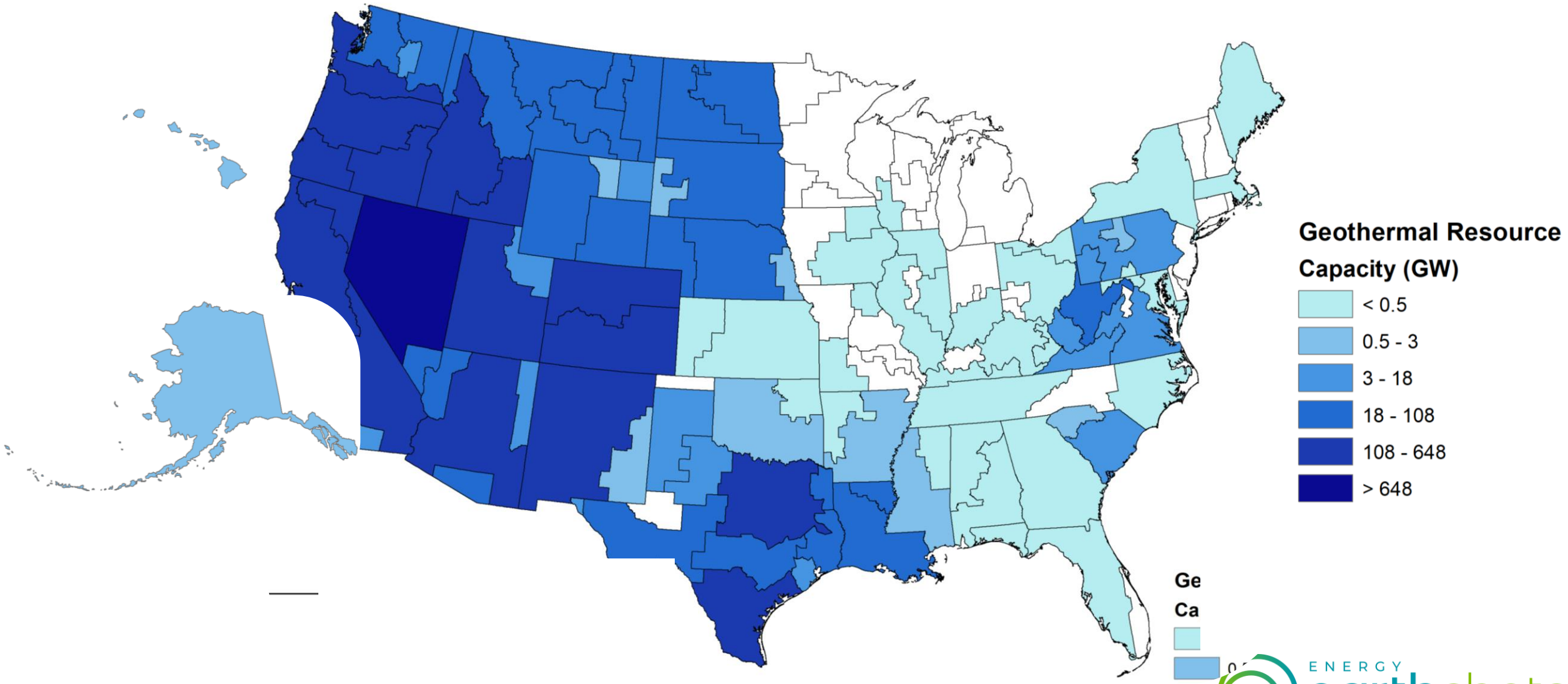
U.S. Geothermal Resources



EGS Science and Technology Challenges

DEEP

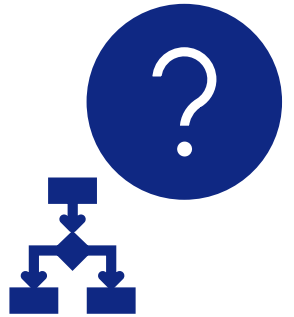
4,000 to >10,000 feet in the subsurface!

EXTREME

Hot, hard, abrasive rock, corrosive conditions

UNKNOWN

- Lack of data
- Lack of models necessary to approximate the subsurface



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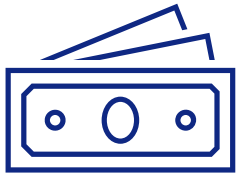
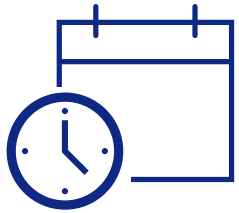
Enhanced Geothermal

Reduce the cost of enhanced geothermal system electricity to $45/MWh, enabling deployment of 40 gigawatts by 2035



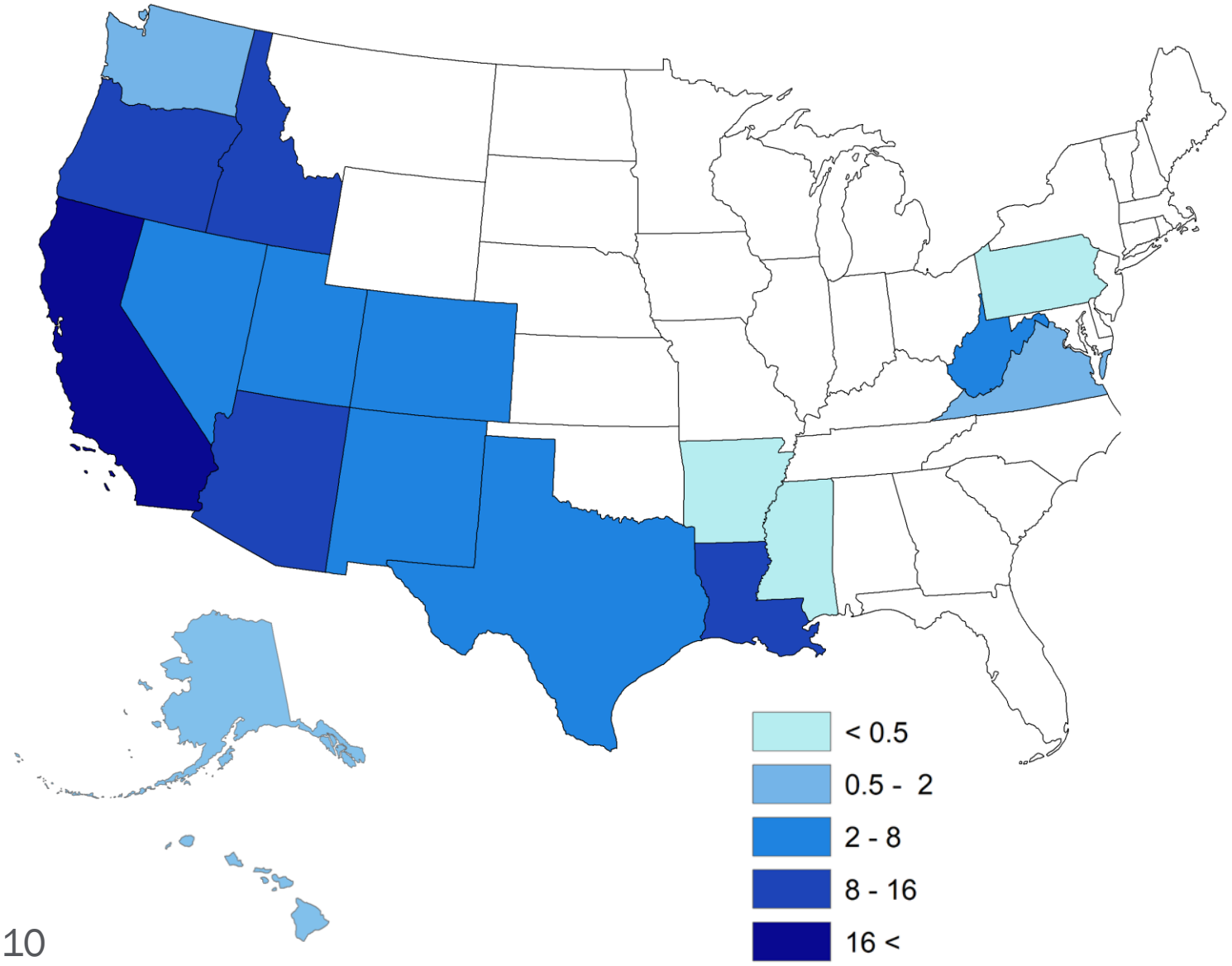
$ 45/MWh



2035

Benefits of Realizing the Enhanced Geothermal Shot

2050 Deep EGS Deployment Capacity (GW)



Nationwide expansion of EGS for power

Clean heating & cooling for up to 45 million U.S. households

Drives just transition & leverages 140,000 fossil workers

Critical Technology Improvements to Achieve the Target

Resource Characterization

- Improved data gathering
- Improved resource identification with fewer wells
- Integration of High-Performance Computing

Well Construction

- Faster drilling
- More + larger wells
- Reduced cement and casing costs

Reservoir Production

- Higher fluid flow from wells
- Advanced wellbore completions (zonal isolation)

Plant

- Larger plants to accommodate higher fluid flow rates

Characterization, well construction, and reservoir production are interconnected and tightly coupled activities.

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Interagency Stakeholders

Collaboration for nationwide geothermal resource assessment

Strong interest by TIP Directorate to partner on R&D initiatives

Collaborate on permitting through interagency working group

Ongoing collaboration to deploy geothermal power on military bases

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External Stakeholders

Energy Justice and Environmental Concerns

- Robust community engagement process for research, development, and demonstration
- Address public concerns and perceived issues
  - *Induced seismicity, water usage, wildlife habitat*

Industry

- Host industry roundtables
- Engage oil & gas, mining, and other subsurface operators to invest
- Utility engagement at the national, regional, and local levels

Labor

- Workforce analysis
- Union engagement (training, apprenticeships)
- Leverage oil and gas expertise

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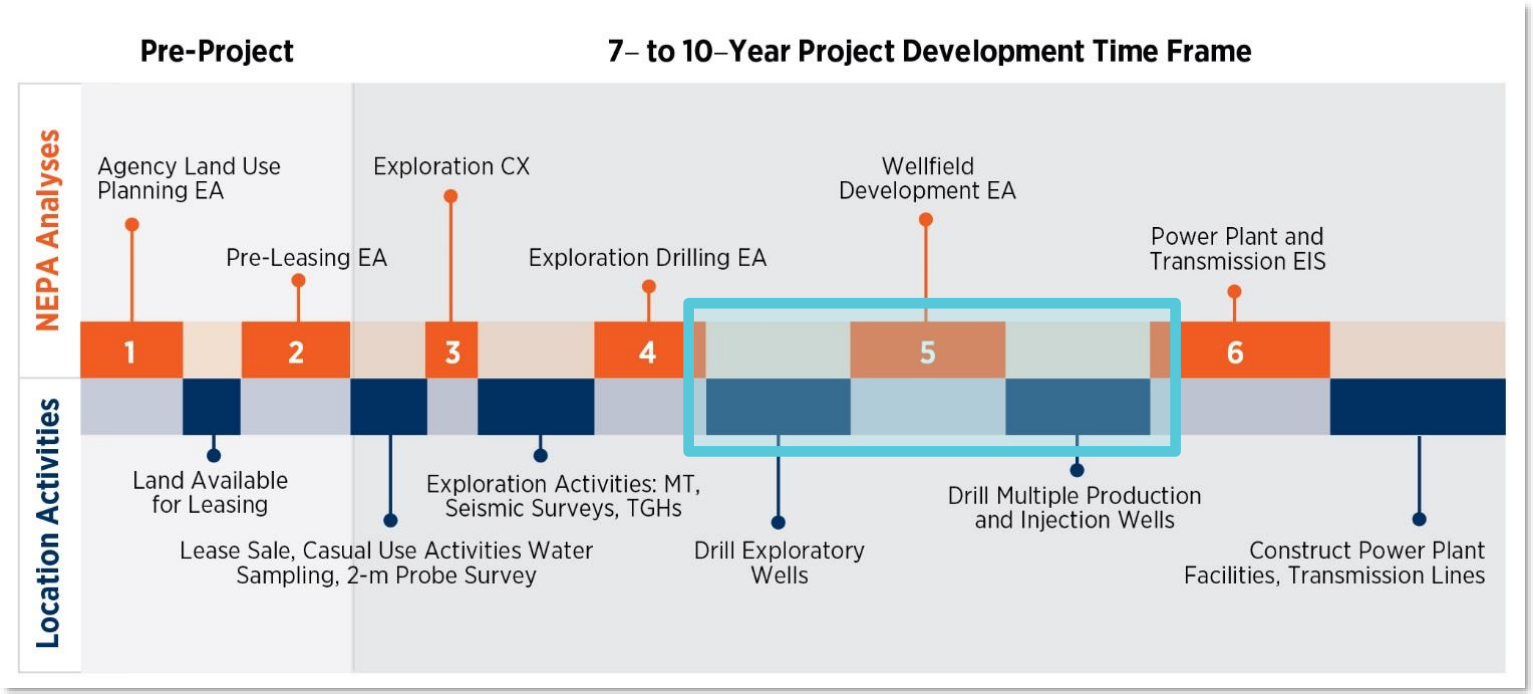
Geothermal Project Permitting Timelines



Regulatory uncertainty and inefficiency – particularly in drilling stages – create long and uncertain development timelines.

Optimizing permitting timelines <u>alone</u> could increase installed geothermal electricity-generation capacity to 13 GWe by 2050.

- Federal interagency task force to address geothermal permitting timelines.
- Will provide recommendations directed toward federal agency regulators, California and Nevada state regulators, the National Renewable Energy Coordination Office, and relevant Congressional Committees

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Source: Young, Levine, Cook, Heimiller and Ho, 2019. "*GeoVision* Task Force Report: Barriers An Analysis of Non-Technical Barriers to Geothermal Deployment and Potential Improvement Scenarios."

How Can You Stay Informed and Get Involved?

- GTO's Drill Down geothermal.energy.gov ("Subscribe to The Drill Down" box)
- GTO Funding Opportunities: geothermal.energy.gov (Select "Funding Opportunities" from dropdown menu)
- EERE's Weekly Jolt Newsletter: energy.gov/eere/eere-news
- EERE Funding Opportunities: energy.gov/eere/funding/eere-funding-opportunities

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