U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

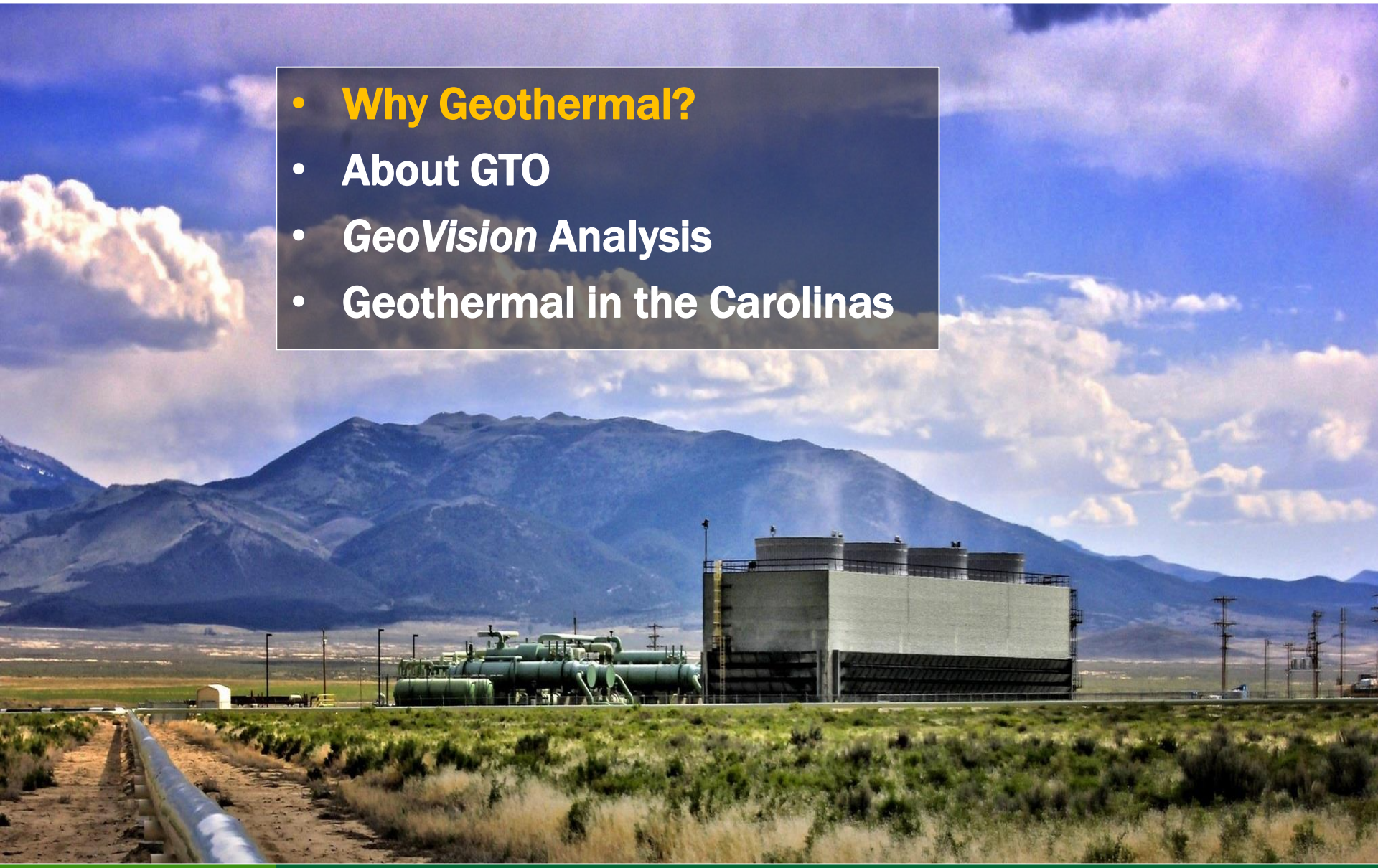
Geothermal Technologies Office

North Carolina Energy Policy Council
November 18, 2019

Susan G. Hamm, Ph.D.
Director

Image: Calpine

Agenda



- **Why Geothermal?**
- About GTO
- *GeoVision* Analysis
- Geothermal in the Carolinas

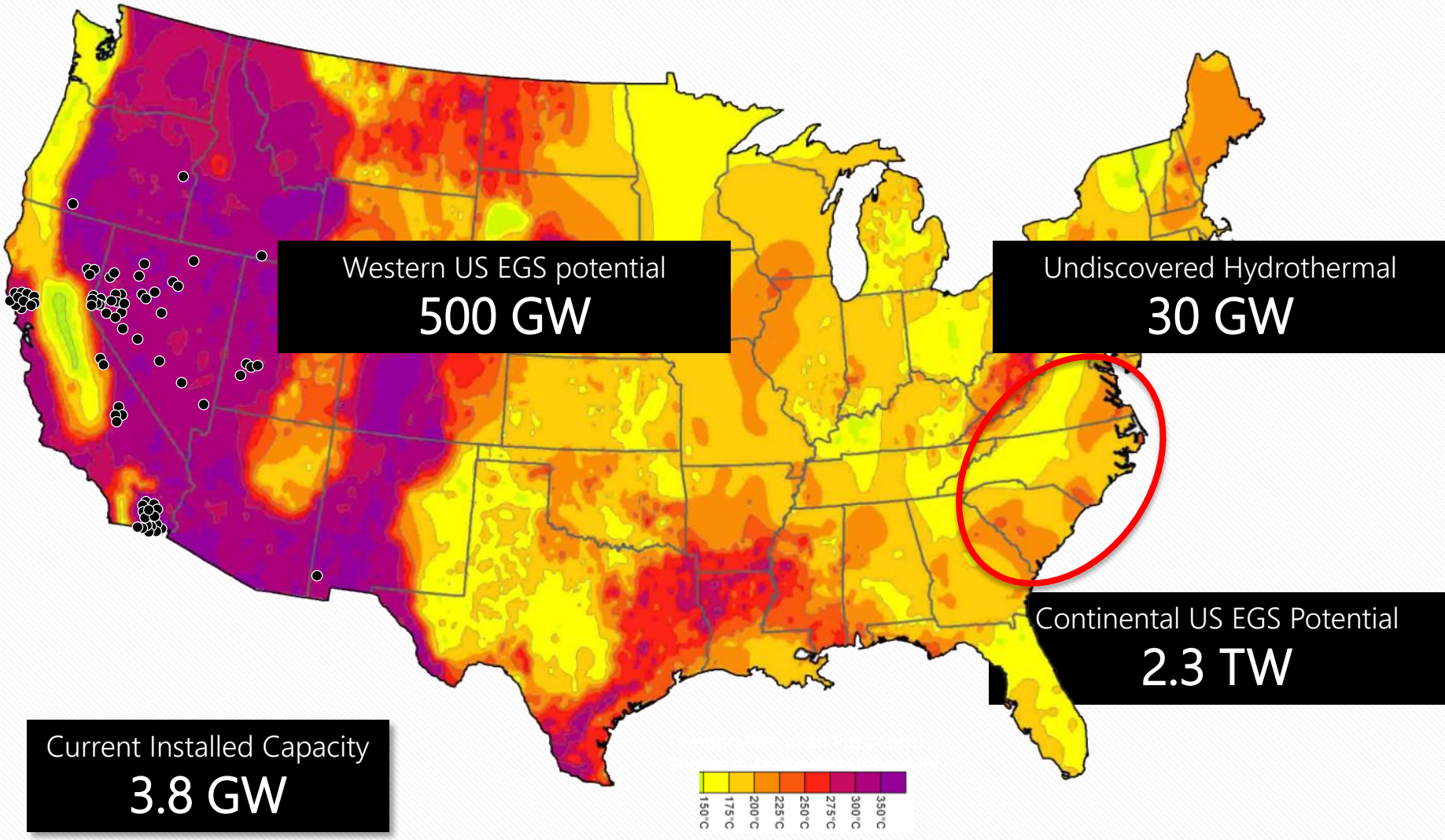
Why Geothermal?

Beneath our feet lies vast, untapped energy potential.

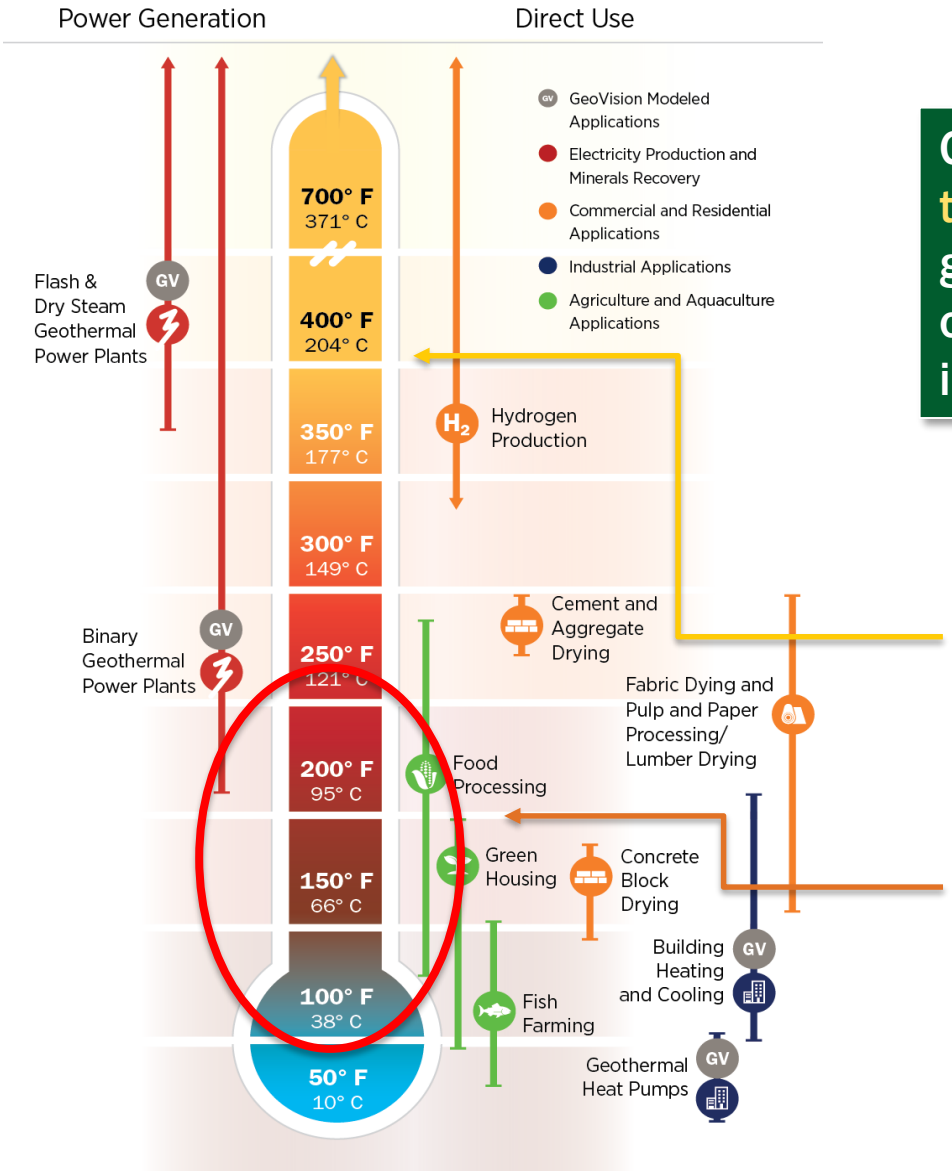
Geothermal energy…

- …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

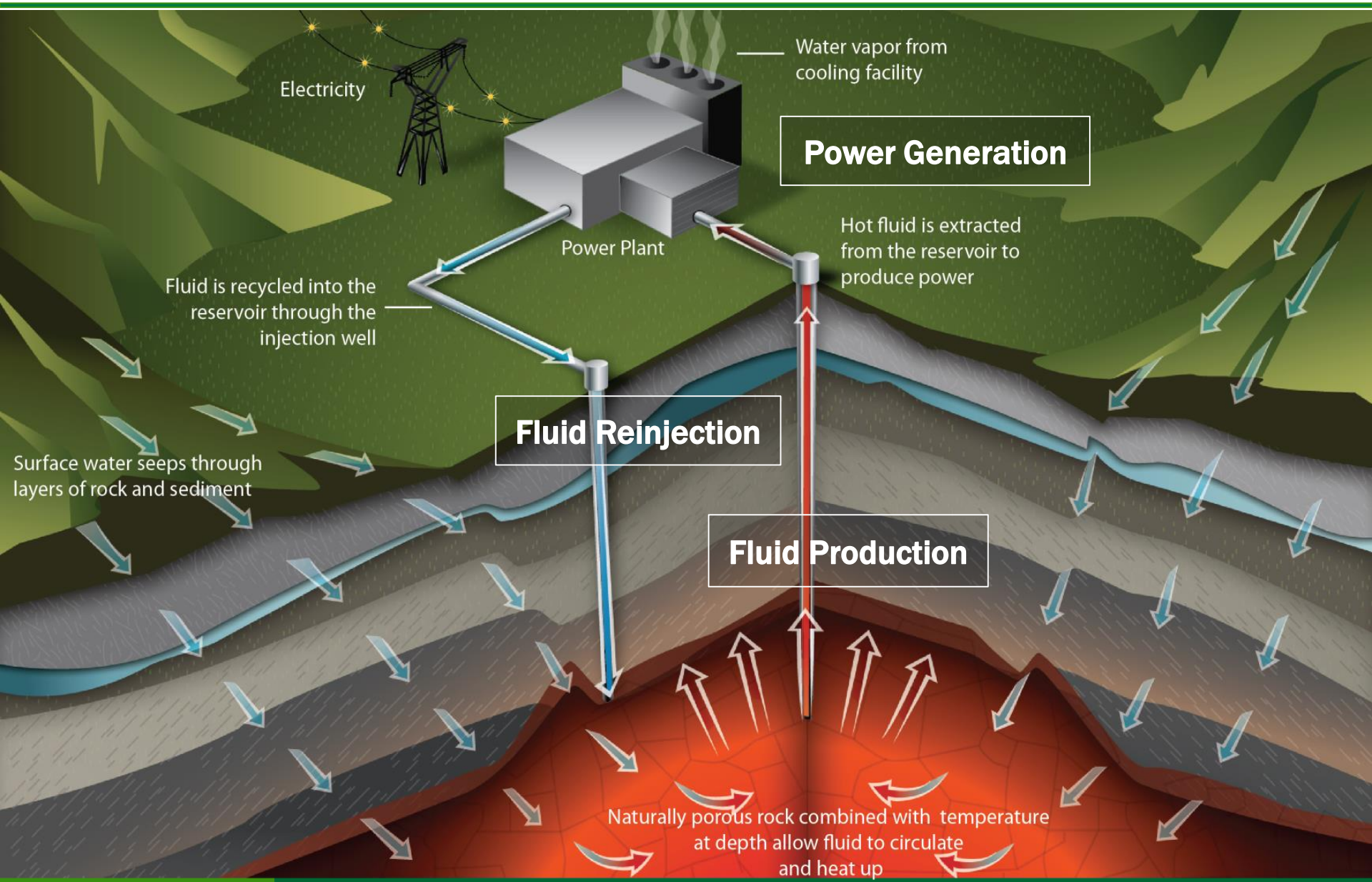


Geothermal offers a broad array of technology applications for both power generation and direct use. This diversity of applications is key to the geothermal industry's continuous growth.

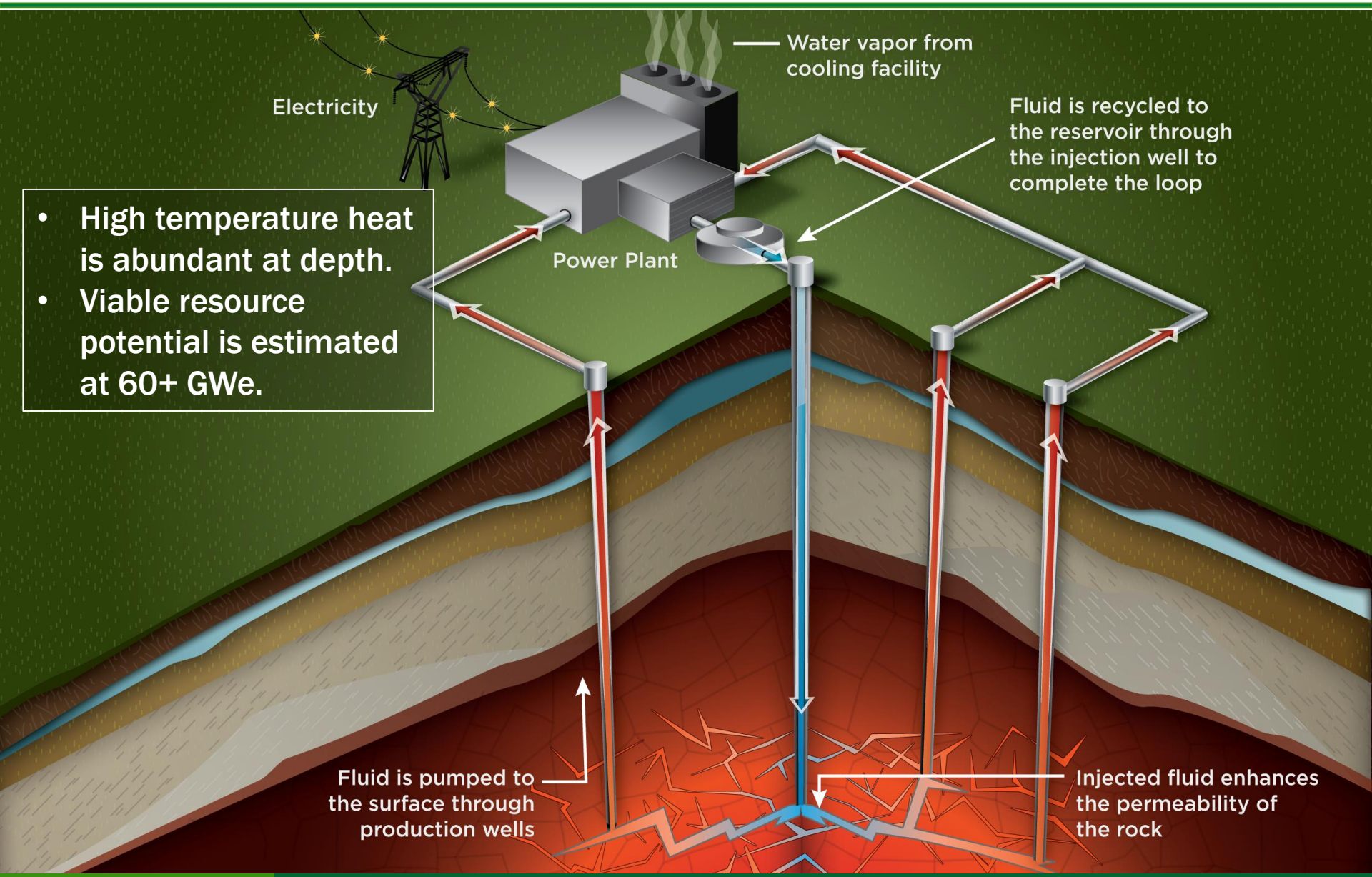
At **higher temperatures**, binary, flash, and dry steam power plants come into play.

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

Geothermal Power Generation

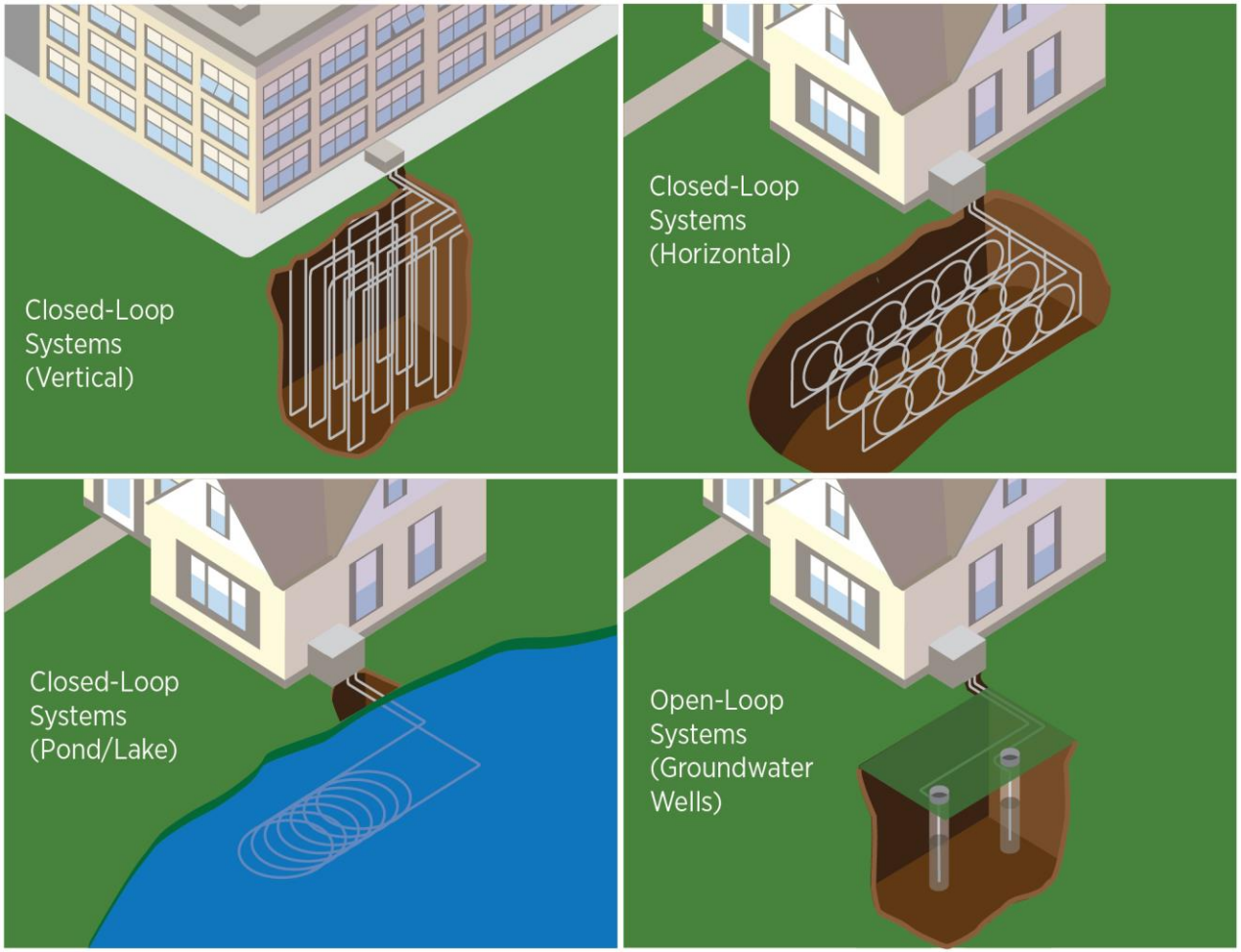


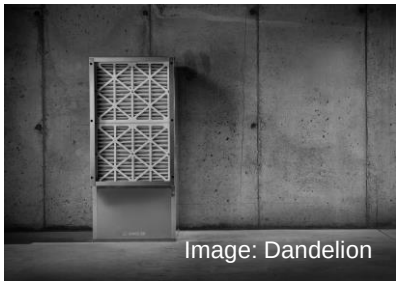
Enhanced Geothermal Systems (EGS)



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

Geothermal Heat Pumps (GHPs)





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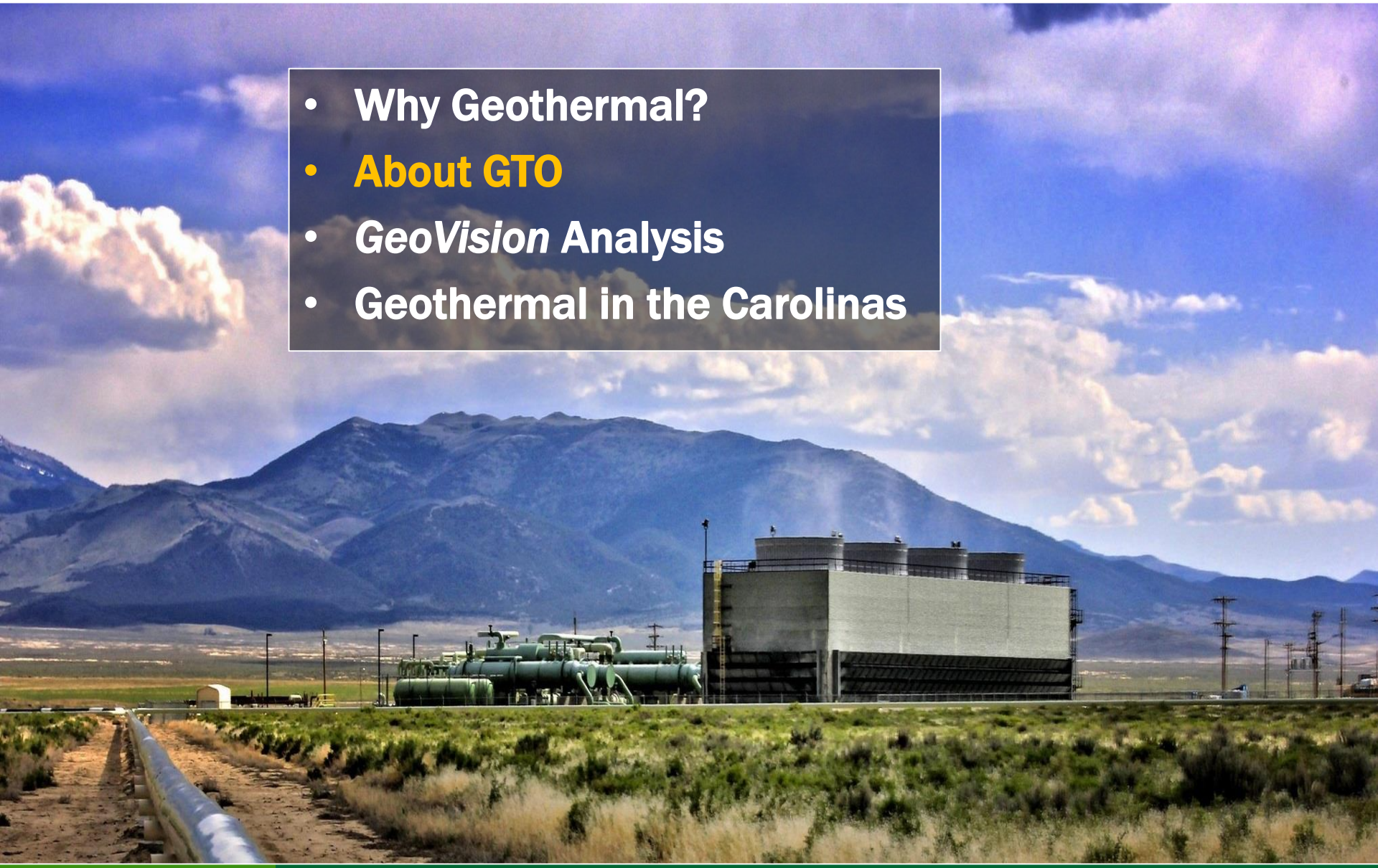

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Renewable Energy @ DOE

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

- Energy affordability
- Energy integration
- Energy storage

Solar Energy Technologies Office

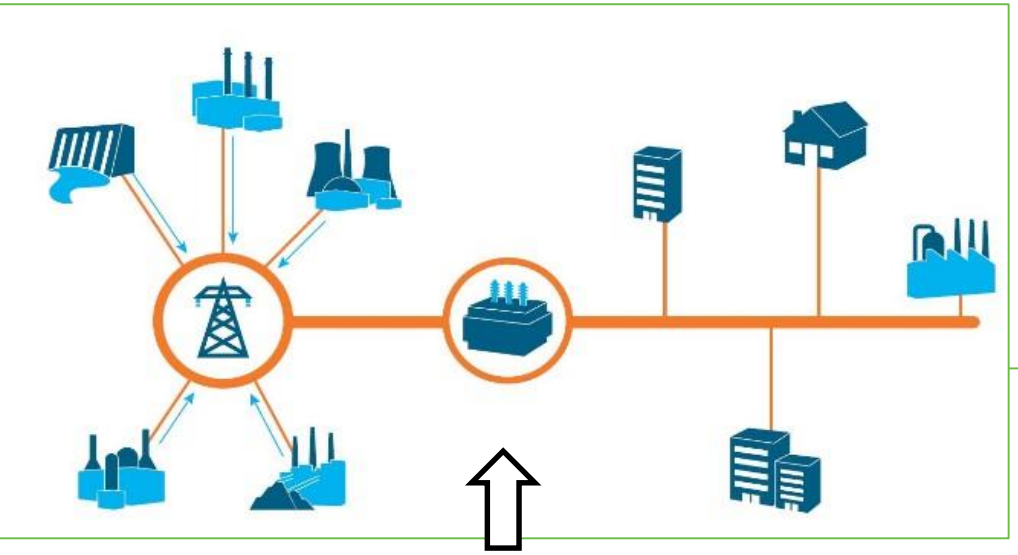
Wind Energy Technologies Office

Geothermal Technologies Office

Water Power Technologies Office

Grid Modernization Initiative

What Does a Modern Grid Look Like?

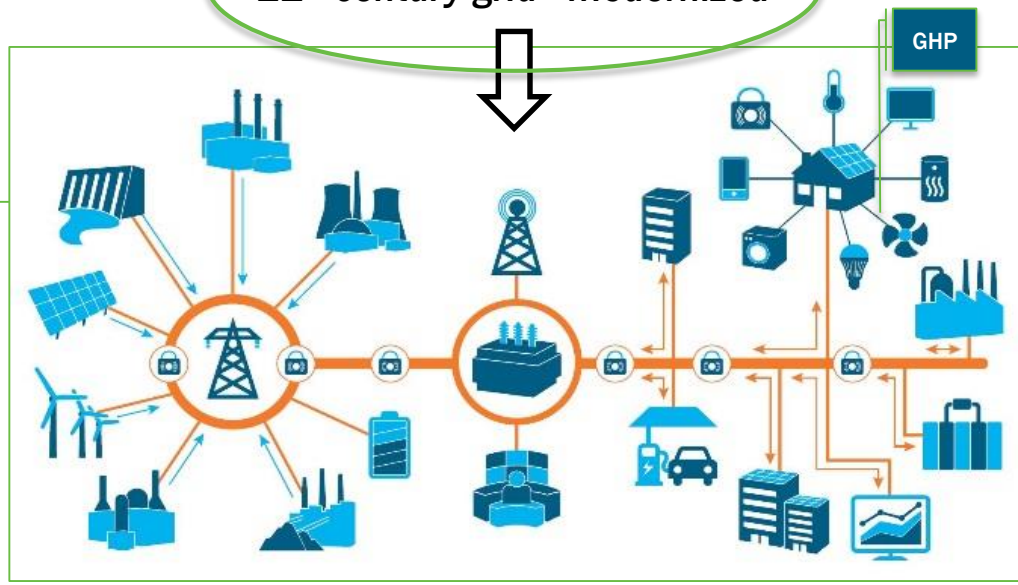


- Centralized generation
- Limited visibility
- Susceptible to extreme events
- Limited consumer options

20th century grid

21st century grid - modernized

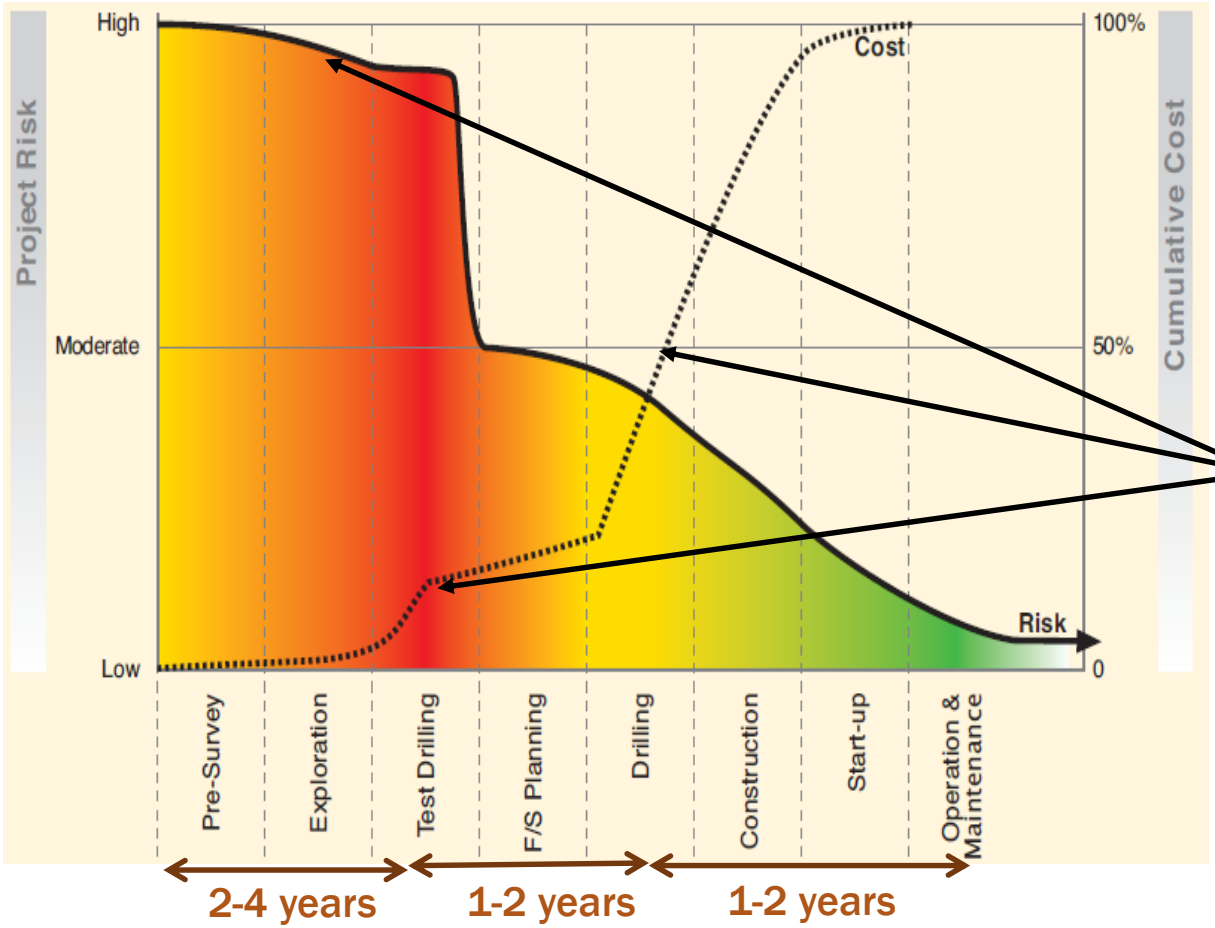
GHP = Geothermal Heat Pump



- Centralized and decentralized generation
- Visibility from generation to the grid edge
- Resilience through microgrids
- Customer choice and participation

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.**

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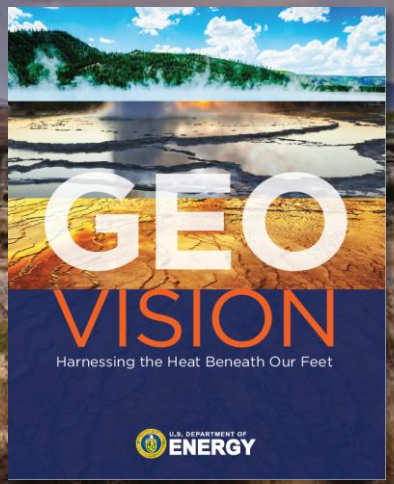
GeoVision Analysis

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…

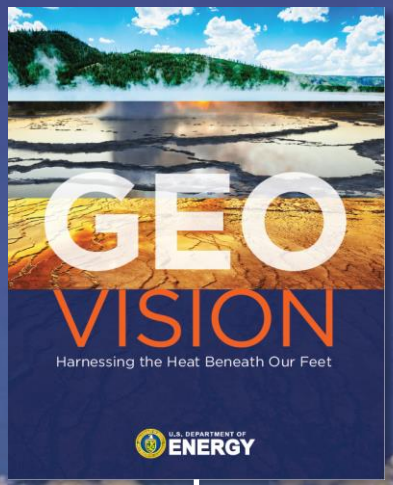
…what level of deployment would be achievable and what would be the corresponding economic benefits to industry and the environmental impacts of those deployment levels on the United States?



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…

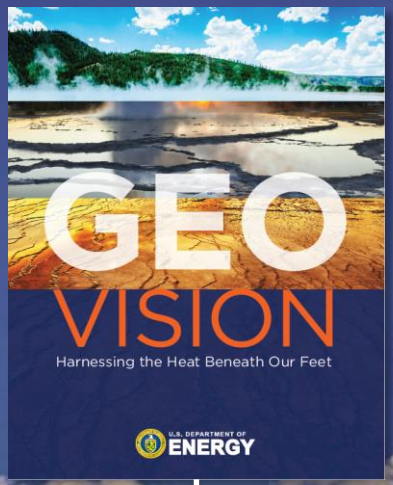
…strengthen its energy base,

…achieve a more stable power grid,

…and gain valuable economic and environmental benefits.

Image: *GeoVision* Report

GeoVision Analysis



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

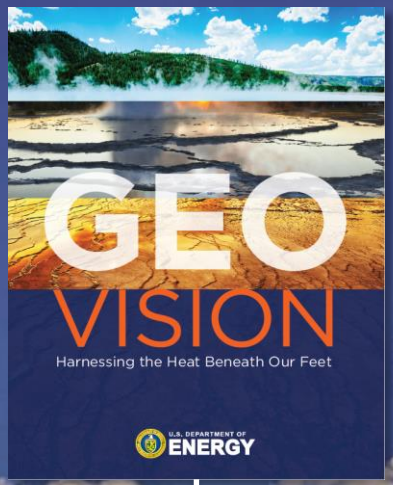
District use could increase by orders-of-magnitude, from a current total of 21 geothermal district heating installations to as many as 17,500 nationwide. Geothermal heat pumps could increase from 2 million to 28 million.

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



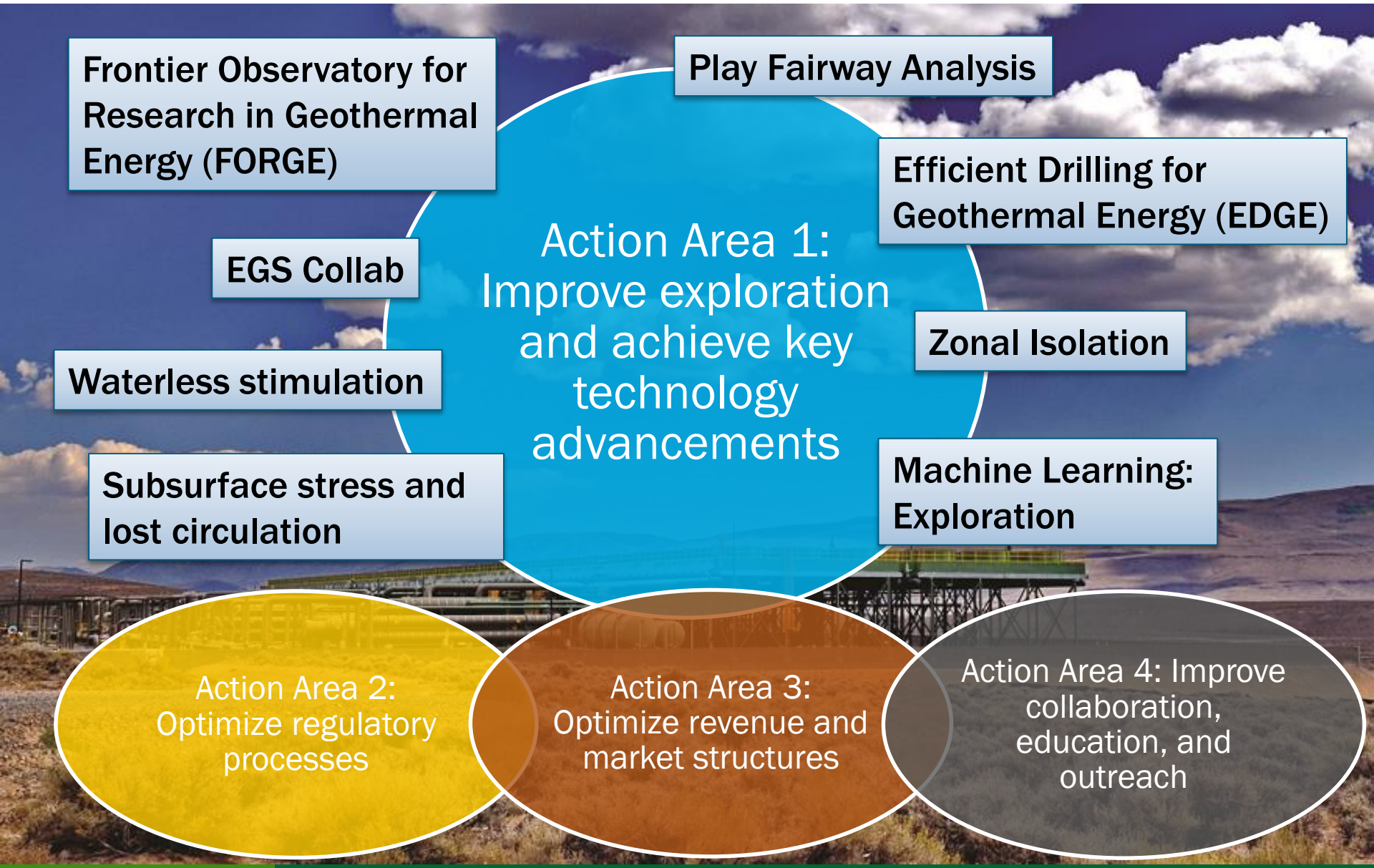
Technology innovation is essential – it improves our understanding of subsurface conditions, helps to reduce risk, and accelerates growth of domestic geothermal power.

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

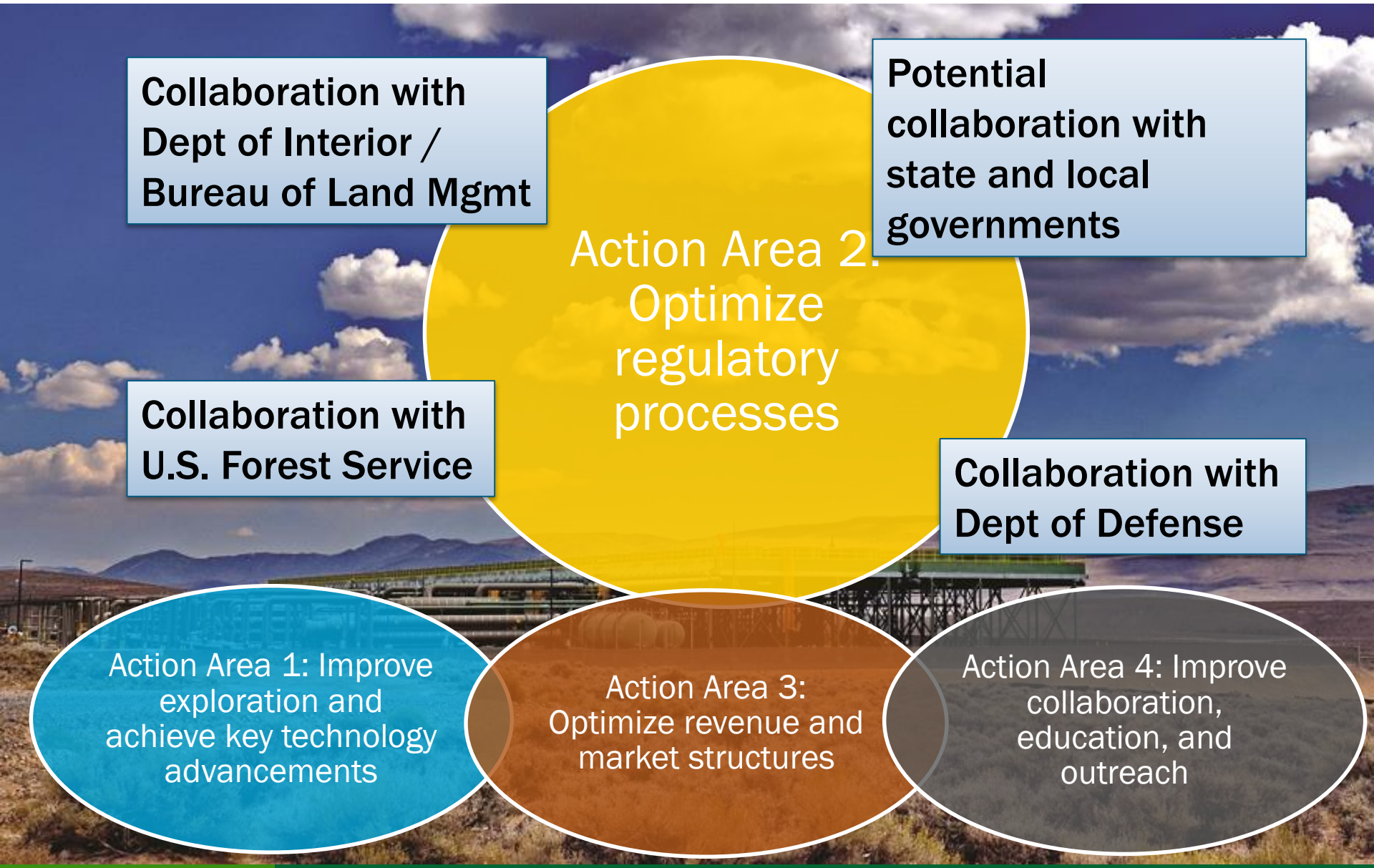
Image: *GeoVision* Report

The *GeoVision* Roadmap

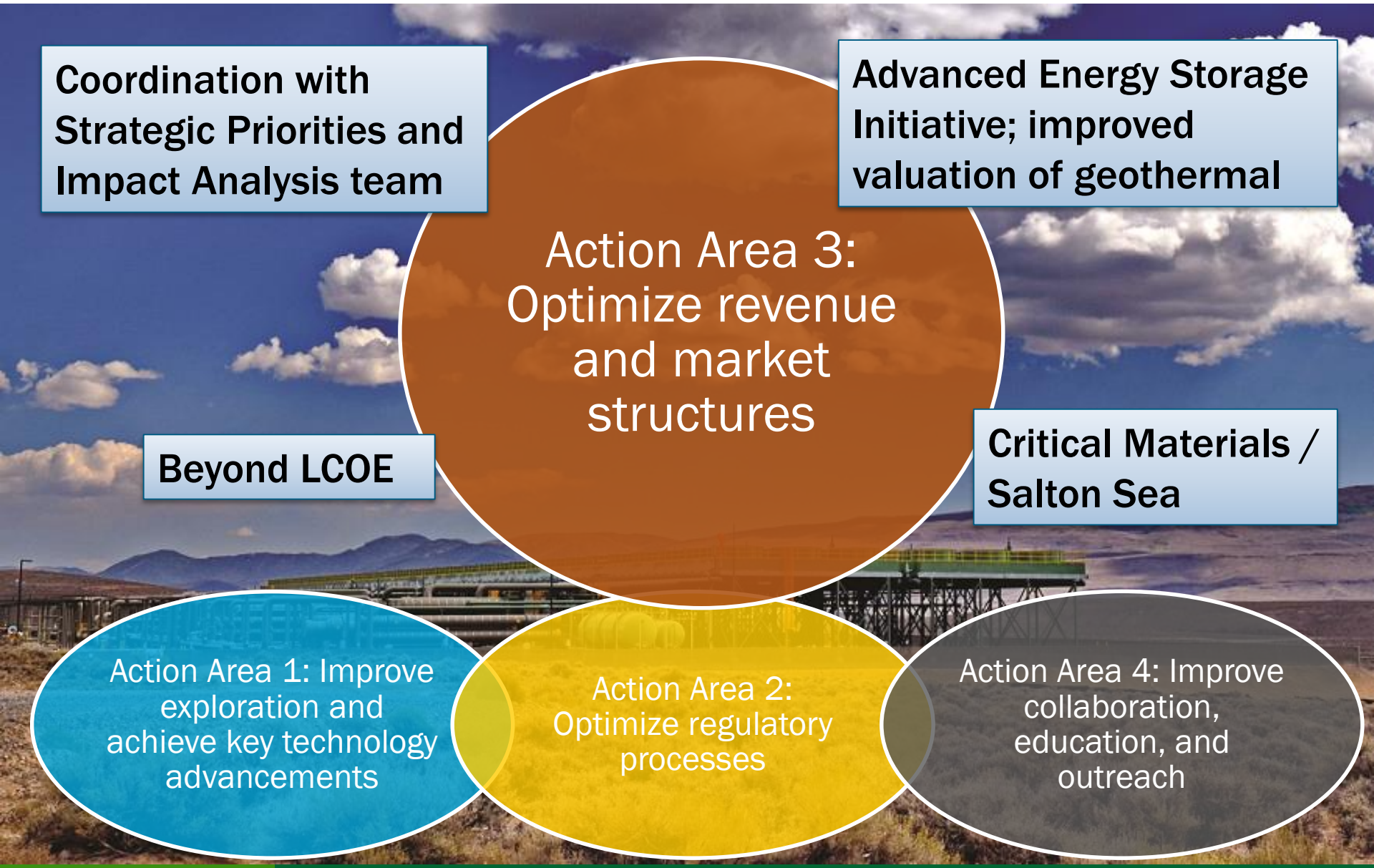
GTO Research



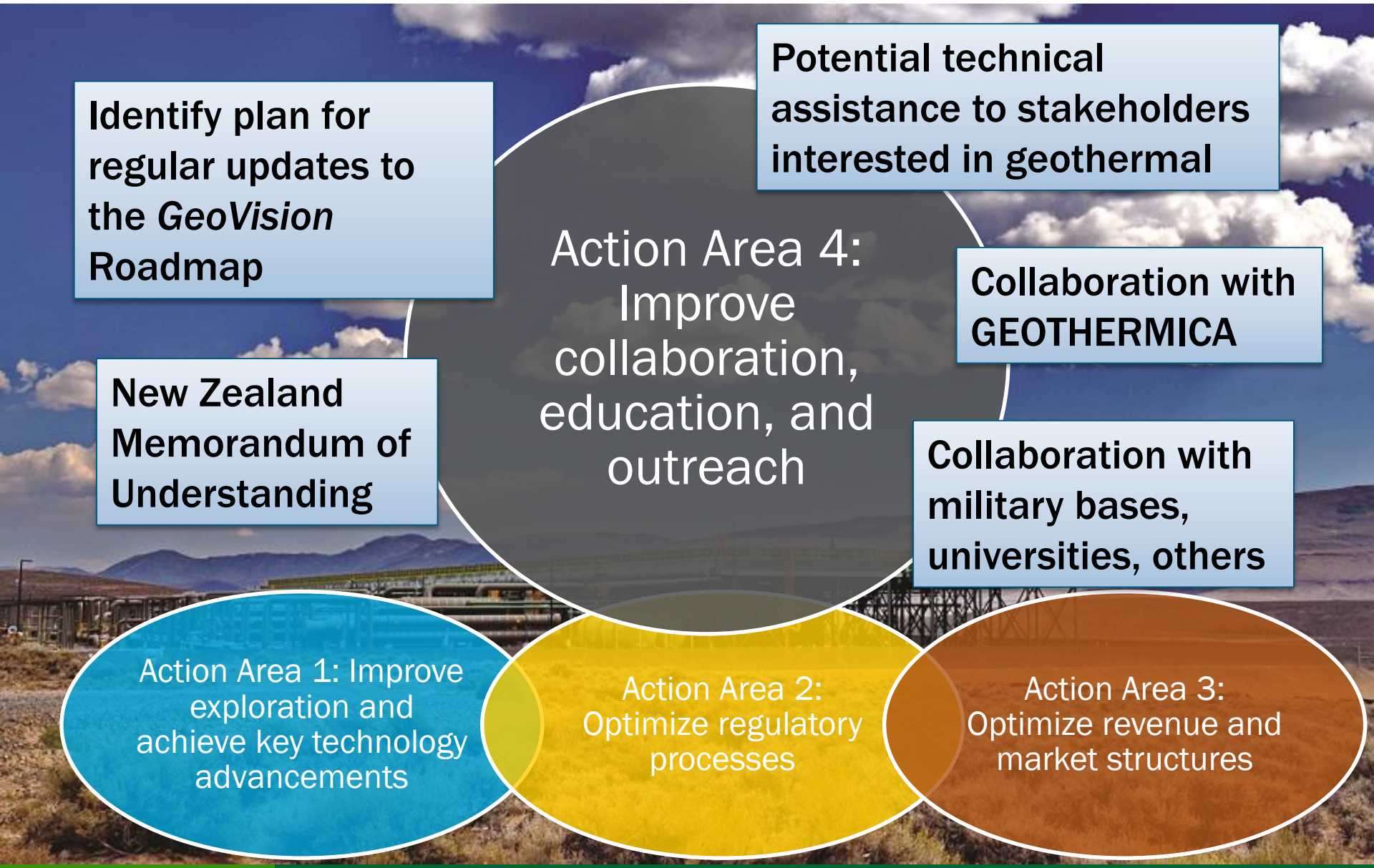
GTO Research



GTO Research



GTO Research



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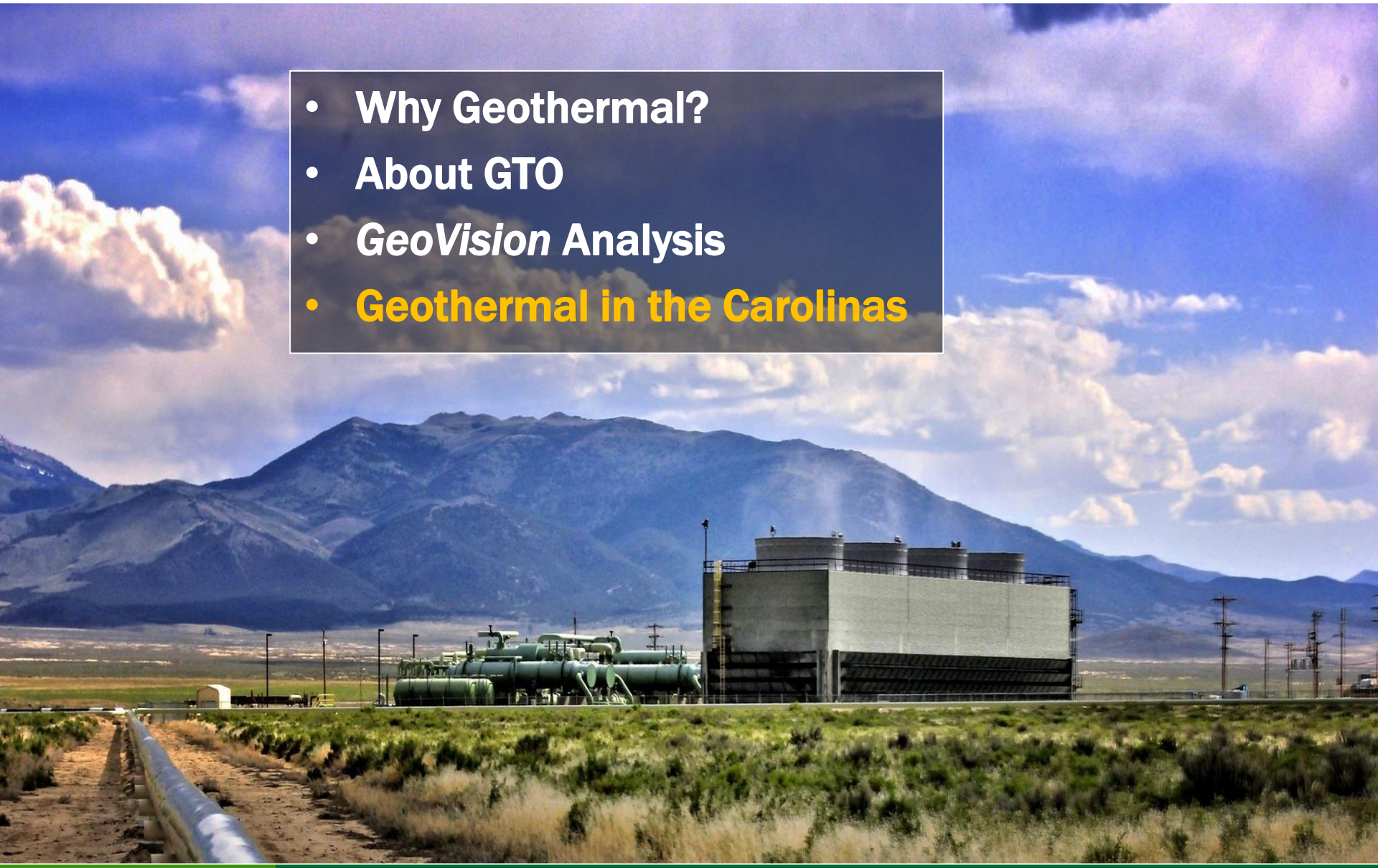

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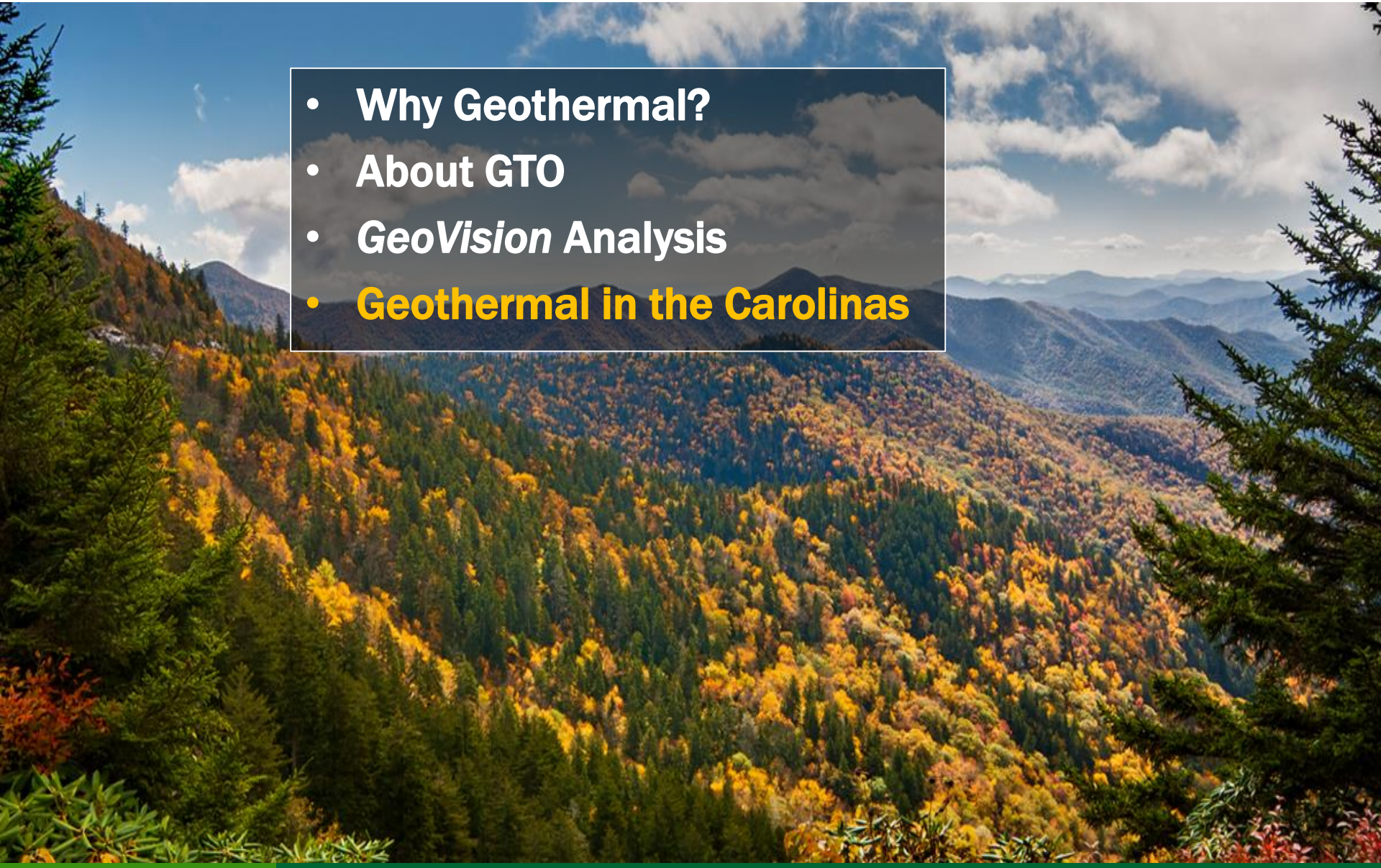

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Geothermal in North Carolina

According to a July 2015 report by the
North Carolina Sustainable Energy Association:

"North Carolina's soil is well suited for GHPs."

The report indicates that the geothermal industry already has an impact in North Carolina:

- 12% of all clean energy firms in NC are geothermal.
- NC geothermal businesses generated at least $143 million in revenues in 2014.
- Geothermal accounts for 3% of North Carolina's clean energy income.

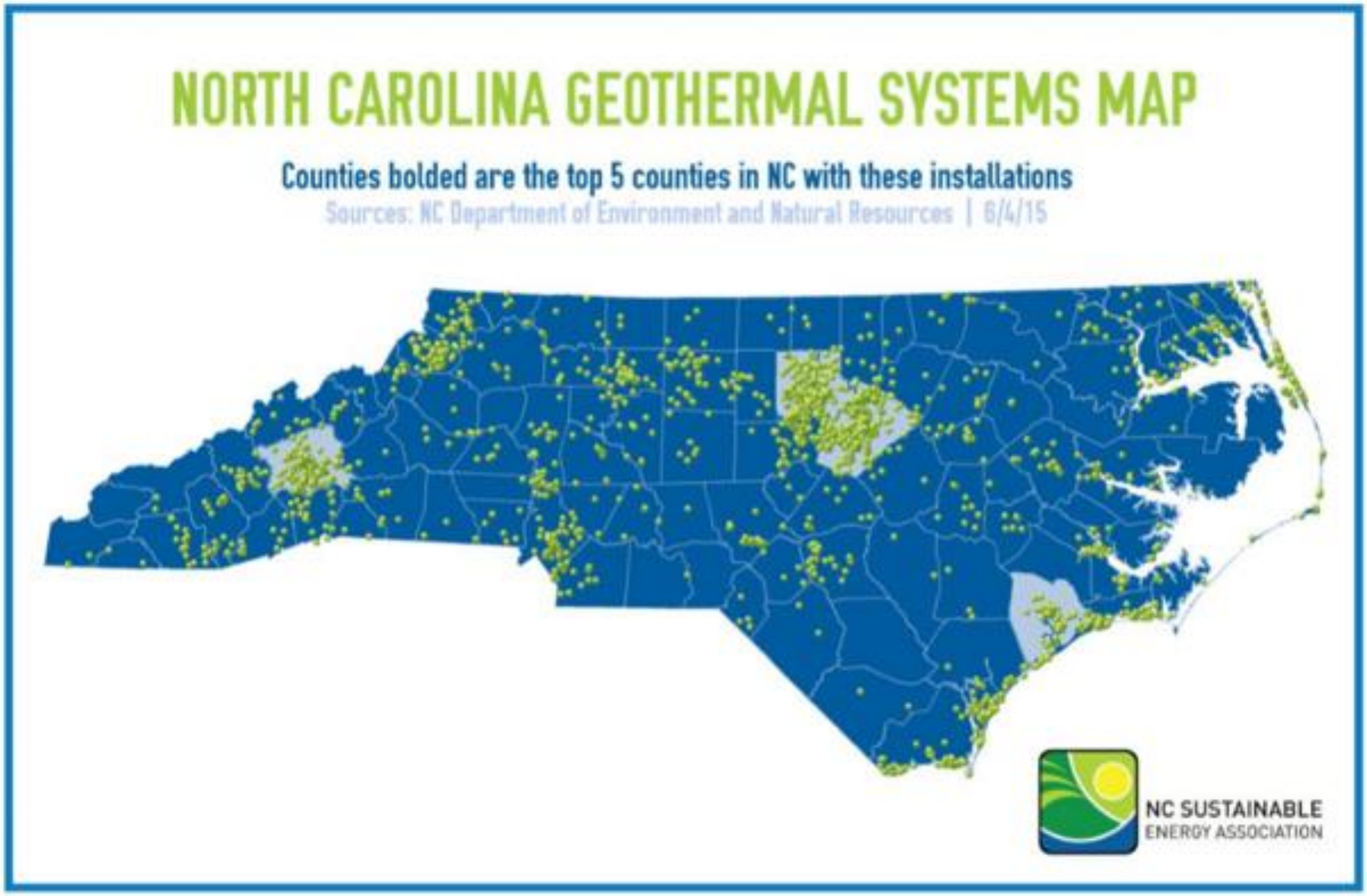
Source: North Carolina's Geothermal Industry: Uncovering Impact and Opportunities (July 2015). North Carolina Sustainable Energy Association. https://energync.org/wp-content/uploads/2017/03/NCs_Geothermal_Industry.pdf

Geothermal in North Carolina

- According to the Air-Conditioning, Heating, and Refrigeration Institute, since the NC Renewable Energy Investment Tax Credit was extended to include GHPs in 2009, more than 10,500 units have been shipped to North Carolina.
- At least 2,015 systems have obtained state-level permitting from North Carolina Department of Environmental Quality since 1978.
- Fort Bragg is the world's largest military installation (by population) and recently installed multiple GHPs to supplement existing HVAC systems.
- Today, the top 5 counties in terms of permits are Buncombe, Orange, Durham, Wake, and Onslow.

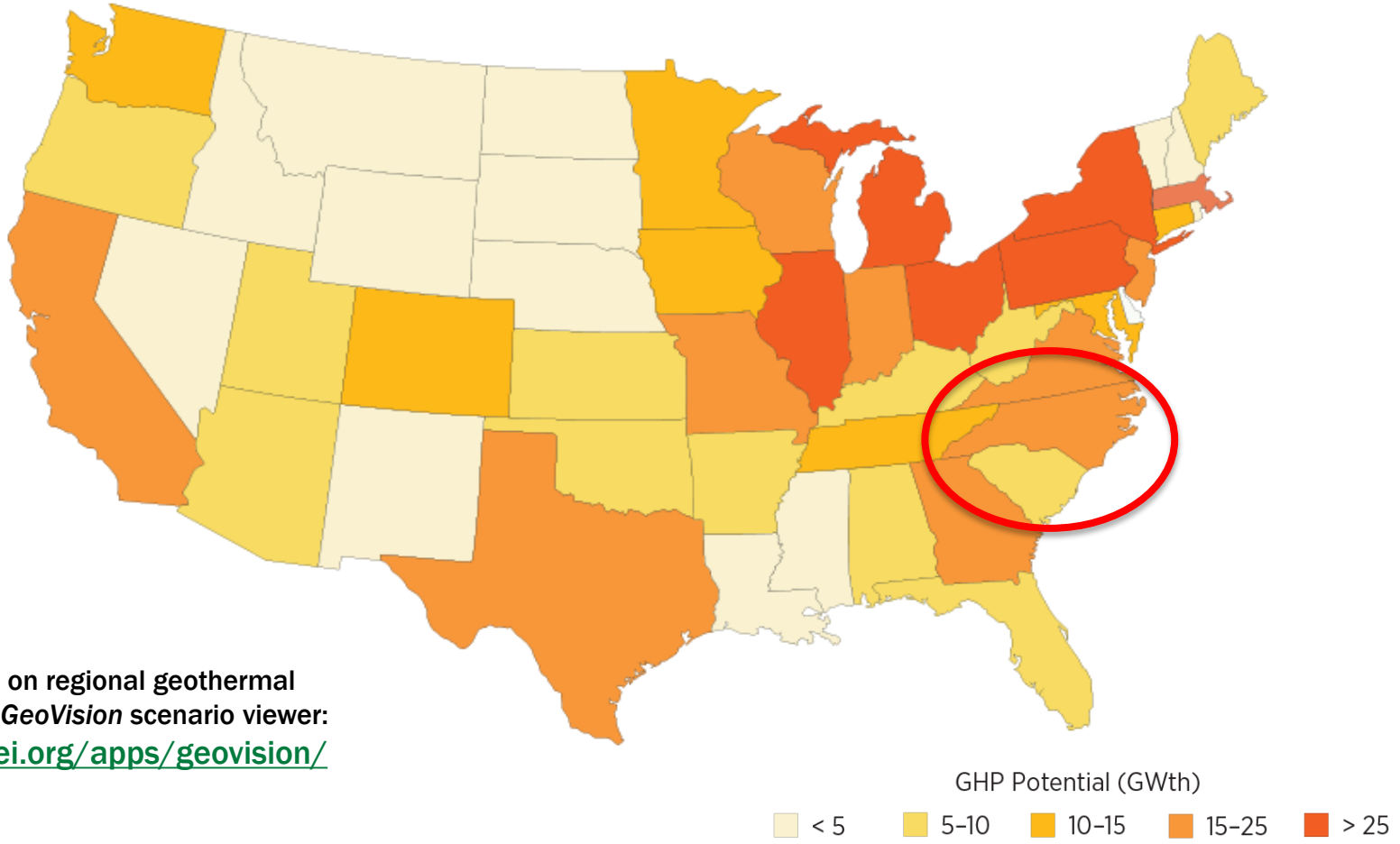
Source: North Carolina's Geothermal Industry: Uncovering Impact and Opportunities (July 2015). North Carolina Sustainable Energy Association. https://energync.org/wp-content/uploads/2017/03/NCs_Geothermal_Industry.pdf

Geothermal in North Carolina



Opportunities for Geothermal in the Carolinas

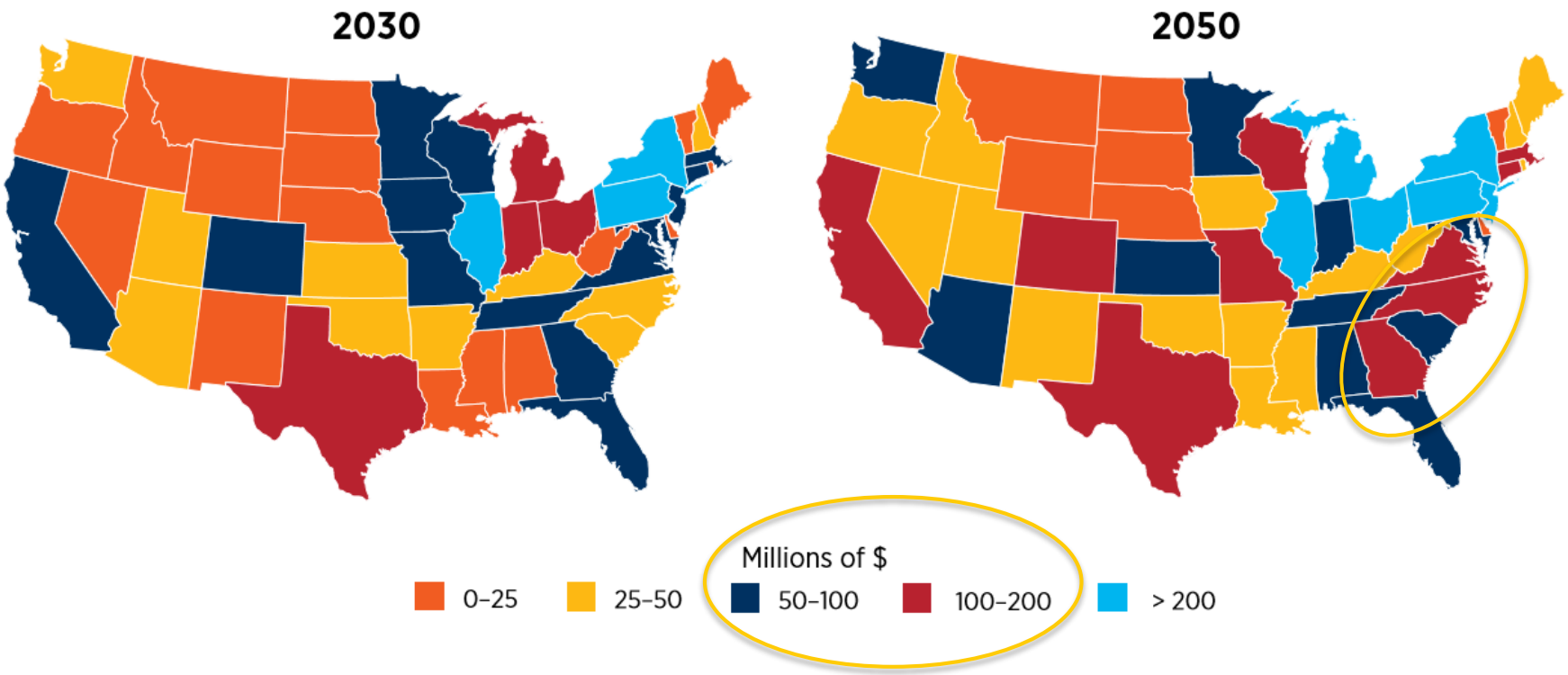
The *GeoVision* GHP Breakthrough scenario indicates significant economic potential for **geothermal heat pumps** in the Carolinas – more than **25,000 MW_{th}** by 2050. North Carolina accounts for 73% of this total with more than **18,000 MW_{th}** by 2050.



View more data on regional geothermal potential in the *GeoVision* scenario viewer: https://openei.org/apps/geovision/

Opportunities for Geothermal in the Carolinas

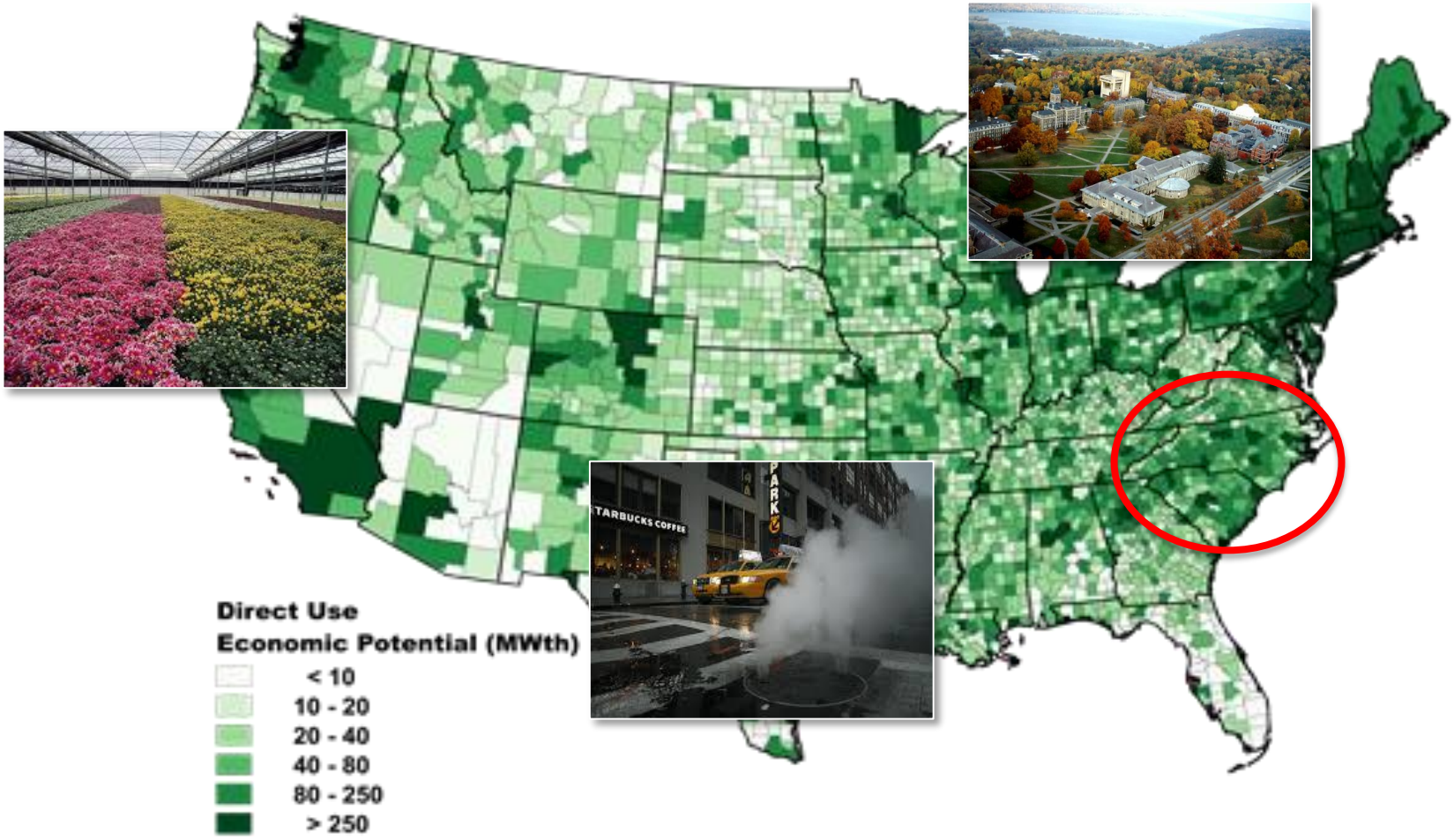
From 2030 to 2050 in the *GeoVision* GHP Breakthrough scenario, increases in GHP expenditure occur mainly in six states, including North Carolina.



Geothermal heat-pump expenditures (in millions of USD) for 2030 (left) and 2050 (right) by state under the *GeoVision* analysis Breakthrough scenario.

Opportunities for Geothermal in the Carolinas

The *GeoVision* Technology Improvement scenario indicates high economic potential for **geothermal district heating** installations – more than 14,000 MW_{th} in the Carolinas by 2050, with almost **10,000 MW_{th} of that in North Carolina alone**.



State and Local Planning for Energy (SLOPE) Platform

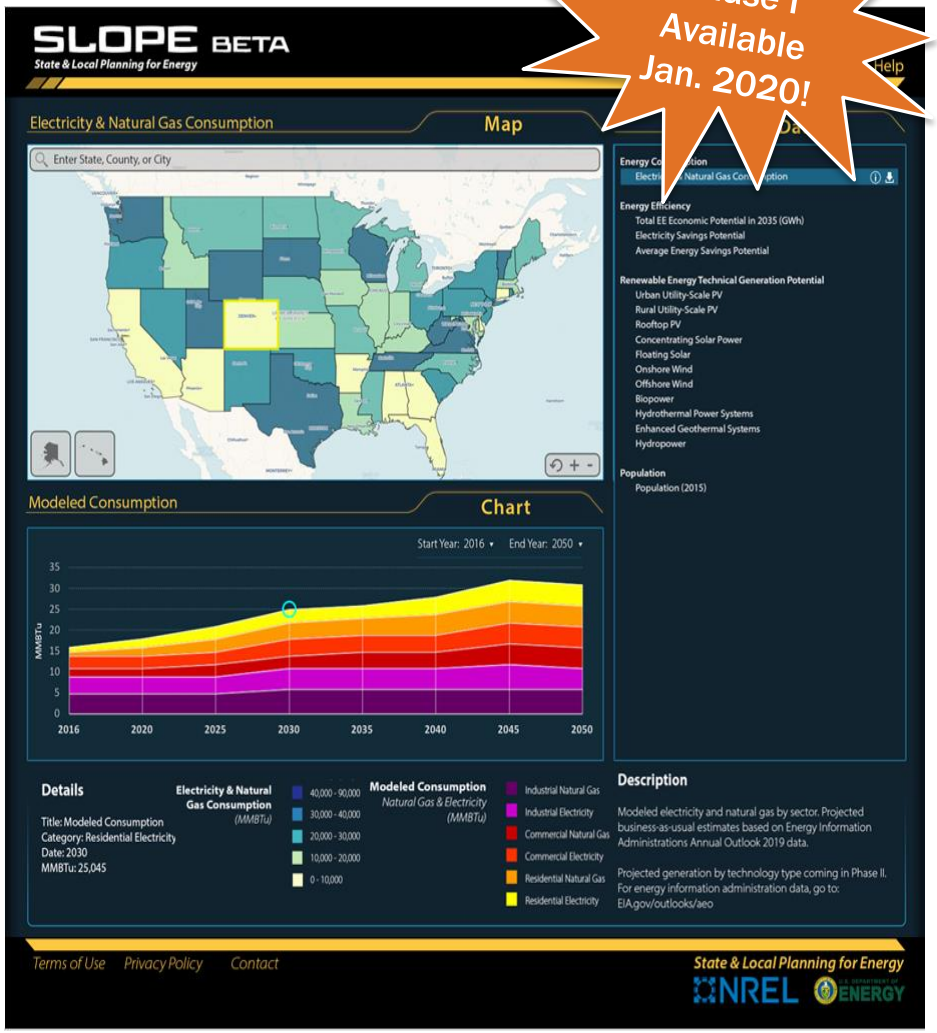
- Delivers state- and locally-specific energy planning data in the areas of energy efficiency, renewable energy, and sustainable transportation.
- Enables "apples-to-apples" comparisons of adjustable energy futures with inputs from variety of data points, such as:
  - Electricity and natural gas consumption
  - Renewable energy generation potential
  - Levelized cost of energy (LCOE)
  - Projected population

Phase I: Projection data available (Jan. 2020)

Phase II: Integrated, granular platform enabling user saved settings and transportation and generation mix data (2020)

Phase I: Mock up

Phase I Available Jan. 2020!



Questions? Contact: Aaron.Ng@ee.doe.gov

Resources

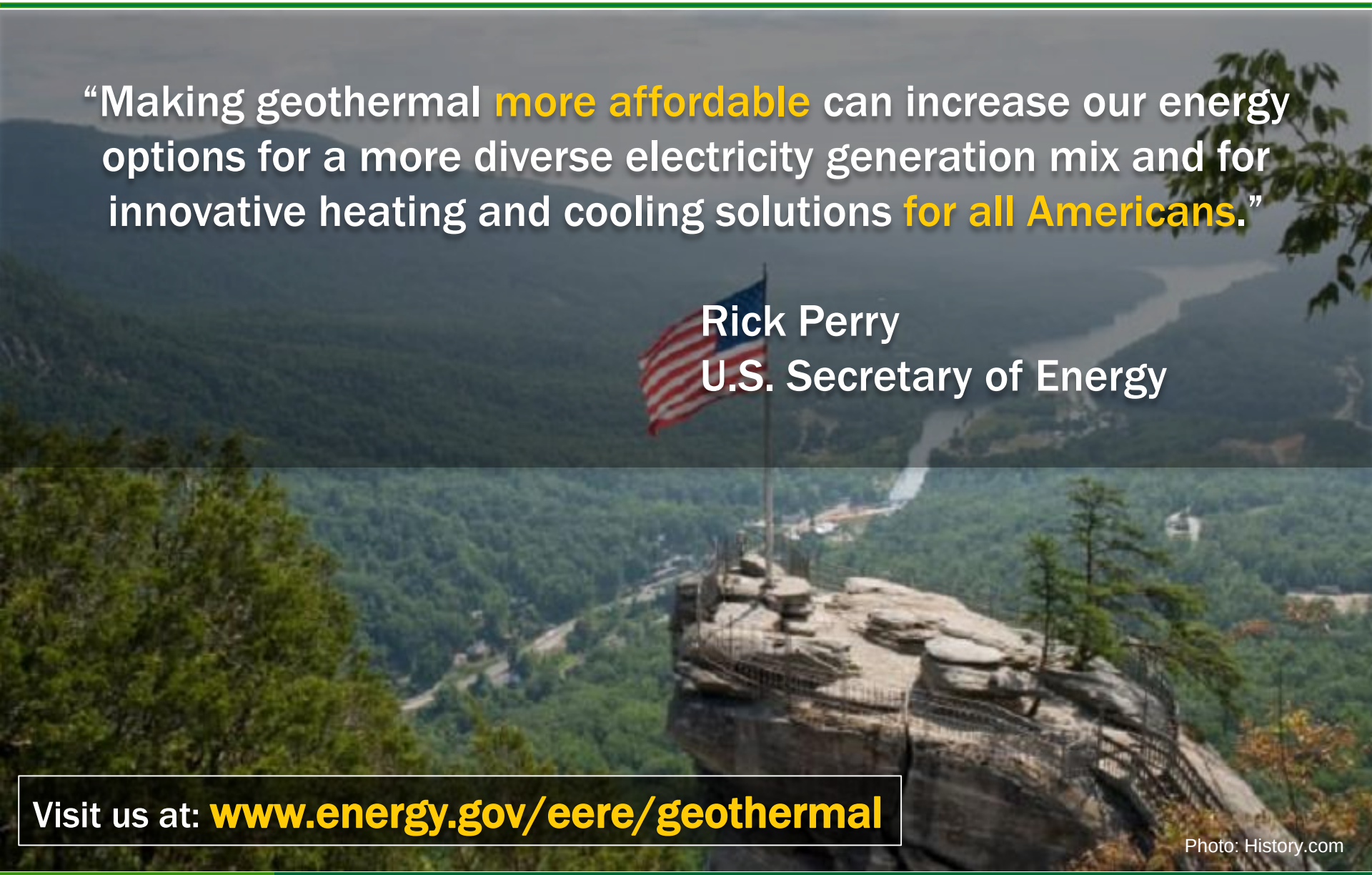
NC Sustainable Energy Association – Geothermal Heat Pumps
https://energync.org/geothermal-heat-pumps/

Carolina Country magazine: "It's Geothermal"
https://www.carolinacountry.com/your-energy/it-s-geothermal

NC Department of Environmental Quality
http://portal-legacy.deq.nc.gov/web/wq/aps/gwpro/geothermal

Photo: History.com

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: History.com