U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Geothermal Technologies Office

Quarterly Update: July 29, 2021

Image: Calpine

Today's Agenda

July 29, 2021 / 2:00-3:15 PM ET
Webinar topics or suggestions? Contact us at: DOE.geothermal@ee.doe.gov

Topic	Speaker
News & Updates • WOO FOA Updates • Lithium Extraction Prize • Energysheds RFI **FY 2022 Forecast** • GTO Budget • EERE Mission & Priorities • GTO Initiatives	Sue Hamm, GTO Director
NREL Geothermal Market Report	Sean Porse, GTO DMA Lead Analyst Jody Robins, Lead Author, NREL
Q&A	Submit your questions

Wells of Opportunity FOA: Updates

- Submissions are now due by **August 16, 2021.**
- Selection notifications will go out **October 27, 2021**, with award negotiations to immediately follow.
- **New program policy selection factor:** The degree to which the proposed project addresses the current Administration's goal to develop a carbon pollution-free electric sector by 2035 and a net-zero emissions economy by 2050.

July 22, 2021

U.S. Department of Energy Announces Updates to Wells of Opportunity Funding Opportunity

Today, the U.S. Department of Energy's Geothermal Technologies Office announced changes to the **Wells of Opportunity** funding opportunity announcement (FOA). Released in June, this FOA will provide up to $14.5 million to support active field testing of enhanced geothermal systems (EGS) technologies and techniques within existing wells. The Wells of Opportunity 2021 FOA solicits the partnership of well owners or operators to help cost-effectively bring more geothermal power online using their existing wells.

Geothermal Lithium Extraction Prize: Updates

- Phase One submission deadline has been extended to **September 2, 2021.**
- In addition to competitors affiliated with a U.S. academic institution, domestic **small businesses and university incubator partners** are now eligible to participate.

June 22, 2021

Energy Department Announces Expanded Eligibility and New Deadlines for Geothermal Lithium Extraction Prize

The U.S. Department of Energy (DOE) has expanded the eligibility requirements and set new deadlines for its Geothermal Lithium Extraction Prize. The Prize, funded by DOE's Geothermal Technologies Office and administered by the National Renewable Energy Laboratory, is designed to advance technologies that improve the economics and minimize environmental impacts of lithium extraction from geothermal brines. Participants compete in three escalating challenges to identify, develop, and test solutions for an opportunity to win

DOE Energysheds RFI

- DOE is accepting comments on this RFI through **August 10, 2021.**
- Looking to define the concept and definition of an **energyshed and energyshed management systems,** and their application to the electric grid.
- To learn more, visit eere-exchange.energy.gov / **DE-FOA-0002548**

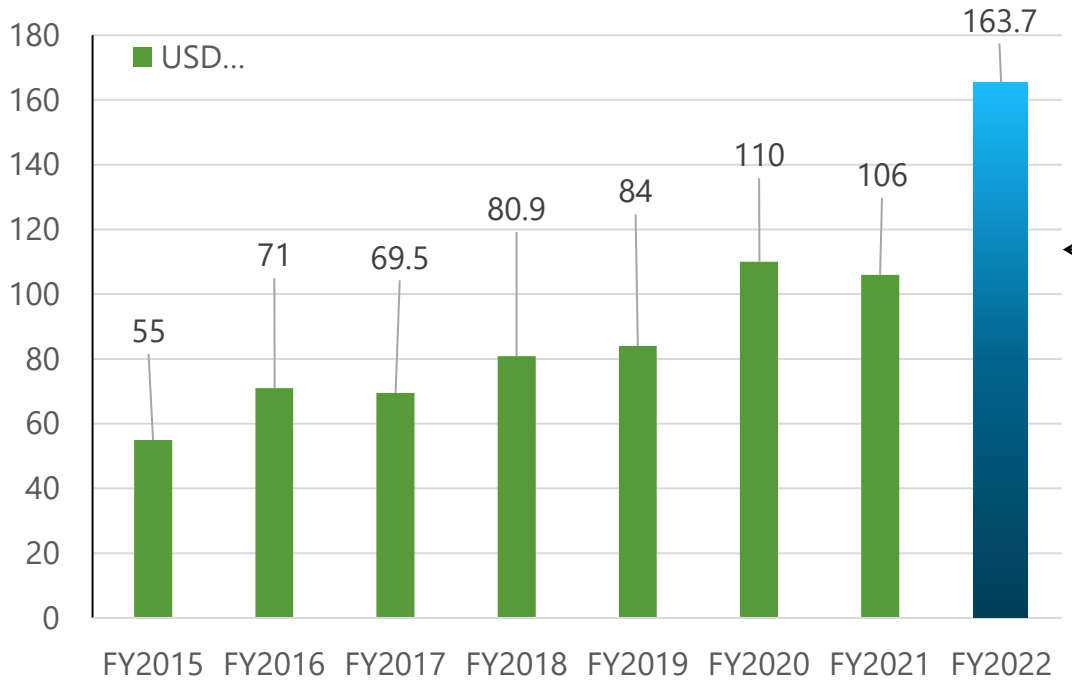
July 16, 2021

U.S. Department of Energy Seeks Public Input Regarding Energysheds

The U.S. Department of Energy (DOE) announced a request for information (RFI) seeking feedback on the concept and definition of an "energyshed" and energyshed management systems, as well as their application to the electric grid. An energyshed has been referred to as an "area in which all power consumed within it is supplied within it." This concept encourages communities to consider where their energy comes from geographically as well as the resources used to generate it.

The Office of Energy Efficiency and Renewable Energy (EERE) is examining how locally generated renewable energy sources can offer communities energy independence, security, and resilience. More information on EERE's efforts regarding energysheds can be

GTO FY22 Budget



54% increase FY21 to FY22
197% increase FY15 to FY22

Areas of emphasis in FY 2022

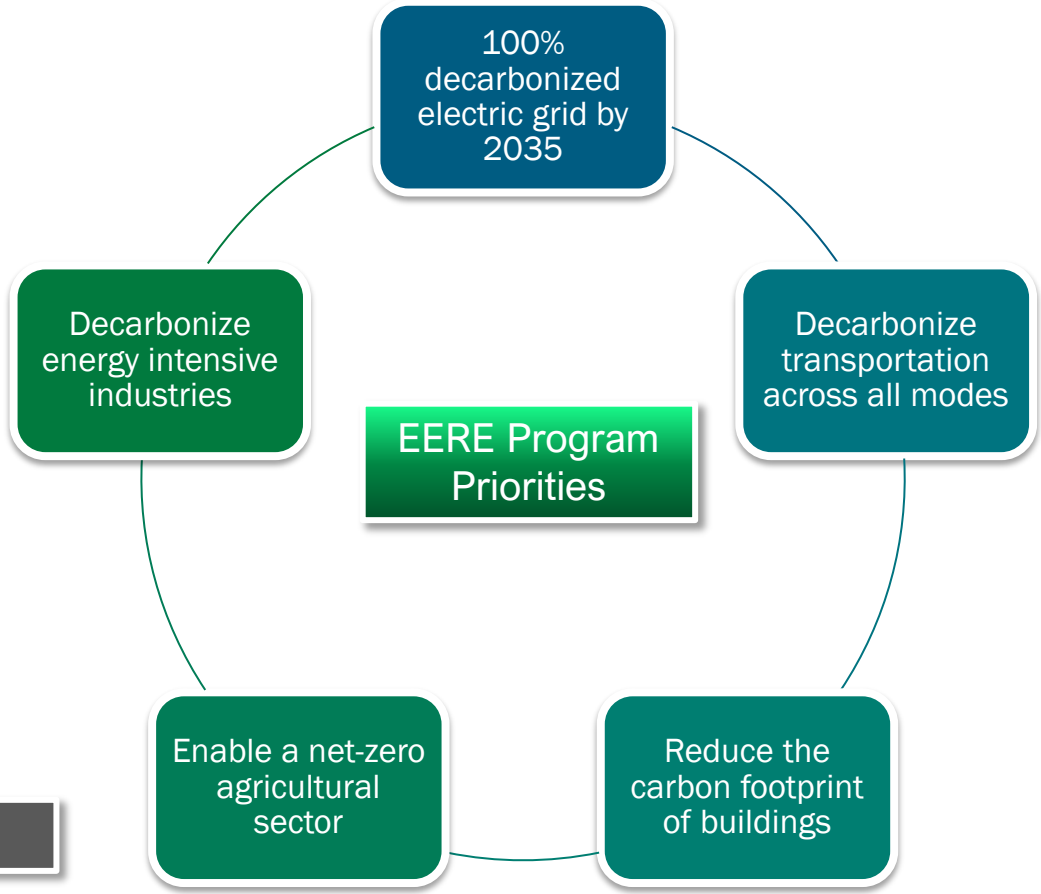
- Achieve a **carbon pollution-free electricity sector** no later than 2035.
- Help **reduce the carbon footprint** of the U.S. building stock by 80% by 2035.
- Accrue **benefits to disadvantaged communities.**

Alignment to EERE Priorities

EERE Mission

Accelerate the research, development, demonstration, and deployment of technologies and solutions to equitably transition America to net-zero greenhouse gas emissions economy-wide by **no later than 2050,** and…

…ensure the clean energy economy **benefits all Americans,** creating good paying jobs for the American people -- especially workers and communities impacted by the energy transition and those historically underserved by the energy system and overburdened by pollution.



Keys to Ensure the Greatest Impact

Environmental Justice & Equity

Diversity in STEM

Workforce Development

State & Local Partnerships

FY 2022 Highlights

Frontier Observatory in Research in Geothermal Energy (FORGE) ($20M)

Utah FORGE drilled the first-ever highly deviated geothermal well at a rate twice the industry standard. In FY 2022, GTO will support the next R&D solicitation, contributing to meeting Administration goals for a carbon-free electric grid.

Drilling Technology Demonstration Campaign ($20M)

This campaign will enable field demonstration to prove utility and efficacy to industry and attract future private investment and use to further the Nation's goal to a 100 percent clean energy economy.

Geothermal Energy from Oil and gas Demonstrated Engineering (GEODE) ($10M)

This is a new consortium designed to leverage the oil & gas subsurface industry to help solve geothermal energy's toughest challenges.

Shown here is a drilling rig at the FORGE site outside of Milford, Utah. RD&D at FORGE continues through 2024 and will drive technological advances in enhanced geothermal systems. Photo: Eric Larson / FORGE Utah

FY 2022 Highlights

Community Geothermal Heating & Cooling Technical Assistance & Deployment ($15M)

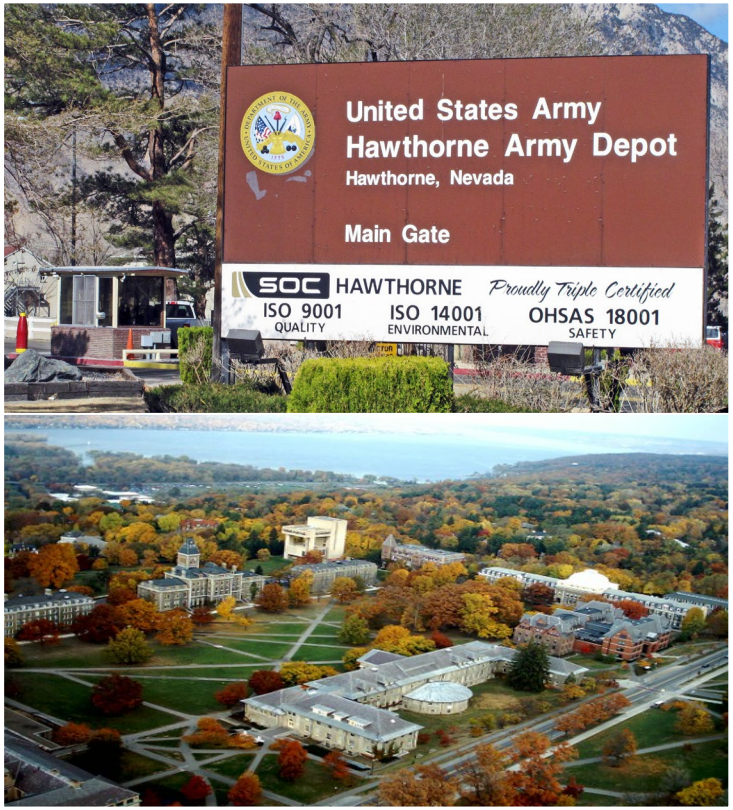
This initiative funds technical assistance to demonstrate, deploy, and implement community-scale direct use geothermal district energy systems through installation of geothermal heat pumps (GHP) and/or direct use of geothermal fluids.

Federal Partnerships for Geothermal Installations ($5.4M)

GTO and FEMP will make it possible for Federal agencies (DOD, GSA, State, NASA, DOE Labs, Park Service) to consider geothermal energy to heat/cool (and in some limited cases, potentially power) their installations.

Next Generation Connected Communities ($5M)

GTO will collaborate with the Building Technologies Office to demonstrate the market viability of highly energy-efficient, demand-flexible, low-carbon buildings integrated with distributed energy resources (DERs) to reliably and cost-effectively contribute to America's transition to a zero-carbon grid.



Military installations and university campuses are among the variety of locations that can benefit from direct use geothermal. Shown here are the Hawthorne Army Depot in Nevada and Cornell University in New York.

NREL Geothermal Market Report

Sean Porse, DMA Lead Analyst
Geothermal Technologies Office

Jody Robins, Senior Drilling Engineer
National Renewable Energy Laboratory

Key Findings from the *2021 U.S. Geothermal Power Production and District Heating Market Report*

Jody C Robins
National Renewable Energy Laboratory
07.29.21

Photo by Eric Larson, Utah FORGE

Project Team

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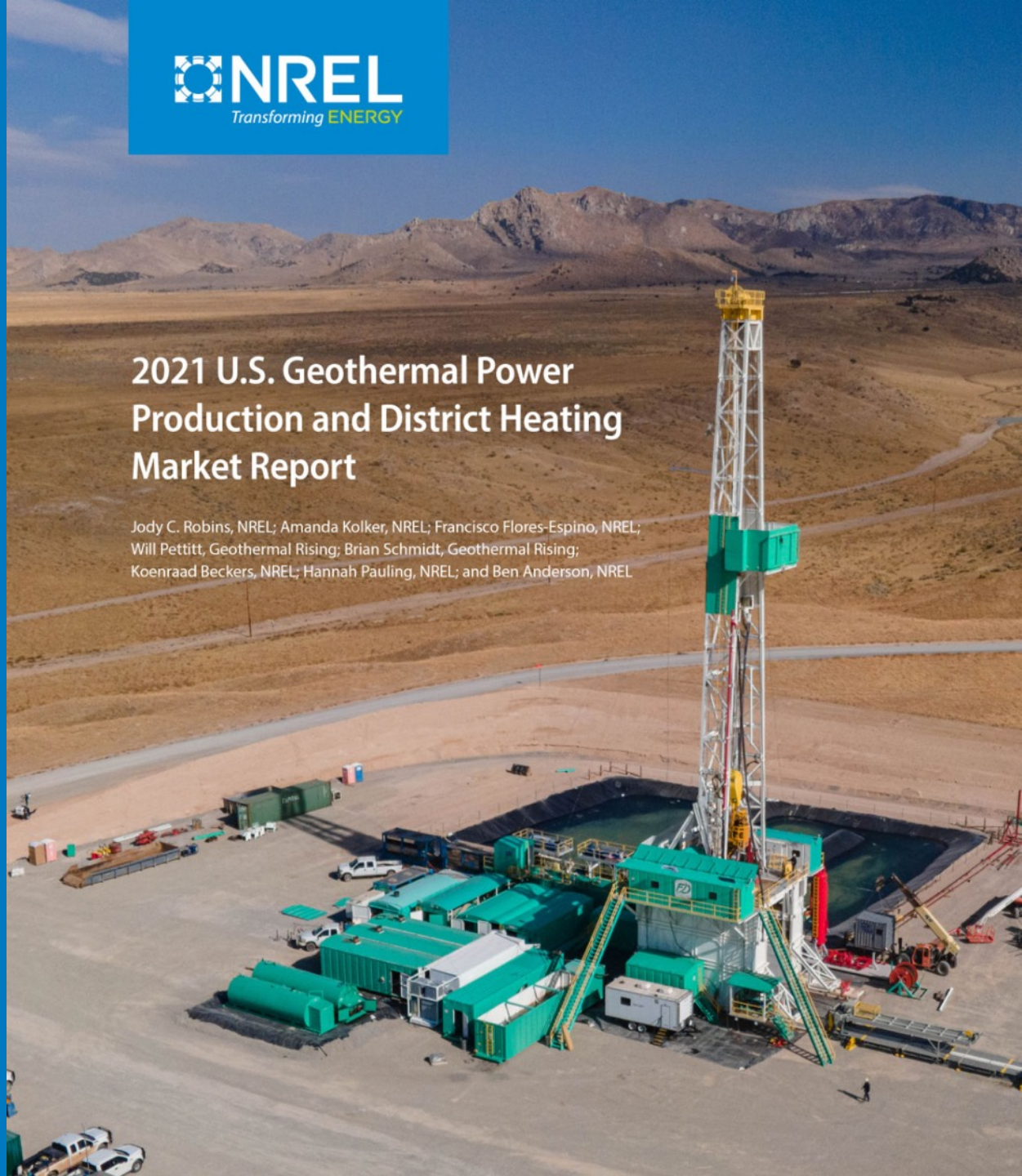
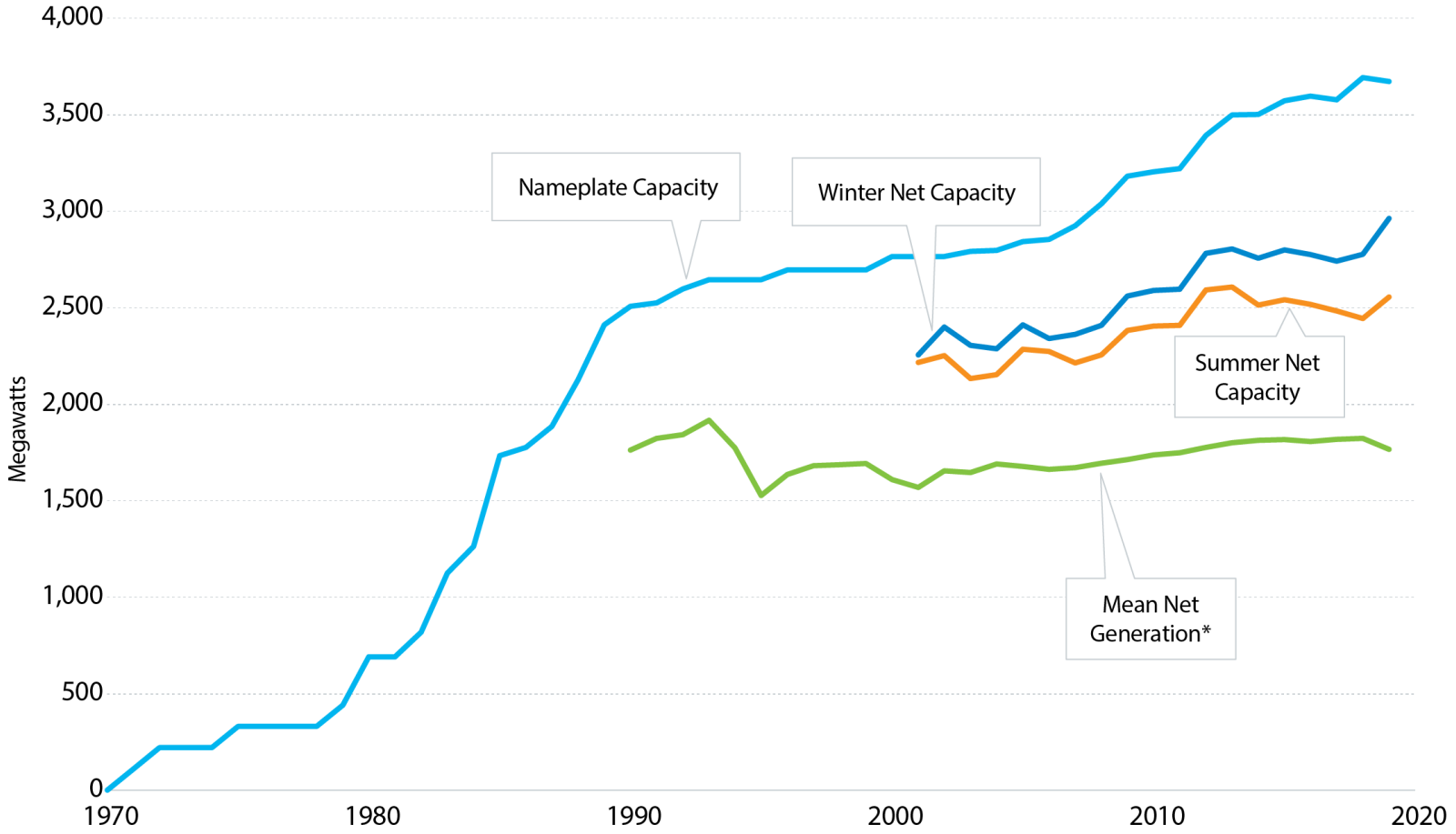
- Developed by team from NREL and Geothermal Rising with financial support from GTO.
- Provides geothermal stakeholders with up-to-date U.S. power production and district heating data.
- Evaluates the impact of state and federal policy and presents current research on geothermal development.



U.S. Geothermal Power Update

Photo by Dennis Schroeder, NREL 48144

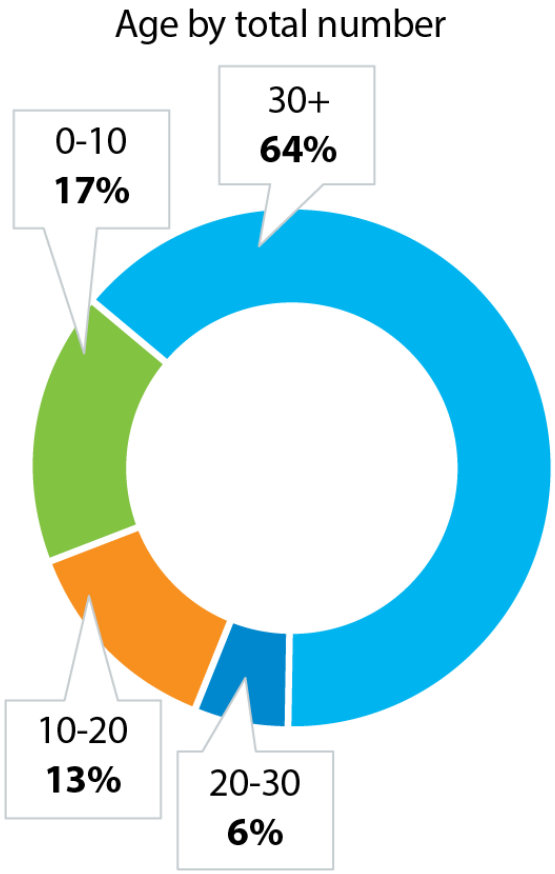


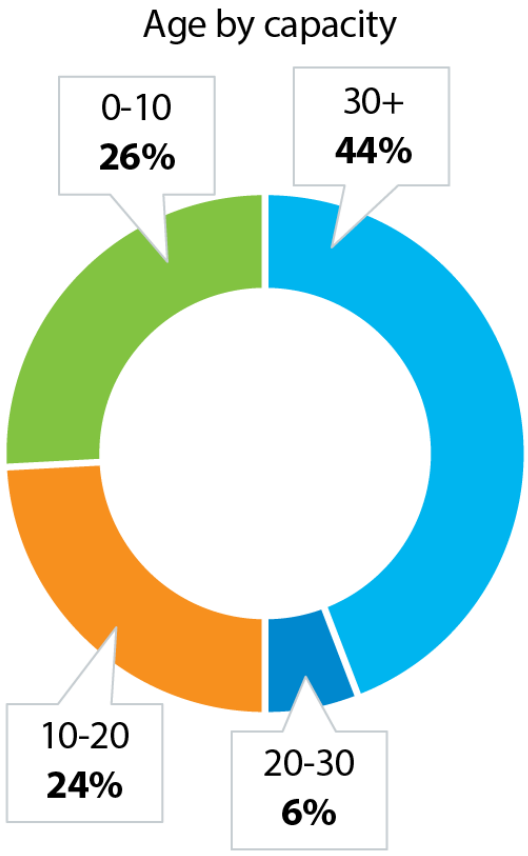
50 Years of U.S. Geothermal Deployment

- Current U.S. geothermal power generation nameplate capacity is 3,676 MW from 93 power plants
- Of this, 1,300 MW are located on public lands
- From 2016 through 2020, 7 new power plants adding 186 MW were brought online
- In the same time period, 11 plants with 103 MW of capacity were retired

U.S. Geothermal Power Production Fleet Age

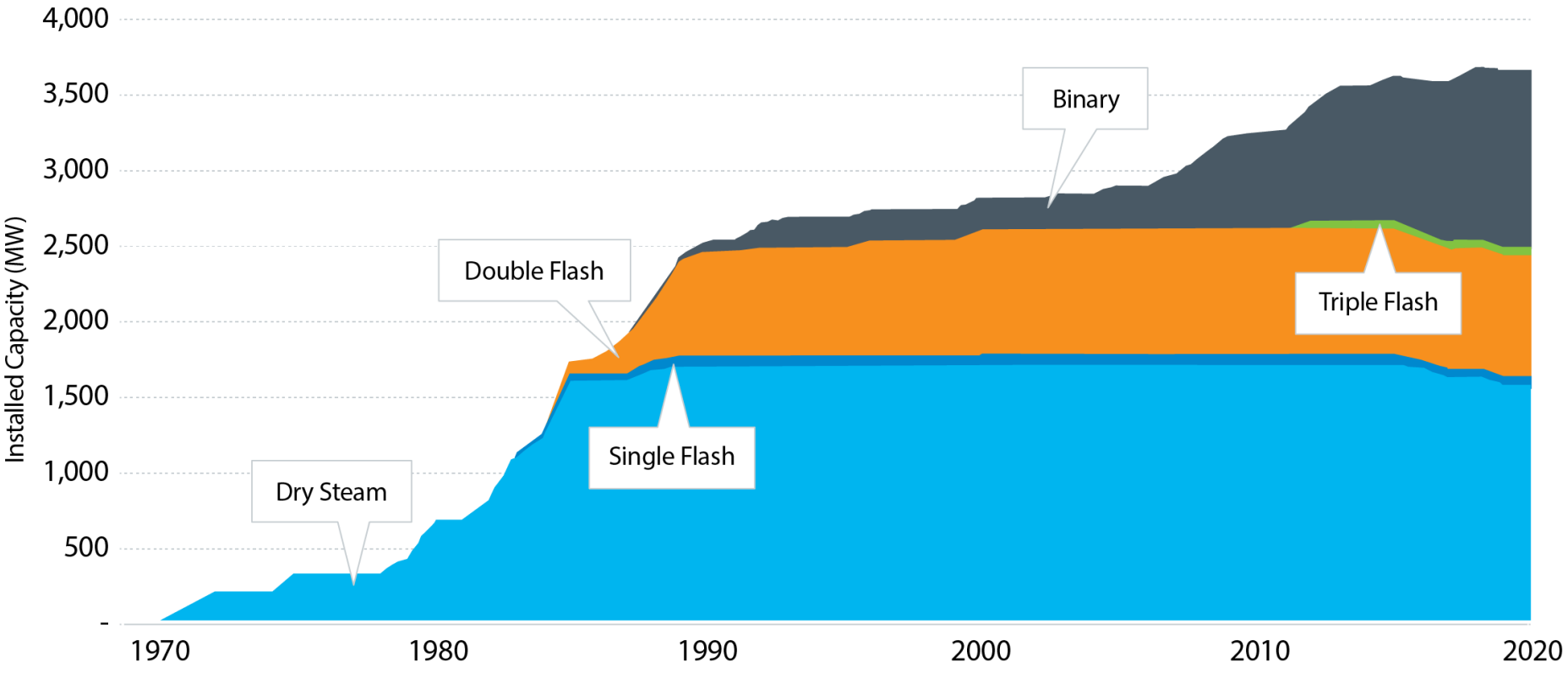
- Older geothermal plants and fields tend to experience a reduction in capacity.
- Currently 44% of U.S. geothermal plants representing 64% of capacity are more than 30 years old.
- In 2009, 4% of U.S. geothermal plants representing 11% of capacity were more than 30 years old.





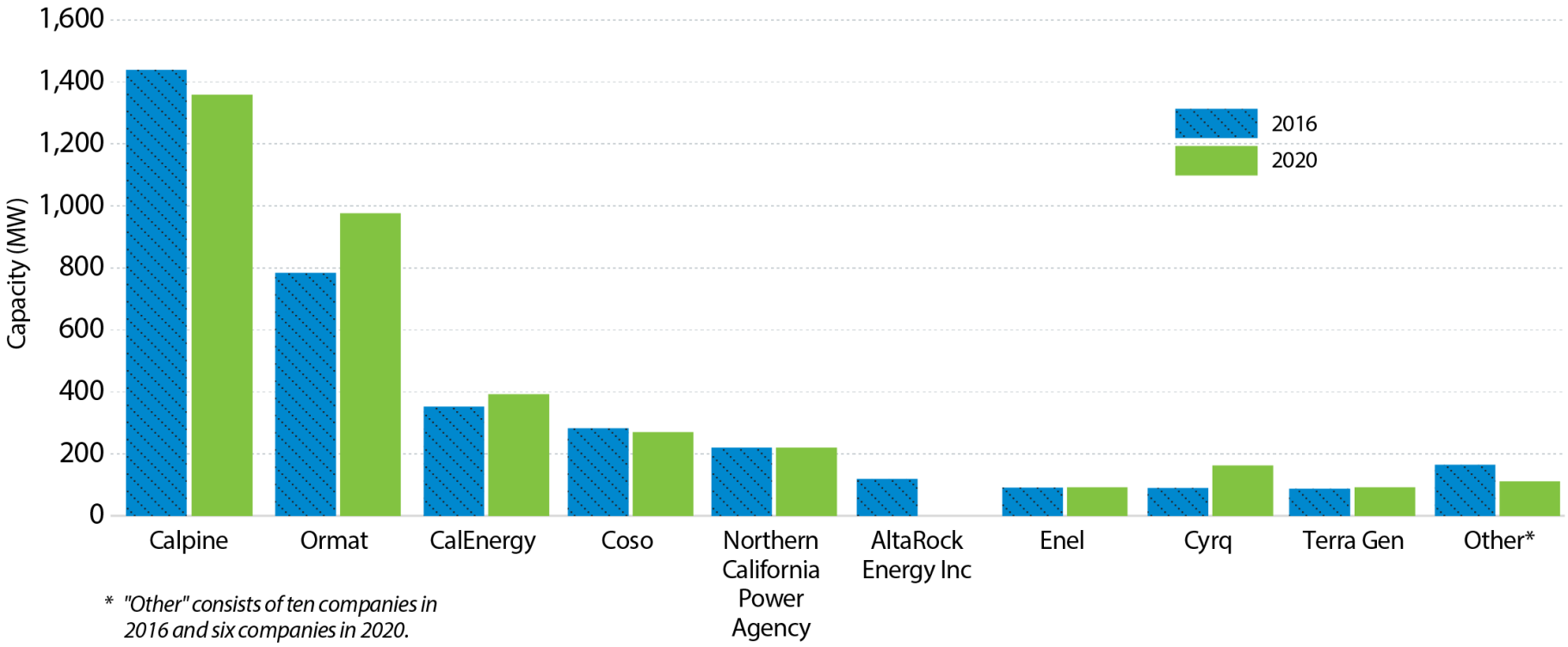
U.S. Geothermal Capacity by Plant Technology

Trend: *Most new plants in the U.S. are environmentally friendly binary plants.*



U.S. Geothermal Capacity by Operator

The majority of U.S. geothermal capacity is operated by Calpine and Ormat



* "Other" consists of ten companies in 2016 and six companies in 2020.

U.S. Geothermal Capacity by State

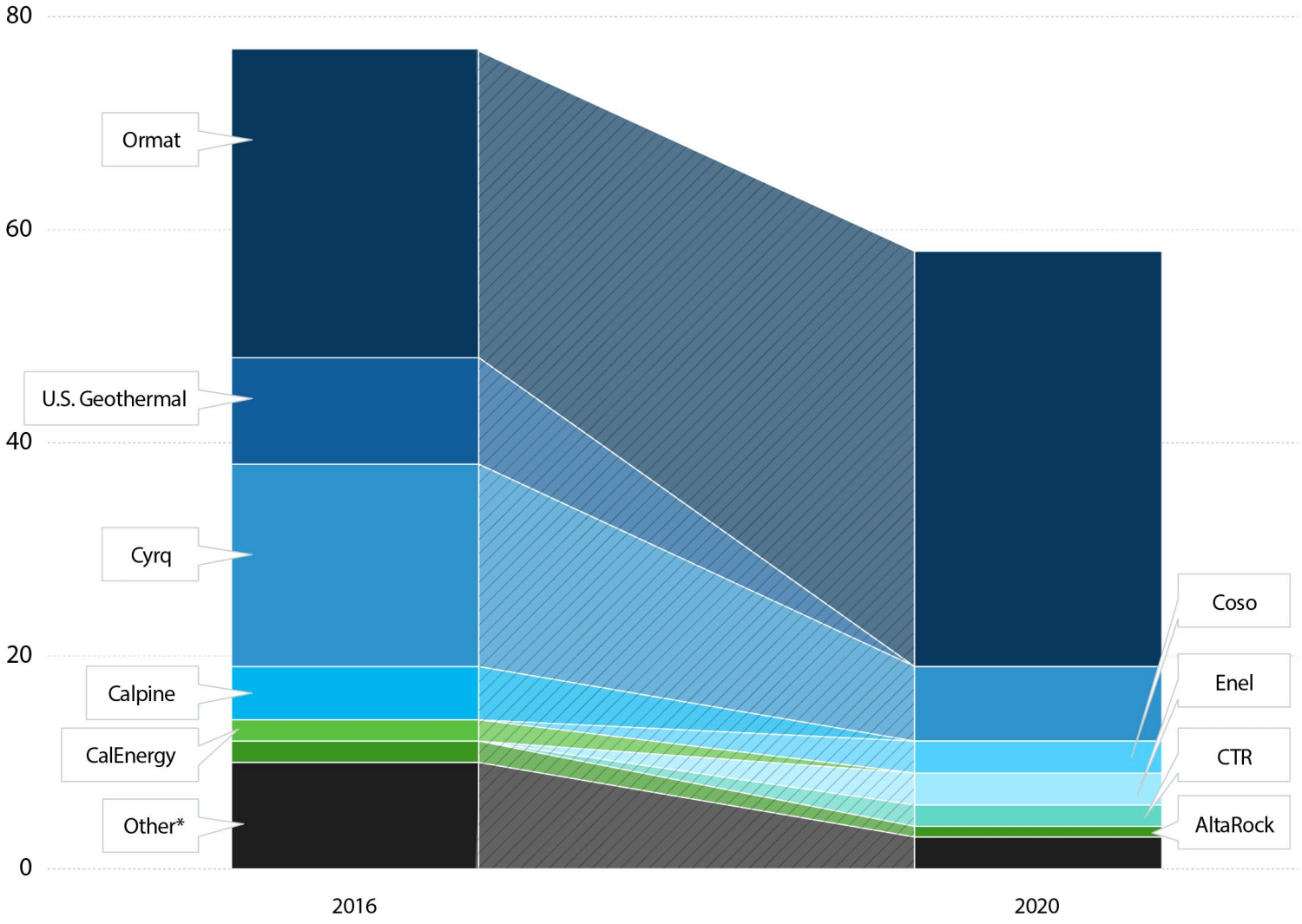
California and Nevada contain more than 90% of the current U.S. geothermal capacity

Project Pipeline

California and Nevada contain more than 90% of the current U.S. geothermal capacity

Developing Projects by Operator

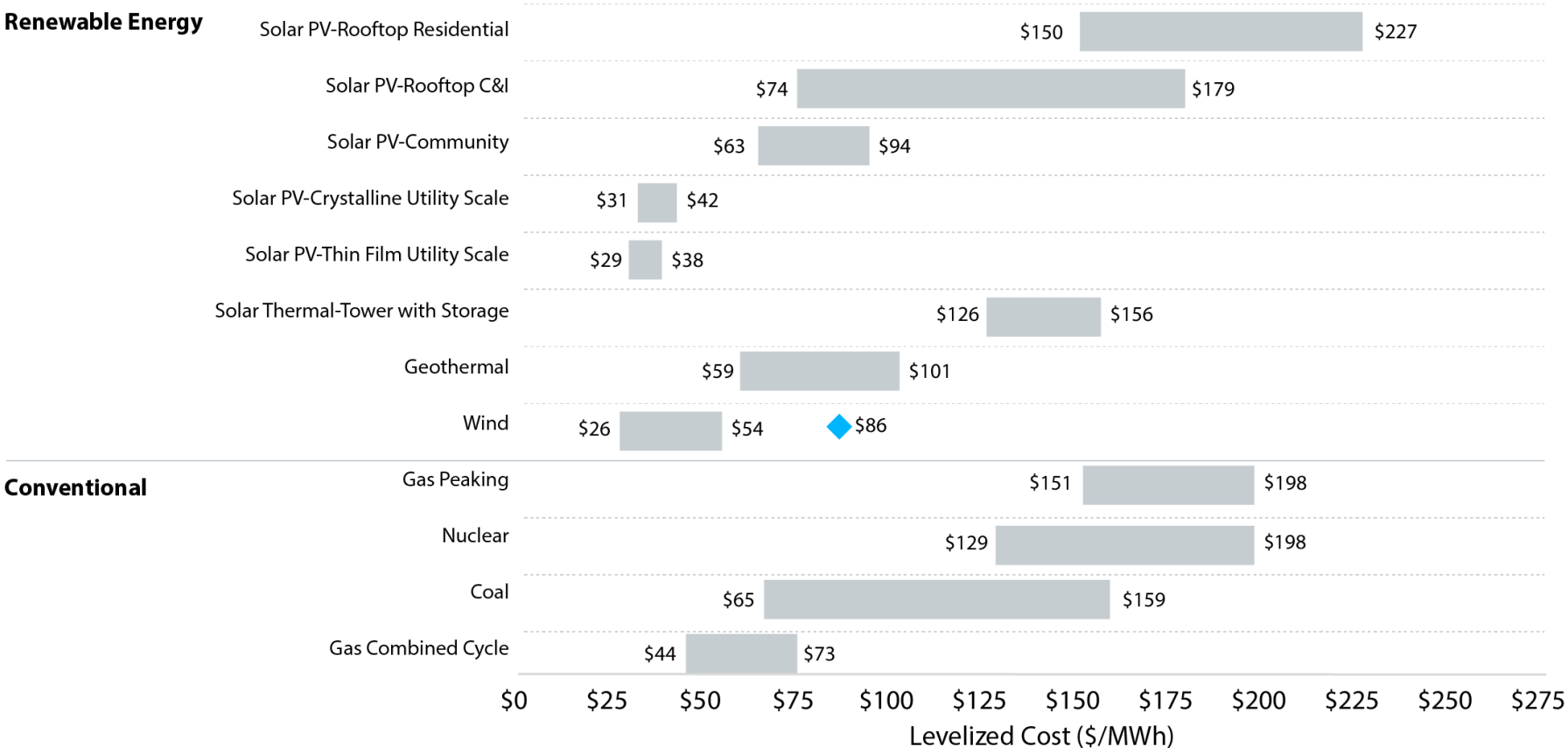
Geothermal developing projects in the United States have decreased from 77 in 2016 to 58 in 2019



* "Other" consists of six companies for 2016 and one company for 2020.

Geothermal Power Production Levelized Cost of Electricity (LCOE)

LCOE is a useful metric for comparing the costs of different technologies, but undervalues baseload generators like geothermal

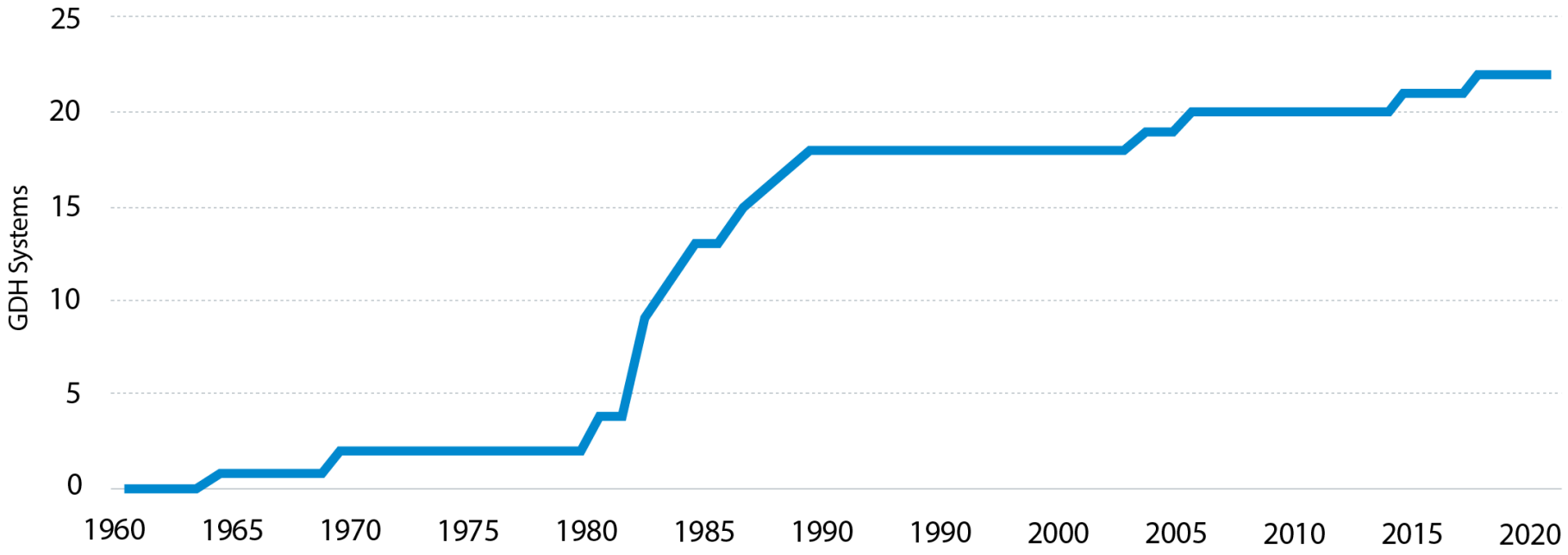


Source: Lazard 2020

Future Opportunities

U.S. Geothermal District Heating Update

Photo courtesy of the City of Boise, Idaho



Geothermal District Heating (GDH) in the United States

GDH technology has been in use in the United States for more than a century

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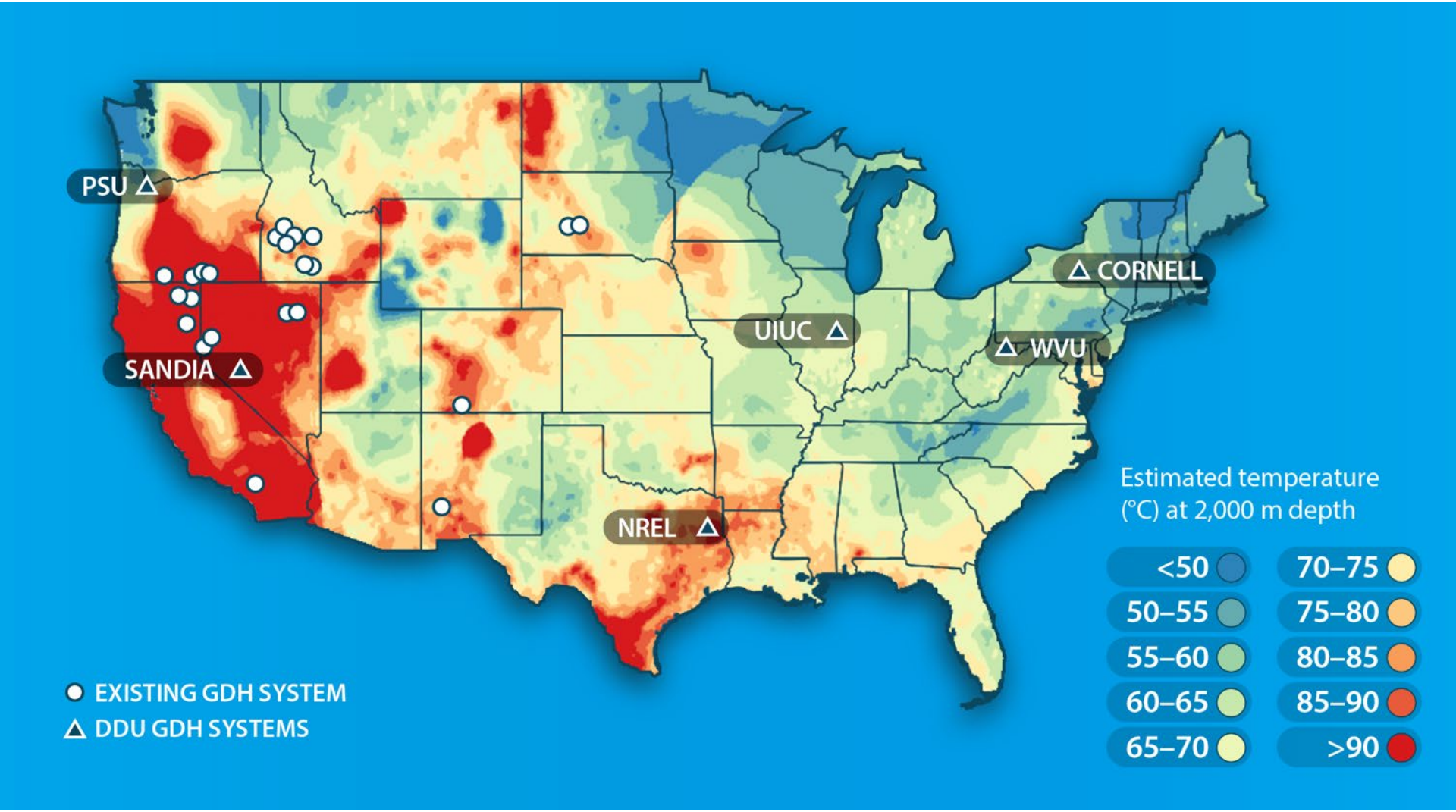
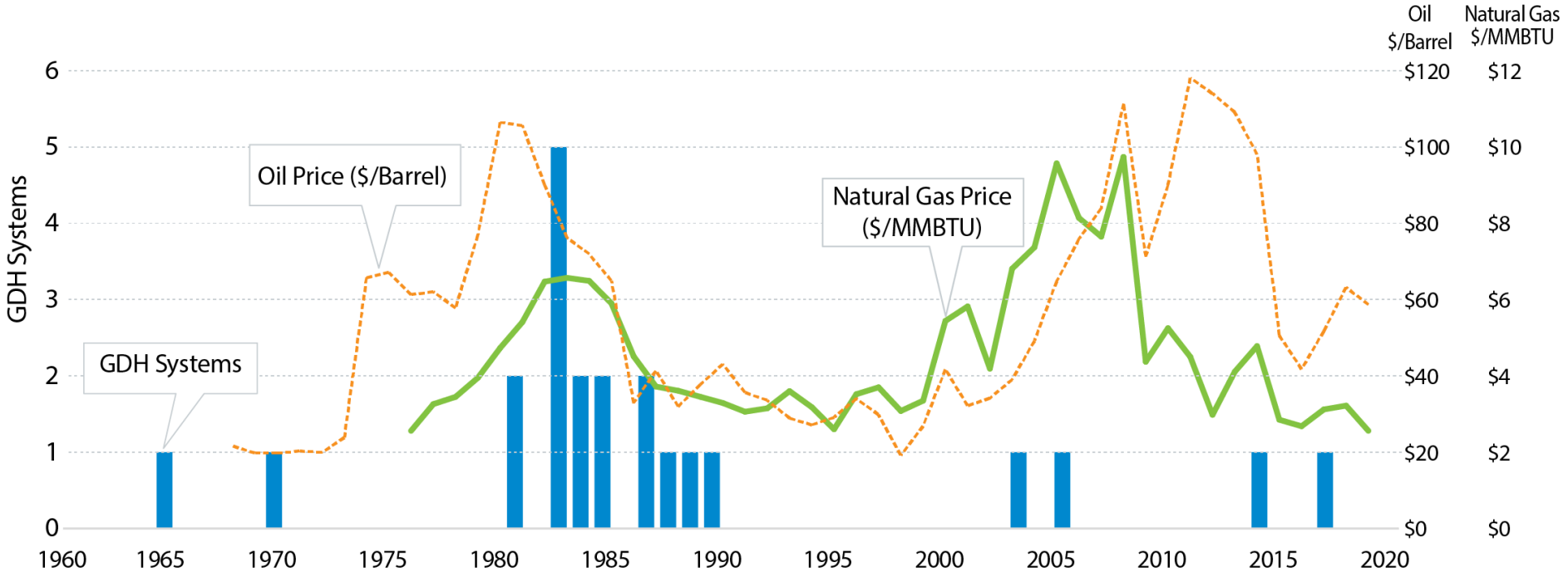
Location of GDH systems and DDU Projects

Location of existing GDH systems and DDU projects overlaying a temperature at 2,000m depth map



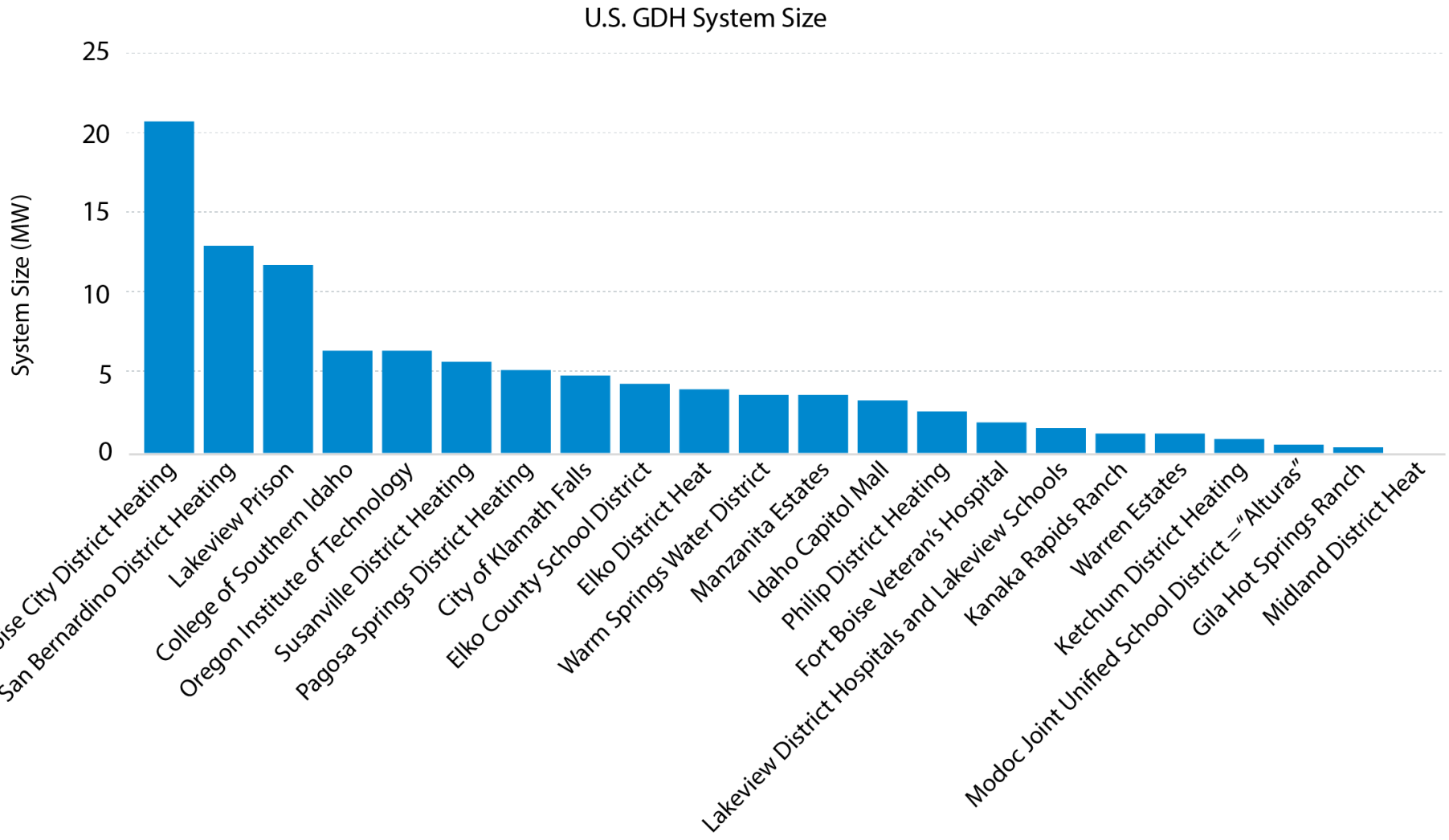


GDH vs Competing Heat Sources

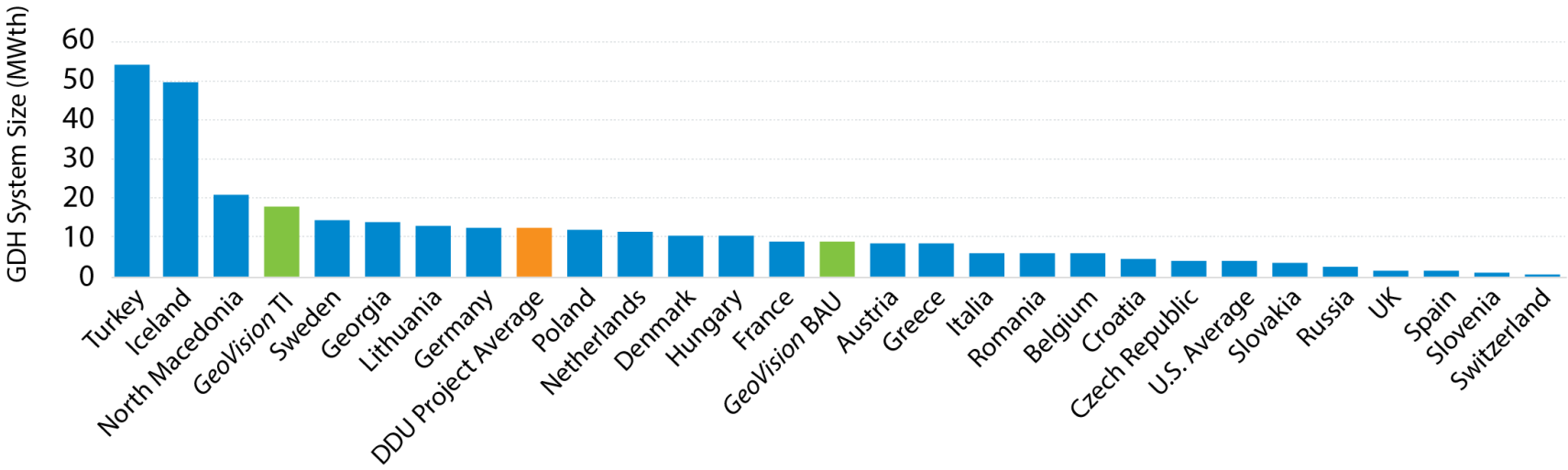
The increase in GDH development in the 1980s coincided with an increase in oil and gas prices, but the same was not seen in the 2000s

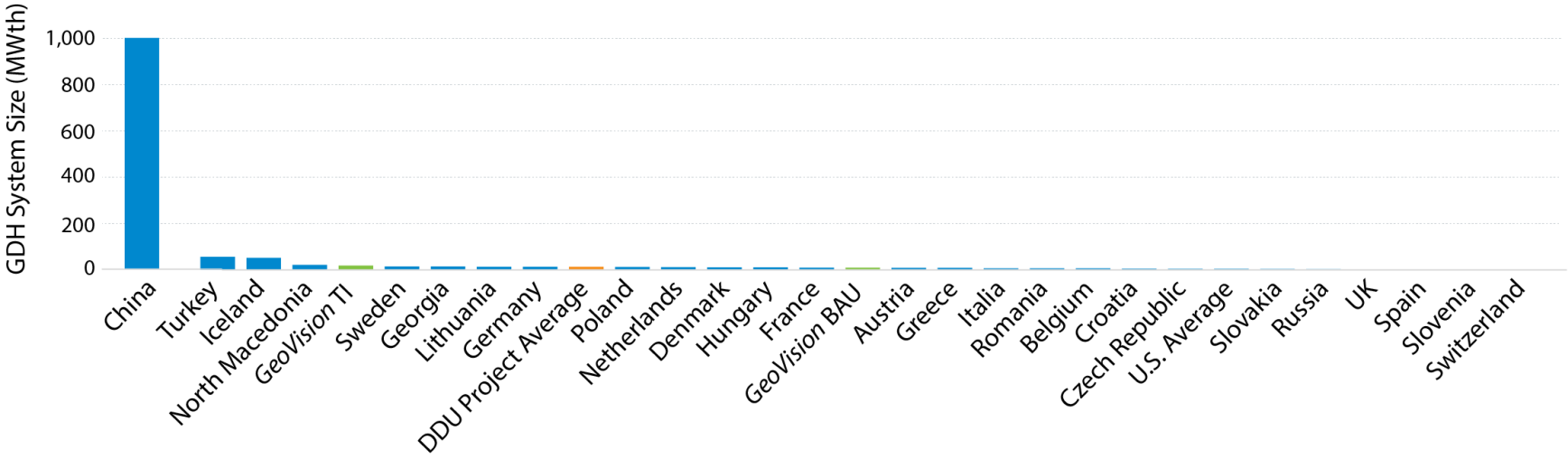
U.S. GDH System Size

Average U.S. GDH systems range in size from 0.1 MWth to just over 20 MWth, with an average of 4 MWth



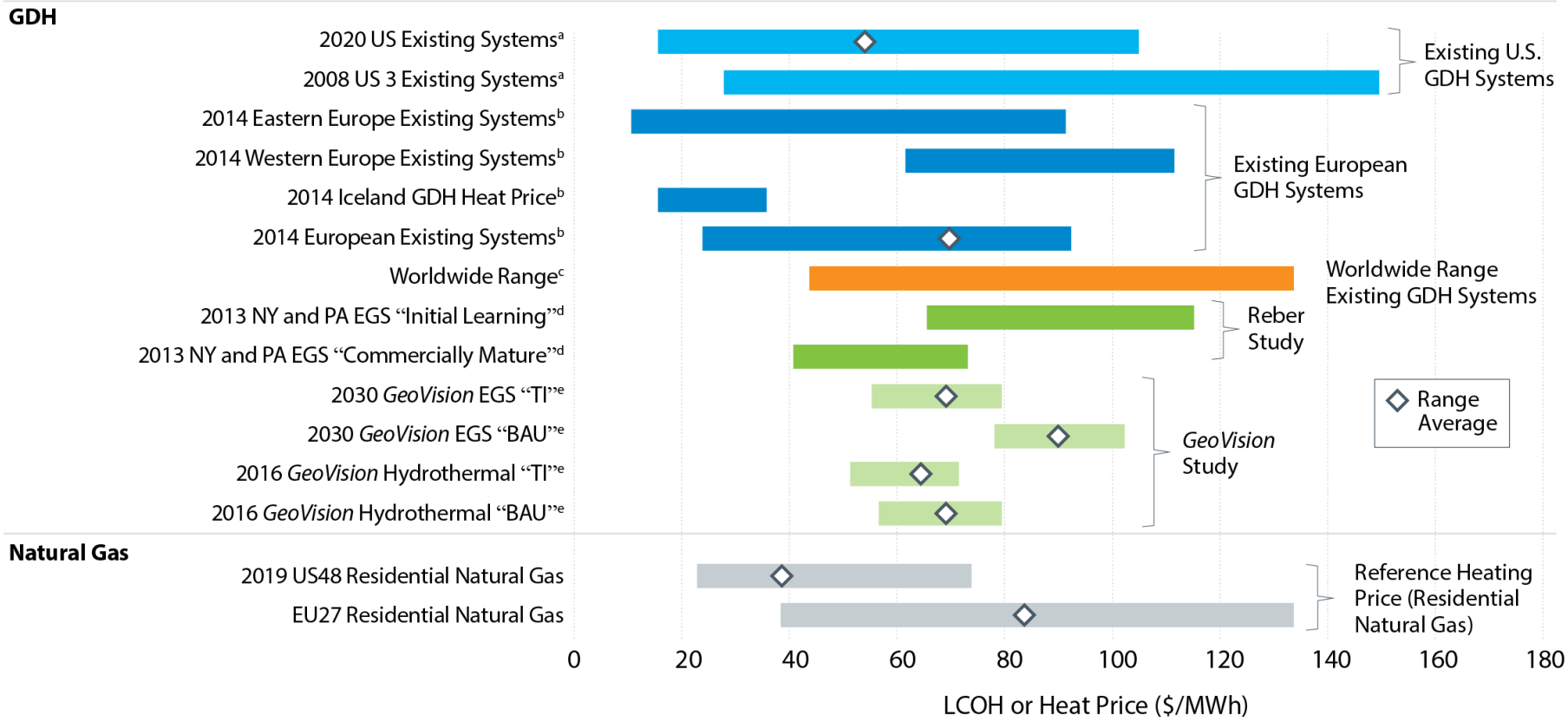
Worldwide GDH System Size





U.S. GDH Levelized Cost of Heat (LCOH)

Estimated LCOH for the U.S. GDH systems ranges from $15 to $105/MWh, with an average of $54/MWh

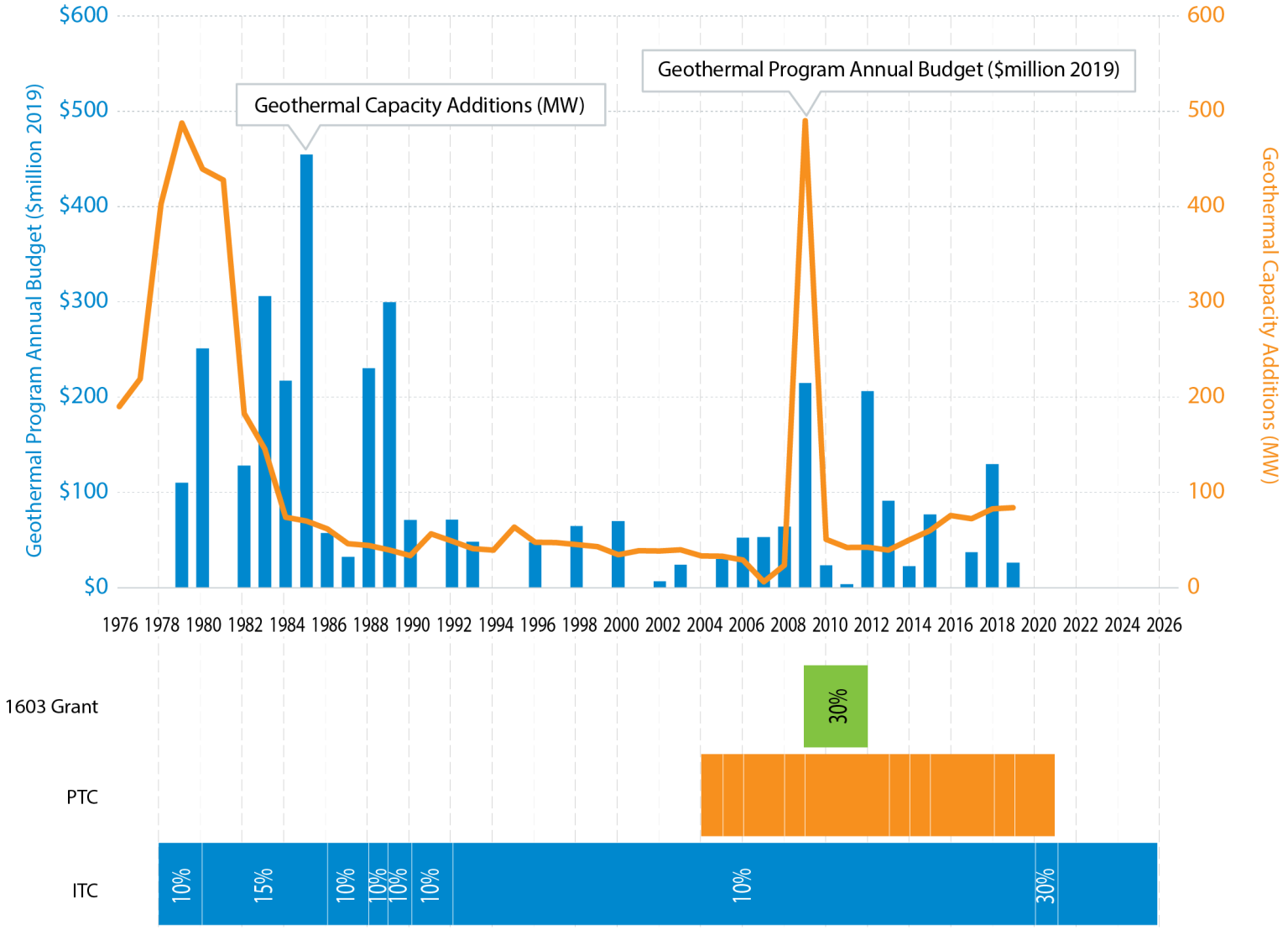


[a]LCOH of existing U.S. GDH systems as calculated in this study and as reported by Thorsteinsson (2008).
[b]LCOH of GDH systems in Europe.
[c]LCOH of worldwide GDH systems.
[d]Simulated LCOH values for EGS GDH systems in New York and Pennsylvania by Reber (2013).
[e]Simulated LCOH values for GDH systems nationwide using the dGeo tool in the *GeoVision* study.
Other Sources: EIA 2020a; EuroStat 2020

State and Federal Policies

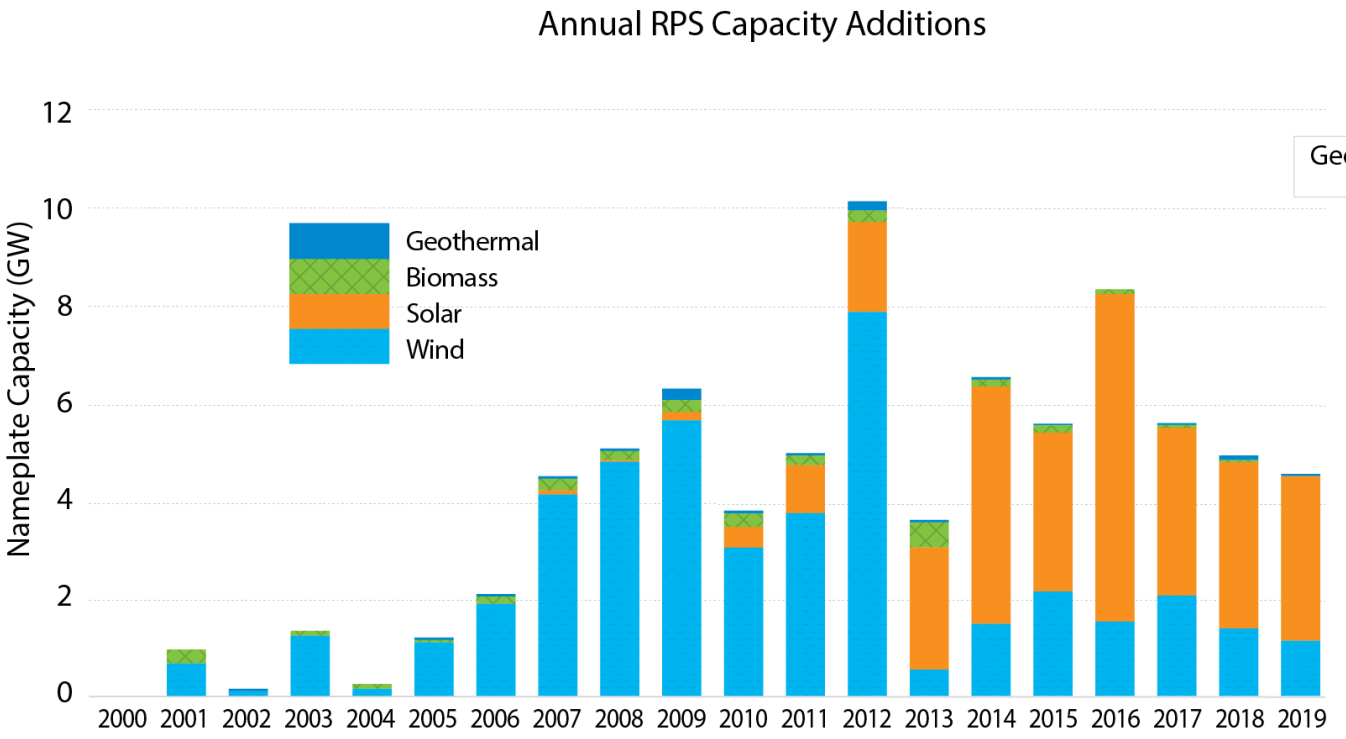
Federal Policy

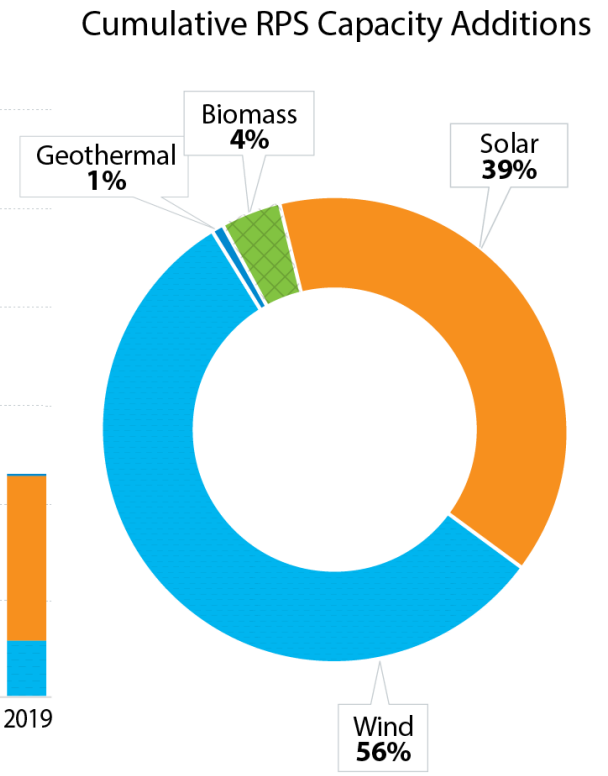
In the 10 years following the signing of PURPA, 2,086 MW of geothermal energy was installed

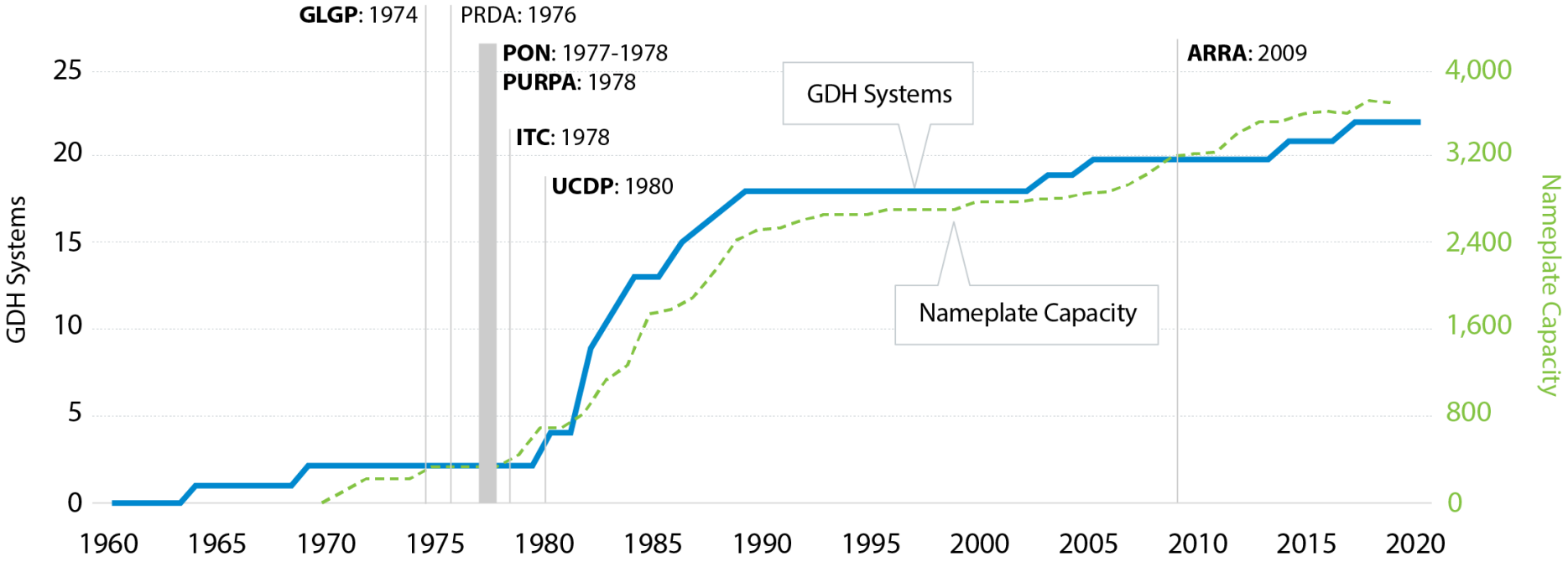


State Policies

Twenty-eight states have renewable portfolio standards (RPS) that count geothermal power as an eligible resource, seven of which include direct use







Impact of Policy on Geothermal Growth

Beginning in the mid-1970s, a number of DOE financial assistance and risk mitigation programs and state incentives were available to support geothermal deployment

Market Opportunities for Geothermal Energy

Photo from iStockphoto, 1252389422

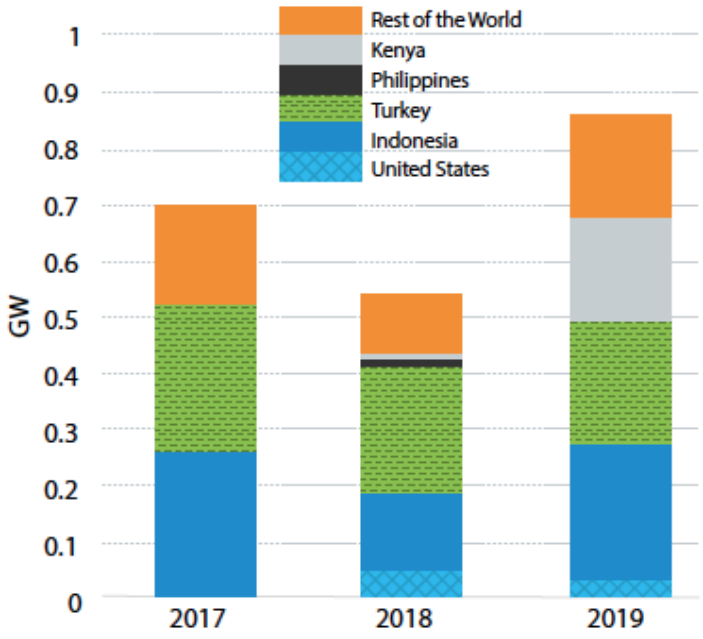
Emerging Technologies

- Enhanced Geothermal Systems (EGS) and closed-loop
- Hybrid power plants (esp. geothermal plus solar)
- Mineral extraction (esp. lithium)
- Thermal energy storage
- Oil and gas co-production/sedimentary geothermal
- Geothermal for cooling
- Supercritical geothermal
- Geothermal microgrids

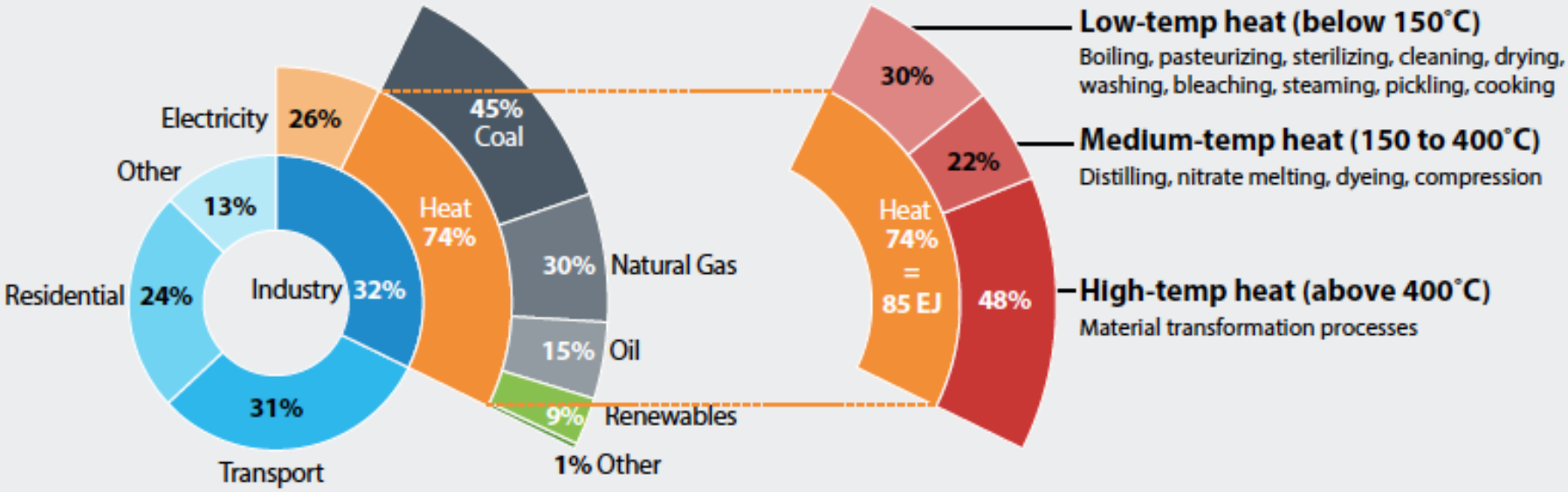
Risk Mitigation

Risk insurance funds for GDH projects exist in France, Germany, Iceland, the Netherlands, and Switzerland.

- Grants
- Convertible grants
- Payable grants (loans)
- Public insurance
- Public financing
- Public private partnership
- Private insurance
- Direct government investment



Geothermal capacity additions in selected countries, 2017–2019
Source: IEA (2020a)



Global industrial heat demand
Source: Philibert (2017)

Industrial Heat Use

The vast majority of industrial heat is provided by fossil fuels and only 9% from renewables

Photo courtesy of the City of Boise, Idaho

Increasing the use of geothermal energy for U.S. electricity, heating, and cooling can significantly contribute to Biden Administration decarbonization goals to cut U.S. emissions by half in 2030 and achieve a carbon-free electric sector by 2035

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https://www.nrel.gov/docs/fy21osti/78291.pdf

Thank You

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NREL/TP-5700-78291

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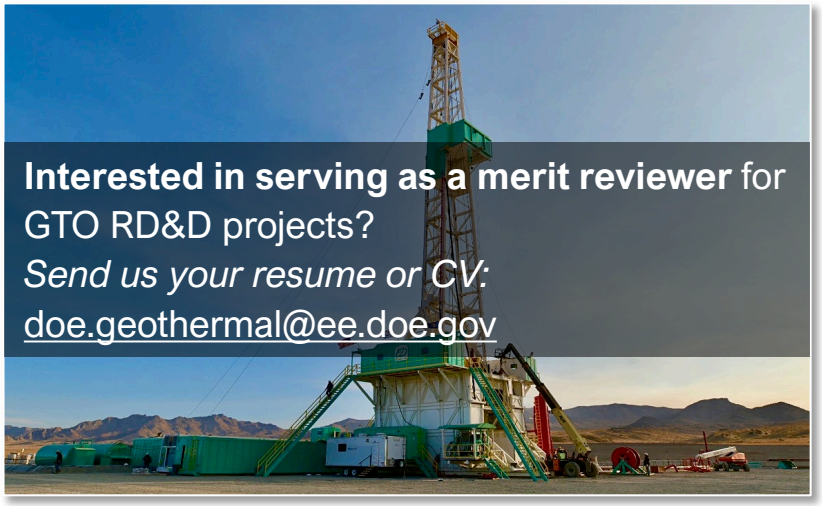
Opportunities

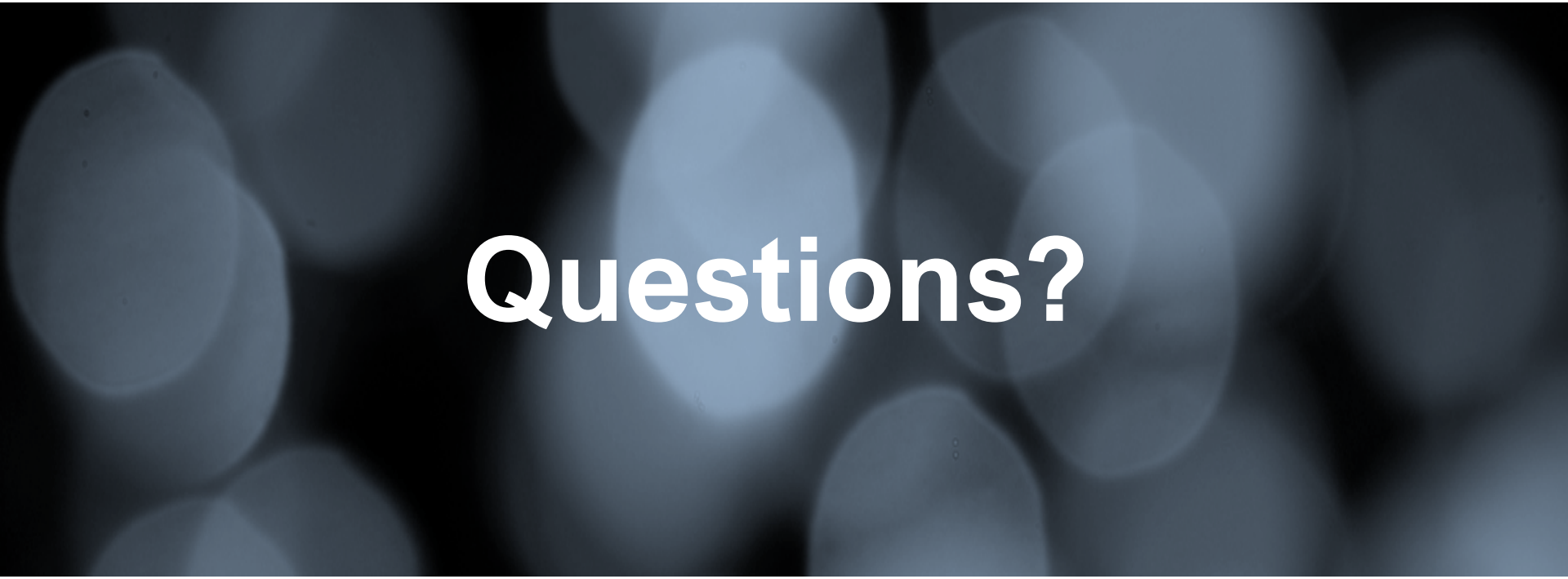
Get the hottest geothermal news from *The Drill Down*, the new monthly newsletter from GTO!
Sign up today: geothermal.energy.gov



Looking to ENERGIZE Your Career? EERE is searching for enthusiastic, driven professionals!
View open opportunities:
energy.gov/eere/employment-opportunities-eere

AGU FALL MEETING
New Orleans, LA & Online Everywhere
13–17 December 2021

Developments in Geothermal Energy – session led by Zach Frone, Tim Kneafsey, Mathew Ingraham, and Paul Schwering. Abstracts due Aug 4!
Learn more: agu.org/fall-meeting



The **Geothermal Technologies Office (GTO)** works to reduce the cost and risk associated with geothermal development by supporting innovative technologies that address key exploration and operational challenges.

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