U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

The United States' Clean Energy Goals

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Office of Energy Efficiency and Renewable Energy

EERE MISSION

Our mission is to drive the research, development, demonstration and deployment of innovative technologies, systems, and practices that will put America on an irreversible path to:

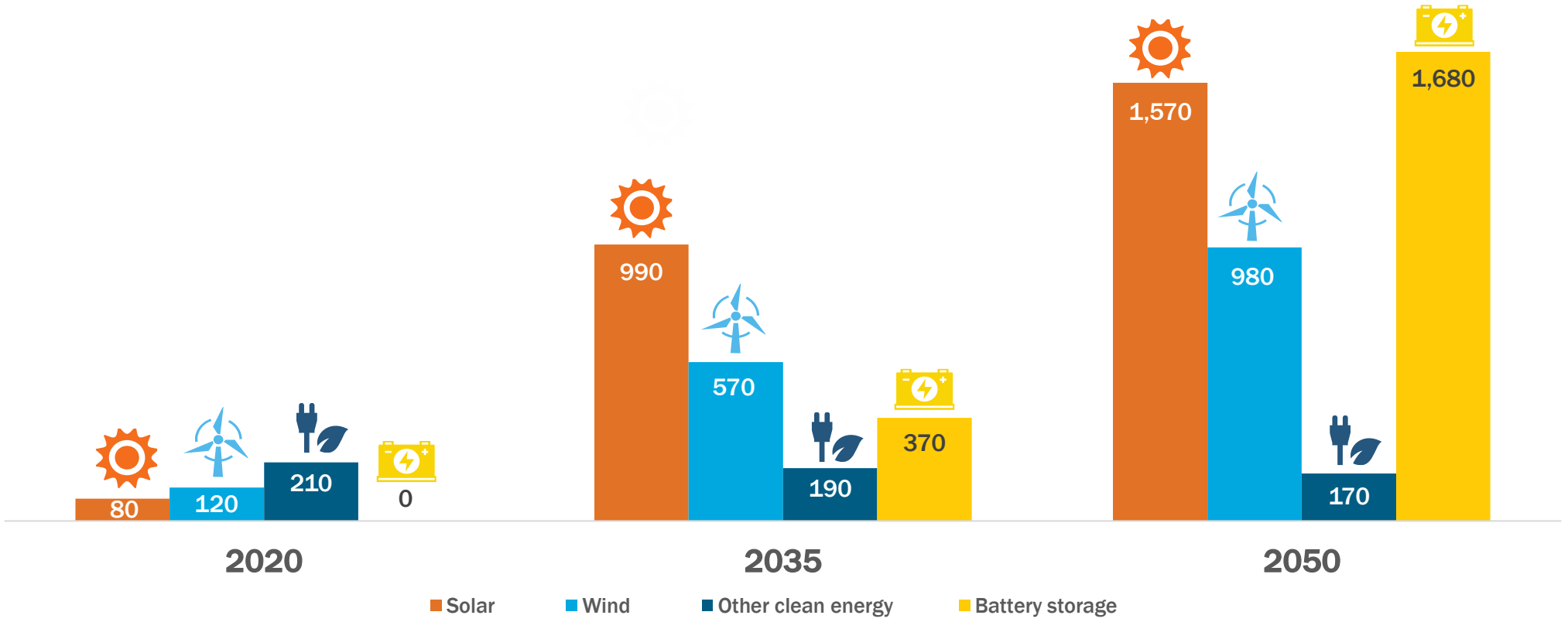
- **Achieve a carbon-free electricity sector by 2035; and**
- **Equitably transition America to net-zero greenhouse gas emissions economy-wide by no later than 2050**

PRIORITIES

- 100% decarbonized electric grid by 2035
- Decarbonize energy intensive industries
- Decarbonize transportation across all modes
- Reduce the carbon footprint of buildings
- Enable a net-zero agricultural sector

We need a lot of clean energy to meet our goals

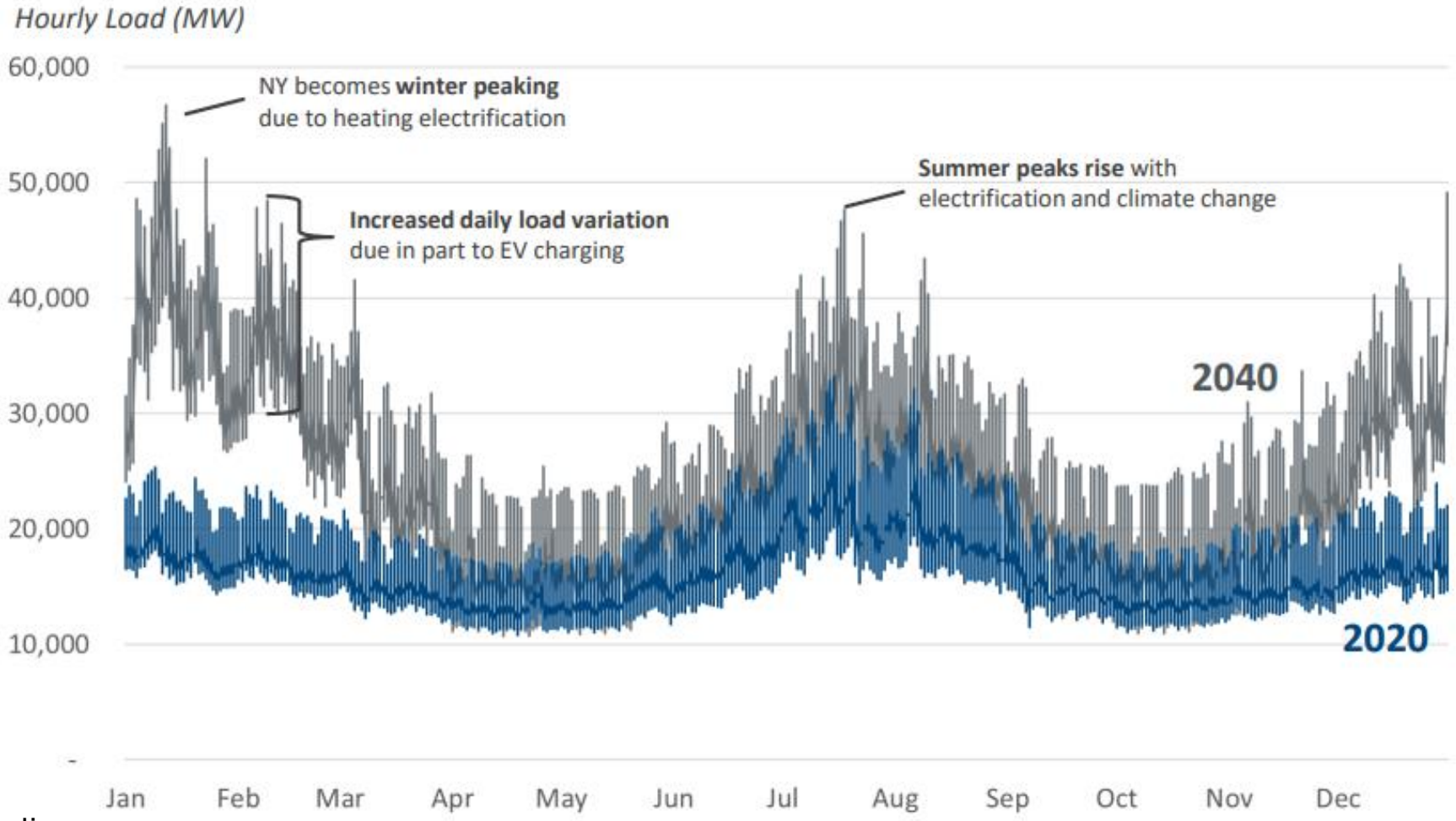
One example scenario from the NREL Solar Futures Study: Renewable energy capacity to achieve ~95% decarbonization by 2050



Other clean energy is biomass, geothermal, hydropower including pumped storage, and nuclear

Electrification will increase and shift peak demand

Now the highest grid demand peaks are on summer afternoons.
With building electrification, the demand peaks on winter mornings will be even higher



Source: NYISO modeling

How do we accomplish this?

RDD&D efforts in solar, wind, water, and geothermal power to help **reduce the costs** and accelerate the use and **integration of renewables** in a **reliable, secure, and resilient grid**.

Accelerate Deployment

Enable widespread adoption of existing technologies

Sustain Cost Reductions

Drive continued cost reductions

Increase Resource Flexibility & Diversity

Maximize flexibility and reliability of generation & load

Support a Modernized Grid

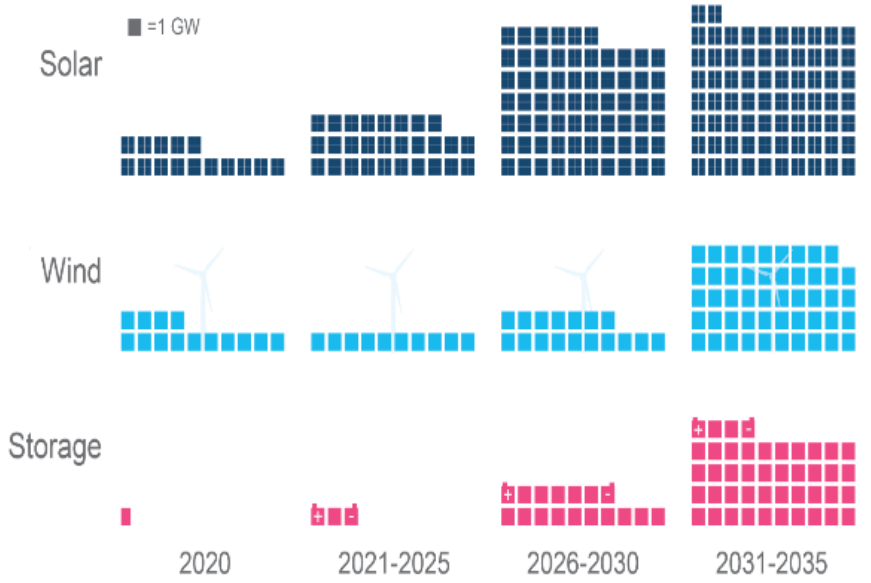
Optimize grid infrastructure & mgmt. to a renewable energy-led system, through

Support U.S. manufacturing and secure supply chains

Ensure renewable energy technologies benefit workers and communities

Solar Energy Goals

- **Rapid deployment:**
  - Our goal is to install an average of 30 GW of solar capacity per year between now and 2025 and 60 GW per year from 2025-2030.
- **Reduce costs:**
  - We're investing in research with a goal to cut the cost of utility solar by 60%. This would make utility-scale solar the least expensive option for new electricity generation everywhere in the United States.
- **Accelerate solar job growth:**
  - We are working to provide workforce training and grow our manufacturing. We have set a goal of at least 300,000 diverse solar employees and 1 GW per year of new U.S. PV manufacturing capacity installed.
- **Prioritize energy and environmental justice:**
  - We're especially focused on removing barriers to equitable solar access and supporting a diverse and inclusive workforce. We've set a goal of goal for 100% of U.S. energy consumers to be able to choose residential or community solar that does not increase their electricity cost.



Historical vs. projected **annual** technology deployment rates under the Decarb+E scenario in the Solar Futures Study

Benefits and Goals of Offshore Wind Development

- The U.S. has set a goal to deploy 30 GW of offshore wind by 2030 and unlocking more than 110 GW of deployment by 2050.
- There is over 2 TW of offshore wind technical resource potential, including the nation's premier wind speeds to deliver energy directly to coastal load centers.
- Offshore wind energy can complement other renewables to meet daily power demand cycles.
- U.S. manufacturing and marine sectors revitalization with annual investments of more than $12B in project capital investments and employment opportunities for more than 44,000 workers by 2030 and 77,000 workers by 2050.

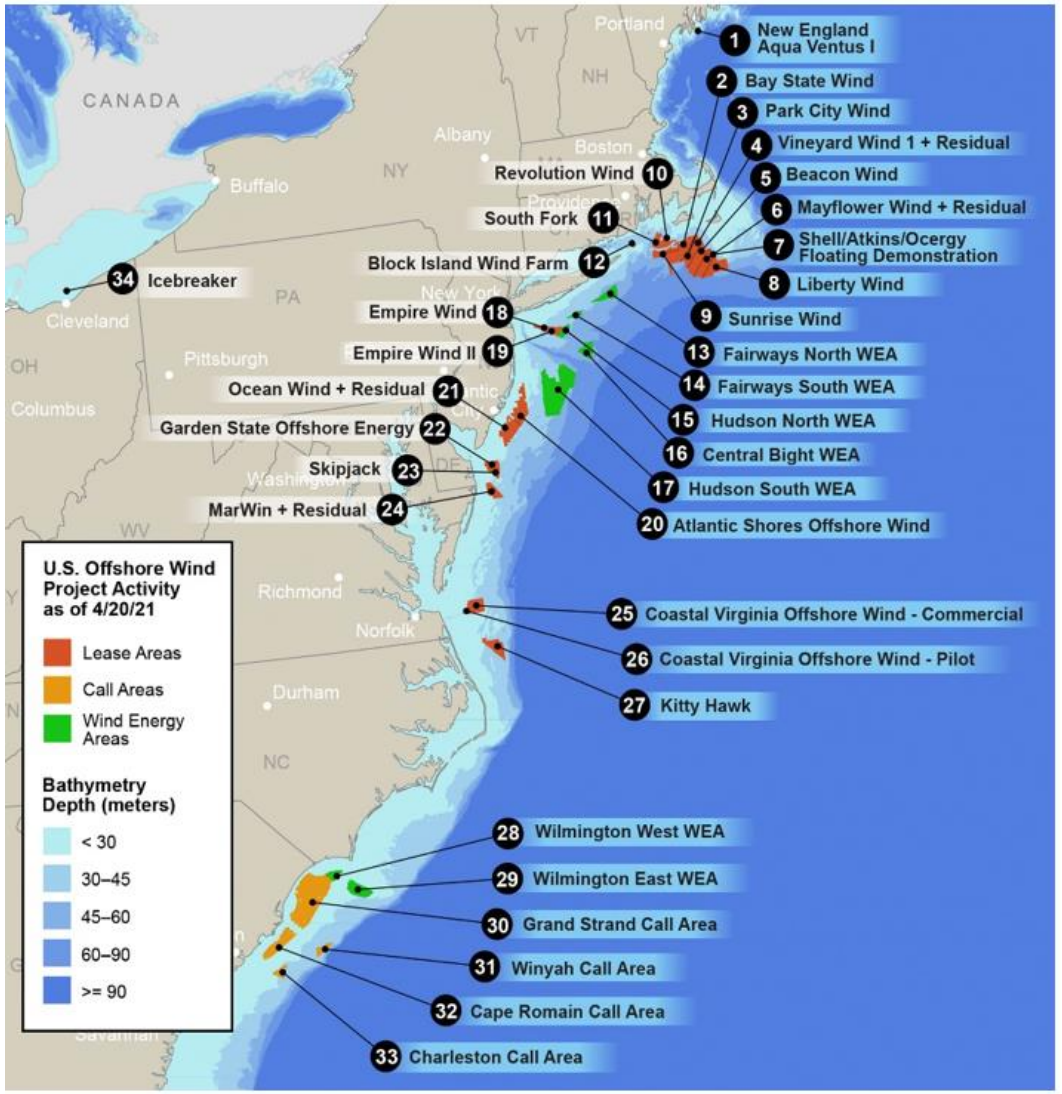
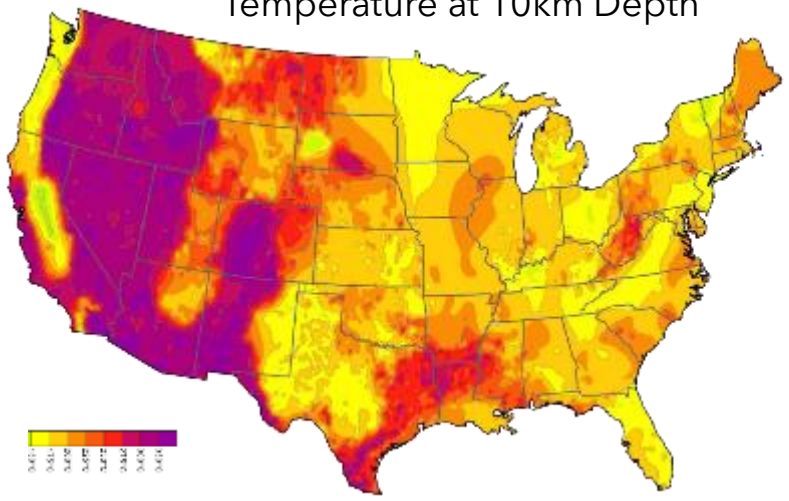


Image source: NREL (2021, 2016)

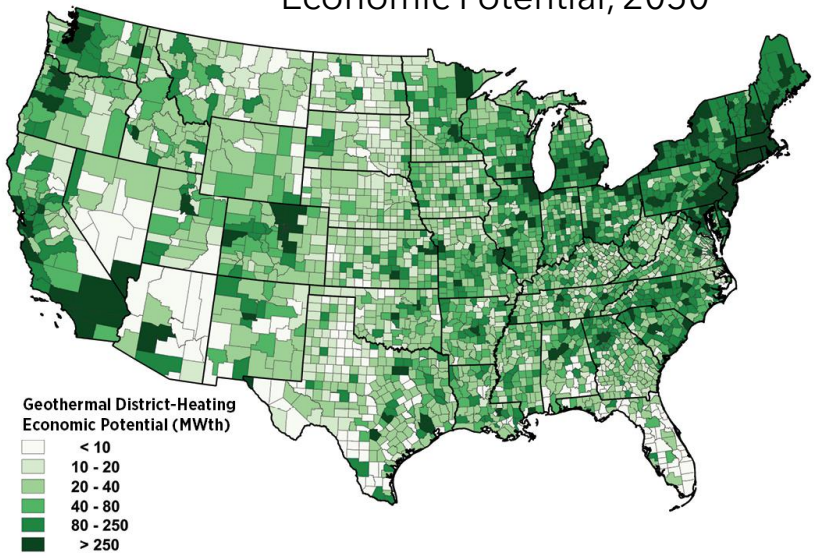
Geothermal Energy Goals

- **Topline Goals**
  - Drive toward a carbon-free electricity grid by supplying 60 GW of Enhanced Geothermal Systems and hydrothermal resource deployment by 2050.
    - This would be 8% of U.S. power generation
  - Decarbonize building heating and cooling loads through installing 17,500 geothermal district heating systems and 28 million geothermal heat pumps nationwide by 2050.
- **Current Project Goals**
  - Make Enhanced Geothermal Systems (EGS) a commercially viable electricity generation option for the U.S.
  - Discover and develop geothermal resources with no surface expression.
  - Develop economically effective direct lithium extraction technologies from geothermal brines.

Temperature at 10km Depth



Geothermal District Heating Economic Potential, 2050



Renewable Resources Must be Part of a Reliable and Resilient Grid

In order to support economy-wide needs, the electricity system must be designed and operated to ensure:

Renewable Energy Integration: reliable operation with high-levels of variable, power electronics-based generation

Grid Infrastructure Expansion: new infrastructure to deliver electricity across distance and enable system-wide flexibility

Widespread Electrification: the rapid accommodation of major new sources of demand from transportation and industry

Resilience and Security: continued operation in the face of emerging threats, and fast recovery and limited losses from outages

- Full Economy Decarbonization
- Modern, Affordable Infrastructure
- Climate Adaptation and Resilience
- Equity and Environmental Justice

Siting, Permitting and Land Use Challenges

- Our renewable energy goals will require using a lot of land:
  - Solar energy may require over 16,000 mi^2 (41,000 km^2) by 2050
    (Source: Solar Futures Study)
  - Land-based wind may require between over 200,000 mi^2 (over 500,000 km^2)
    (Source: Princeton New-Zero America study)
- This land use means it may cause environmental and economic impacts, land use conflicts, and the potential for local opposition.
- To build large-utility solar and wind infrastructure we must go through Federal and state siting and permitting

Large solar farm in Texas

DOE support can include →

- Providing Data and Analysis
- Empowering Communities in the Process
- Research to Reduce Wildlife Impacts
- Behavioral Science Research
- Maximizing Benefits with Innovative Siting Strategies
- Expanding Clean Energy on Public Lands

Infrastructure Investment and Jobs Act

Key pieces include:

- The largest investment in clean energy transmission and the grid in American history, with a focus on upgrading aging infrastructure and building resilience
- Significant funding for clean energy demonstrations and research hubs, especially in rural areas and economically hard-hit communities
- R&D into battery supply chains
- Funds to boost low-income energy efficiency and advance renewable energy research and development

Thank you!

Distributed Solar Energy Can Play a Key Role

Potential and benefits

- 1/3 of solar energy in the United States is produced by small-scale solar, such as rooftop installations
- The national technical potential of rooftop PV is 1,118 (GW)
- Distributed solar boosts can combine with battery storage and microgrids to boost resilience when extreme weather and other disruptions occur.

Projects include:

- SolarAPP, a tool to advance safe and affordable home solar through permitting automation.
- Increasing solar access for people who can't put solar on their own roofs through the National Community Solar Partnership.
- SolSmart, a program that recognizes communities that have taken key steps to address local barriers to solar energy.

SolarAPP

Major Barriers to Offshore Wind Energy Deployment

- **Higher costs compared to established energy generation sources**
  - Costs associated with design, skills, and equipment for ocean deployments
  - We have a goal to cut costs by 40-50% by 2030
- **Nascent industry with immature supply chain**
  - Relatively early-stage industry, particularly floating systems
  - Need to design for US-based mass manufacturing
  - Technology challenges associated with deploying floating offshore wind in deep waters
  - Lack of suitable port infrastructure and specialized construction vessels
- **Uncertainty in the project pipeline**
  - Long-term certainty is needed to attract the hundreds of billions of dollars in investment needed to sustain the industry
- **Historically complex siting and permitting processes**
  - Concerns around fishing, recreation, tourism, military missions and radar, and environmental impacts to marine species and habitats
- **Limited capacity of the existing grid infrastructure**
  - Requires transmission lines to reach these platforms

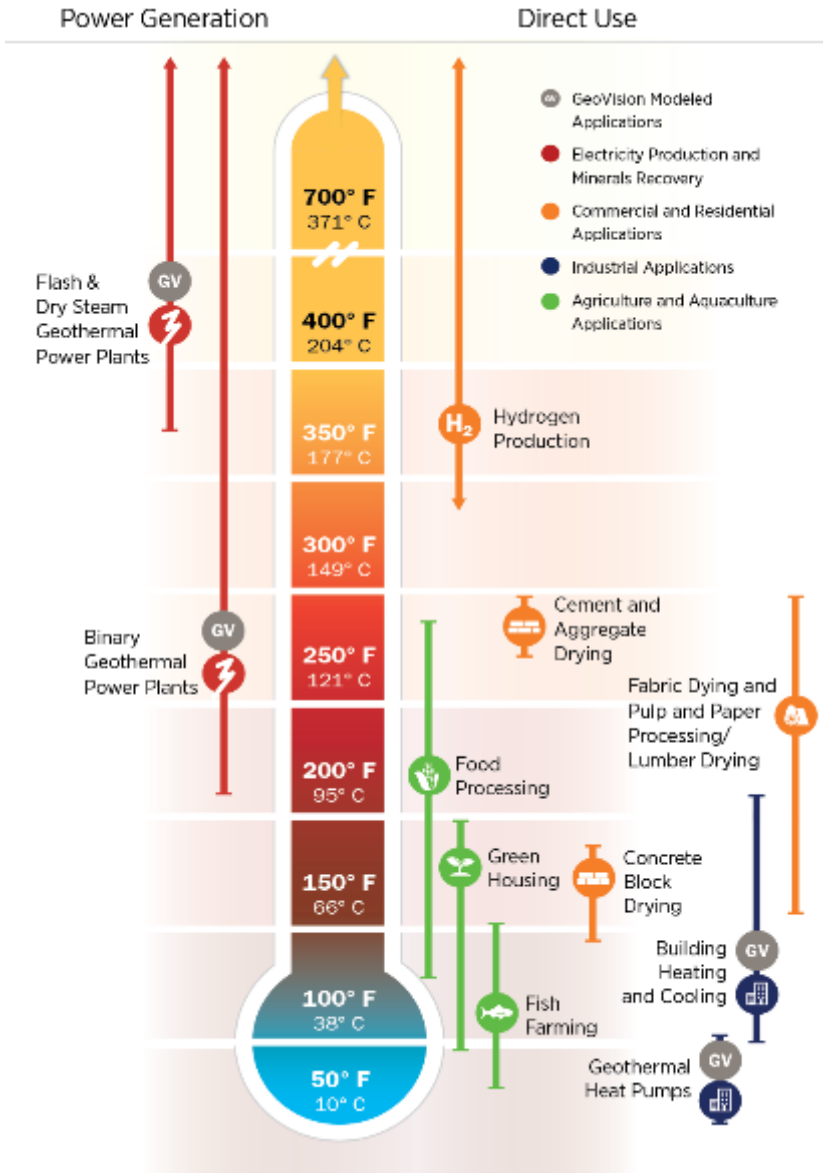
Benefits and Challenges of Geothermal Energy

Benefits:

- It is a clean source of energy that is very dependable and always available. This makes optimal for baseload energy to the power grid.
- Geothermal has the potential to reduce emissions equivalent to taking 26 million cars off the road for a year. Most of this potential is untapped.
- It can be used for power production, heating and cooling homes and communities, as well as energy storage.
- Geothermal has a physical footprint far smaller than other energy sources.

Challenges:

- Drilling costs are high – wells can cost $10-15 million or more
- It's challenging to identify and quantify a "hidden" resources
- Permitting often requires multiple reviews
- Understanding of the subsurface is still developing, including how to develop technology to create permeability where we need it and keep fractures open.
- We need education to help communities know about and understand the geothermal potential in their areas.



Example of Projects to Address Siting and Land Use Challenges

- **Providing Data and Analysis:**
  - We're conducting data collection and creating and updating resource maps and models to determine the potential for renewable energy resources, including where they overlap with other land uses, for use by planners, developers, and other stakeholders.
- **Empowering Communities in the Process:**
  - We're working to increase community readiness for clean energy development, including by hosting workshops to better understand and raise important community priorities and equity concerns, running pilots, and providing trainings for local officials on resources.
- **Research to Reduce Wildlife Impacts:**
  - We're funding research and impact mitigation tools focused on better understanding and reducing impacts to natural ecosystems.
- **Behavioral Science Research:**
  - We're using research, workshops, polling, to better understand the drivers of public opinion on development; including on around property values and community identity, support for combining land uses, and understanding knowledge flow of local zoning officials.
- **Maximizing Benefits with Innovative Siting Strategies:**
  - We're researching the potential for new ways to site renewables and co-existence with other land/ocean uses to mitigate impacts and increase benefits, including co-location with pollinators, grazing, and crops at commercial farms, floating photovoltaics, and the ability to return economic activity to areas in need including on former mine lands.
- **Expanding Clean Energy on Public Lands:**
  - As 40% of US land is public land, we're encouraging development and reducing barriers to building renewable energy on in these areas.