



U.S. DEPARTMENT OF
ENERGY

Office of the
**UNDER SECRETARY
FOR SCIENCE & INNOVATION**

Energy Earthshots™ Initiative

Advanced Scientific Computing Advisory
Committee Meeting

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9/28/2023



Energy Earthshots™: Call to Action



“...I’ve asked the Secretary of Energy...to speed the development of critical technologies to tackle the climate crisis. No single technology is the answer on its own because every sector requires innovation to meet this moment.”

President Joseph R. Biden
April 23, 2021



"Over the coming weeks...DOE will be announcing new goals for bold, achievable leaps in next-generation technologies—

This is our generation’s Moonshot.”

Secretary Jennifer M. Granholm
April 23, 2021



Energy Earthshots™: Necessary and Urgent

Energy Earthshots target the remaining, major RD&D breakthroughs *we know we must achieve* in the next decade to solve the climate crisis and reach our 2050 net-zero carbon goals.

- Make a major impact to **reduce emissions**
- Address the **hardest technology barriers**
- Set highly **ambitious decadal targets**
- Are **compelling, bold, and inspirational**
- Significantly **engage stakeholders**



Energy Earthshot™ Framework

MISSION

Ambitious

Bold and aspirational at the scale of 2030 and 2050 necessity

Technology focused

Establishes cost, performance or other target in a specific DOE tech space

Purposeful

Singularly focused on reducing emissions at scale and foundational to U.S. clean energy agenda

Leading the way

Places DOE and U.S. as central thought leader of global clean energy trajectory

STRATEGIC ALIGNMENT

Resources aligned

Coordinated DOE budget requests

Informed with strategic planning

Science to applied energy near- and long-term RDD&D vision, analysis and periodic reassessments

Stakeholders engaged

Engages stakeholders from universities, national labs, industry throughout each stage

IMPLEMENTATION

Clearly-communicated

Clear, compelling, highly-visible core message tied to DOE innovation story

Measurable progress

Innovation progress evaluated against benchmark targets

Jobs, economic, and energy justice

Impact assessments on opportunity for job creation, equity, and domestic economy

Decisive

Allows DOE to become more risk tolerant, streamlined, and prioritized around achieving targets

Energy Earthshot™ Portfolio

Generation & Grid



Floating Offshore Wind S

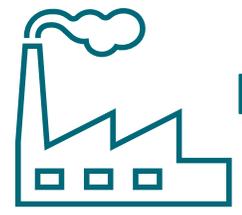


Enhanced Geothermal



Long Duration Storage

Industry

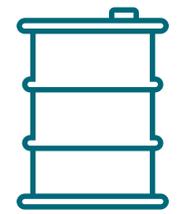


Industrial Heat



Hydrogen

Transportation



Clean Fuels & Products



Carbon Negative

Achieving the Energy Earthshot™ can save \$850 billion and avoid ~3.9 Gt CO₂

Independent analysis by Third Way for the Cumulative and Combined Impacts (2021-2050)

Announced June 2021- September 2023



Hydrogen, Long Duration Storage, Carbon Negative

Hydrogen Shot™ seeks to reduce the cost of clean hydrogen by 80% to \$1 per 1 kilogram in 1 decade (“1 1 1”).

Long Duration Storage Shot™ seeks to reduce the cost of grid-scale energy storage by 90% for systems that deliver 10+ hours of duration within the decade.

The **Carbon Negative Shot™** target is durable and scalable CO₂ removal under \$100/net metric ton CO₂e within a decade.

Enhanced Geothermal, Floating Offshore Wind, Industrial Heat, and Clean Fuels & Products

Enhanced Geothermal Shot™ seeks to reduce the cost of EGS by 90%, to \$45 per megawatt-hour (MWh) by 2035.

Floating Offshore Wind Shot™ seeks to reduce the cost of floating offshore wind in deep waters by more than 70%, to \$45 per megawatt-hour by 2035.

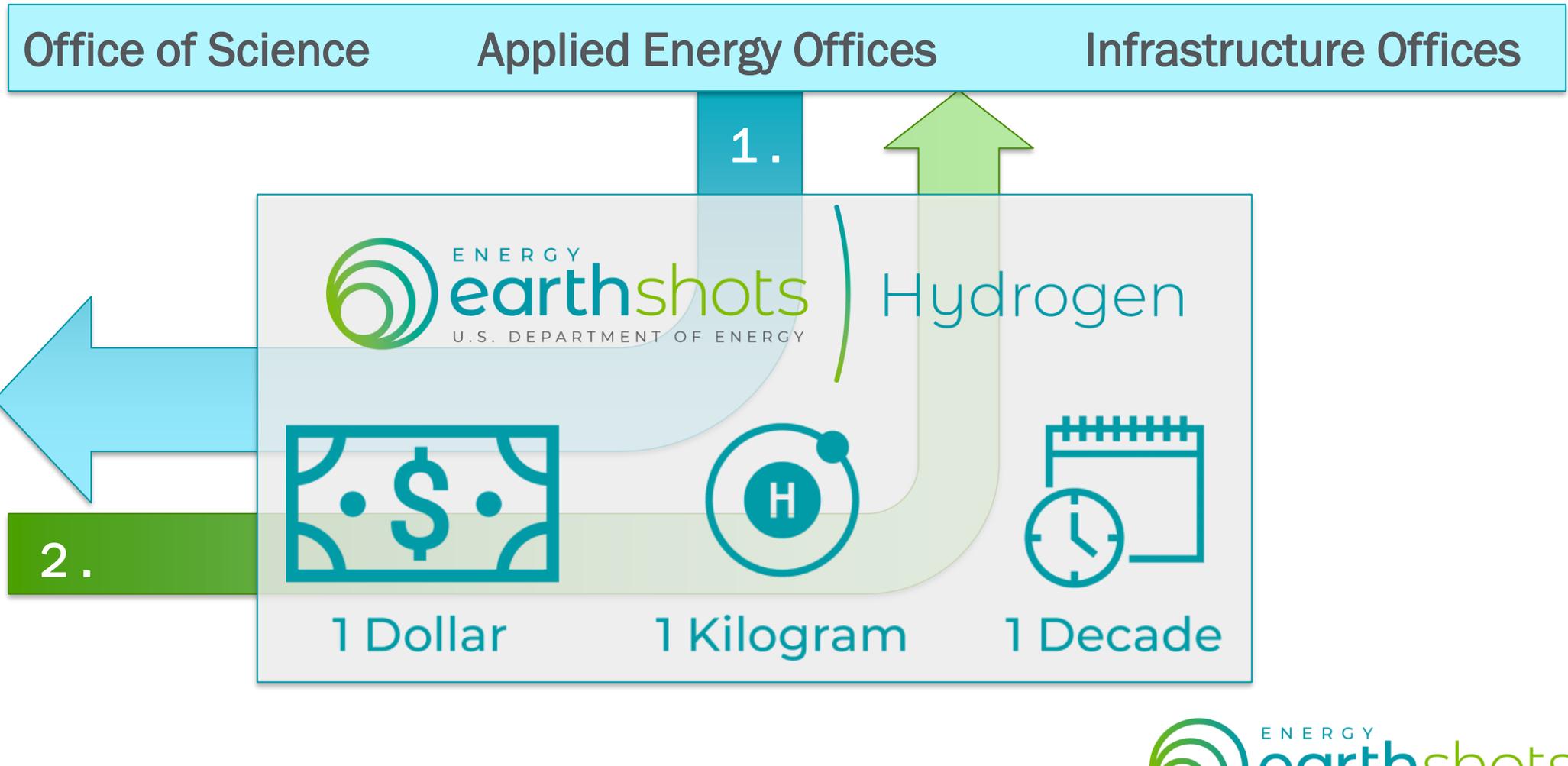
Industrial Heat Shot™ seeks to develop cost competitive industrial heat decarbonization technologies with at least 85% lower greenhouse gas emissions by 2035.

Clean Fuels & Products Shot™ aims to develop cost-effective fuels and products from sustainable carbon sources to achieve 85% lower net GHG emissions by 2035



Strategic Alignment: Feedback loop

1. An Energy Earthshot focuses “All-hands” attention on a singular target
2. Scientific and strategic learnings, guides “All-hands”



Strategic Alignment: What “All-Hands” looks like from the street



1 Dollar



1 Kilogram



1 Decade

Snapshot of work
June 21- Sept 23



Resources aligned

Energy Earthshot Research Centers

BIL: Clean Hydrogen Electrolysis, Manufacturing, and Recycling

BIL: Regional Clean Hydrogen Hubs

Informed with strategic planning



BES Roundtable Foundational Science for Carbon-Neutral Hydrogen Technologies

DOE Clean Hydrogen Strategy and Roadmap

Pathways to Commercial Liftoff: Clean Hydrogen

Stakeholders engaged



PI Meetings

Hydrogen from Next-generation Electrolyzers of Water Workshop



H2 Matchmaker



Decisive & Creative: Hydrogen Shot Fellowship



ASCR's hands in the Energy Earthshots™

- Existing projects and fundamental research (e.g. computational science for climate modeling, subsurface flows, wind energy, etc.)
- FY23 enacted budget and [FY24 budget request](#)
- In FY23, participating in SC wide Energy Earthshot activities (ASCR, BER, BES):
 - Energy Earthshot Research Center (EERC) Lab Call
 - Science Foundations for Energy Earthshots FOA

Reduce the cost of enhanced geothermal system electricity to \$45/MWh enabling 40 Gigawatts deployed by 2035

EGS Science and Technology Challenges

DEEP

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



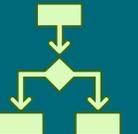
EXTREME

Hot, hard,
abrasive rock,
corrosive
conditions



UNKNOWN

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



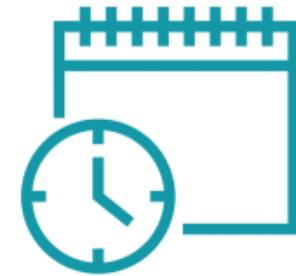


Floating
Offshore Wind™

Reduce the cost of floating offshore wind in deep waters by more than 70%, to \$45 per megawatt-hour by 2035.



>70% Reduction



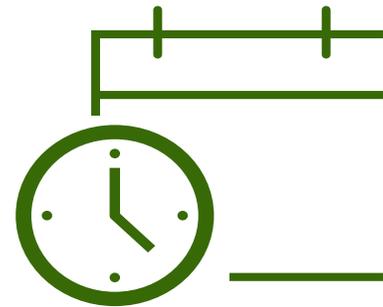
2035



Develop cost-effective fuels and products from sustainable carbon sources to achieve >85% lower net GHG emissions by 2035

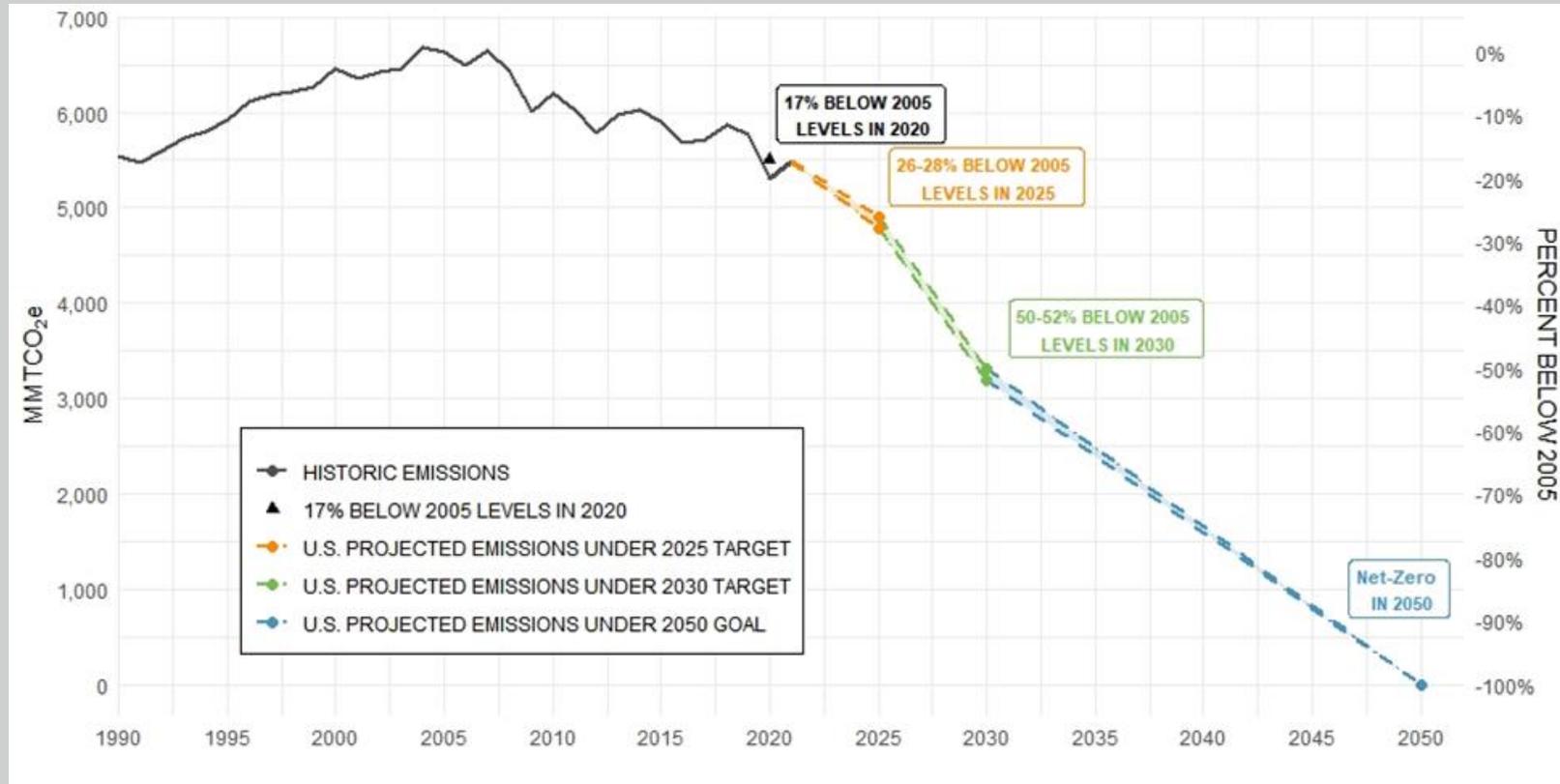


>85% net reduction
vs. fossil-based sources



2035

The challenge is great, *and achievable*



The Long-Term Strategy of the United States, Pathways to Net-Zero Greenhouse Gas Emissions by 2050

The challenge requires *All-Hands-On-Deck* from *fearless innovators*

“We need *fearless innovation* to bring down the costs of batteries, to commercialize carbon capture, to make blue and green hydrogen market ready, and perhaps most of all, we need a mindset that overcomes resistance to change. Many are stuck on the status quo,”

Secretary Jennifer M. Granholm

[President Biden’s Leader Summit on Climate, “Unleashing Climate Innovation”
Session,](#)

April 23, 2021

What are the opportunity spaces for ASCR in the Energy Earthshots™?



Thank you.