

Overview of the Industrial Efficiency and Decarbonization Office

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Director

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Building a Net-zero, Clean Energy Future

The U.S. industrial sector (manufacturing, agriculture, mining, and construction) accounts for:

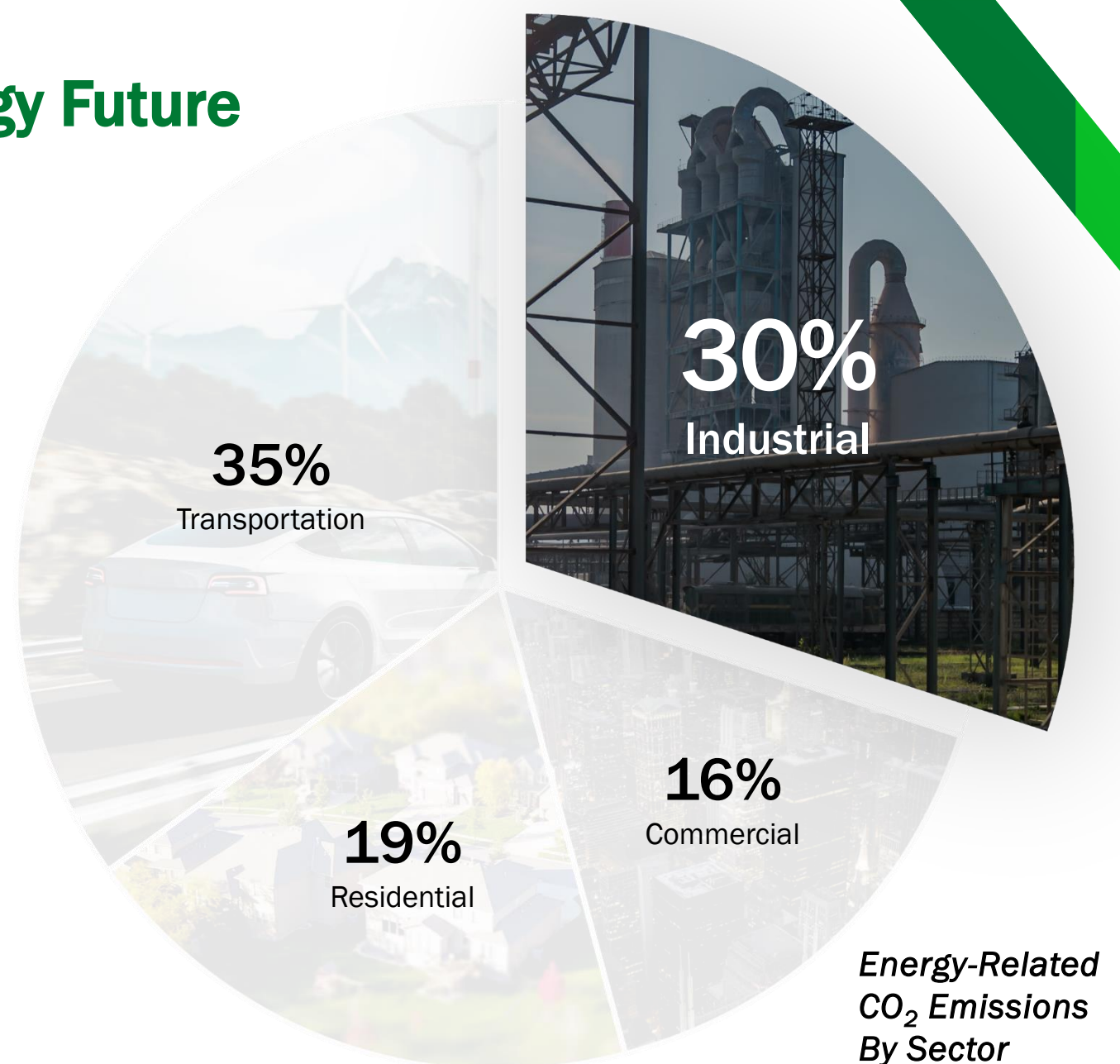
33% of the nation's primary energy use

30% of CO₂ emissions

Anticipated industrial sector energy demand growth of 30% by 2050 may result in a:

17% CO₂ emissions increase*

*EIA, Annual Energy Outlook 2021 with Projections to 2050.



Decarbonizing Industry is an Opportunity for America's Economy

U.S. manufacturing
subsector...



CONTRIBUTES

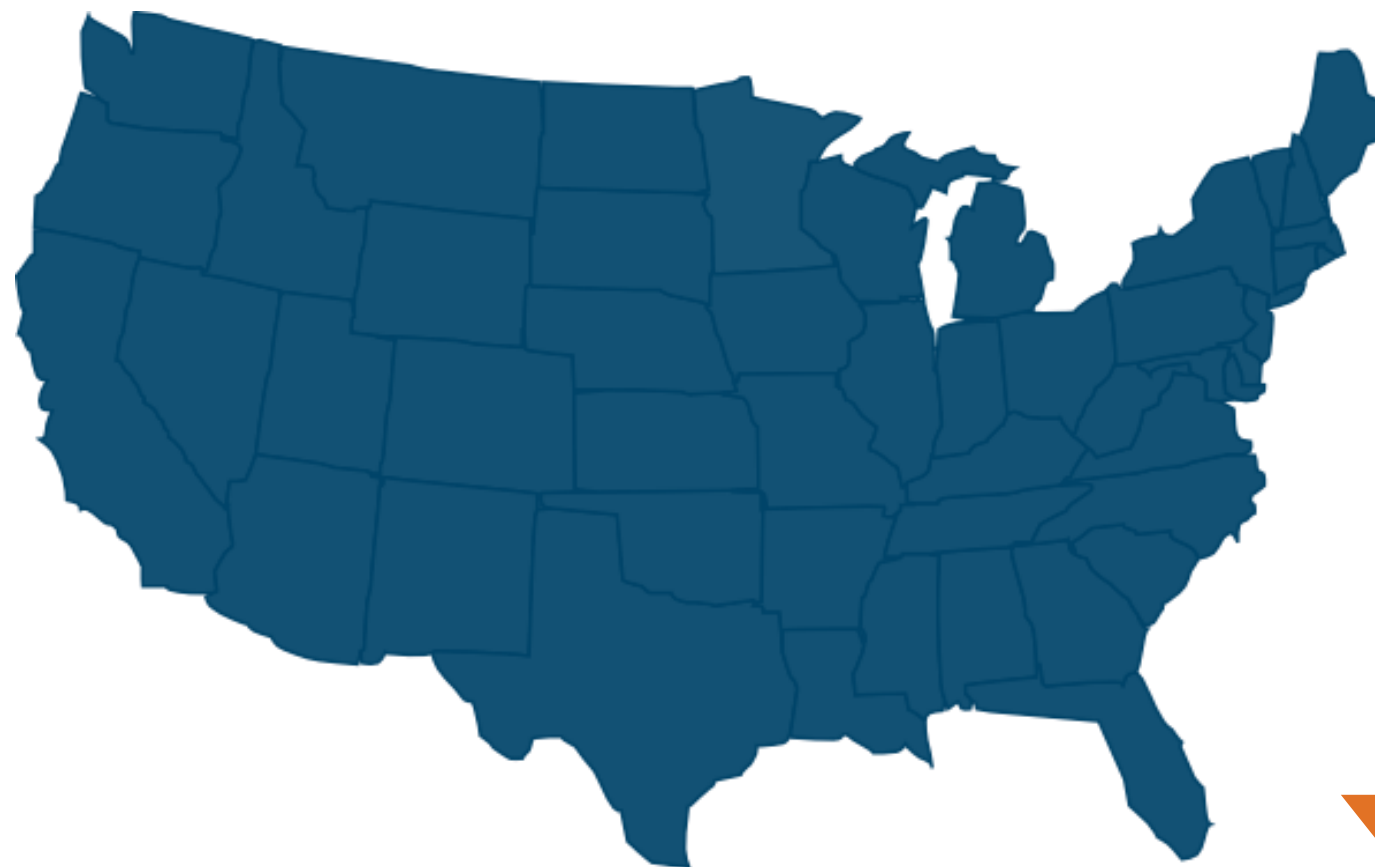
\$2.35 trillion to
the U.S. Economy

GENERATES

11% of U.S. GDP

CREATES

11.4 million jobs



While working to
DECREASE
CO₂ emissions



Systemic barriers to industrial decarbonization

Investment scale → In the range of

\$700 Billion –

1.1 Trillion

just for 8 industrial sector of focus in the IRA :



Chemicals



Refining



Iron &
Steel



Food &
Beverage



Cement



Pulp &
Paper



Aluminum



Glass

Estimated that

60%

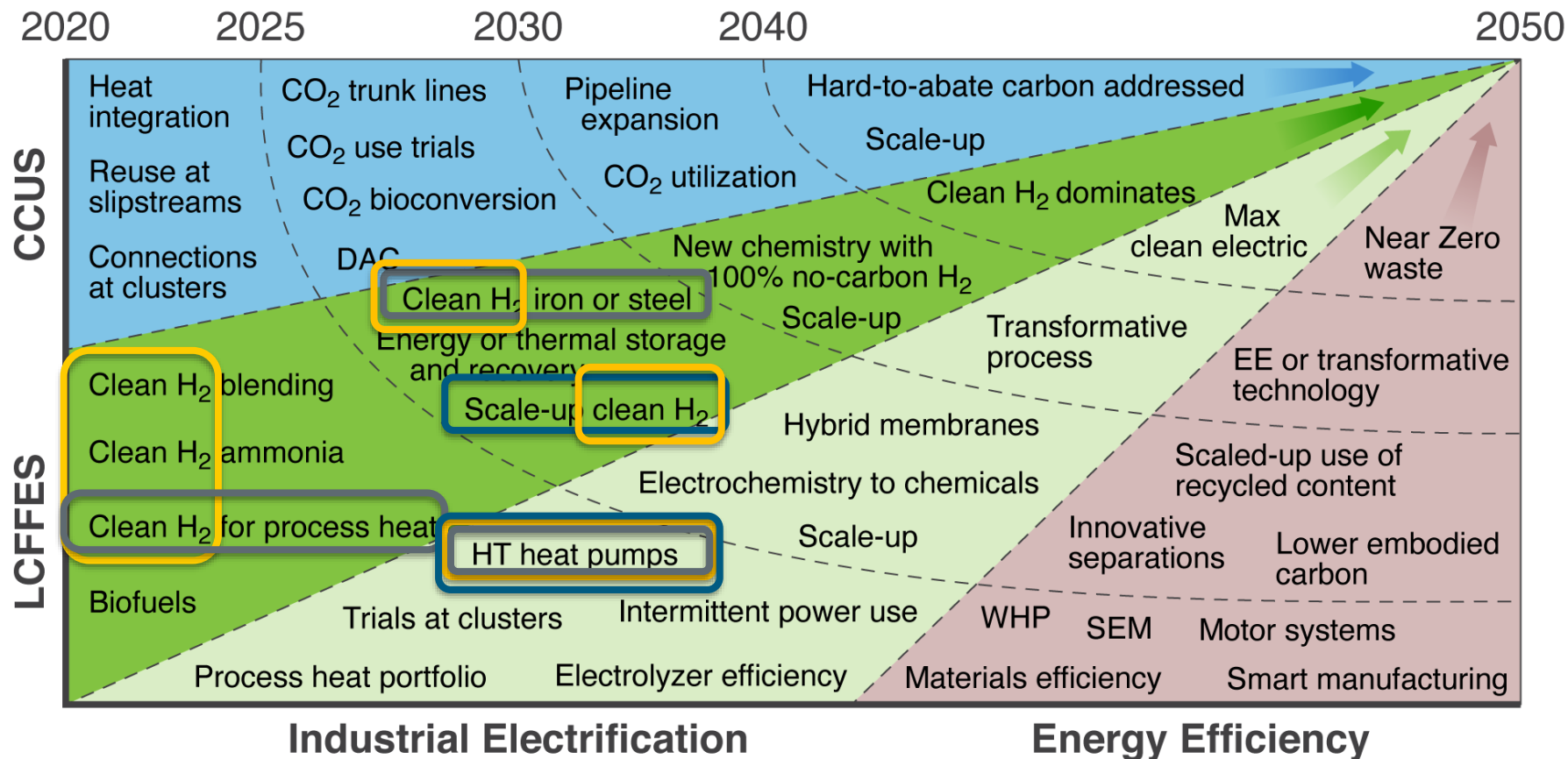


by 2030 will come from technologies that are not net-positive decarbonization levers with existing IRA tax credits or require further R&D to address

Targeted investment for research, development, and pilot-scale demonstrations is a need and opportunity for U.S. manufacturing

Source: DOE Pathways to Commercial Liftoff; Industrial Decarbonization https://liftoff.energy.gov/wp-content/uploads/2023/10/LIFTOFF_DOE_Industrial-Decarbonization_v8.pdf

Landscape of Needed RD&D Investment



Industrial GHGs require approaches at multiple levels:

Core process

Facility

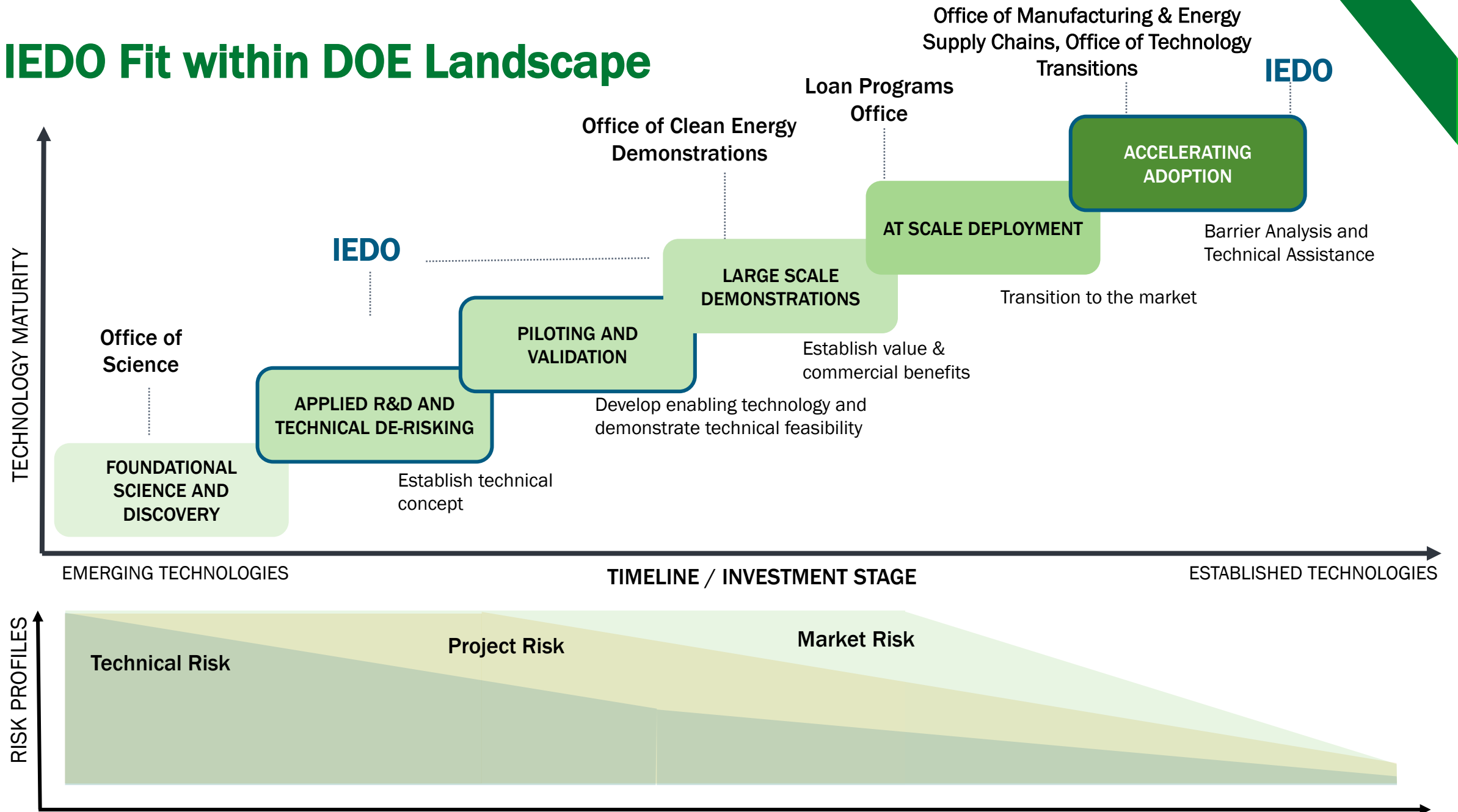
Beyond plant bounds

Landscape of major RD&D investment opportunities for industrial decarbonization between now and 2050.

LCFFES = Low Cost Fuels, Feedstocks, and Energy Sources; CCUS = Carbon Capture Utilization and Storage

Source: [Industrial Decarbonization Roadmap](#)

IEDO Fit within DOE Landscape



Industrial Efficiency and Decarbonization Office (IEDO)



Energy- and Emissions-
Intensive Industries

FY23 = \$131M



Dr. Paul Majsztik



Cross-sector Technologies

FY23 = \$90.5M



Isaac Chan



Technical Assistance
and Workforce Development

FY23 = \$45M



Anne Hampson

\$266.5
Million FY23 Budget



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Director



Anne Hampson
Acting Deputy Director



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Chief Engineer



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Operations Supervisor

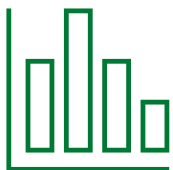


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Energy, Environmental, and Economic Justice (EEEJ) Focus



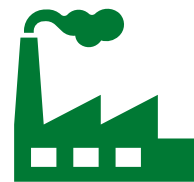
Assess industry's impact on energy justice and energy equity
Establish baseline **metrics** to determine progress goals



Engage with and involve **stakeholders** in decision making
Expanding **accessibility** to industrial assistance programs for Disadvantaged Communities (DACs)



Identifying **equity**-related barriers and high-priority groups that may benefit from decarbonization technologies
Leverage **Community Benefits Plan** (CBP) to select projects that advance EEEJ and DEIA goals

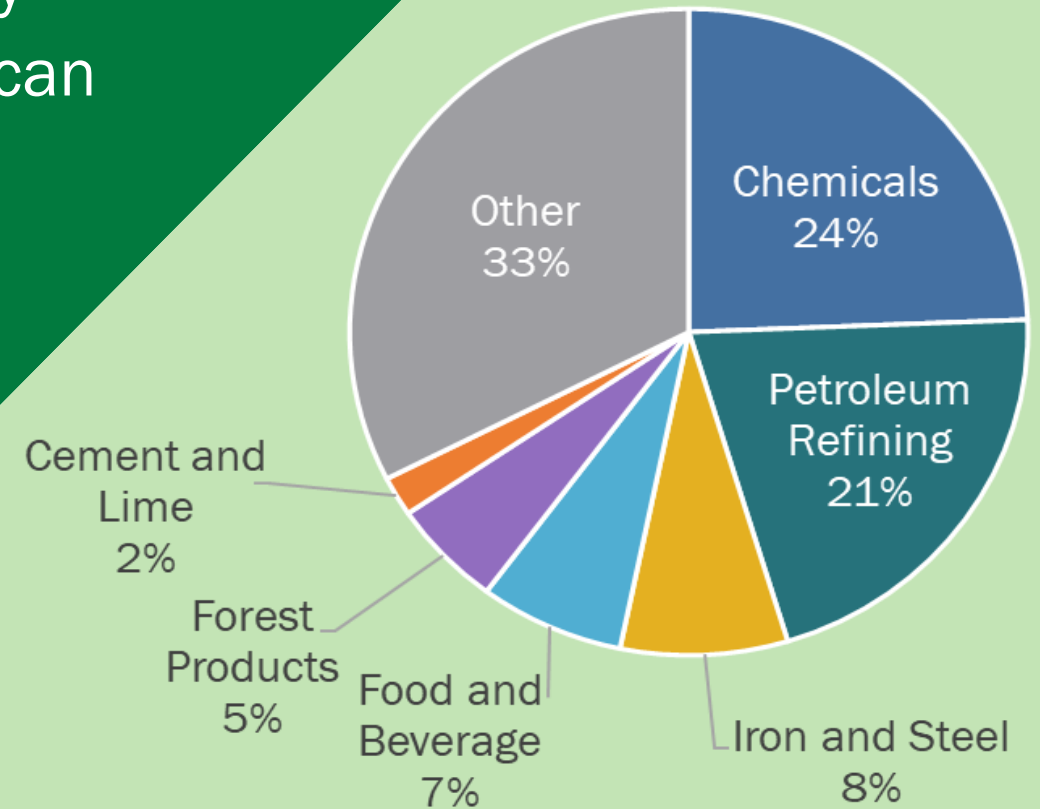


Develop **alternatives** to on-site combustion of fossil fuels
Accelerate the adoption of alternative feedstocks with **lower life-cycle environmental impact**

IEDO is committed to an equitable implementation of industrial decarbonization technologies

IEDO's Research & Development Strategy

IEDO invests in both **sector-specific** technology solutions and **cross-cutting** technologies that can be applied across the industrial sector.



U.S. Manufacturing Energy-related CO₂ Emissions by Sector, 2020: 1124 MMT CO₂. Source: 2021 EIA AEO

Energy- and Emission-Intensive Industries



IRON & STEEL
1,469 TBtu
100 MMT CO₂e



CHEMICALS
(including production of low-carbon fuels)
4,842 Tbtu
332 MMT CO₂e



FOOD & BEVERAGE
1,935 TBtu
96 MMT CO₂e



FOREST PRODUCTS
2,883 TBtu
80 MMT CO₂e



CEMENT & CONCRETE
367 TBtu
66 MMT CO₂e



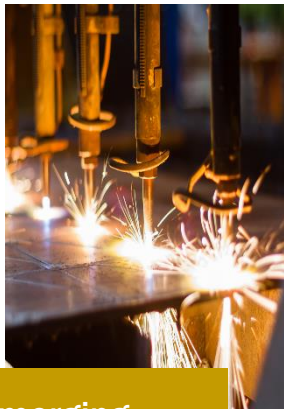
Cross-Sector Technologies



Thermal Processes
& Systems



Low-Carbon Fuels,
Feedstocks, &
Energy Sources



Emerging
Efficiency



Water & Wastewater
Treatment

IEDO Funded Projects

FY22 Industrial Efficiency and Decarbonization:

- **\$135M** for 40 projects to decarbonize the five highest-emitting industrial subsectors (projects in progress).

FY23 IEDO Multi-Topic:

- **\$171M** for 49 projects to advance high-impact applied RD&D projects to decarbonize the U.S. industrial sector. Includes sector-specific and cross-sector approaches (projects selected Jan. 25th).

Decarbonization of Water Resource Recovery Facilities:

- **\$27.8M** for 10 projects to decarbonize the entire life cycle of Water Resource Recovery Facilities (projects in progress).



2023 IEDO Multi-Topic FOA Selections

\$171M for 49 projects across 21 states; 16 will be led by private industry, 22 by academic institutions, 3 by non-profit organizations, and 8 by DOE National Laboratories

- Decarbonizing Industrial Heat (10 projects, \$25.3 million)
- Low-Carbon Fuels Utilization R&D (6 projects, \$20.7 million)
- Exploratory Cross-Sector R&D (5 projects, \$14 million)
- Decarbonizing Chemicals (6 projects, \$30.5 million)
- Decarbonizing Iron and Steel (7 projects, \$37 million)
- Decarbonizing Food and Beverage Manufacturing (5 projects, \$11.1 million)
- Decarbonizing Cement and Concrete (5 projects, \$20 million)
- Decarbonizing Forest Products (5 projects, \$12 million)

www.energy.gov/eere/iedo/funding-selections-fy23-industrial-efficiency-and-decarbonization-multi-topic-foa

JUST ANNOUNCED : New EEl and CST Funding Opportunities

FY24 Cross-Sector Technologies FOA:

- **\$38M** to accelerate the innovative, cross-sector technologies required to decarbonize industry.

FY24 Energy- and Emissions-Intensive Industries

- **\$83M** to focus on applied RD&D for the highest GHG-emitting industrial subsectors, specifically: chemicals and fuels; iron and steel; food and beverage; building and infrastructure materials (including cement and concrete, asphalt pavements, and glass); and forest products.



Arizona State University to Lead New DOE Institute Focused on Electrifying Process Heat

- The Electrified Processes for Industry without Carbon (**EPIXC**) Institute is DOE's 7th Clean Energy Manufacturing Innovation Institute.
- EPIXC will:
 - Allocate up to **\$70M** in federal funding over the next 5 years to fund RD&D projects to electrify process heating.
 - Mobilize a multisector coalition of private companies, National Labs, universities, labor unions, and community partners to create an innovation ecosystem.
 - Bridge the gap between research and commercialization to move novel electrification processes out of the lab and into the market.



ELECTRIFIED PROCESSES FOR
INDUSTRY WITHOUT CARBON



Chemicals and Refining Priorities

Crosscutting



- Carbon capture integration



- Low-carbon fuels
- Low-carbon & electrified process heating



- Waste heat recovery

Sector-Specific



- Sustainable feedstocks (especially carbon)
- Electrochemical reactors
- High-efficiency thermal reactors
- Advanced separations
- Material reuse

Rapid Advancement in Process Intensification Deployment (RAPID)

- A 5-year, \$40 million investment to drive RD&D of advanced process technologies to enable **more resilient, lower cost, and reduced energy and carbon footprint manufacturing** in the process industries.
- Includes the production of chemicals and fuels, which account for **more than a third** of all U.S. industrial emissions and energy consumption.
- RAPID's work will align with the **Clean Fuels & Products Shot**.



Iron and Steel Priorities

Crosscutting



- Low-carbon fuels and electrification for process heating, reheats



- Waste heat recovery

Sector-Specific



- Alternative reductants – hydrogen, ammonia for DRI/HBI; biomass for solid pig iron
- Molten ore processing – molten oxide electrolysis; hydrogen plasma direct smelting
- Carbon capture and storage on existing BF/BOF facilities

Cement and Concrete Priorities

Crosscutting



- Carbon capture from limestone decarbonation



- Electrification & low-carbon fuels



- Waste heat recovery

Sector-Specific



- Alternative binders and process routes to OPC
- Clinker substitutes
- CO₂ mineralization
- Alternative building materials

Food and Beverage Priorities

Crosscutting



- Low-carbon fuels or electrification for steam boilers

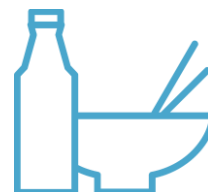


- Low-temperature waste heat recovery from process exhausts
- Smart/flexible manufacturing processes



- Drying and dewatering innovations
- Wastewater recovery and reuse

Sector-Specific



- Alternative protein products
- Waste management and reduction
- Innovative cooling, refrigeration, and freezing solutions

Forest Products Priorities

Crosscutting



- Carbon capture integration with boilers

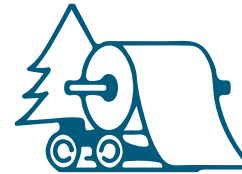


- Low-carbon fuels for lime kilns
- Low-carbon fuels or electrification for steam boilers



- Drying and dewatering innovations

Sector-Specific



- Increase biomass utilization
- Energy efficient separations for concentrating liquor
- Increase fiber yield of pulping
- Increasing solids content in paper forming

National Alliance for Water Innovation

- Energy-water desalination hub led by Lawrence Berkeley National Laboratory
- Focused on early-stage research on desalination and water-treatment technologies to secure affordable and energy efficient water supplies from nontraditional water sources
- Goal: **75% reduction in cost and energy** of desalination



IEDO Technical Assistance & Workforce Development



Public /private partnerships to help manufacturers and industrial organizations set and achieve long-term energy intensity reduction goals



Education and training for the current and future manufacturing workforce



No-cost tools and resources for manufacturers to reduce GHG emissions and improve energy efficiency and competitiveness



End-user support, stakeholder engagement, and technical services for the industrial sector

**TA WORK PRODUCTS
INCLUDE:**

**ENERGY
ASSESSMENTS**

**PEER-TO-PEER
NETWORKING**

**TOOLS &
TRAINING**

**TECHNOLOGY
SCREENING**

**PROJECT
PROFILES**

Better Plants & Better Climate Challenge

- As of 2021, industrial organizations can join the **Better Climate Challenge** and set portfolio-wide GHG emission reduction goals (50% reduction in Scopes 1 & 2, without offsets).
- Since 2011, through **Better Plants**, DOE has partnered with industrial organizations to set and achieve ambitious, long-term, portfolio-wide energy efficiency goals (25% improvement in energy intensity in 10 years).



Better Plants & Better Climate Challenge Impact

Resources

- **Framework for GHG Emissions Reduction Planning** – Guidance on developing detailed, actionable, and portfolio-wide plan to decarbonize an industrial portfolio.
- **Low Carbon Pilot Toolkit** – Tools, resources, and solutions developed over the two-year pilot.
- **Better Plants Energy Bootcamps** – A three-day crash course in industrial energy systems, energy management, and a primer on industrial decarbonization.



2.2 QBTU
of energy saved



\$10.6 billion
saved



1.8%
average annual
energy intensity
improvement rate



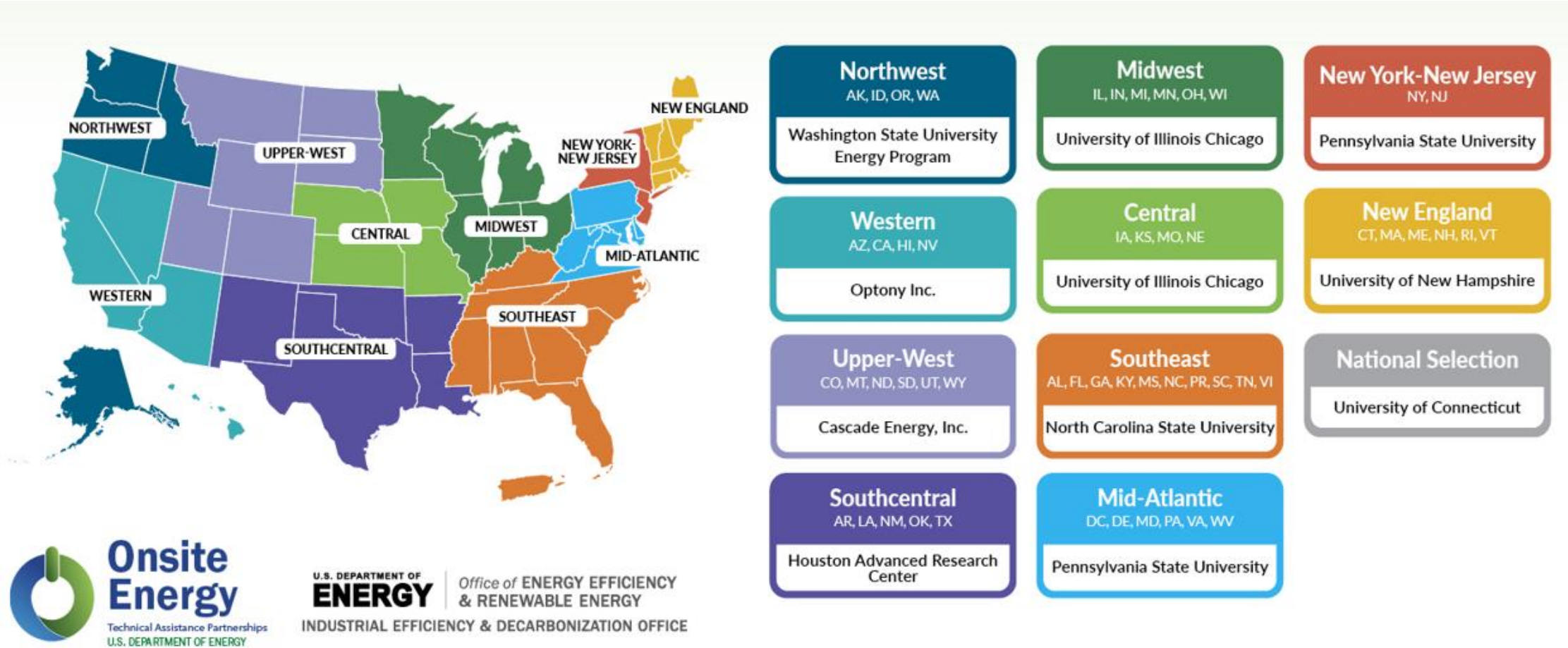
131 million
metric tons of CO₂ saved



14%
of the U.S.
manufacturing footprint

IEDO Onsite Energy Program

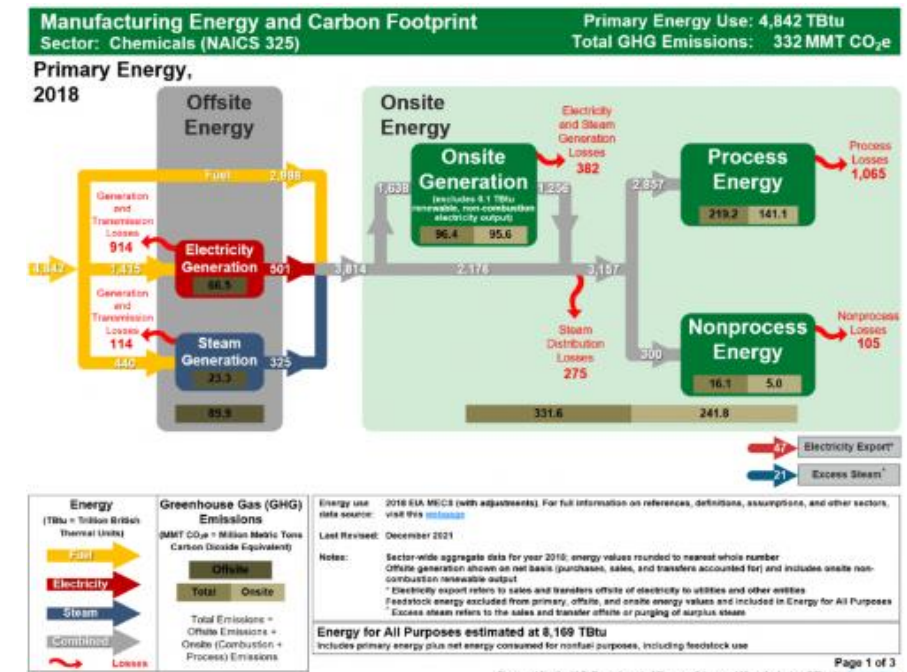
battery storage | combined heat and power | district energy | geothermal |
industrial heat pumps | renewable fuels | solar PV | solar thermal | thermal storage | wind



Strategic Analysis Tools & Resources

IEDO's manufacturing, materials, and lifecycle energy tools and resources use a cross-sector and prospective **life cycle assessment** (LCA) approach that anticipates future benefits and impacts.

- Environmentally Extended Input-output For Industrial Decarbonization Analysis (Eeio-ida) Tool
- Techno-economic Energy & Carbon Heuristic Tool For Early-state Technologies (Techtest) Tool
- Materials Flows Through Industry (Mfi) Tool
- Life Cycle Greenhouse Gas, Technology And Energy Through The Use Phase (Lightenup) Tool
- Plant Water Profiler Tool - Excel, Beta Version (Pwpex V0.1)
- Carbon Fiber Reinforced Plastic (Cfrp) Energy Estimator Tool
- Additive Manufacturing (Am) Energy Impacts Assessment Tool
- Manufacturing Energy and Carbon Footprints



<https://www.energy.gov/eere/iedo/energy-analysis-data-and-reports>

Thank You!

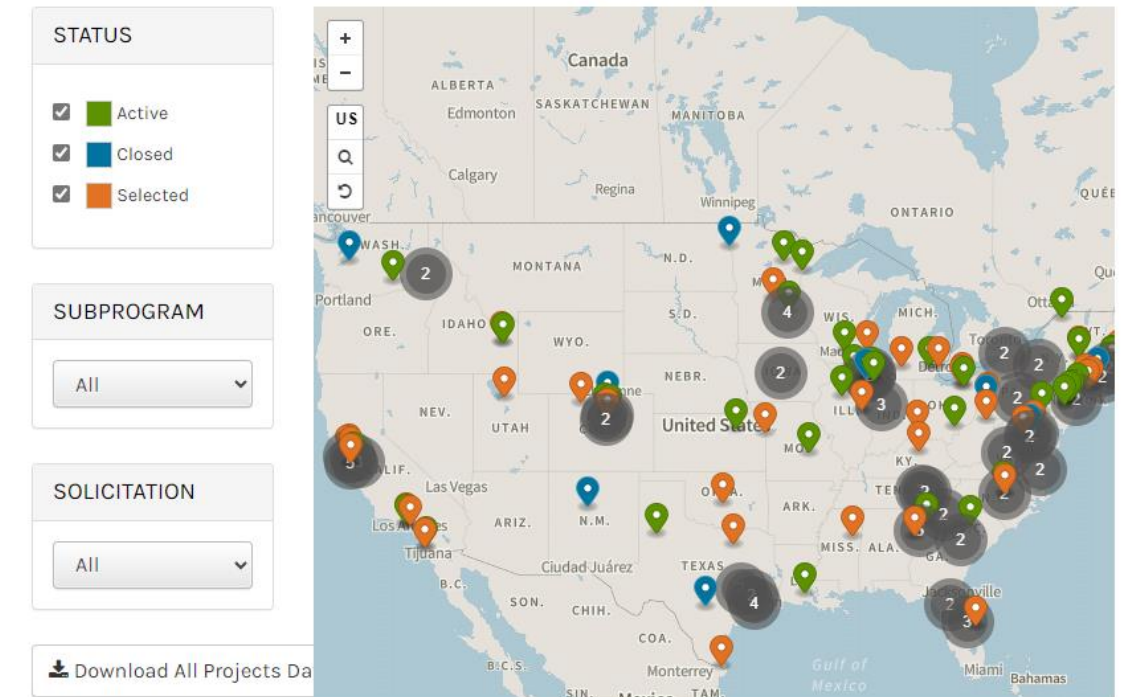
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IEDO Project Database



www.energy.gov/eere/iedo/iedo-project-database



IEDO Offsite 2024
March 12 - 14, 2024

