

U.S. DEPARTMENT OF  
**ENERGY**

Office of ENERGY EFFICIENCY  
& RENEWABLE ENERGY

INDUSTRIAL EFFICIENCY & DECARBONIZATION OFFICE



# Industrial Efficiency and Decarbonization Office (IEDO)

Dr. Avi Shultz, Deputy Director,  
Industrial Efficiency and Decarbonization Office

AMMTO/IEDO Peer Review

May 16, 2023



# Building a Net-zero, Clean Energy Future

To build a net-zero, clean energy future by 2050, we need to decarbonize the entire U.S. economy:

- ✓ Commercial
- ✓ Residential
- ✓ Transportation
- ✓ Industrial



# Building a Net-zero, Clean Energy Future

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

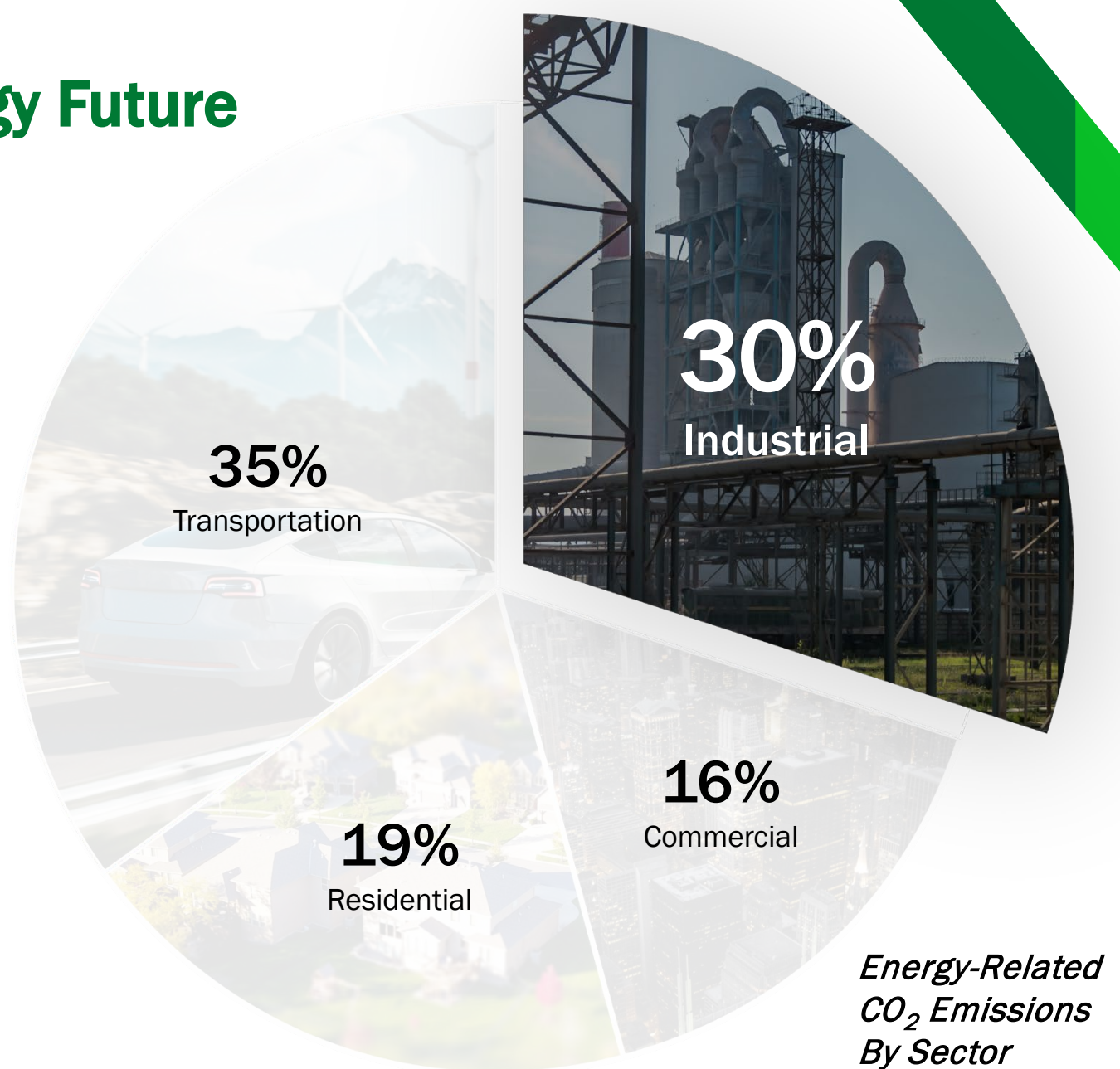
**33%** of the nation's primary energy use

**30%** of CO<sub>2</sub> emissions

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

**17%** CO<sub>2</sub> emissions increase\*

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



*Energy-Related  
CO<sub>2</sub> Emissions  
By Sector*

# Decarbonizing Industry is an Opportunity for America's Economy

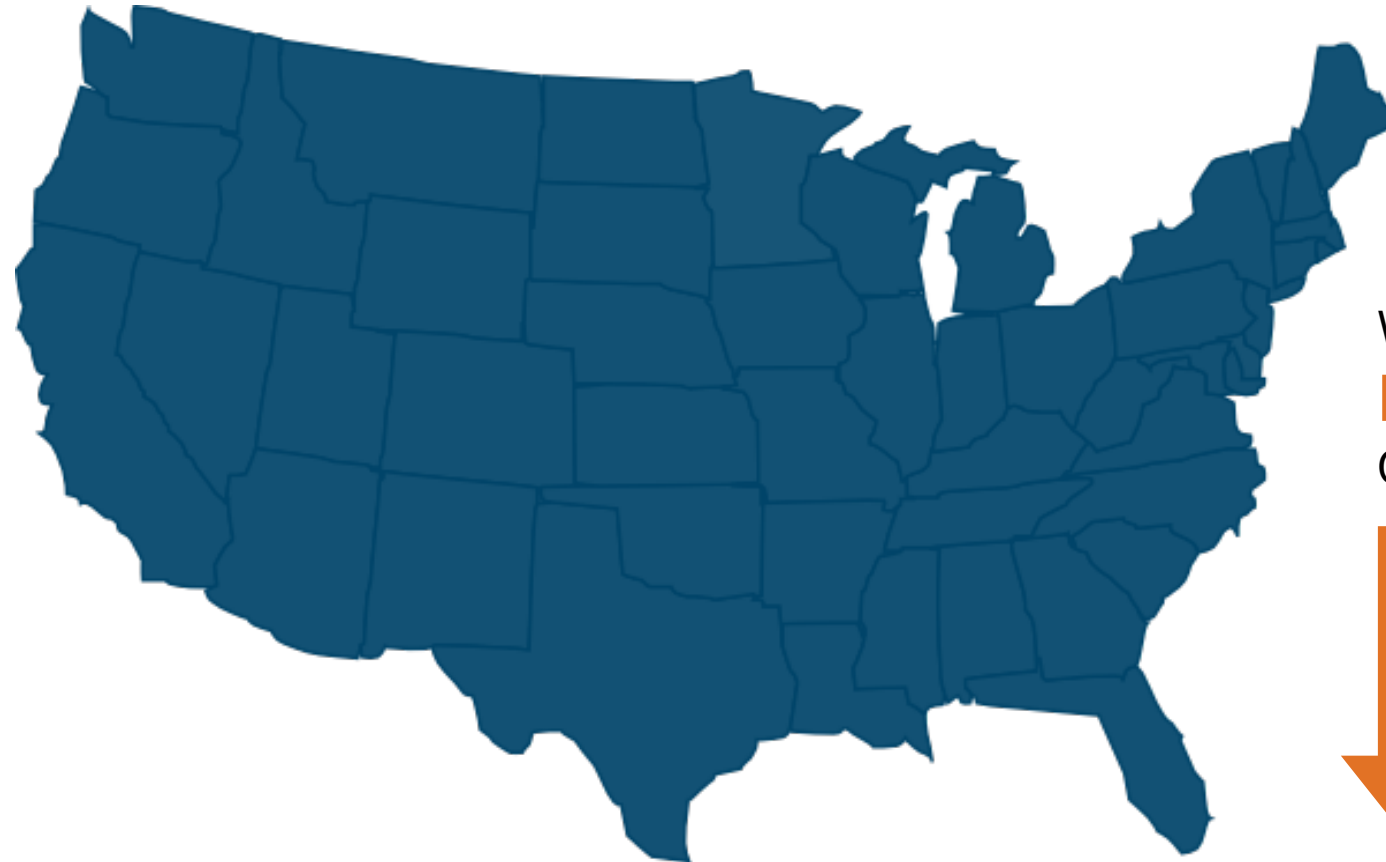
U.S. manufacturing subsector...



**CONTRIBUTES**  
\$2.35 trillion to  
the U.S. Economy

**GENERATES**  
11% of U.S. GDP

**CREATES**  
11.4 million jobs



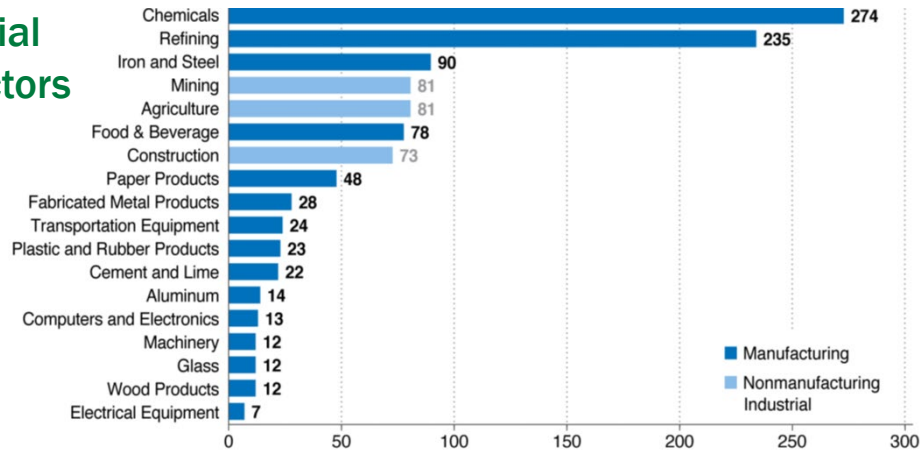
While working to  
**DECREASE**  
CO<sub>2</sub> emissions



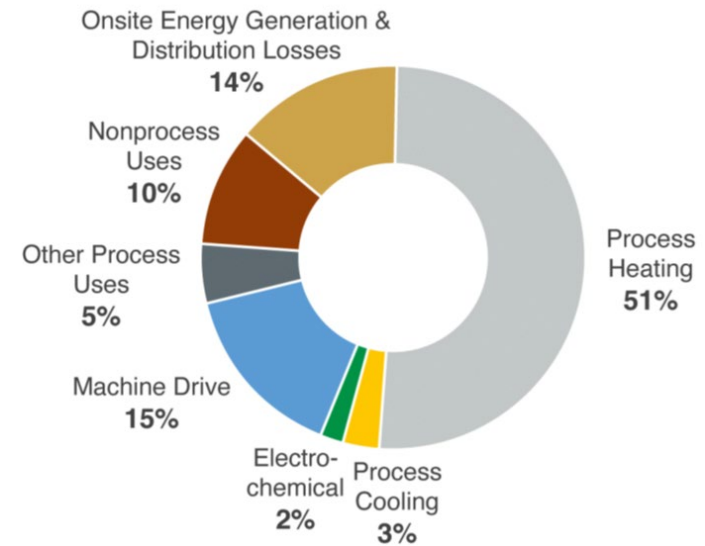
# Systemic Barriers to Industrial Decarbonization

## No One-Size-Fits-All Solution

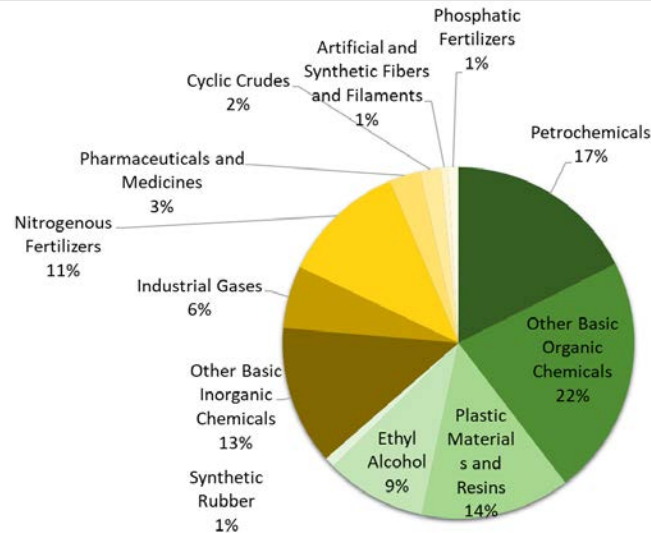
### Industrial Subsectors



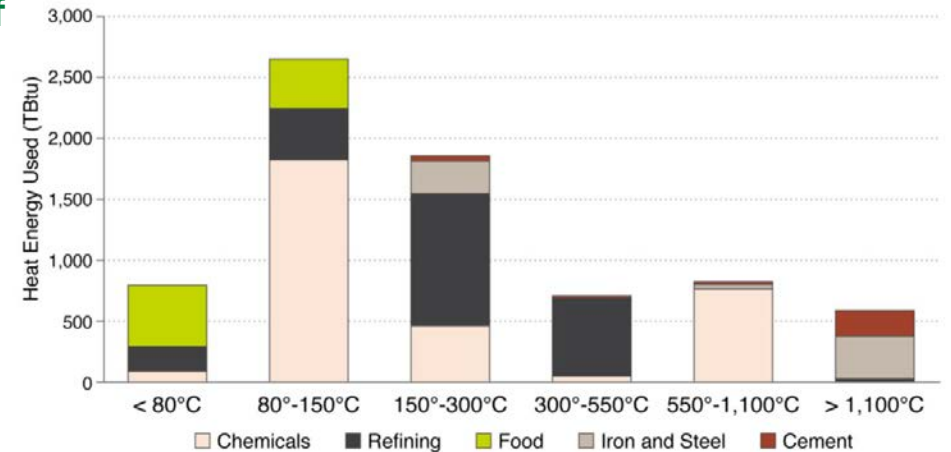
### Onsite Energy Use



### Chemical Products



### Distribution of Process Heat



# Systemic Barriers to Industrial Decarbonization

## Risk to Industry's Bottom Line

Investment scale → In the range of

**\$11-21 Trillion**

just for 4 sectors:



**cement**



**steel**



**ammonia**

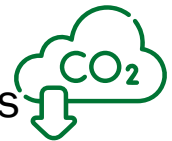


**ethylene**

(McKinsey, 2018)

Estimated that

**60%** of heavy industry emissions reductions



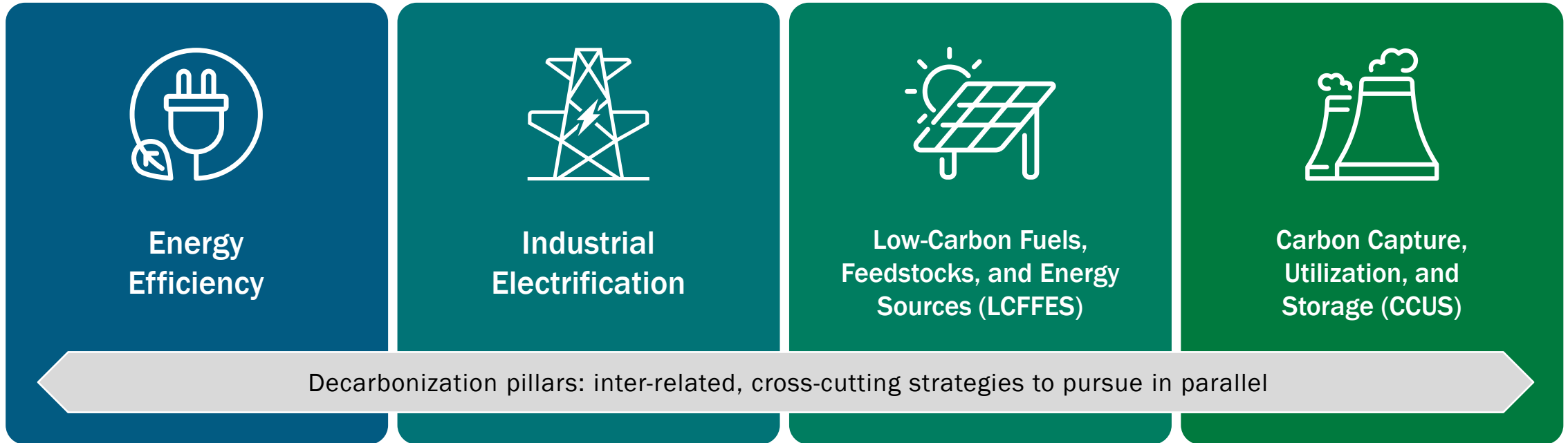
by 2050 will come from technologies that are **not currently market ready**

(IEA, 2022)

Targeted investment for research, development, and pilot-scale demonstrations can help U.S. industry overcome these barriers

# DOE Industrial Decarbonization Roadmap

## Industrial Decarbonization Pillars



Iron & Steel



Chemicals



Food & Beverage

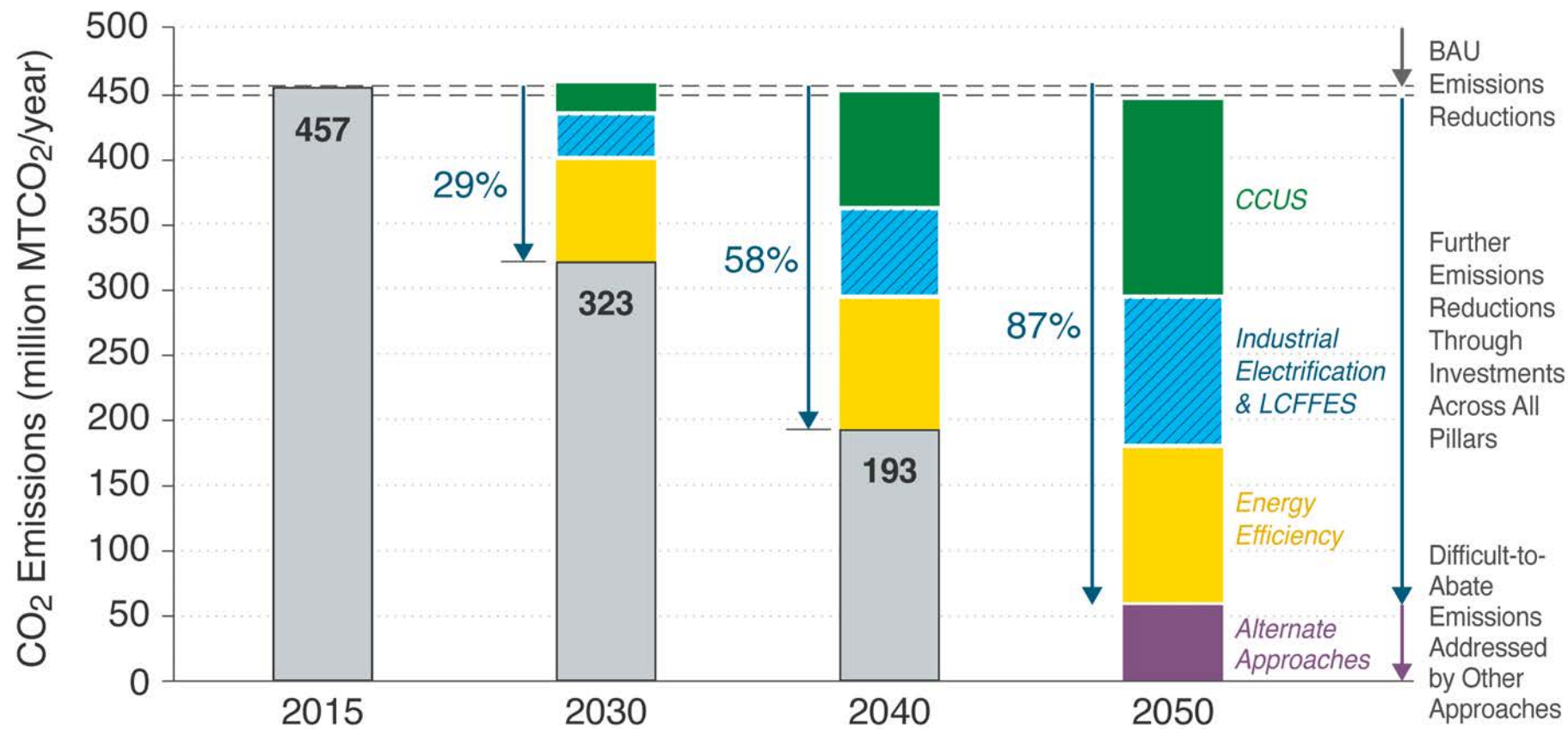


Petroleum Refining



Cement

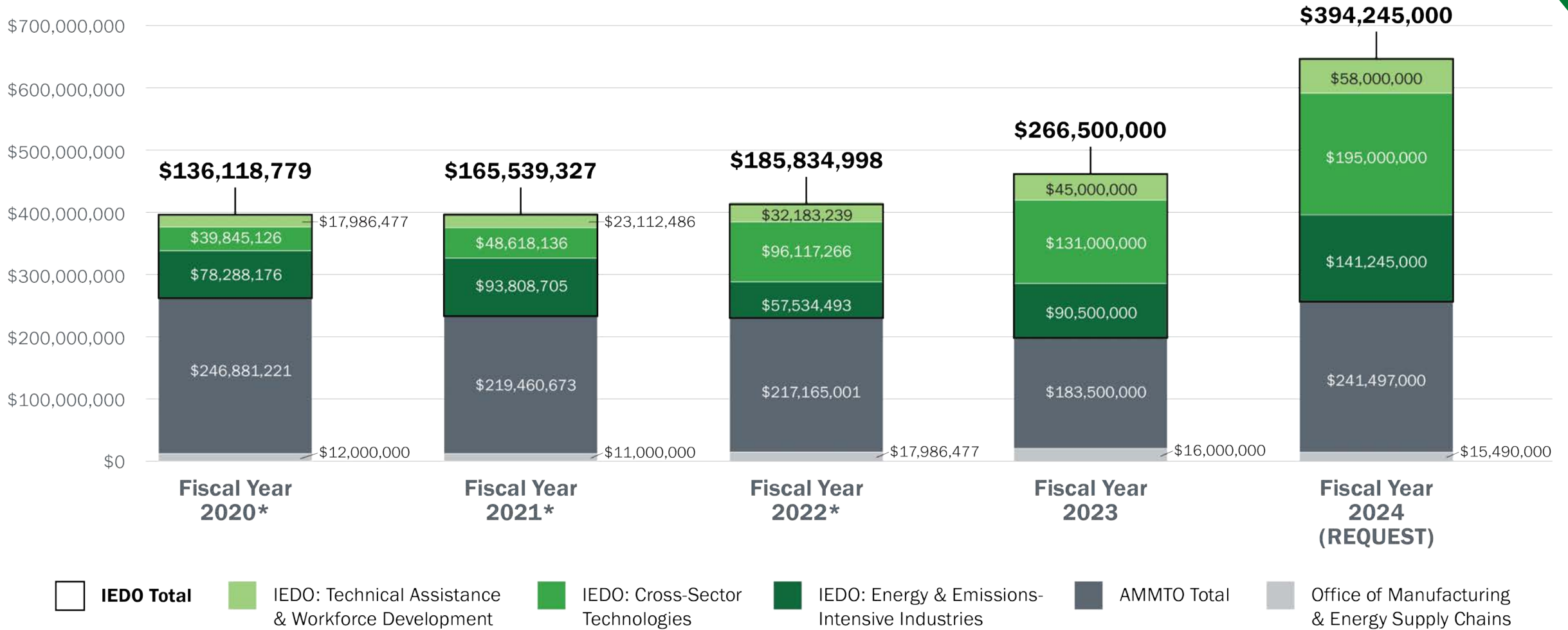
# Path to Net-Zero Emissions by 2050



- Remaining GHG Emissions
- Emissions Reduction by CCUS
- Emissions Reduction by Industrial Electrification & LCFES
- Emissions Reduction by Energy Efficiency
- Emissions Reduction by Alternate Approaches (e.g., Negative Emissions Technologies)



# DOE's Growing Budget for Industrial Decarbonization



\* FY20–FY22 was the Advanced Manufacturing Office (AMO)

# Industrial Efficiency and Decarbonization Office (IEDO)

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## Industrial Efficiency and Decarbonization Office

IEDO leads the development and accelerates the adoption of sustainable technologies that increase efficiency and eliminate industrial GHG emissions.

**50**  
STAFF

Federal staff, contractors,  
and fellows in Golden, CO  
and DOE Headquarters

**\$266.5**  
Million FY23 Budget



Energy- and  
Emissions-  
Intensive  
Industries

**FY23 = \$131M**



Cross-sector  
Technologies  
**FY23 = \$90.5M**



Technical  
Assistance  
and Workforce  
Development

**FY23 = \$45M**

# IEDO Leadership



**Dr. Steven McKnight**  
Acting Director



**Dr. Avi Shultz**  
Deputy Director



**Joe Cresko**  
Chief Engineer



**Lauren Hall**  
Operations Supervisor



**Isaac Chan**  
Program Manager  
Cross-Sector Technologies



**Dr. Paul Majsztzik**  
Program Manager  
Energy- and Emissions-  
Intensive Industries



**Anne Hampson**  
Program Manager  
Technical Assistance and  
Workforce Development

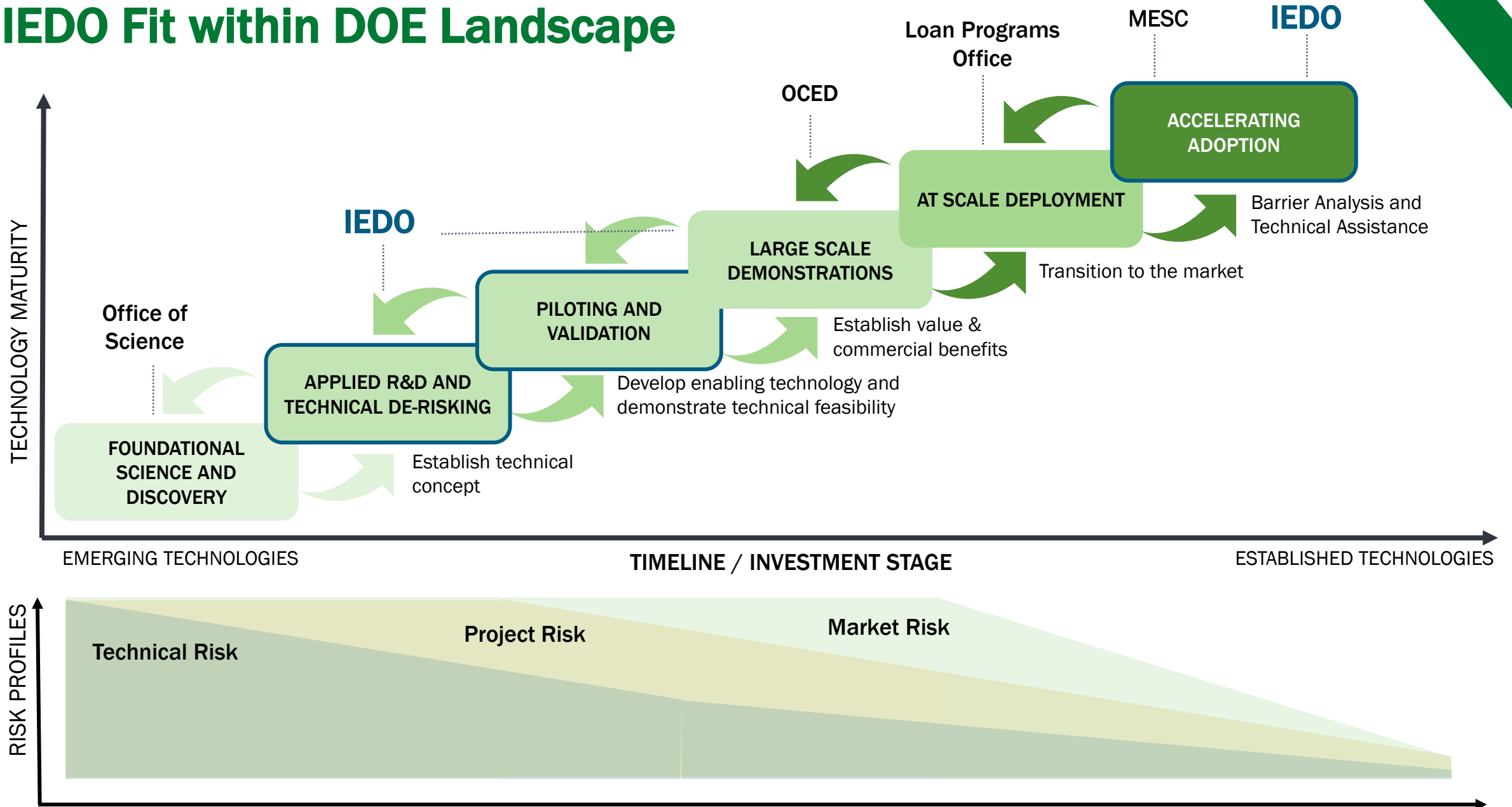


**Ava Coy**  
Acting Program Manager  
Technical Project Officers

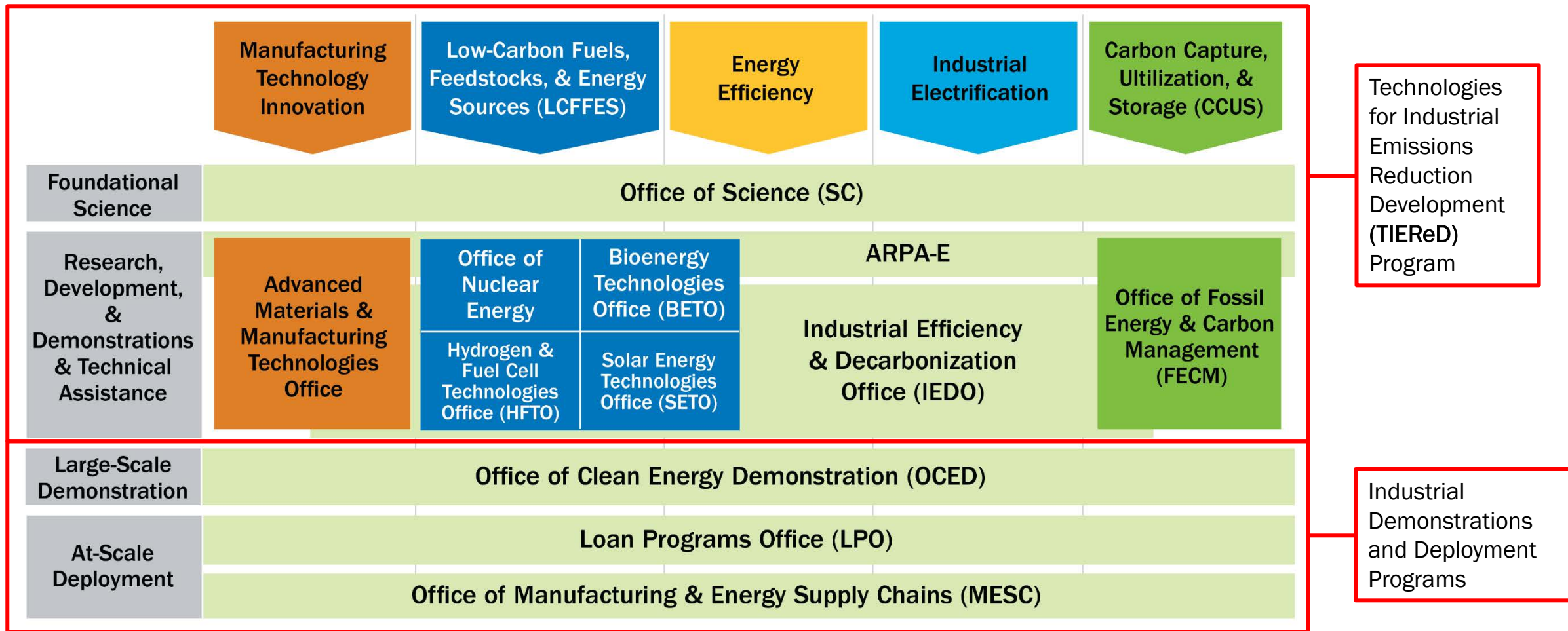


**Mattie Gainer**  
Strategic  
Communications Lead

# IEDO Fit within DOE Landscape

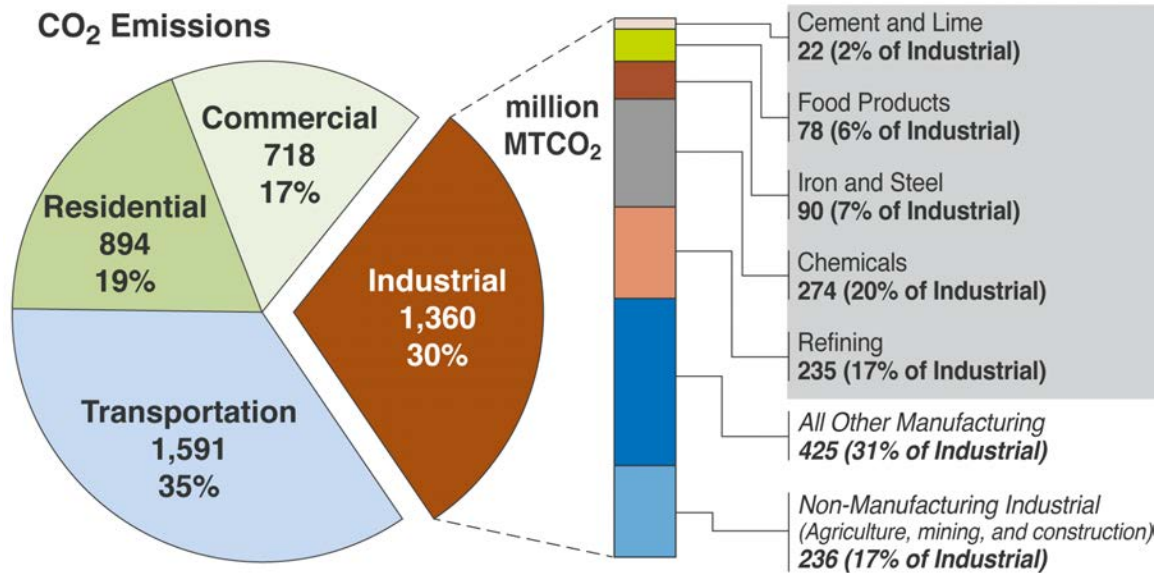


# DOE Offices Share a Common Strategic Framework

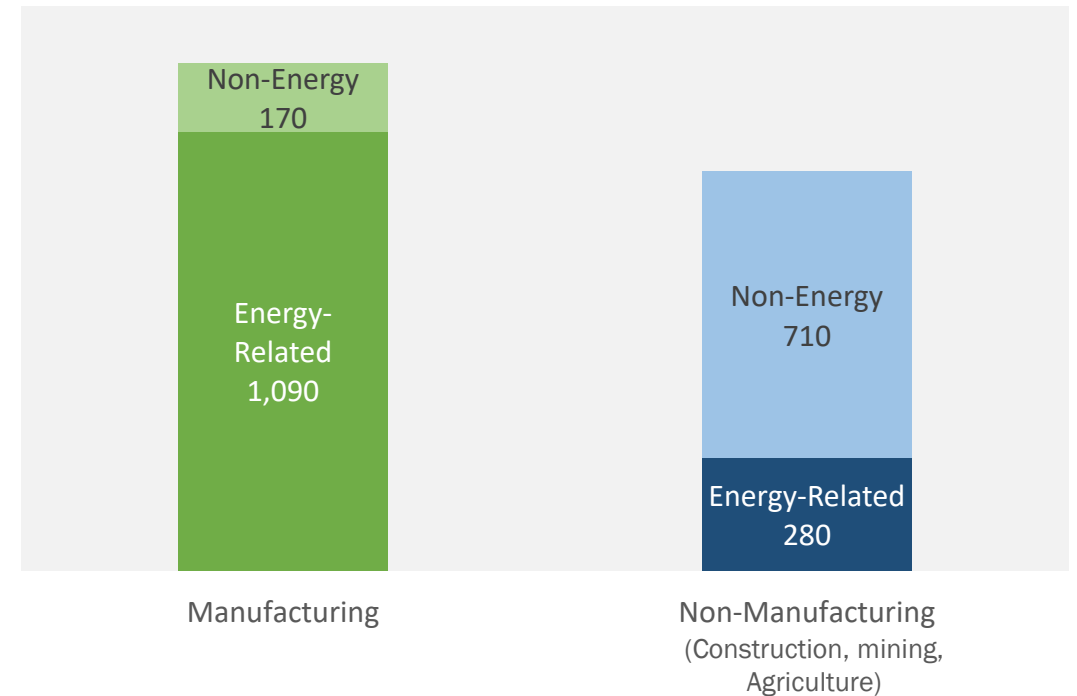


# IEDO's Focus on Energy Intensive Manufacturing Subsectors

Energy Related CO<sub>2</sub> Emissions Across U.S. Industry



Total CO<sub>2</sub>-Equivalent GHG Emissions Across U.S. Industry



**The five top manufacturing subsectors are responsible for 51% of energy-related industrial CO<sub>2</sub> emissions**

Data source: Energy Information Administration (EIA) [Annual Energy Outlook 2021 with Projections to 2050](#) and other EIA and EPA source

# IEDO Priorities

Chemicals/Refining	Iron and Steel	Cement and Concrete	Food and Beverage	Forest Products
Sustainable Feedstocks (especially carbon)	Alternative reductants - hydrogen, ammonia for DRI/HBI; biomass for solid pig iron	Alternative binders and process routes to OPC	Low-carbon fuels or electrification for steam boilers	Increase biomass utilization
Low Carbon Fuels	Molten ore processing – molten oxide electrolysis; hydrogen plasma direct smelting	Carbon capture from limestone decarbonation	Low-temperature waste heat recovery from process exhausts	Low-carbon fuels for lime kilns
Low Carbon and Electrified Process Heating	Carbon Capture and Storage on Existing BF/BOF facilities	Clinker Substitutes	Alternative protein products	Low-carbon fuels or Electrification for steam boilers
Electrochemical reactors	Electrowinning - molten salts; aqueous	CO <sub>2</sub> mineralization	Smart/Flexible manufacturing processes	Energy efficient separations for concentrating liquor
Waste heat recovery	Low-carbon fuels and electrification for process heating, reheats	Waste heat recovery	Drying and dewatering innovations	Process Electrification
Carbon capture integration	Waste heat recovery	Electrification & low carbon fuels	Waste management and reduction	Carbon capture integration with boilers
High efficiency thermal reactors		Alternative building materials	Innovative cooling, refrigeration and freezing solutions	Drying and dewatering innovations
Advanced separations			Wastewater Recovery and Reuse	Increase fiber yield of pulping
Material reuse				Increasing solids content in paper forming

# IEDO Priorities

## Crosscutting: Carbon Capture, Utilization, and Storage (CCUS)



Chemicals/Refining	Iron and Steel	Cement and Concrete	Food and Beverage	Forest Products
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Advanced separations			Wastewater Recovery and Reuse	Increase fiber yield of pulping
Material reuse				Increasing solids content in paper forming



# IEDO Priorities

## Crosscutting: Low-Carbon Fuels and Electrified Heating



Chemicals/Refining	Iron and Steel	Cement and Concrete	Food and Beverage	Forest Products
Sustainable Feedstocks (especially carbon)	Alternative reductants - hydrogen, ammonia for DRI/HBI; biomass for solid pig iron	Alternative binders and process routes to OPC	<b>Low-carbon fuels or electrification for steam boilers</b>	Increase biomass utilization
<b>Low Carbon Fuels</b>	Molten ore processing – molten oxide electrolysis; hydrogen plasma direct smelting	Carbon capture from limestone decarbonation	Low-temperature waste heat recovery from process exhausts	<b>Low-carbon fuels for lime kilns</b>
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Advanced separations			Wastewater Recovery and Reuse	Increase fiber yield of pulping
Material reuse				Increasing solids content in paper forming

# IEDO Priorities

## Crosscutting: Energy and Materials Efficiency



Chemicals/Refining	Iron and Steel	Cement and Concrete	Food and Beverage	Forest Products
Sustainable Feedstocks (especially carbon)	Alternative reductants - hydrogen, ammonia for DRI/HBI; biomass for solid pig iron	Alternative binders and process routes to OPC	Low-carbon fuels or electrification for steam boilers	Increase biomass utilization
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Advanced separations			Wastewater Recovery and Reuse	Increase fiber yield of pulping
Material reuse				Increasing solids content in paper forming

# IEDO Priorities

## Crosscutting: Water Treatment and Management



Chemicals/Refining	Iron and Steel	Cement and Concrete	Food and Beverage	Forest Products
Sustainable Feedstocks (especially carbon)	Alternative reductants - hydrogen, ammonia for DRI/HBI; biomass for solid pig iron	Alternative binders and process routes to OPC	Low-carbon fuels or electrification for steam boilers	Increase biomass utilization
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# IEDO Priorities

## Sector-Specific Innovations



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# Energy- and Emissions-Intensive Industries

IEDO accelerates the readiness of emerging, industry-specific technologies to decarbonize the most energy- and emissions-intensive industrial subsectors.



Dr. Paul Majsztik  
Program Manager



## IRON AND STEEL

1,469 TBtu  
100 MMT CO<sub>2</sub>e



## CHEMICALS

(including production of  
low-carbon fuels)  
4,842 Tbtu  
332 MMT CO<sub>2</sub>e



## FOOD & BEVERAGE

1,935 TBtu  
96 MMT CO<sub>2</sub>e



## FOREST PRODUCTS

2,883 TBtu  
80 MMT CO<sub>2</sub>e

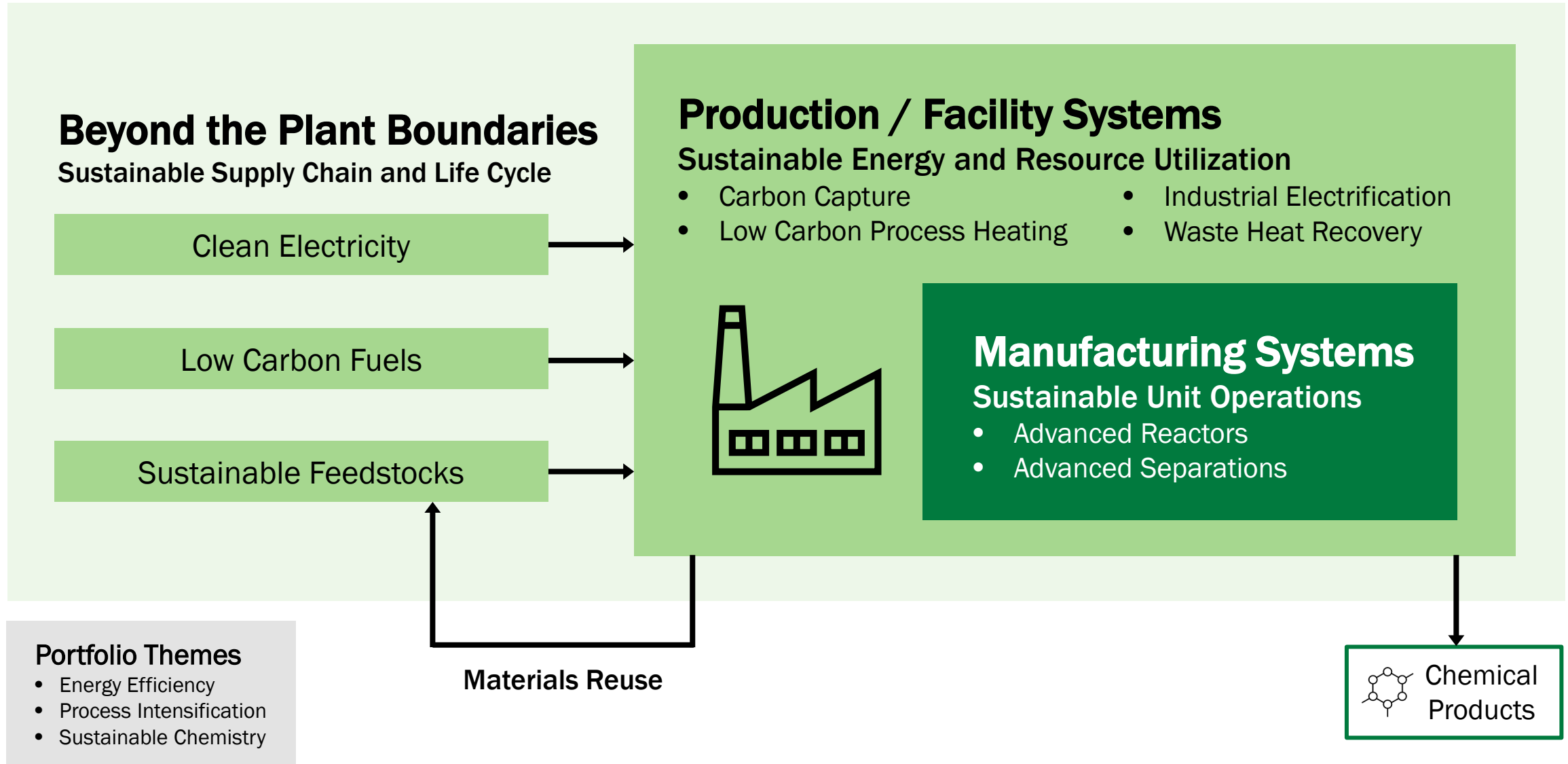


## CEMENT & CONCRETE

367 TBtu  
66 MMT CO<sub>2</sub>e

DOE [Manufacturing Energy and Carbon Footprint](#), based on EIA Manufacturing Energy Consumption Survey (MECS) data for 2018

# IEDO Strategies for Chemicals Sector Decarbonization



# Sustainable Chemistry and Decarbonization

Future chemical processes under development must be fully sustainable, addressing:

- ✓ Toxicity to human health and the environment
- ✓ Energy consumption and related emissions
- ✓ Minimized natural resource impacts



# Cross-Sector Technologies

The Cross-Sector Technologies subprogram accelerates the readiness of energy- and emissions-reducing components, systems, and operational technologies, across a broad range of industries.



Isaac Chan  
Program Manager



Thermal Process  
& Systems



Low-Carbon Fuels,  
Feedstocks, & Energy Sources



Emerging Efficiency



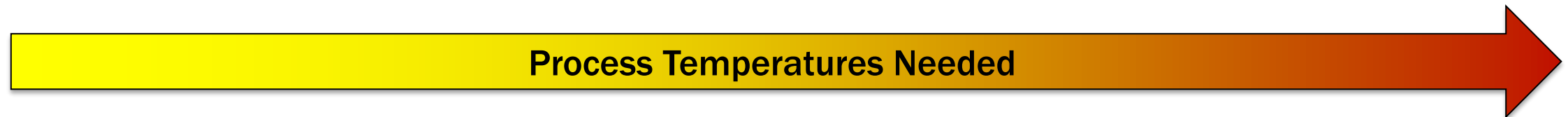
Water & Wastewater  
Treatment



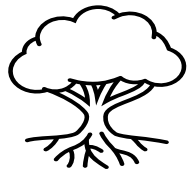
# Tackling Emissions from Industrial Heat Across the Industrial Sector

Develop cost competitive industrial heat decarbonization technologies with:

   
> 85% Lower Emissions 2035



**drying**  
paper,  
batteries



**steam**  
pasteurized food

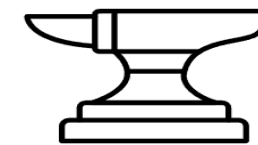


**distillation**  
high purity  
chemicals



**melting**  
formed plastics,  
semiconductors

**smelting**  
iron, copper,  
vehicle bodies



**calcining**  
cement,  
fuel cell catalysts



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

- The Electrified Processes for Industry without Carbon (EPIX) Institute is DOE's 7th Clean Energy Manufacturing Innovation Institute.
- EPIX 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



# IEDO's Technical Assistance Efforts

**Technical Assistance:** Partners with and enables industry to accelerate the adoption of technologies, programs, and best practices that improve efficiency and decarbonization.

**Workforce Development:** Promotes the development of a diverse mix of new workers and upskills existing workers for the industrial jobs of today and the future.



Anne Hampson  
Program Manager



Public /private partnerships to help industrial organizations set and achieve 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

**PROGRAMS INCLUDE:** ONSITE ENERGY | PROGRAM 50001 | READY & SEP 50001 | WORKFORCE DEVELOPMENT

# Why Companies Join Better Plants

## Recognition

### Developing Innovative, Replicable Solutions with Market Leaders

- National Recognition
- Peer to Peer Networking
- Better Building Solutions Center

## Technical Assistance

### Making Energy Efficient Investments Easier

- Software tools for Energy Management
- Financing Navigator
- Diagnostic Equipment Program
- Technical Publications

## Access to Innovation

### Innovation to Drive Savings

- DOE National Lab Visits
- Industrial Technology Validation

## Workforce Development

### Helping You Meet Your Challenges of Today, and Tomorrow

- In-Plant Trainings
- Virtual trainings and bootcamps
- Energy and Decarbonization boot camps



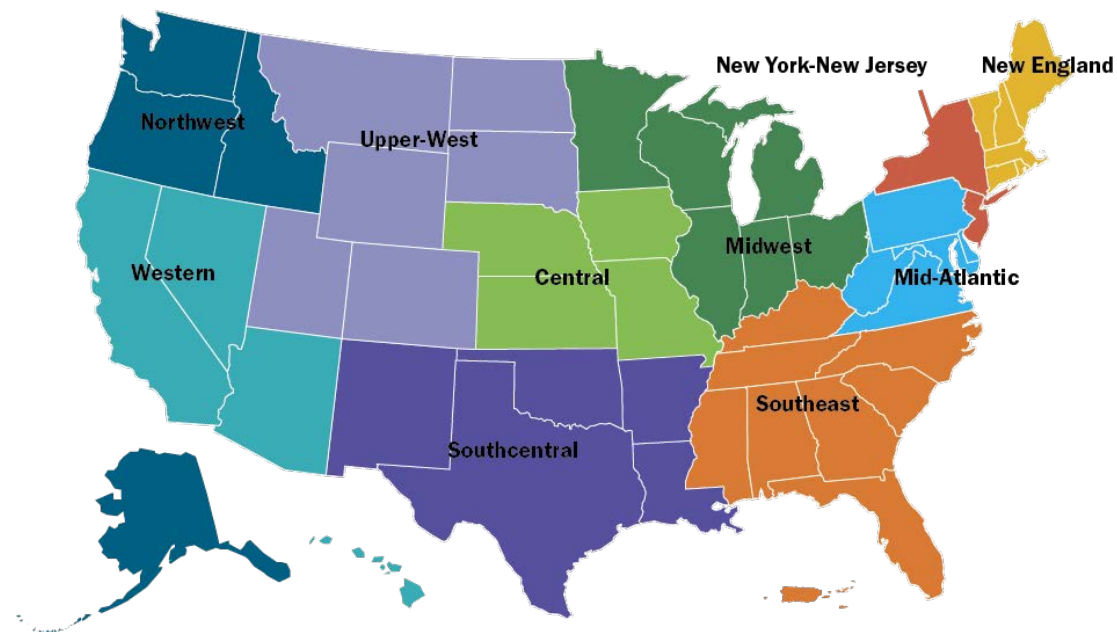
# IEDO Onsite Energy Program

The Onsite Energy Program is a new initiative to provide technical assistance for industrial facilities and other large energy users to increase the adoption of onsite clean energy technologies.

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

**The Onsite Energy Program will establish a regional network of Technical Assistance Partnerships (TAPs) to help:**

- Deploy onsite renewable energy and storage technologies
- Identify cost-effective options for achieving clean energy targets
- Highlight pathways for accelerating the integration of onsite clean energy technologies
- Reduce greenhouse gas emissions while prioritizing energy justice and workforce development



# IEDO is Hiring - Join Our Team!

## Current IEDO Career Opportunities

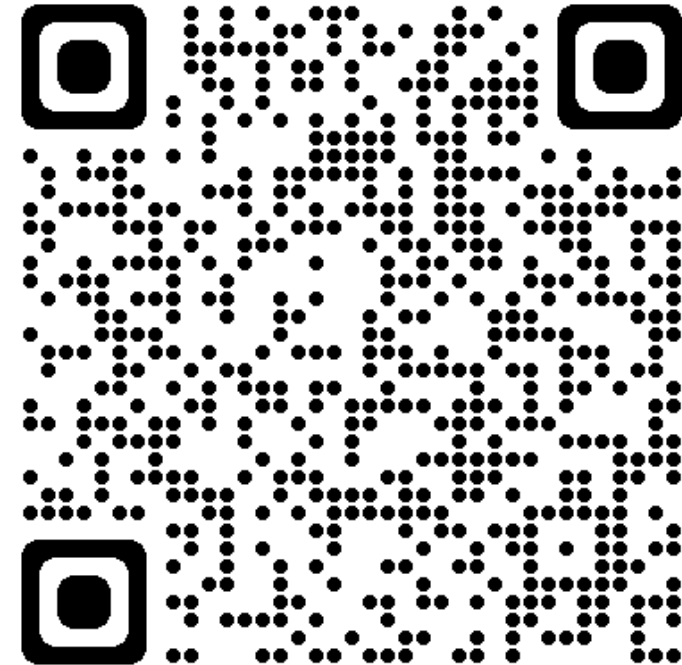
- Cross-Sector Industrial Decarbonization Technologies Technology Manager
- Technical Project Officer (2 open positions)
- Technical Project Officer Program Manager
- Energy- and Emissions Intensive Industries Sr. Technology Manager
- Energy- and Emissions-Intensive Industries Technology Manager

Interested in applying?

Visit our careers page or scan the QR code:

<https://www.energy.gov/eere/iedo/iedo-careers>

Email: [IEDOJobs@ee.doe.gov](mailto:IEDOJobs@ee.doe.gov)



**Thank you!**

