

Decarbonizing America's Industrial Sector

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Thermal-Mechanical-Chemical Energy Storage Workshop
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Building a Net-zero, Clean Energy Future

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

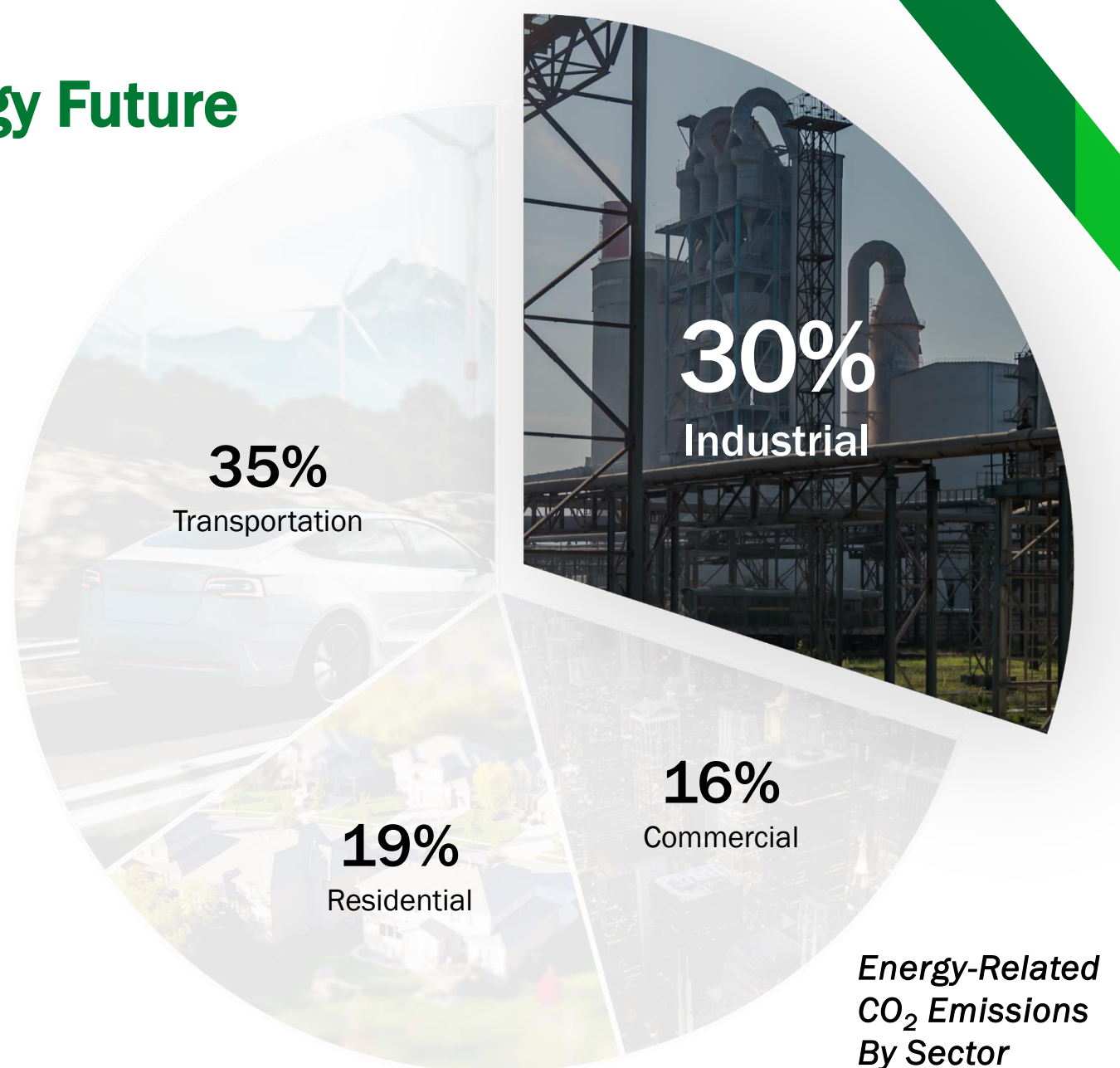
33% of the nation's primary energy use

30% of CO₂ emissions

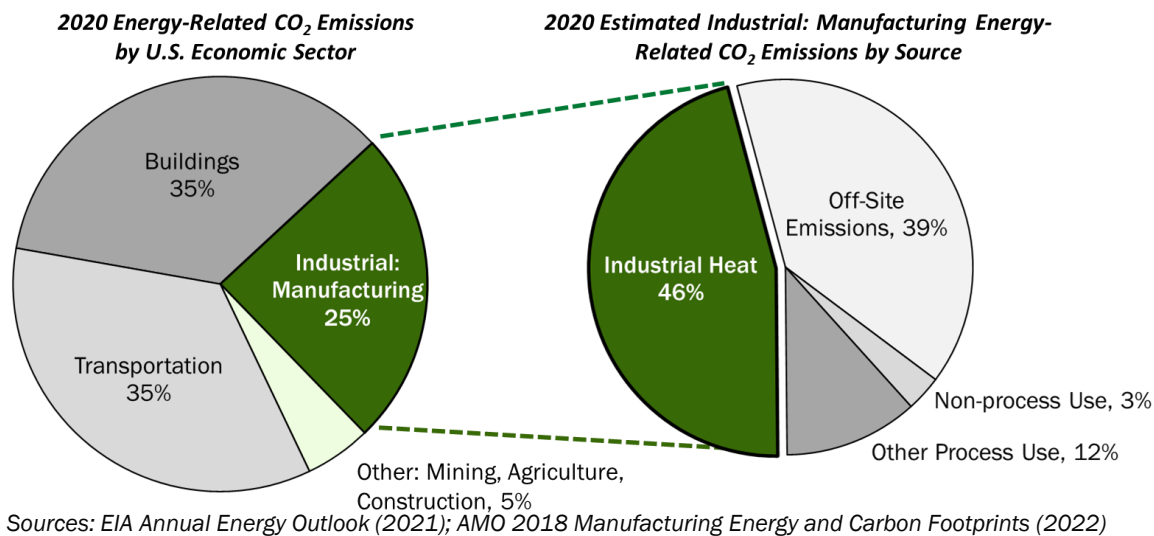
Anticipated industrial sector energy demand growth of 30% by 2050 may result in a:

17% CO₂ emissions increase*

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



11% of U.S. Energy-Related Emissions are from Industrial Thermal Systems



Develop cost competitive industrial heat decarbonization technologies with at least 85% lower greenhouse gas emissions by 2035



>85% Lower Emissions



2035

Goal: Reduce the amount of heat and/or emissions from heat to make cleaner products

 Generate Heat from Clean Electricity	 Integrate Clean Heat from Alternative Sources	 Innovative Low- or No-Heat Process Technologies
Reduce Emissions: electrify equipment & use clean electricity, improve energy efficiency	Reduce Emissions: switch to low-emissions heat sources and increase thermal storage	Reduce Emissions: new chemistry and emerging approaches to reduce heat demand
Examples: heat pumps, microwave heating, resistive heating, etc.	Examples: solar thermal, nuclear, geothermal, hydrogen, some sustainable fuels, etc.	Examples: advanced separations, electrolysis, ultraviolet curing, biobased manufacturing, etc.

Enabling technologies and systems: e.g. energy storage, materials, modeling, data analytics, etc.

IEDO Energy Storage Portfolio

\$12M Across Diverse Portfolio to Advance Multiple Storage Modalities, Media, Scales, and Applications

- **FY22 SBIR/STTR**

- *High Operating Temperature Thermal Energy Storage* (2 awards; \$0.4 M)

FY22 Industrial Efficiency and Decarbonization FOA.

Topic Area 6: Cross-sector Decarbonization Technologies

- Area of Interest 1 – *High Operating Temperature Thermal Energy Storage* (1 award; \$6.7 M)

- **FY23 IEDO Multi-Topic FOA.** Subtopic 3a: Enabling Flexible Industrial Energy Use

- Area of Interest 2 – *Thermal Energy Storage Systems* (1 award; \$5.0 M)

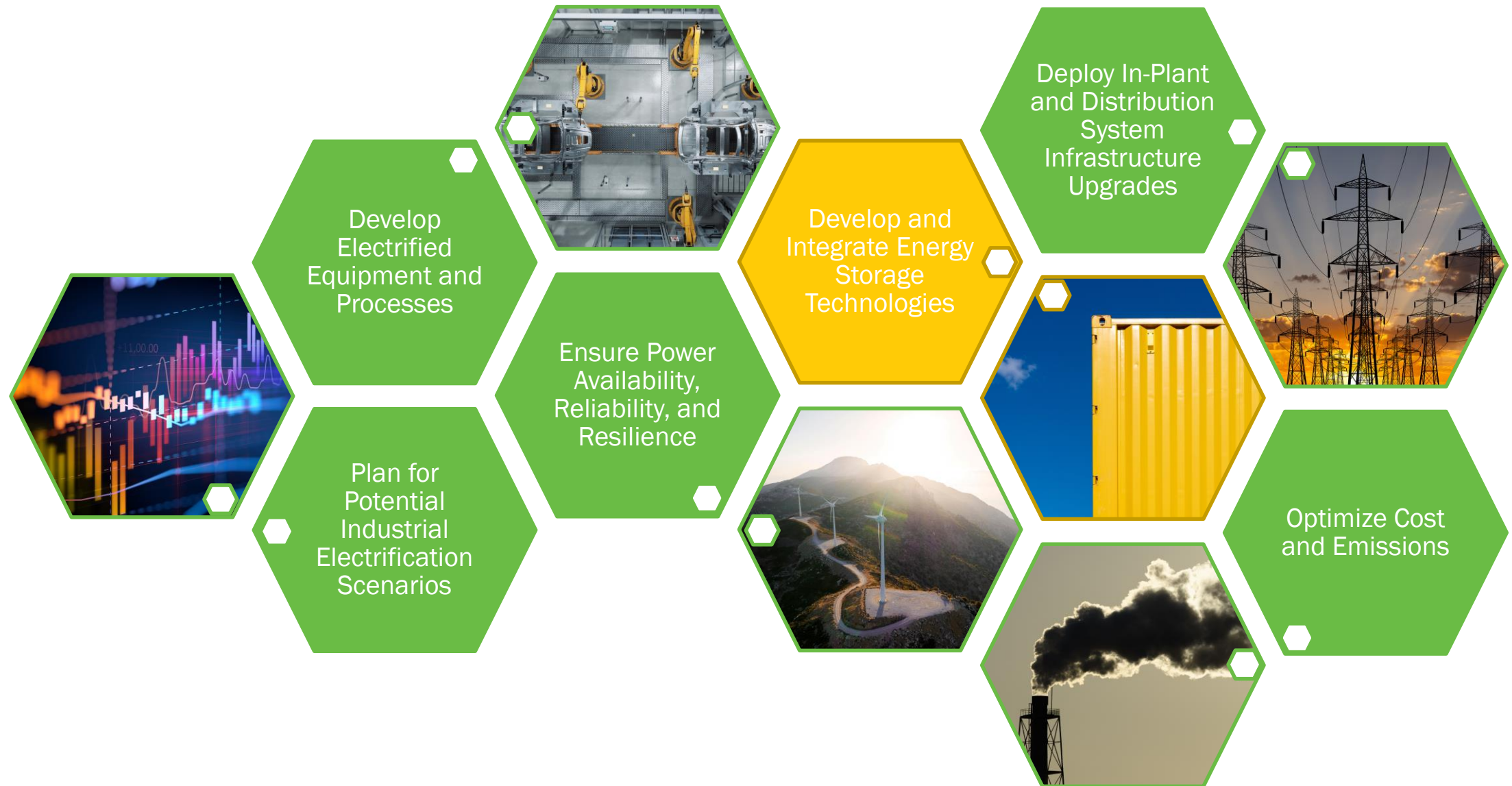
- **Coming Soon: Industrial Energy Storage System Prize**

- Industrial cooling energy storage
- High temperature industrial energy storage
- Industrial thermal storage for hybrid cooling, heating, and power

Example metrics from IEDO FY23 Multi-Topic FOA

Objective/ Goal	Metric	Minimum	Stretch Target	Baseline Performance
Increased flexibility	% energy usage around baseline	+/- 35%	+/- 70%	<i>Applicant defined</i>
Round trip efficiency	energy delivered/ energy input	≥ 70%	≥ 90%	<i>Applicant defined</i>
Exergetic efficiency of the storage system	exergy used in industrial process/exergy input	≥ 50%	≥ 70%	<i>Applicant defined</i>
Thermal cycles	Charge-Discharge cycles	1,000	10,000	<i>Applicant defined</i>
Thermal Capacity	MW·h	5	50	<i>Applicant defined</i>
Payback period	years	8	3	<i>Applicant defined</i>
Discharge time	hours	10	48	<i>Applicant defined</i>
Cost	\$/kW·h	Cost analysis should indicate parity with other readily available energy sources.		

Industry-Grid Integration: Supporting Industrial Electrification



Onsite Energy Program

<https://betterbuildingssolutioncenter.energy.gov/onsite-energy/taps>

The U.S. Department of Energy's (DOE) Onsite Energy Program provides technical assistance, market analysis, and best practices to help industrial facilities and other large energy users increase the adoption of onsite clean energy technologies.

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



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IEDO is Hiring: Help decarbonize the U.S. industrial sector!

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- Senior Advisor on Industrial Markets

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- Industrial Decarbonization Fellowship