



# ENERGY EARTHSHOTS: THE FRONTIER OF CLIMATE INNOVATION

Industrial Heat Shot™ &

Affordable Home Energy Shot

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Secretary for Buildings & Industry, Office of  
Energy Efficiency & Renewable Energy

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# INDUSTRIAL HEAT SHOT

Develop cost competitive industrial heat decarbonization technologies...



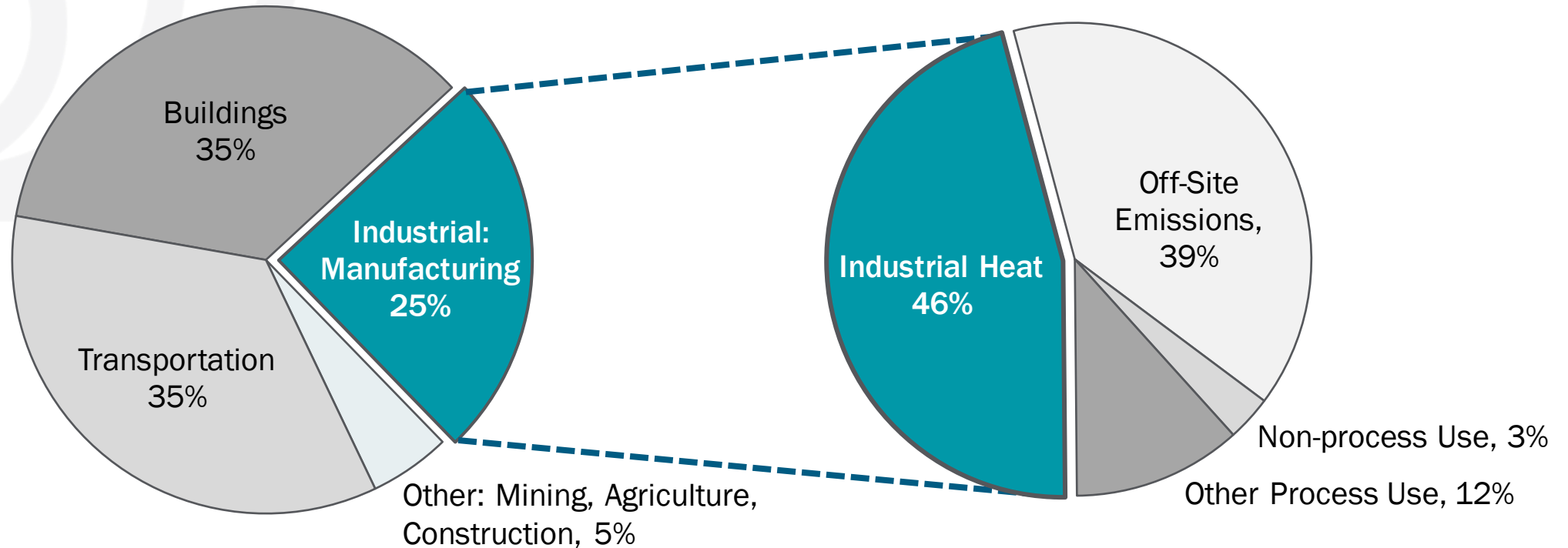
...with at least **85%**  
**lower** GHG emissions...



...by **2035**

# Why Industrial Heat?

## U.S. Energy-Related Emissions: ~11% **Attributable to Industrial Heat**



2020 Energy-Related CO<sub>2</sub> Emissions by U.S. Economic Sector

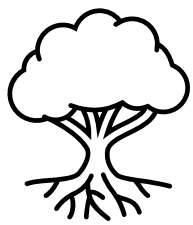
2020 Estimated Industrial: Manufacturing Energy-Related CO<sub>2</sub> Emissions by Source

# Why Industrial Heat?

## Industrial Heat is Essential and Pervasive:

Every major industry subsector uses heat in different ways to make products...

**drying**  
paper,  
batteries



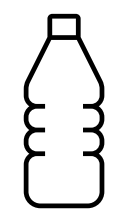
**steam**  
pasteurized food



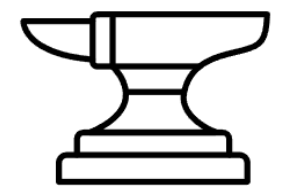
**distillation**  
high purity  
chemicals



**melting**  
formed plastics,  
semiconductors



**smelting**  
iron, copper,  
vehicle bodies



**calcining**  
cement,  
fuel cell catalysts



~300°C

Process Temperatures Needed

>800°C

# Three Pathways

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



## Generate Heat from Clean Electricity

**Reduce Emissions:**

electrify equipment & use clean electricity, improve energy efficiency

**Examples:**

resistive heating, heat pumps, microwave heating, thermal storage, etc.



## Integrate Clean Heat from Alternative Sources

**Reduce Emissions:**

switch to low-emissions heat sources

**Examples:**

solar thermal, nuclear, geothermal, hydrogen, some sustainable fuels



## Innovative Low- or No-Heat Process Technologies

**Reduce Emissions:**

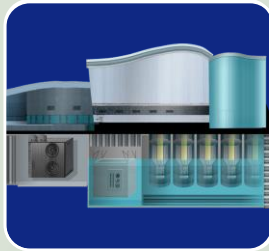
new chemistry and emerging biotechnology processes to reduce heat demand

**Examples:**

bio-based manufacturing, electrolysis, ultraviolet curing, advanced separations, etc.

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

# All-Hands-on-Deck Effort



## Office of Science

- Foundational R&D capabilities at the user facilities
- High performance computing for manufacturing

## Industrial Efficiency and Decarbonization Office

RD&D in manufacturing processes, technologies, products, facilities, and supply chains

## Nuclear Energy

RD&D to expand nuclear energy to industrial, transportation, and energy storage applications

## Bioenergy Technologies Office

RD&D of processes using alternative feedstocks and low/no heat manufacturing options

## Hydrogen and Fuel Cell Technologies Office

RD&D of clean hydrogen technologies for low-carbon feedstocks and fuels

## Fossil Energy and Carbon Management

RD&D to convert captured carbon into products without the need for heat or using substantially less heat

## Solar Energy Technologies Office

RD&D in concentrated solar thermal and thermal storage technologies

## Office of Clean Energy Demonstrations

Industrial decarbonization demonstration projects

DOE National Laboratories RD&D

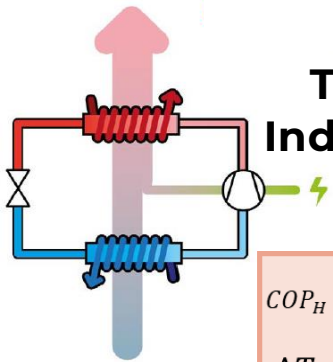
# DOE is Driving Innovation



Industrial Heat™

## Industrial Efficiency and Decarbonization (IEDO, June 2023)

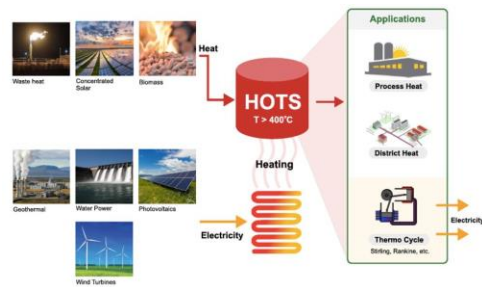
*Announced awards for RD&D projects* that advance industrial heat pumps, thermal storage, and other technologies to decarbonize thermal processes



**Higher Temperature Industrial Heat Pumps**

$$COP_H = \frac{\text{heat output}}{\text{electric power input}}$$

$$\Delta T_{Lift} = T_H - T_C$$



## High Operating Temperature Storage

## Electrified Processes for Industry without Carbon (IEDO, May 2023)

*Announced selection of EPIX* to develop electrified industrial heating processes, supporting technologies, and a skilled workforce



ELECTRIFIED PROCESSES FOR INDUSTRY WITHOUT CARBON

## EERCs & Science Foundations for Energy Earthshots (SC, September 2023)

*\$264 million awarded for Basic Research in Support of Energy Earthshots*, including 2 Research Centers and 6 Science Foundations projects for IHS





# DOE is Driving Innovation



**Hydrogen Hubs (OCED, October 2023)**  
*\$7 billion for seven Regional Clean Hydrogen Hubs* to accelerate the deployment of low-cost, clean hydrogen for a broad range of end uses, including industrial heat

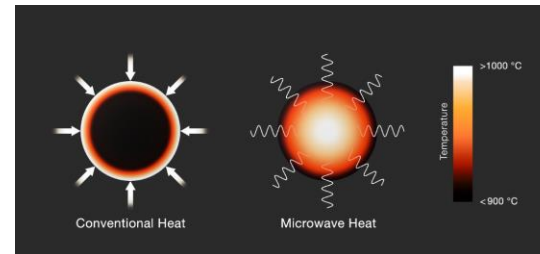


**IEDO Multi-Topic FOA (IEDO, January 2024)**  
*Announced awards for RD&D projects* that advance electrification, heat pumps, low-/no-heat processes, hydrogen end-use, and thermal storage

**Industrial Heat Shot Summit (S4, October 2023)**  
*Convened DOE leaders, members of Congress, and climate champions* to discuss the importance of decarbonizing industrial heat, EEJ, and potential technology pathways

**IEDO FY24 FOAs (IEDO, December 2023 and January 2024)**  
*Advancing technologies to decarbonize industrial heat*, including cross-sector approaches and targeted investments in energy-intensive industries

## Membrane separations



## Electromagnetic heating





# Affordable Home Energy Shot

# The Energy Affordability Challenge

Our imperative is to deliver equitable solutions to households with the highest energy burdens.



## High energy burdens

**1 in 4** households face high energy burdens (>6% of income spent on energy).



## Energy affordability challenges

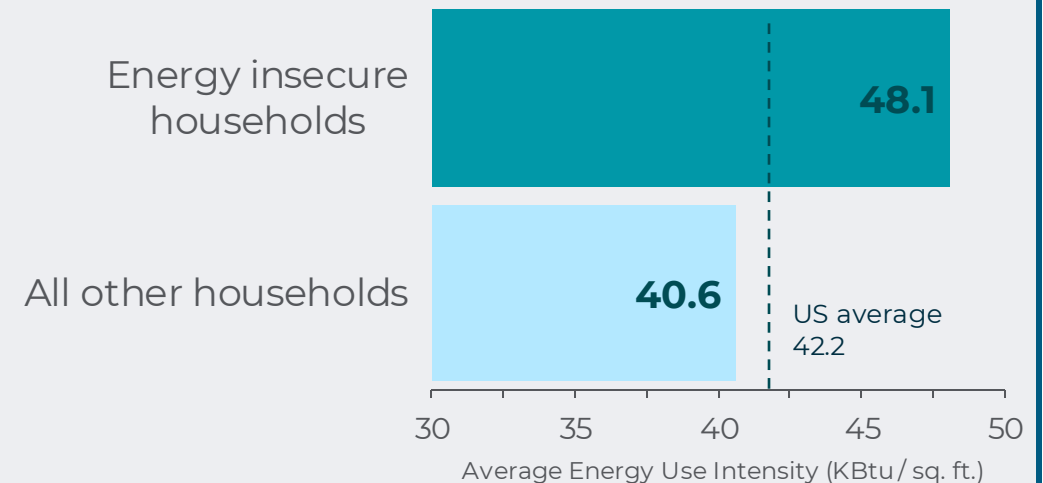
**1 in 5** households were unable to pay an energy bill in full in 2022.



## Adverse pollution & health impacts

Black children are nearly **twice as likely** to have asthma compared to the national average.

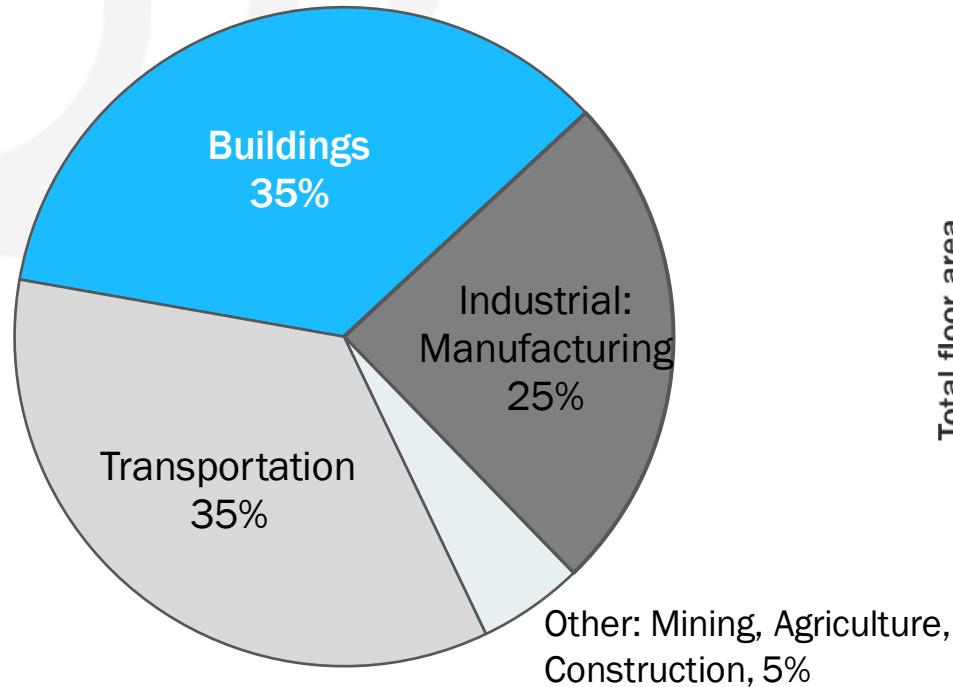
## Households that experience energy insecurity live in less efficient homes.



Source: US Energy Information Administration, 2020 Residential Energy Consumption survey

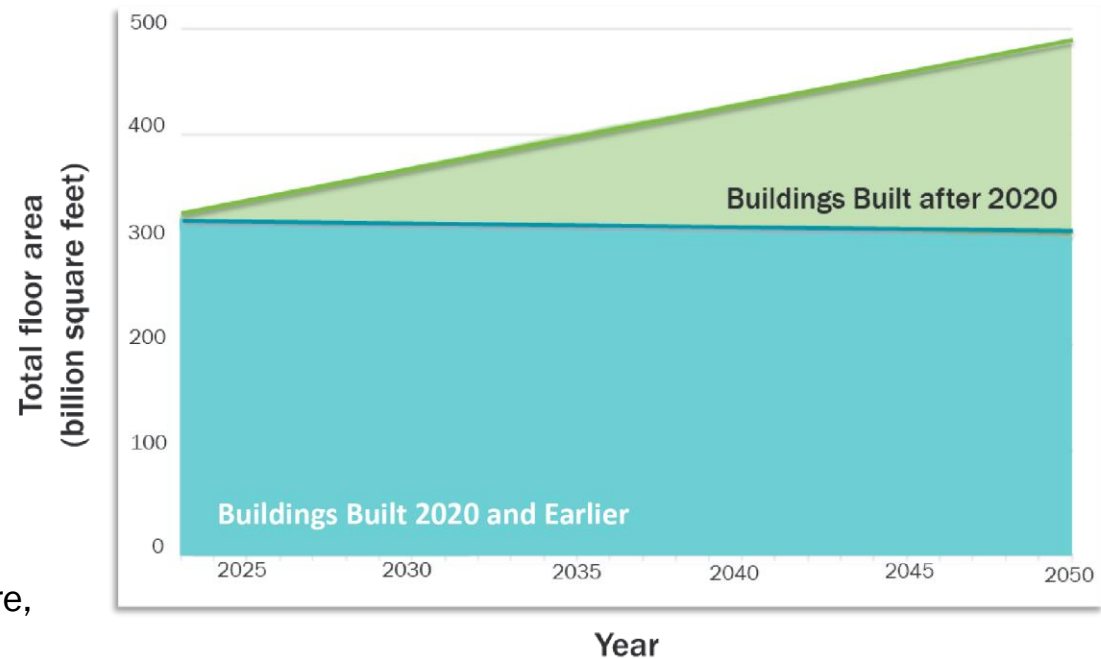
# Building Decarbonization Must Be Accelerated

Buildings are a **leading emitter of GHGs** in the United States



2020 Energy-Related CO<sub>2</sub> Emissions by U.S. Economic Sector

**Retrofits are key:** The majority of buildings that will exist in 2050 have already been built today



Source: ACEEE calculations based on data in EIA AEO 2023; LBNL Building Performance Standards Overview graphics

# Lead Target

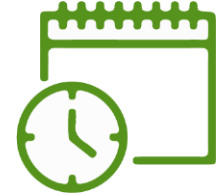
**Reduce by 50%+ the cost of retrofit packages needed to decarbonize affordable housing while lowering energy bills by 20% within a decade.**



50% lower  
upfront cost



20% lower  
energy bills






Within a  
decade

# Three Technology Areas Unlock Cost Savings and Energy Performance

Integrated designs will deliver whole-home solutions




## Building Envelope\*

Improved livability and comfort make for more resilient homes

-  Advanced leakage detection
-  Low-impact retrofit techniques
-  Panelized exterior insulation




## Efficient Electrification\*

Smaller, compact equipment and streamlined systems enable affordable and adaptable installations

-  Lower-voltage equipment
-  Plug-and-play HP designs
-  Integrated ventilation packages

## Smart Controls\*

Flexible energy loads transform homes into energy resources

-  Grid-interactive technologies
-  Smart electric panels
-  Shared circuit control between loads

\*Listed technologies are examples of what could be achieved in each area and are not representative of every solution possibility



# Example: Funding in Action

## The Buildings Upgrade (Buildings UP) Prize

Provides more than \$22 million in cash prizes and technical assistance to support the transformation of existing U.S. buildings into more energy-efficient and clean energy-ready homes, commercial spaces, and communities.

**45 Phase 1 winners** across the U.S. include:

- **Fairbanks, AK** – A program increasing access to affordable energy upgrades for low-income housing & nonprofits in Alaska on the frontline of climate change.
- **Evanston, IL** - Renovating affordable housing for climate resiliency, with focus on Black and Latin(x) neighborhoods.



**Duluth, MN**

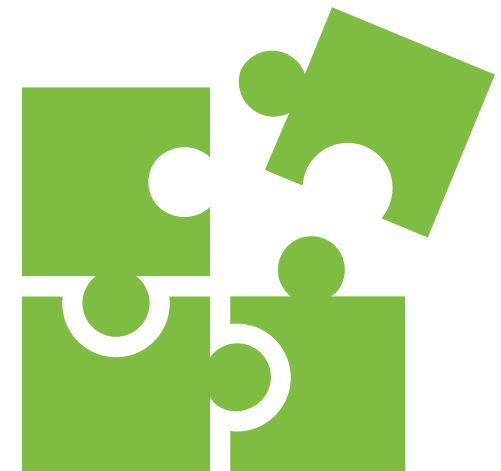


# Partner with Us!

**Connect us with your constituents, so together we can create solutions that are meeting stakeholders where they are to innovate and advance the market.**

Ways that we can work together –

- **Stakeholder Events:** can we partner with you to have them in your district?
- **Creation of a Roadmap:** we need the input of your constituents
- **Introduce Us to Constituents:** we need the hear from your constituents for their input that can inform future funding opportunities such as FOAs, prizes, etc.



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