ACEEE – Building the Industrial Heat Pumps Domestic Market

Andrew Hoffmeister
Neal Elliott
Paul Scheihing
Hellen Chen

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Smart Energy. Clean Planet. Better Lives.

About ACEEE:

The American Council for an Energy-Efficient Economy (ACEEE), is a nonprofit research organization that develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

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Presenters

Andrew Hoffmeister, ACEEE
Andrew Hoffmeister conducts research on industrial decarbonization for ACEEE's industrial team. His work focuses primarily on the analysis of emerging technologies, such as industrial heat pumps, policy research at the state, federal, and international level, and the study of other prominent decarbonization pathways, including intelligent efficiency

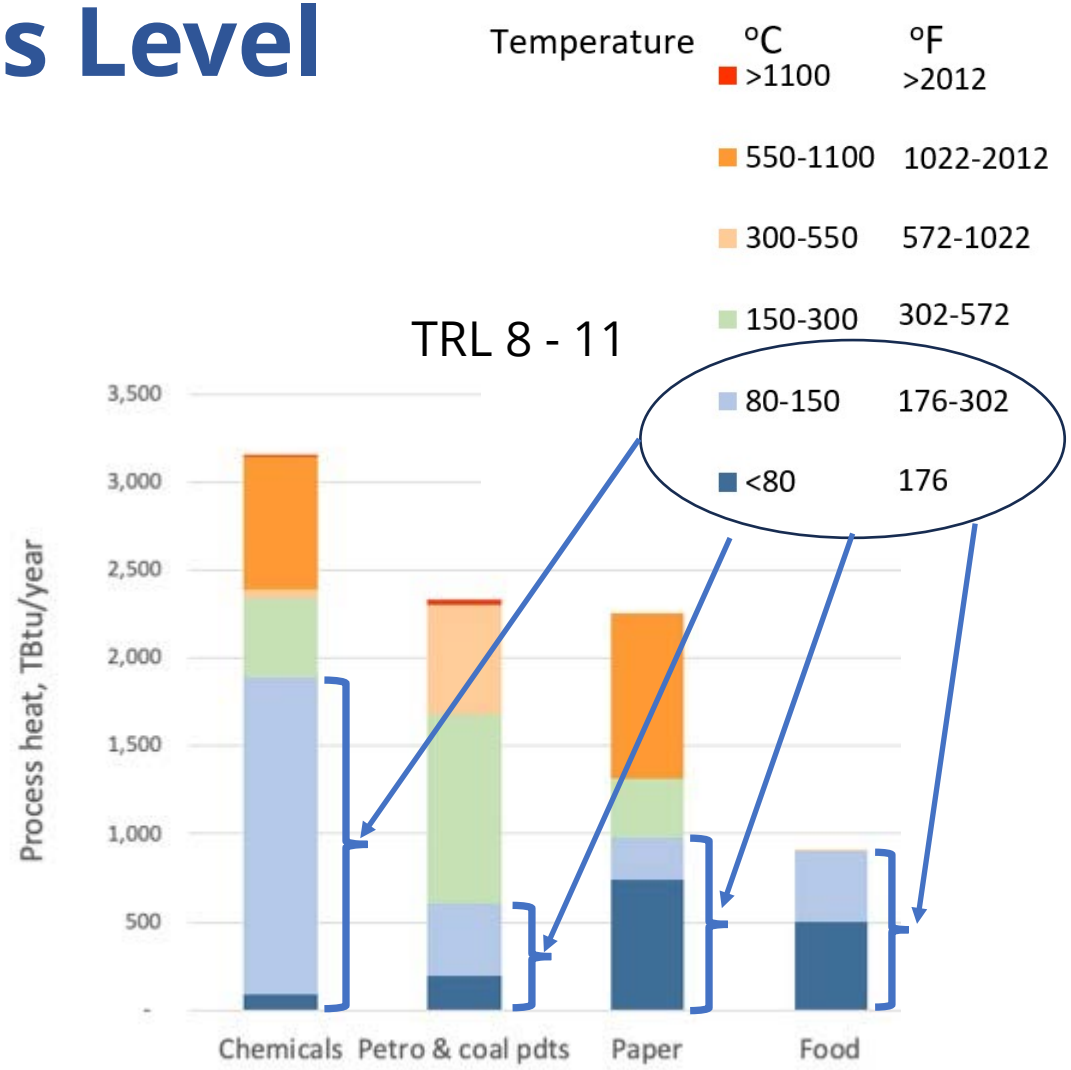
Paul Scheihing, 50001 Strategies LLC
Paul Scheihing is principal of 50001 Strategies LLC, where he provides industrial energy efficiency and energy management expertise and is a consultant for ACEEE. He previously worked within the U.S. Department of Energy Advanced Manufacturing Office for 30 years and was the lead on the Superior Energy Performance program. He has also managed many other RD&D programs including DOE's Industrial Heat Pump program from 1988 to 1995.

IHP Technology Readiness Level

Table 1.2 ▷ **Industrial heat pump technology readiness by temperature range**

Temperature range	Technology readiness level (TRL)	Example process
<80 °C	TRL 11: Proof of market stability	Paper: De-inking Food: Concentration Chemical: Bio-reactions
80 °C to 100 °C	TRL 10: Commercial and competitive, but large-scale deployment not yet achieved	Paper: Bleaching Food: Pasteurisation Chemical: Boiling
100 °C to 140 °C	TRL 8-9: First-of-a-kind commercial applications in relevant environment	Paper: Drying Food: Evaporation Chemical: Concentration
140 °C to 160 °C	TRL 6-7: Pre-commercial demonstration	Paper: Pulp boiling Food: Drying Chemical: Distillation Various industries: Steam production
160 °C to 200 °C	TRL 8-9: First-of-a-kind commercial applications for small-scale MVR systems and heat transformers TRL 4-5: Early to large prototype	Various industries: High-temperature steam production
>200 °C	TRL 4: Early prototype	Various industries: High-temperature processes

Readiness level: TRL 1 to 5 | TRL 6 to 7 | TRL 8 to 11

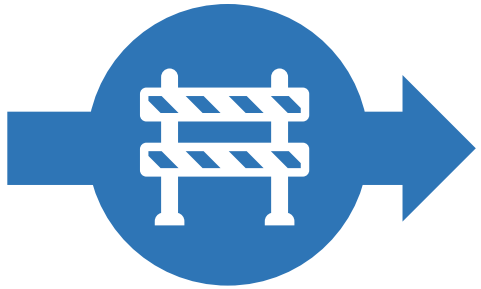


Source: World Energy Outlook

Market transformation is needed in both IHP supply and stoking demand

Where we are (2023):

- End-users have process heat needs that can be met with available IHP tech and new plants are looking to be 100% electrified and fueled by 100% carbon-free electricity
- The U.S. has fallen behind the EU and others in IHPs, industrial electrification technology and knowledge
- There is limited knowledge and experience on the application of IHPs for end-users
- There is **limited commercial product availability** of IHPs in the U.S

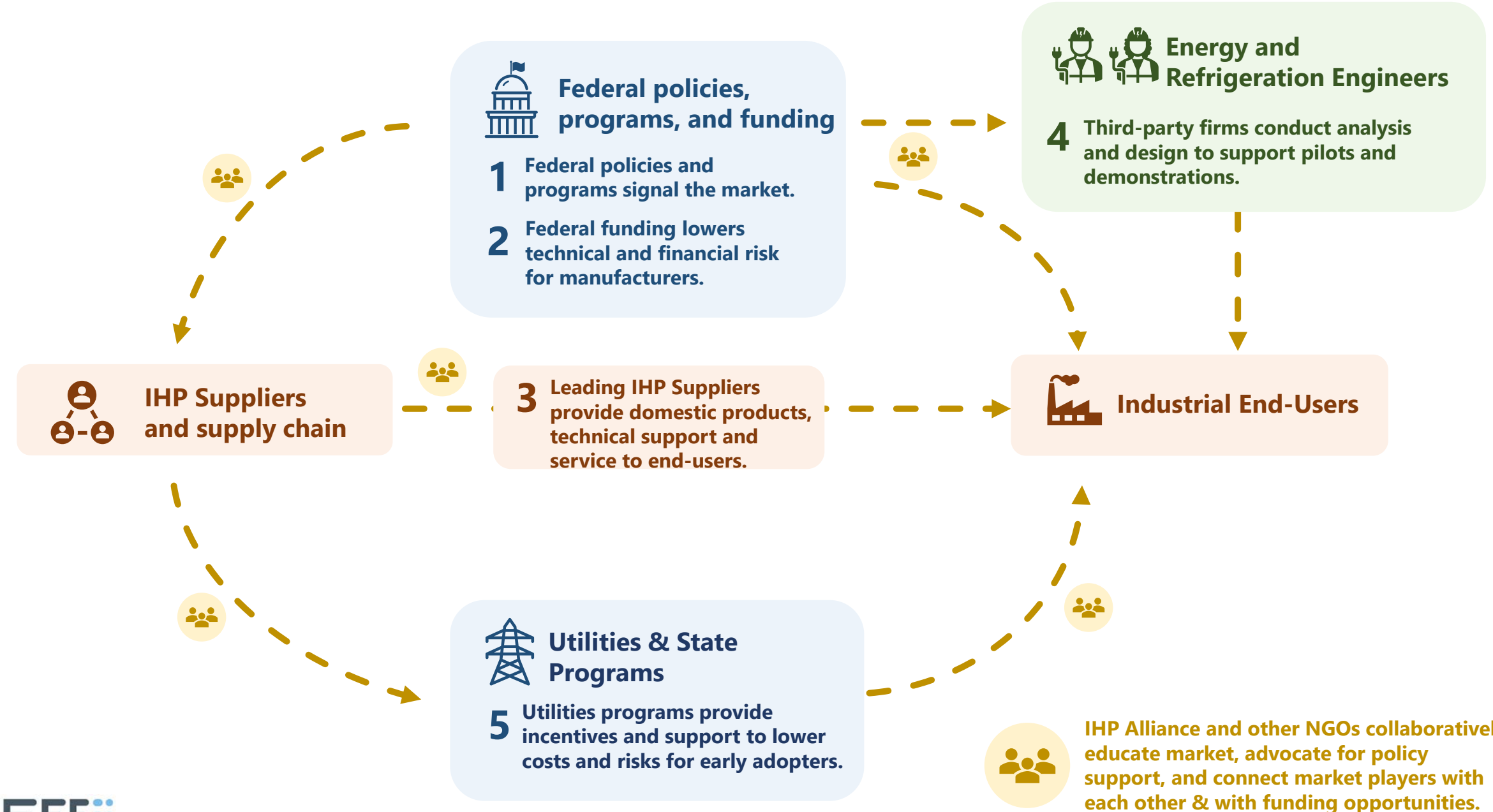


Current Barriers

Where we want to be (2030)

- IHP implementation at scale in both new and retrofitted facilities
- Decarbonization of process heat, boiler heat, enabling of integrated solutions (i.e., thermal storage, on-site renewables, smart manufacturing)
- Full market awareness of IHP potential; IHPs viewed as standard practice for process heating
- Robust domestic IHP manufacturing, value chain supported by capable workforce, creating jobs in underserved communities

How to transform the market



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Identified Barriers

IHP Supply	IHP Demand	Utility Regulators and Program Designers
Limited domestic workforce for manufacturing IHPs, handling of high-pressure refrigerants	Limited domestic IHP product and vendor support available, complicating implementation timelines	Large-scale industrial electrification not considered in current grid planning
IHP suppliers not manufacturing product at scale domestically	Lack of proven energy, GHG, and cost savings demonstrated with validated, domestic, public case studies	Few programs currently exist to incentivize IHP implementation
Codes and regulatory inconsistencies restrict importing product for pilots, and eventually for domestic manufacturing	Economic constraints for end-users, especially in retrofits and for early-adopters	Regulatory restrictions on fuel switching in some states
Perceived risk from suppliers and implementers due to lack of demonstrations and market assessments	Need for engineering and TA to support design, implementation and integration of IHPs	Need to find interested candidate sites for pilots, analysis for best opportunities

Narrative Theory of Change – Qualitative Milestones

**assumes workforce and clean electricity efforts occurring in parallel*

Key

- Overcomes utility barriers
- Overcomes supply and demand barriers
- Overcomes barriers for all

2023

- Utilities begin customer segmentation analyses
- Pilot/demonstration opportunities identified

Utilities launch incentive programs for IHP implementation

- Pilots launched by utilities with DOE TAP coordination
- Standard IHP bid spec developed

Consistent refrigerant policy developed and adopted

- Use cases and public data readily available

Accelerated IHP retrofits, thermal system redesign enabled by network of TA, engineering, robust market

EARLY ADOPTION | **EARLY MAJORITY**

Grid planning for industrial electrification begins

- Onshoring of international expertise
- Trainings offered by technical assistance hubs

2026

- End-users have trusted marketplace options for myriad applications. IHP interests met by multiple domestic bids
- Public performance data collected from pilots.

2028

- Clean electricity infrastructure sufficient for growing demand
- IHP implementation occurring in at least 50% of new greenfield facilities

2030

- 30 - 40 % market adoption of process heat applications that can be reached by available IHP technology

Emerging Focuses

- Refrigerants
  - Upcoming ACEEE LinkedIn Article, engaging with refrigeration companies, IHP manufacturers to overcome barriers
- Thermal design
  - Shift from engineering analyses predicated on steam systems and designing for maximum thermal quality/quantity, to designing for minimum thermal requirements
- Boiler decision-making timelines
  - Need to determine repair and replacement dynamics
- Pilots and demonstrations
  - Need for pilots and demos through utilities, DOE TAP territories, manufacturing facilities to build market confidence

IHP Alliance

- Assistance with utility program design
- How to leverage state policy
- Utility based pilot projects

*in addition to advocating, communicating policy action

Utilities and Energy Governance Orgs.

- Suppliers Group
- Evaluation of needs, barriers

IHP Manufactures & Suppliers

- Buyers Group
- Evaluation of needs, barriers
- Training(s) on IHP use

Industrial End-Users

Value chain

- Connection to implementers
- Connection to technical assistance measures

Energy Engineers

- Thermal analysis; what are thermal needs of each system? Re-engineering of thermal systems in retrofitting

Contact

ahoffmeister@aceee.org

hchen@aceee.org

paul.scheihing@50001strategies.com

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Upcoming conferences and resources

ACEEE Energy Efficiency as a Resource	October 16–18, 2023	Philadelphia, PA
Renewable Thermal Collaborative Summit	October 19-20, 2023	Washington D.C.
ACEEE 2024 Hot Water Forum & Hot Air Forum	March 12– 4, 2024	Atlanta, GA
ACEEE 2024 Summer Study on Energy Efficiency in Buildings	August 4–9, 2024	Pacific Grove, CA

ACEEE Refrigerants/Working Fluids Article	November 2023
ACEEE IHP Engineering and Design Principles Article	December 2023