ACEEE – Building the Industrial Heat Pumps Domestic Market

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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.

Learn more at aceee.org
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.
### Table 1.2: Industrial heat pump technology readiness by temperature range

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

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

**IHP Suppliers and supply chain**

1. Federal policies and programs signal the market.
2. Federal funding lowers technical and financial risk for manufacturers.
3. Leading IHP Suppliers provide domestic products, technical support and service to end-users.

**Utilities & State Programs**

4. Third-party firms conduct analysis and design to support pilots and demonstrations.

**Energy and Refrigeration Engineers**

5. Utilities programs provide incentives and support to lower costs and risks for early adopters.

IHP Alliance and other NGOs collaboratively educate market, advocate for policy support, and connect market players with each other & with funding opportunities.
### Identified Barriers

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

*assumes workforce and clean electricity efforts occurring in parallel

**2023**
- Utilities begin customer segmentation analyses
  - Pilot/demonstration opportunities identified

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

**2030**
- 30 - 40% market adoption of process heat applications that can be reached by available IHP technology

**Key**
- Overcomes utility barriers
- Overcomes supply and demand barriers
- Overcomes barriers for all
Emerging Focuses

• Refrigerants
  o Upcoming ACEEE LinkedIn Article, engaging with refrigeration companies, IHP manufacturers to overcome barriers

• Thermal design
  o 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
  o Need to determine repair and replacement dynamics

• Pilots and demonstrations
  o 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.

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

Industrial End-Users

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

Value chain

- Suppliers Group
- Evaluation of needs, barriers

IHP Manufactures & Suppliers

- Connection to implementers
- Connection to technical assistance measures

Energy Engineers

Suppliers Group

- Evaluation of needs, barriers

Suppliers Group

- Connection to technical assistance measures
Contact

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## Upcoming conferences and resources

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<tr>
<td>ACEEE Energy Efficiency as a Resource</td>
<td>October 16–18, 2023</td>
<td>Philadelphia, PA</td>
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<tr>
<td>Renewable Thermal Collaborative Summit</td>
<td>October 19-20, 2023</td>
<td>Washington D.C.</td>
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<tr>
<td>ACEEE 2024 Hot Water Forum &amp; Hot Air Forum</td>
<td>March 12– 4, 2024</td>
<td>Atlanta, GA</td>
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<tr>
<td>ACEEE 2024 Summer Study on Energy Efficiency in Buildings</td>
<td>August 4-9, 2024</td>
<td>Pacific Grove, CA</td>
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<tr>
<td>ACEEE Refrigerants/Working Fluids Article</td>
<td>November 2023</td>
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<tr>
<td>ACEEE IHP Engineering and Design Principles Article</td>
<td>December 2023</td>
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