



Industrial Heat Pump Market Transformation –

*Presented at the first
Industrial Heat Pumps Workshop*

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Neal Elliott
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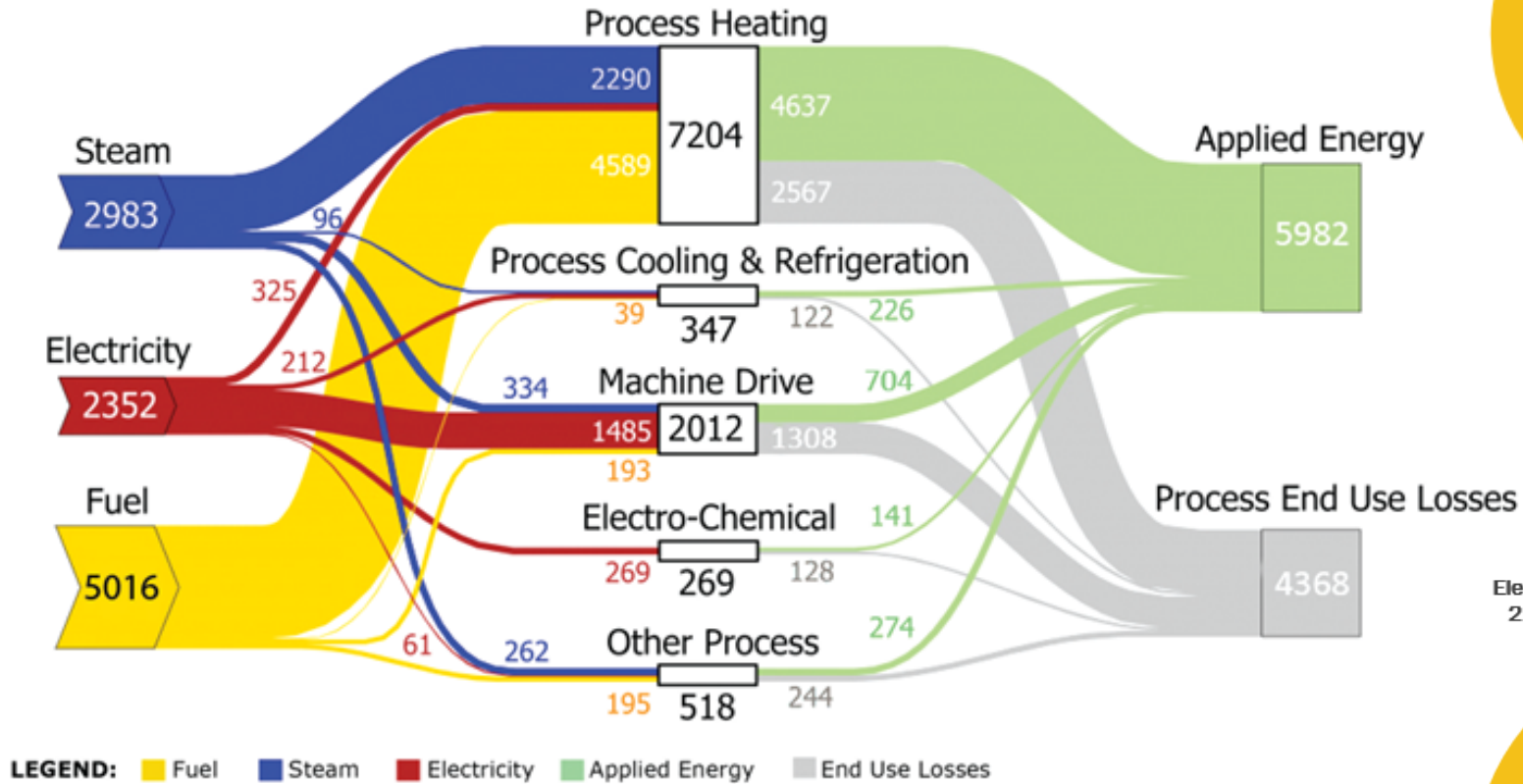
7/11/2023

Agenda

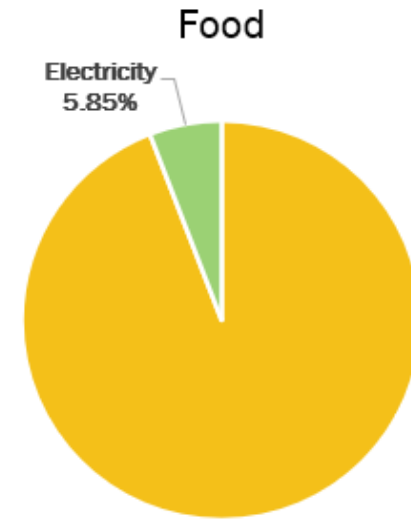
10:00–10:30 AM Pre-workshop Networking (tea and coffee served)	
10:30–10:55 AM	Welcome and Introduction
10:30–10:35	Agenda overview (Dan Brown – Cascade Energy)
10:35–10:55	ACEEE ongoing work on IHP market transformation (Andrew Hoffmeister, Neal Elliott, Paul Scheihing – ACEEE)
10:55–12:20 PM	Global IHP Experience
10:55–11:15	IHP technology readiness, economic conditions and sustainable refrigerants [VIRTUAL] (Cordin Arpagaus – Eastern Switzerland University of Applied Sciences)
11:15–11:35	EU High Temperature Heat Pump (HTHP) demonstrations [VIRTUAL] (Veronika Wilk – Austrian Institute of Technology)
11:35–11:45	Q&A for Cordin and Veronika and discussion
11:45–12:10	IEA Annex 58, HTHP applications (Benjamin Zühlsdorf – Danish Technological Institute)
12:10–12:20	Q&A for Benjamin and discussion
12:20–1:00 PM Lunch (Buffet style)	

1:00–1:35 PM Global IHP Experience (continued)	
1:00–1:25 PM	Policy learnings from Denmark on IHP support, REPowerEU Initiative (Fabian Bühler – Danish Energy Agency)
1:25–1:35 PM	Q&A for Fabian and discussion
1:35–1:45 PM	Announcement of U.S. Industrial Heat Pump Initiative and Partnerships (Nora Efram – ACEEE)
1:45–2:35 PM	Supply Chain Efforts (Initiative Partners)
1:45–2:00	Renewable Thermal Collaborative (RTC) and IHP user perspectives (Blaine Collison – David Gardiner & Associates)
2:00–2:15	National Electrical Manufacturers Association (NEMA), and IHP manufacturer perspectives (Steve Griffith – NEMA)
2:15–2:35	Q&A for Blaine and Steve and discussion
2:35–3:00 PM Networking Break (coffee and cookies served)	
3:00–3:40 PM	Utility Perspectives
3:00–3:15	Electric Power Research Institute perspective: challenges, district heating, drying applications. (Ammi Amarnath – EPRI)
3:15–3:30	Utility perspective: ongoing work, learnings from customers (Chase Cortner – Southern Company)
3:30–3:40	Q&A for Ammi and Chase and discussion
3:40–4:20 PM	Policy Support and Federal Investment
3:40–4:10	Department of Energy's ongoing effort: IHP R&D, upcoming funding opportunities, Industrial Heat Shot , Electrified Processes for Industry without Carbon (EPIX) Institute (Yaroslav Chudnovsky – DOE)
4:10–4:20	Q&A for DOE and discussion
4:20–4:50 PM	Energy Engineering perspectives
4:20–4:40	Need for implementers, engineering, regionality, early pathways (Steve Koski– Cascade Energy)
4:40–4:50	Q&A for Steve and discussion
4:50–5:00 PM	Wrap up: summary, next steps, upcoming work products and events (Andrew Hoffmeister, Neal Elliott – ACEEE)
5:00 PM Adjourn	
5:00–7:00 PM ACEEE Summer Study Welcome Reception for conference attendees	

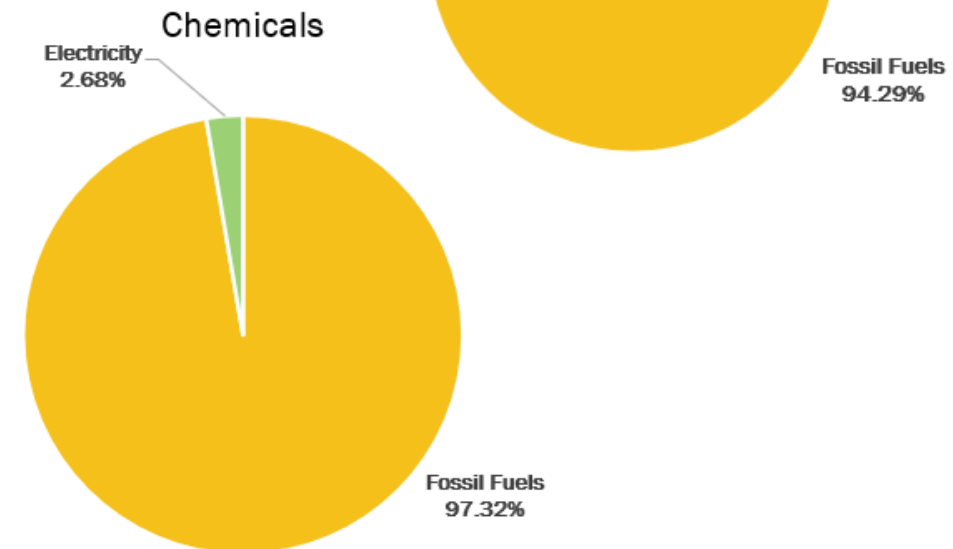
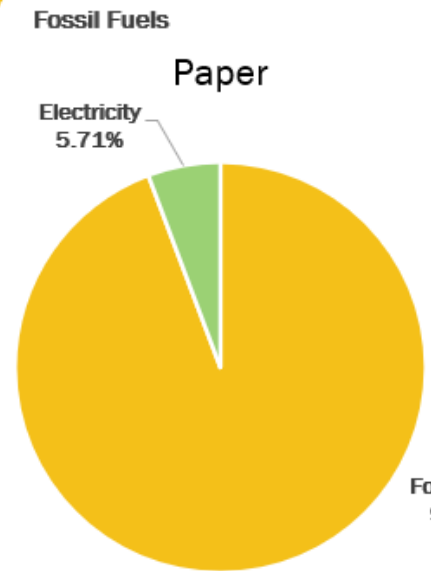
Process Heat Accounts for Most (~70%) Industrial Energy Use



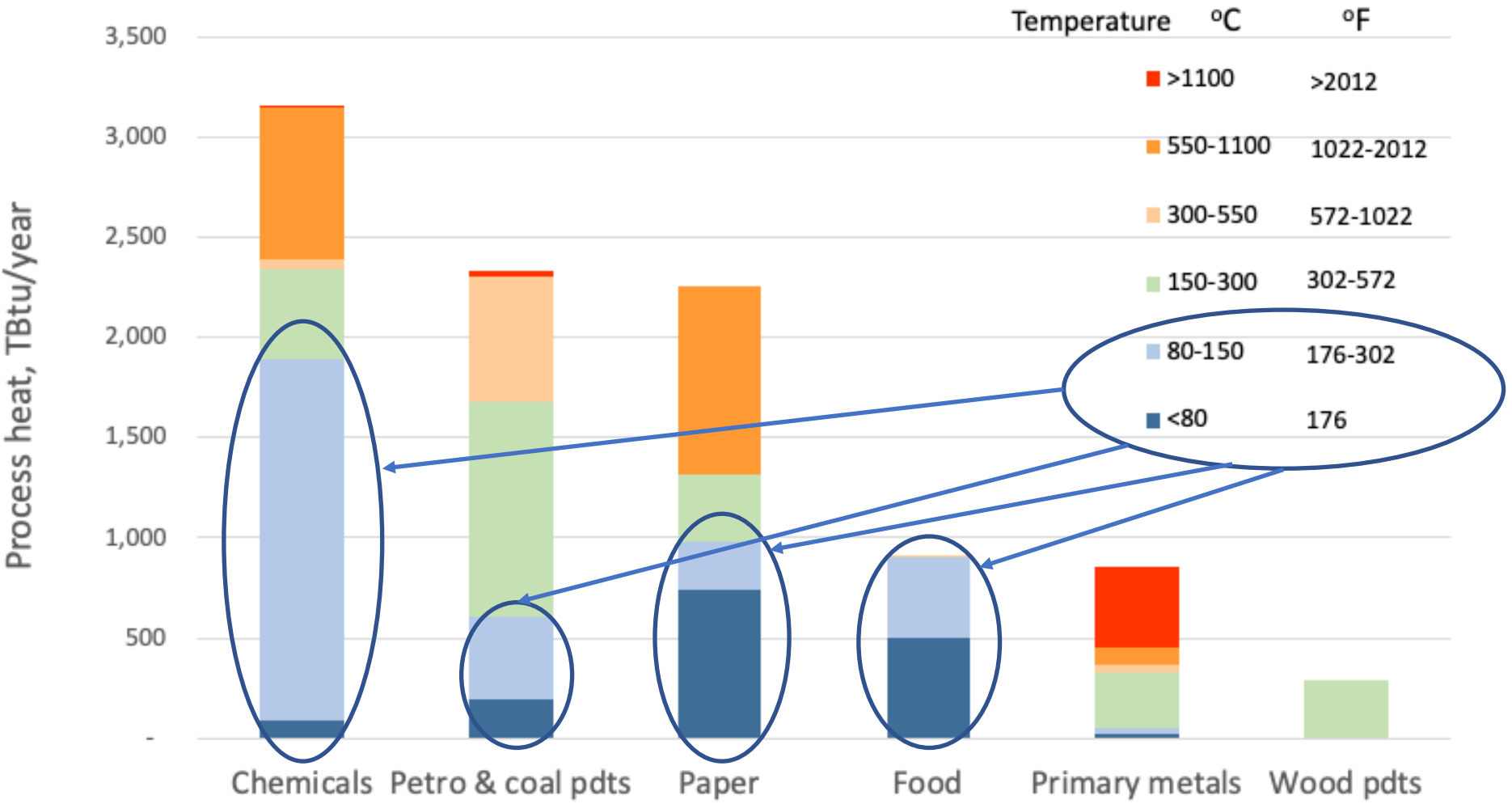
U.S. Manufacturing Sector Process Energy Flow in 2010



*Process heat fuel consumption for key industries

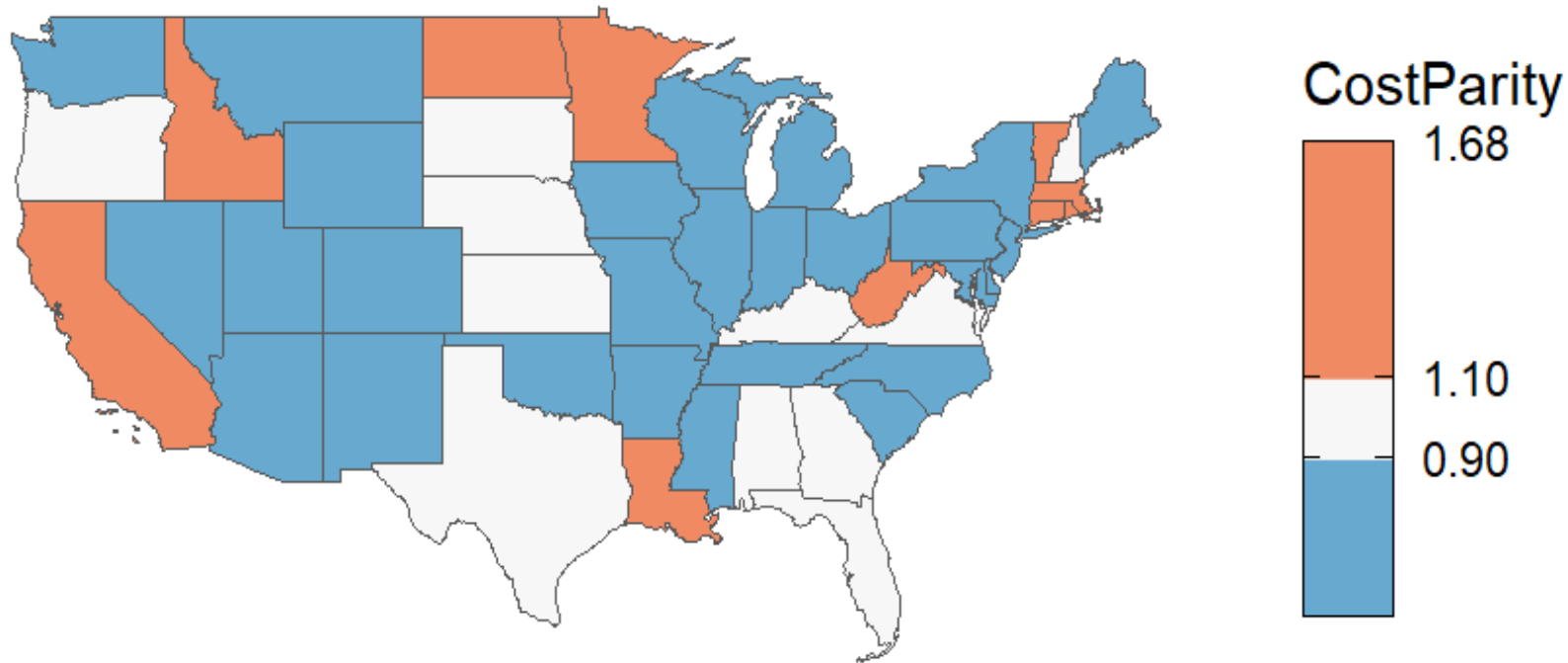


Significant Industrial Process Heat is at or Below 150 °C



Data Source: McMillan 2019

Many States have Favorable Cost Parity for IHPs



- Blue states indicate areas where operating an industrial heat pump is likely more affordable than running a natural gas-powered equipment
- Based on electricity/natural gas ratios
- Assumes a COP of 4.0

IHP Research Phase 1: Opportunity Scouting

- Process heat: 51% of industrial on-site energy use. The large, early, cross-cutting GHG reduction opportunity
- Three industry groups -good early focus for IHPs, as they have high amount of process heat < 200° C
 - Food & Beverage
 - Pulp & Paper
 - Chemicals
- IHPs research shows combined potential impact of;
 - Net energy savings 26-32% (427-518 TBtus/year)
 - CO₂ savings 30-43 million tons/year
 - Simultaneous cooling needs met
 - 5 GW-hour/year electricity needed
- Simple paybacks can be under 2 years, depending on electricity/ natural gas price ratio
- Policy enablers can accelerate adoption



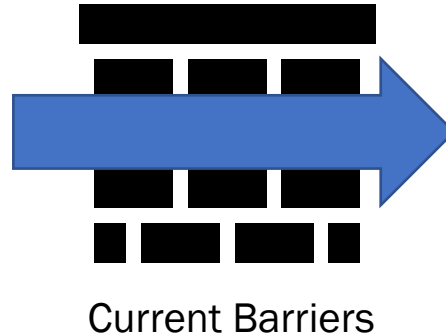
Report: <https://www.aceee.org/research-report/ie2201>

Website: <https://www.aceee.org/industrial-heat-pumps>

Market Transformation is Needed in both Supply and Stoking Demand

Where we are:

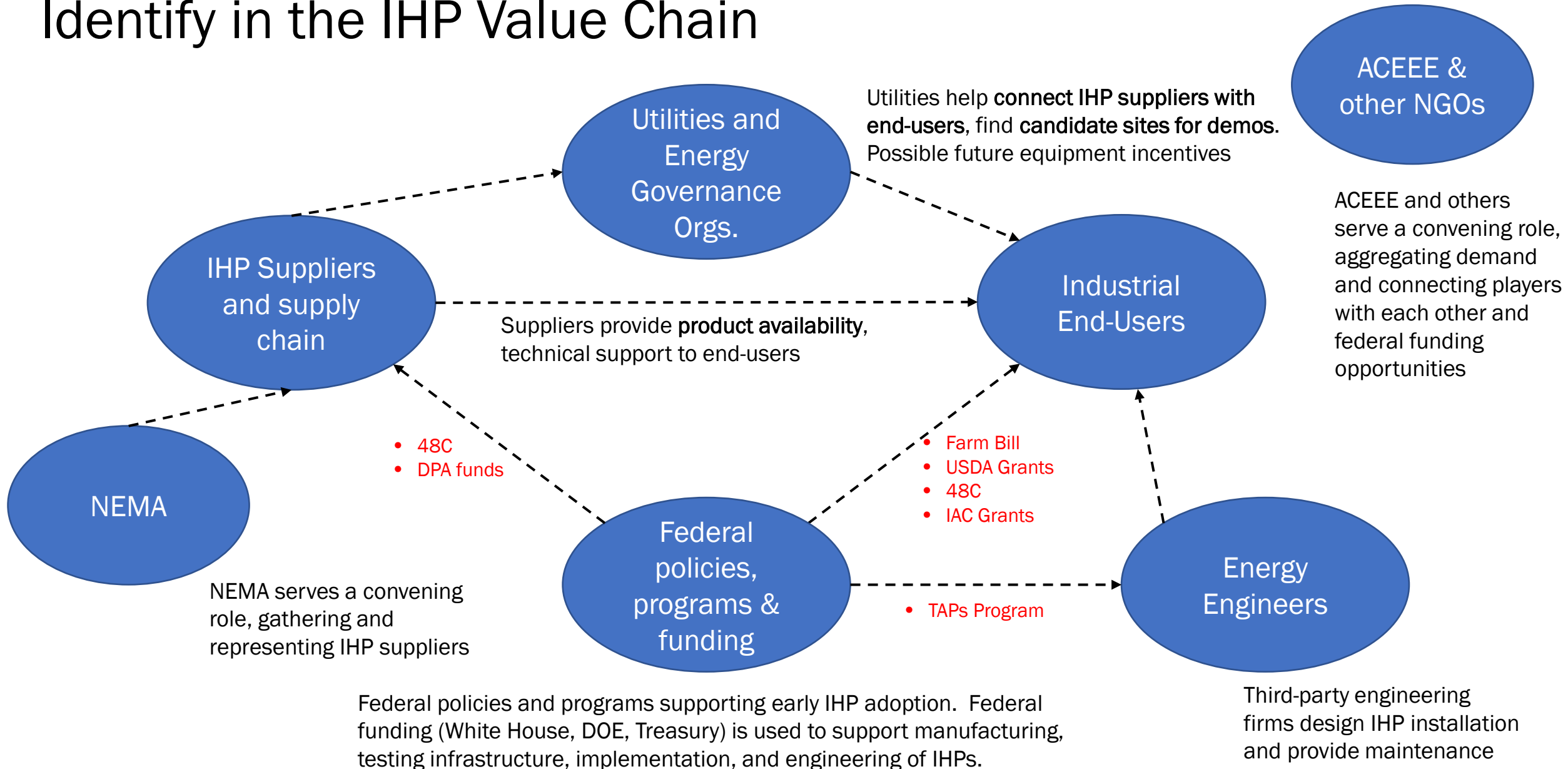
- End-users have process heat needs that can be met with available IHP tech
- There is **limited commercial availability** of IHPs in the U.S.
- The U.S. has fallen behind the EU and others in IHPs, industrial electrification at large
- New plants are looking to be fueled by 100% carbon-free electricity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



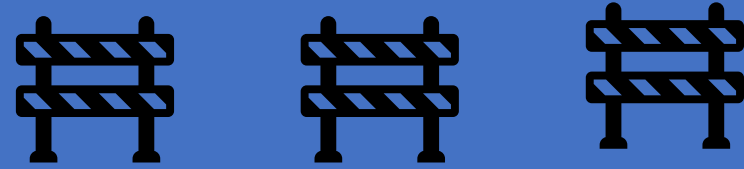
Where we want to go:

- Robust domestic IHP market supported by capable workforce
- IHP implementation at scale in both new and retrofitted facilities
- Decarbonization of process heat, enabling of other solutions (I.E., thermal storage, on-site renewables)
- IHP manufacturing and implementation support equity, create jobs in underserved communities
- Full market awareness of IHP potential

There are Important Stakeholder Interconnections to Identify in the IHP Value Chain



Highlighted Barriers



Supply Side:

- Workforce gaps
- Intellectual property constraints on IHP components
- Large manufacturers not operating domestically at scale
- Codes and regulatory constraints
- Perceived risk from suppliers, implementers w/out demonstrations/market assessment

Demand Side:

- Limited domestic IHP product availability
- Lack of demonstrated energy/GHG and cost savings
- Lack of knowledge of opportunity
- Limited current vendor support for international product
- Need engineering to support implementation and integration at end-user facilities
- Resource adequacy - supply of electricity
- Economic constraints for end-users, large capex investment
- Fuel switching

Ongoing ACEEE Work to Help Overcome Barriers

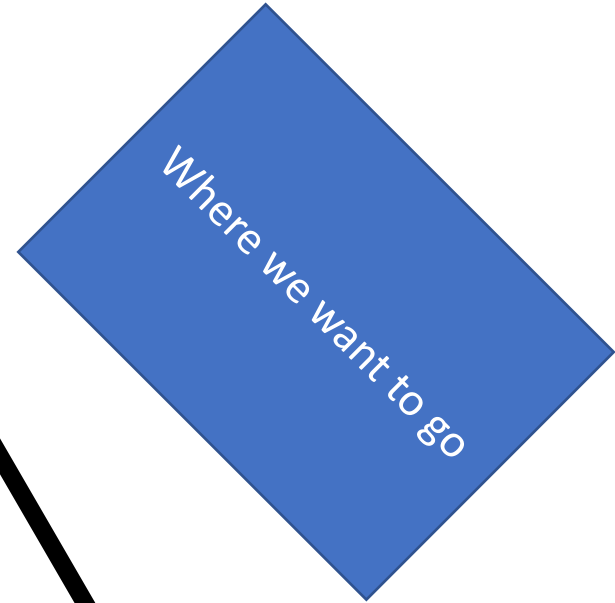
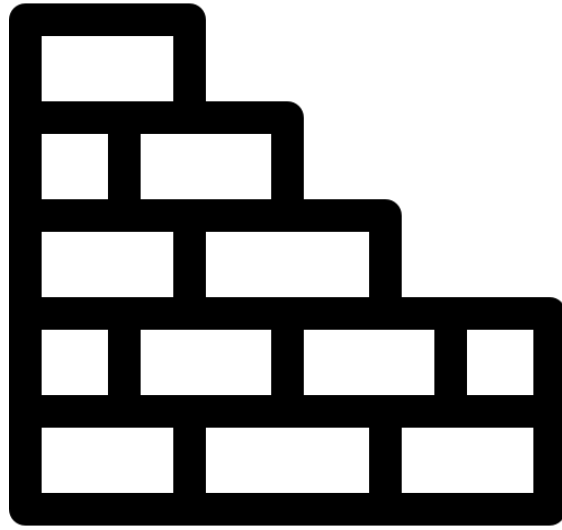
Supply Side:

- ACEEE and partners are engaging with DOE, White House, Treasury, and other possible sources of federal funding to:
 - **outline the most significant barriers IHP manufacturers face in increasing domestic production, and possible enablers**
 - connect players with funding opportunities (FOAs) as we gain understanding
- Identifying contacts with IHP suppliers for further collaboration, NEMA
- ACEEE response to RFI on DPA co-funding for heat pumps

Demand Side:

- ACEEE is engaging with utility sponsors, creating IHP pilot projects for end-users in their service territories
- ACEEE is engaging with the Renewable Thermal Collaborative and their network of end-users

*Pilots give proof of concept & build knowledge base in the marketplace for both suppliers and end-users



*Combination of policy action & connection of key supply chain actors



Use of DOE's IACs and TAPs program for implementation assistance and maintenance

Alleviating codes constraints for IHP components and refrigerants

Creation of a national industrial heat pump test facility

Co-funding opportunities for demonstrations

Utility programming in support of IHP implementation

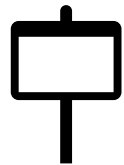
National trainings on opportunities for engineers, others

Next Steps

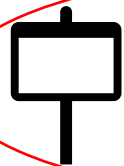
Understanding of barriers, coalition, alignment on consistent messaging

Communicating priorities, identifying best pathways for mitigating barriers

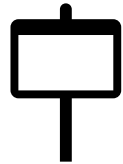
Affecting action, demonstrations, funding



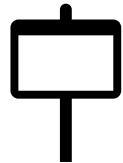
ACEEE, NEMA, RTC IHP Initiative



IHP Workshop at ACEEE Summer Study



Convening of stakeholders from across IHP value chain



Public event for stakeholders to commit to accelerating US IHP market



Congressional briefing/hearing On IHPs



Advancing installed IHP capacity and pilots

Key Outcomes

Upcoming Events and Resources

- ACEEE IHP report: <https://www.aceee.org/research-report/ie2201>
- ACEEE IHP website landing page: <https://www.aceee.org/industrial-heat-pumps>
- RTC industrial electrification report: <https://www.renewablethermal.org/electrifying-us-industry/>
- RTC suite of three Heat Pump Decision Support Tools: <https://www.renewablethermal.org/heat-pump-decision-support-tools/>
- Australian Alliance for Energy Productivity's online heat pump estimator: <http://www.heatpumpestimator.com/>
- LBNL Electrification of U.S. Manufacturing With Industrial Heat Pumps report: https://eta-publications.lbl.gov/sites/default/files/us_industrial_heat_pump-final.pdf
- Next IHP workshop at ACEEE's Energy Efficiency as a Resource Conference in October



Questions?