Friday, December 6, 2024

Illinois Commerce Commission (ICC) Future of Gas Pilot Ideas

ICC Staff is implementing a pilot development process with interested stakeholders, to explore the advisability and parameters of potential pilots. This process is being introduced as part of the ICC Future of Gas Workshops. This is an opportunity for any interested party to propose pilot ideas for ICC Staff to consider. This is a process to generate ideas; ICC Staff recognizes ideas may need further discussion and development.

Deadline

Pilot ideas are due no later than Friday, December 6, 2024.

Questions

Please direct any questions about pilot development to: Jim Zolnierek, Bureau Chief, Public Utilities, Illinois Commerce Commission (Jim.Zolnierek@illinois.gov) or 217-785-5278

Submitter Information

Name of Submitting Company or Organization	American Council for an Energy-Efficient Economy (ACEEE)
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If the idea is submitted jointly by more than one company or organization, identify the additional submitters:	Hellen Chen, Archie Fraser (ACEEE), Graeme Miller, Cliff Haefke, Ben Campbell (UIC ITAC/TAP), Nicholas Crowder (Ameren IL), Brent Nakayama, Thomas Tyler (Ameren/Leidos).

Description of Pilot Concept

Title of Pilot Concept	Industrial Heat Pump Cohort
Which Illinois utility would the pilot idea apply to? Hold the "crtl" key to select more than one.	Ameren Illinois (joint gas-electric) ComEd (electric only) MidAmerican Energy (joint gas-electric) Mt. Carmel Public Utility Co. (joint gas-electric) Nicor Gas (natural gas only)

Identify the category of the pilot concept. Hold the "crtl" key to select more than one.

Electrification | Energy Efficiency | Other

If the "Other" category was selected, please explain:

Waste heat recovery: for sites that have simultaneous heating and cooling, there is potential to reuse waste heat for another process using an industrial heat pump (IHP). In these cases, there is also an opportunity to do a pinch analysis to optimize heating/cooling efficiency. Pinch refers to the narrowest point or area where a hot stream and cold stream meet, indicating the optimum area for heat exchange between the streams.

For more information, please see Natural Resources Canada's Pinch Analysis Guide here: https://natural-resources.canada.ca/energy-efficiency/data-research-insights-energy-efficiency/commercial-industrial-innovation/industrial-systems-optimization/process-integration-and-pinch-analysis/pinch-analysis-guide/pinch-analysis.

Identify key technologies involved in the idea and any technical criteria:

IHPs are a critical technology for de-fossilizing industrial process heat and creating non-energy benefits, and the food and beverage industry represents an excellent opportunity to demonstrate that potential at scale because of its simultaneous heating and cooling needs and high replicability.

An IHP is an electrically or mechanically driven system that uses the same cycle as a refrigerator or domestic HP, i.e., evaporation of a working fluid to draw in heat, compression of vapor for transfer, condensation to release heat, and expansion to prepare for the next round of evaporation, replacing primarily fossil fuel sources like natural gas boilers. Industrial scale heat pumps are larger than 100 kW in capacity and deliver temperatures from a lower heat-source temperature to a heat-sink temperature greater than 150 °F (65 °C). IHPs reduce energy use and emissions when the benefits of reusing waste heat are greater than the energy needed to run the heat pump. Typically, IHPs deliver three times more process heat than the energy required to drive them (this ratio is called the coefficient of performance or COP). IHPs are unique because:

• They are one of the few decarbonizing technologies that is ready for deployment at scale but currently underutilized.
• They are one of few economically viable pathways to mitigate emissions from industrial process heat, which typically accounts for over 50% of on-site industrial energy use.
• They enable thermal systems to move to more efficient designs—from prevailing approaches that use maximum requirements for quality/quantity to new, optimized approaches that start with minimal requirements.

The below list illustrates project goals and targets. The selected baseline performance will be specific to each pilot site and be compared to a business-as-usual thermal system using hot water generators or boilers powered by natural gas or propane. A facility baseline for similar process and size will be used for any newer builds, while retrofits will be compared to previous system performance. We will achieve these targets by working closely with engineers to perform thermal analyses, helping sites select the most cost-effective components for systems, and using available data from each project to streamline future implementations.

• Analyze and improve payback period considering quantified co-benefits, funding, clean energy: minimum target <6 years, stretch target <4 years
• Coefficient of performance (COP) at highest supply temperature: min target +1 COP from base case, stretch +3 COP
• Energy reduction for thermal process (e.g., boiler/fossil fuel replacement) [% reduction in energy consumed for overall facility]: min >15%, stretch >40%
• Yearly energy cost reduction [% reduction due to cost of electricity over fuel]: min >15%, stretch >40%
• Cohort members: min 5, stretch 15

Purpose of Pilot Concept and Key Considerations

Provide a description and rationale for the idea. What is the general purpose and benefits of this pilot?

Industry is historically an underserved sector by energy efficiency and decarbonization programs. There are significant quick wins to be accessed by the emerging market capacity of electric technologies like IHPs. Electrification investments will future proof the industrial sector for the clean energy transition, ensuring long-lasting jobs and equitable outcomes.

The project aims to create a cohort of 5-15 IHP pilot sites in the food and beverage industry, accelerating the market readiness of a critical decarbonization technology in an important sector of the IL economy. We will use this funding to form and manage the cohort, connect it with resources, and use its experience to provide research that supports implementation. We will engage with a group of end-users, including those with steam and hot water needs, and connect them with the technical assistance, funding opportunities (federal, state, and utility), IHP equipment, thermal analysis, and vendor support needed to pursue robust pilots. We will research savings potential, set targets (including payback periods, coefficients of performance, emissions reductions, energy savings, etc.), support implementation, and release public-facing data to compare with legacy fossil-fuel boiler and process heat systems.

Funding will help us gather an IHP cohort, facilitate research, and assist IHP pilot sites in accessing project funding to offset capital costs, reduce perceived risks, and build knowledge and trust in the IHP marketplace. Additionally, utility programs will use the cohort results to expand their support for IHPs, thus increasing GHG reductions in process heat while exploring additional pathways such as clean energy and thermal storage. While ICC funding could be used to fund the cohort management and activities, we envision utilities, in conjunction with other funding mechanisms such as grants and loans, to be used to fund the actual deployment of IHPs for projects, in addition to some cost-share from implementing facilities. This may lead to utility ownership of IHP equipment within facilities to help de-risk the technology, similar to an Energy-as-a-Service model. The cohort approach is innovative and critical because of the lack of public IHP pilots in the U.S., and demonstrations are urgently needed if IHPs are to be part of the clean-energy transition.
The food and beverage industry is an excellent proving ground for IHPs for the following reasons:

• Fossil fuel displacement. According to the U.S. Energy Information Administration's 2018 Manufacturing Energy Consumption Survey, electricity supplies only about 5.8% (11 TBTUs) of process heat in food and beverage manufacturing applications, while natural gas supplies approximately 86% (162 TBTUs). In the Midwest census region, across all manufacturing, electricity supplies 10.8% of process heat (112 TBTUs), while natural gas supplies 78.8% (813 TBTUs). IHPs have the potential to electrify much of this energy demand. Additionally, industrial process heat alone accounts for about 25 MMT CO_2e in Illinois, which is approximately 14% of the state's total energy related emissions. Shifting industrial energy demand from natural gas to low carbon electricity can offset much of these emissions.
• High efficiency. Case studies in the International Energy Agency's (IEA) High Temperature Heat Pump Annexes suggest food processing applications of IHPs can reduce energy consumption by more than 40% by recovering and reusing waste heat from cooling for pasteurizing and cleaning, at coefficient of performance (COP) ranges from 1.8 to 5. Proving COPs at this level will encourage the entire industry to move to IHPs.
• Flexible applications and sources. Within food and beverage facilities, IHPs can provide low-pressure steam, which is a major energy consumer in food processing applications, in addition to heat. This displaces legacy systems (often boilers used for pasteurization, cooking, and deodorizing) and offsets flue gas losses. System efficiency can be increased by capturing process heat or cooling waste from driers and refrigeration equipment to generate additional sources of low-pressure steam or hot water. By linking the thermal energy of different operations across a facility, IHPs enable facility operators to maximize their energy and cost savings and improve overall system efficiency.

We plan to organize an end-user cohort with the support of Illinois Milk Producers Association, Illinois Manufacturers Association, and other similar entities. This project has the potential to unlock easily accessible and replicable cost and energy savings opportunities for farmers and food processing facilities. Moreover, the pilot cohort can scale IHPs in many industrial applications by providing a model that can be extrapolated to other low-to-medium process heat applications (e.g., 65-130 °C or 150-265 °F) to accelerate decarbonization (more example processes listed in Addendum). These IHP opportunities exist across industry, especially in cleaning, drying, preheating, pasteurization, distillation, steam generation, and hot water production. District heating is also an opportunity for IHPs due to the process overlap between building and industrial heating that could inform the implementation of heat pumps in commercial and institutional building applications.

Identify any example(s) of similar pilot concepts.

Our cohort concept aims to replicate the functions of Strategic Energy Management (SEM) cohorts or ISO 50001 Ready cohorts. SEM cohorts are based on peer-centered learning between a small group of non-competitive industrial customers. These programs typically provide workshop, training and coaching to build not only energy savings for the facility but also contribute to continuous improvement and stakeholder engagement. More information about this model can be found here (http://www.cascadeenergy.com/wp-content/uploads/2015/05/1_Overview-of-SEM-Cohorts1.pdf), which presents the list of participating utilities and incentives as well as information on the SEM cohort process. Similarly, the U.S. Department of Energy (DOE) has also provided technical assistance and cohort support for the International Organization for Standardization's Energy Management System Standard, also known as ISO 50001. The groups consist of energy team members from various U.S. sectors: industrial, commercial, and institutional, who can receive up to a year of support from national experts through monthly training and coaching, as well as access to a variety of resources and tools, including peer-to-peer learning (Source: betterbuildingssolutioncenter.energy.gov/sites/default/files/DOE_50001-Ready_Cohort.pdf).

Explain how existing programs / incentives / projects would interact with the pilot concept.

The IHP cohort will be led by ACEEE, whose primary role is to gather and share data from the following primary cohort activities: thermal analysis, opportunity identification; community engagement, incorporation of diversity, equity, inclusion and accessibility; pilot groundwork, and connection to supply chain resources. Supply chain resources include the IHP Alliance network, technical assistance e.g., through the DOE Industrial Training and Assessment Center (ITAC) and the DOE Onsite Energy Technical Assistance Partnership (TAP), and funding streams through state, utility, and/or federal agencies. ACEEE plans to use the networks of the IHP Alliance to gather input from IHP suppliers through our partners at NEMA and potential IHP end-users through our partners at the RTC. The Partners in the cohort, including the Energy Resources Center located at the University of Illinois Chicago (UIC), Ameren Illinois, and Leidos, will bring electrification expertise, research support, and industry engagement. Partners will work on accelerating market adoption rate, offer consultation and recommendations, run regional pilots, incentivize and recruit, as well as focus on workforce development. Cohort activities may also include site specific energy model development, treasure hunts to identify and estimate energy and cost savings, and performance tracking. We will leverage contacts with the DOE ITAC/TAP at UIC to inform IHP implementation for their clients with low-to-medium process heat needs, including applications for ITAC Implementation Grants.

Describe the potential timeline and any other implementation considerations.

Preliminary project timeline:
The project will span four years and will be primarily focused on assisting with the establishment of 5-15 pilot sites. Our main activities will include consistent meetings to discuss facility engineering and/or redesign, product selection and integration, personnel training on proper installation and maintenance, and other facility infrastructure upgrades in collaboration with utility partners. These activities will address key technical issues and risks by minimizing downtime for retrofits, optimizing waste heat recovery, right-sizing of IHP systems to meet thermal load requirements, and ensuring access to adequate and low-cost electricity. Project milestones include:

- Year 1: Partner and cohort identification, including outreach and IHP training.
- Year 2: Pilot planning, connections to resources, and equipment purchase.
- Year 3: Implementation and integration.
- Year 4: Data collection, analysis, and case study public release.

Other considerations:

Illinois goals:
Our project is aligned with the Illinois Department of Natural Resources goal of reducing the state's carbon emissions to net-zero by 2050, the Regional Industrial Decarbonization Program identified in the Illinois Priority Climate Action Plan, and the Clean Industry Concierge initiative. We believe this cohort project

focused on industrial electrification will provide proving ground for further action to complement those set by Governor Pritzker toward 100% clean energy by 2050. According to the U.S. Department of Agriculture, Illinois is ranked 5th in number of food and beverage manufacturing establishments at 1,693 facilities (as of 2022). Our cohort approach to food and beverage electrification will simplify IHP integration for other facilities with similar process heat needs. These case studies will help drive market transformation by presenting practical ways to integrate IHP technologies into facilities and providing real-world, domestic, and public data for review by other interested end-users and implementers. IHPs also accelerate industrial competitiveness through the numerous co-benefits they enable, including process modularity, reduced pollutants, future proofing, cost savings, and enhanced product quality. Additionally, with chemicals also contributing largely to IL manufacturing GDP and being another subsector for which IHPs could be deployed, the cohort idea can be expanded beyond food and beverage to start decarbonizing other large industrial subsectors in the IL economy. Illinois' place at the forefront of this technology's market development will ensure a competitive edge for Illinois industrials, long-lasting jobs, and environmental justice for communities in close proximity to manufacturing facilities. Our engagement with both IHP suppliers and end-users suggests a main policy priority should be support for demonstrations, and we see utilities as a main actor in providing incentives for IHP projects.

With carefully measured costs and savings, it will also be possible to add industrial heat pumps as a unique measure to the Illinois Technical Reference Manual (TRM). This will help standardize the energy savings methodology to reflect the unique characteristics of IHP applications. While the current TRM includes measures for residential heat pumps and geo-thermal heat pumps, and allows for custom energy efficiency measures, the inclusion of a separate IHP measure will demonstrate the specificity and replicability of such projects. It will also allow developers to calculate the level of incentive with greater surety which will further reduce barriers to deployment.

Equity considerations:
We anticipate many pilot sites will be in rural areas, some of which may fall within R3 (Restore. Reinvest. Renew) communities who have experienced disinvestment. Agriculture is another sector historically underserved in terms of electrification and energy efficiency, and their energy resources are subject to significant price volatility. With IL's focus on equity and environmental justice, we commit to ensuring that the co-benefits of IHPs reach beyond our pilot sites through comprehensive engagement with the surrounding communities. We will fully utilize existing resources such as institution-wide diversity, equity, inclusion, and accessibility programs to guide our activities, focusing on local partnerships, inclusion of small to medium businesses, and workforce development.

Addendum:
The American Council for an Energy-Efficient Economy (ACEEE), with decades of experience in market transformation and a long-standing Industry Program, bridges the gap between technology, policy, and the market through research. ACEEE's decarbonization goals include a net zero industrial sector by 2050 while bolstering economic growth, jobs, equity, emissions reductions and public health. ACEEE supports solutions that are inclusive as the U.S. transitions to a green economy, working closely with community-based organizations and providing equitable strategies to cities, states, utilities, and federal agencies.

The University of Illinois Chicago (UIC) Energy Resource Center Team (ERC) has extensive collaborative activities with food companies in developing electric technologies for food preservation. It has a strong track record in providing technology transfer bootcamps and hands-on training workshops. The ERC is a leader in helping the Midwest food industry implement energy efficient technologies (e.g., pumps, heating, ventilation) supported by various DOE and state programs (e.g., ITAC and Midwest TAP).

Ameren Illinois, our utility partner, has extensive experience in bringing emerging technologies to market and conducting demonstrations with utility customers and a focus on electrification. Ameren supports currently ongoing explorations of heat pump applications for industrial customers. Leidos leads the commercial and industrial custom energy efficiency programs for Ameren Illinois. Their team has years of expertise in energy management technology, industrial operations, and food processing.

Potential applications for IHPs (Source: IEA Annex 58, HTHP-symposium.org)
Food:
o Slaughterhouses: steam and hot water for cleaning
o Starch drying: air preheating for steam generation

o Sugar industry: process heat between 80-150°C for sugar beets, steam generation for production of 90 °C feed water
Beverage:
o Bottles and wine tanks: hot water & steam for washing, sterilizing during bottling
o Breweries: Process heat of ~100 °C for brewing process (e.g., wort boiling)
Pulp and paper: Drying - low-pressure steam from cooling water of humid exhaust air
Lumber: Wood drying: air heating to 120 °C with moist exhaust air
Chemicals: Steam 120 °C for alcohol distillation using waste heat of cooling tower or condensation heat of distillation column
Plastics: PET bottles: process heat between 80-150 °C for injection molding
Other:
o Drying of animal fodder: low-pressure steam for chamber dryer
o Brick drying: air preheating to 120 °C with moist exhaust air
o District heating networks: hot water production up to 120 °C
o Hospitals: steam 125 °C for autoclaves, sterilization, laundry drying

More resources:
- ACEEE IHP landing page: www.aceee.org/industrial-heat-pumps
o 2022 ACEEE IHP report: www.aceee.org/research-report/ie2201
- IHP Alliance website: industrialheatpumpalliance.org/
- EPRI report: www.epri.com/research/products/000000003002031135