

# Accelerating Industrial Electrification

Renewable Thermal Collaborative  
October 16, 2023

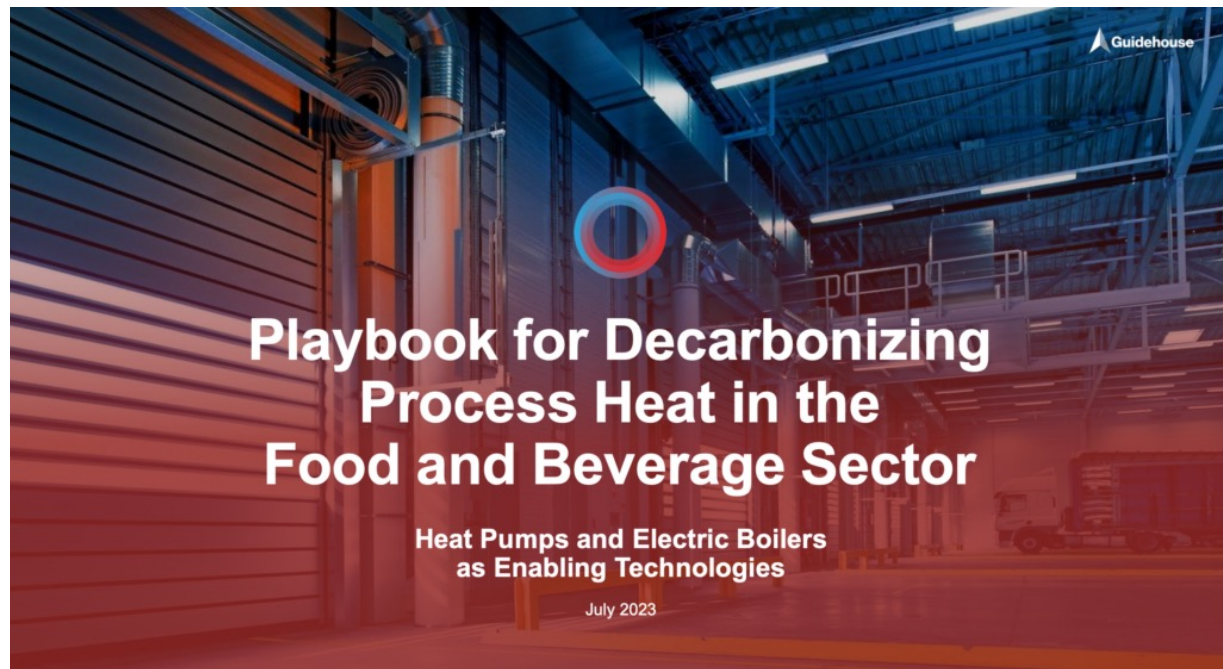
# What is the RTC?

The RTC is the only global, buyer-led coalition focused on decarbonizing thermal energy with renewables.

We focus our work across the intersecting issues of **technology**, **market development**, and **policy**.

RTC Members (buy-side) and Sponsors (solutions-side) are invited to participate in RTC workstreams to:

- Identify and address barriers
- Accelerate solutions
- Implement projects and policies



# Heat Pump Decision Support Tools



Access the tools: <https://www.renewablethermal.org/heat-pump-decision-support-tools/>



# RTC Members

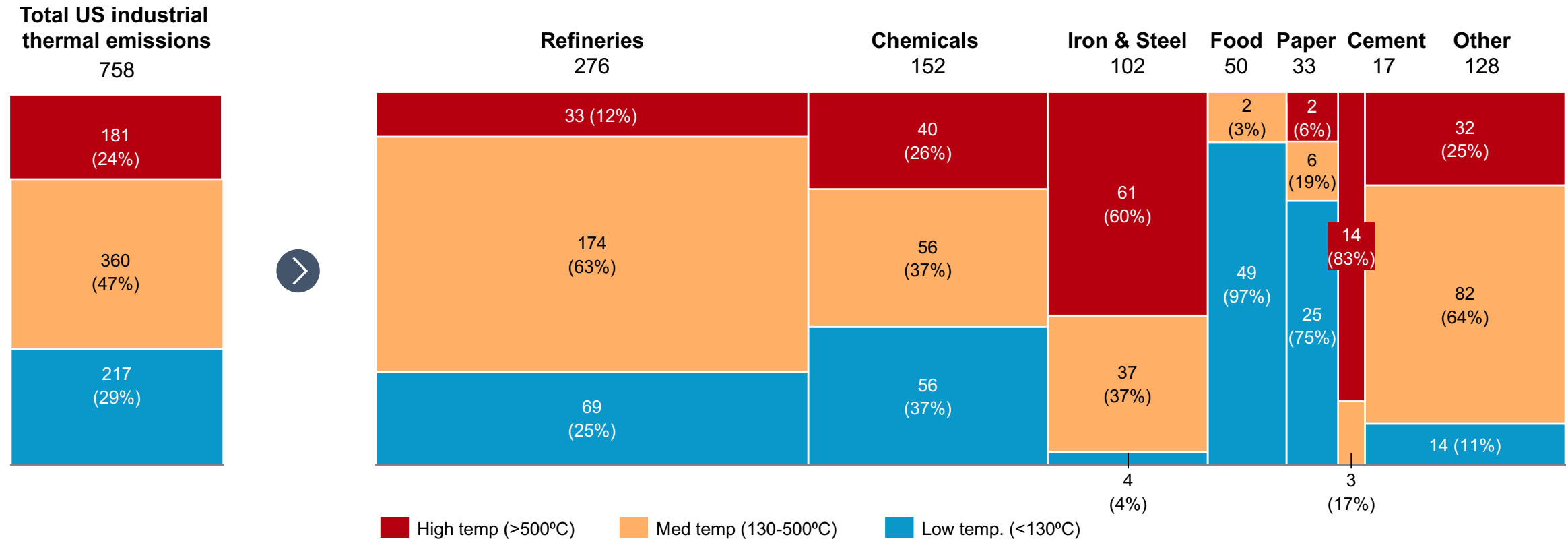


# RTC Sponsors



# Low & medium heat processes dominate industrial thermal emissions and account for ~76% of total

Estimated share of 2018 thermal emissions by temperature range (million tonnes of CO2e)

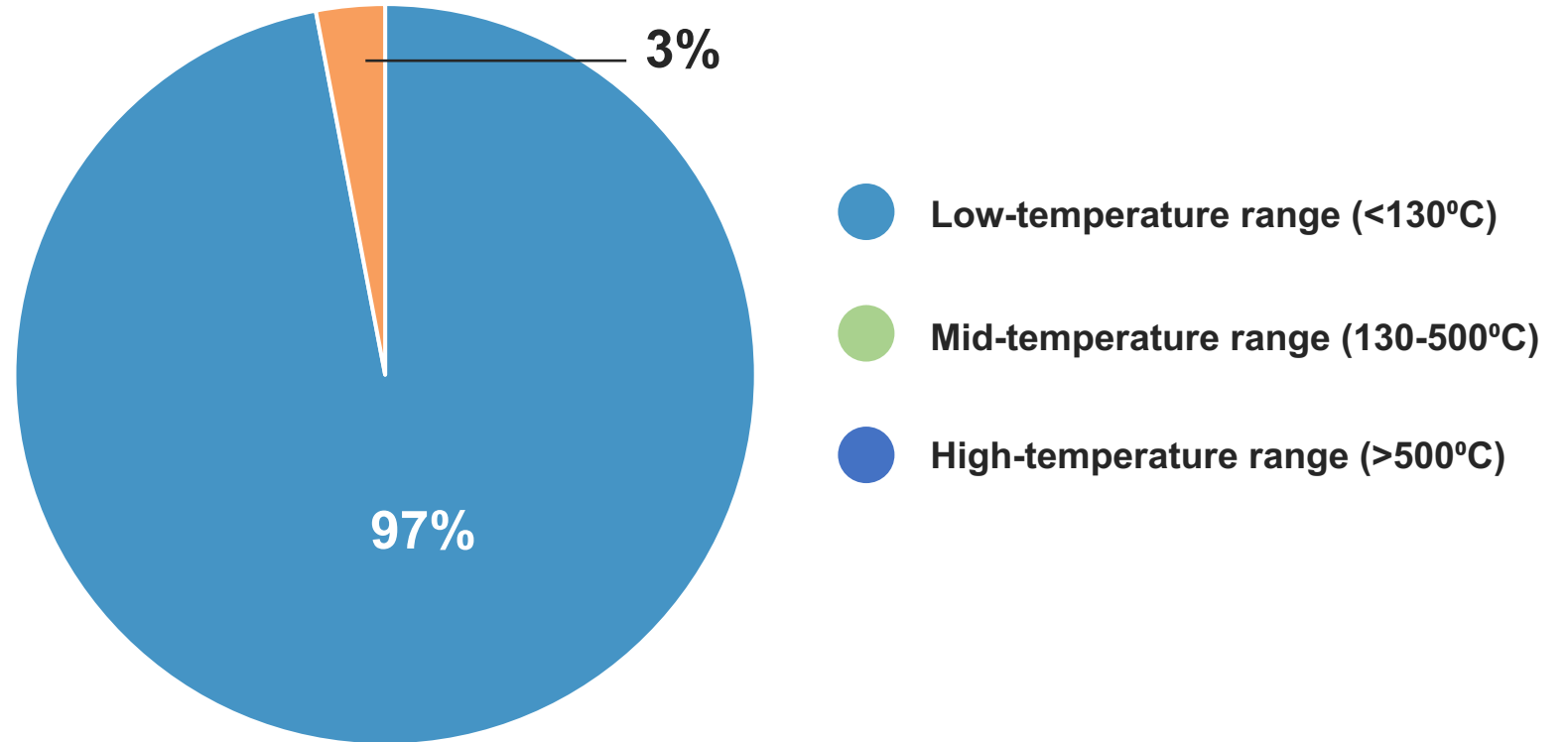


Notes: Energy usage by temperature range was used as a proxy for thermal emissions by temperature range, most of industrial heat is fueled by natural gas across low, medium, and high temperature processes; certain sector emissions (e.g. Iron & Steel, Cement) may skew more towards the higher temperature range as these sectors combust fuels with higher carbon intensity for high temperature processes (e.g. coal in steel making) Source: NREL Manufacturing Thermal Energy Use in 2014 (provides thermal energy use by temperature); EIA Outlook 2019 (provides 2018 energy consumption by fuel); EPA emissions intensity by fuel



**97% of industrial heat needs in the Food and Beverage sector are for applications in the low temperature range (<130°C)**

**Thermal energy consumption (TBtu) by heat temperature range (°C)<sup>1</sup>**



1. NREL Manufacturing Thermal Energy Use in 2014

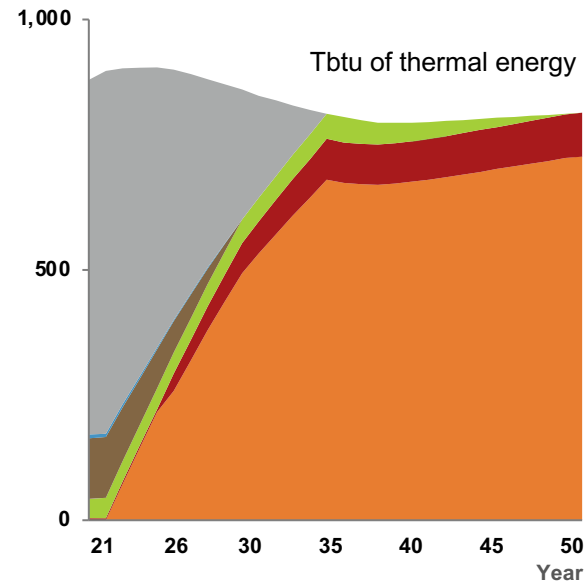
# Thermal decarbonization pathways

**97% of industrial heat needs** are for applications in the low temperature range (<130°C), which can be **decarbonized on an accelerated timeline** with electrification and heat pumps. Natural gas, which combusts at ~1,850°C is not required for most heat needs in the sector.

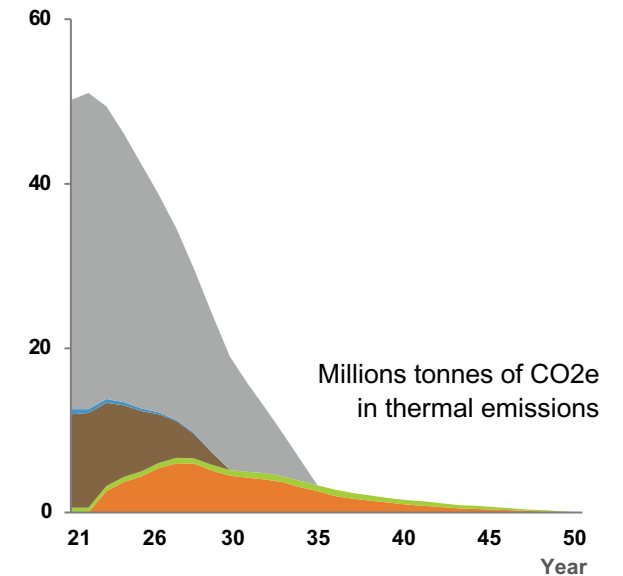
Use of fossil coal and petroleum is **phased out by 2030**, and natural gas **phased out by 2035** – replaced with electrification.

Solar thermal energy with battery storage should also be considered, particularly in the US Southwest, and/or when electric heat pumps have a higher cost to generate heat than fossil natural gas (e.g. California).

Thermal energy consumption<sup>1</sup>



Thermal emissions<sup>2</sup>



1. Total thermal energy consumption based on EIA 2022 Outlook; forecasted energy mix per BCG analysis 2. Thermal emissions calculated based on emissions intensity of individual fuels; RNG and clean hydrogen assumed to be net zero fuels, biomass assumed to have an emissions intensity of 15 kg CO2e per mmBtu, electricity modeled based on US electric grid emissions intensity assuming 80% and 100% renewables by 2030 and 2050 Source: EIA outlook; EIA emissions intensity; BCG analysis



# Approach to Effective Heat Pump Deployment

There are three steps to deploy a heat pump on a processing site

There are detailed slides in the playbook on the aims, implementation considerations and success factors

## 1 Energy optimization to reduce heat demand

- Ensures energy demand has been minimized
- Includes setpoint optimization, de-steaming, waste heat recovery

## 2 Thermal mapping to identify heat pump opportunities

- To establish baseline thermal energy balance and heat recovery opportunities
- Includes identification of heat sources and sinks, pinch analysis

## 3 Heat pump selection and deployment

- Selection of suitable heat pump technology (e.g., mechanical compression, absorption, mechanical vapor recompressions)

**Additional Resource:** The RTC has developed [Heat Pump Decision Support Tools](#) that can further support Energy Buyers with evaluation and selection.

**Step 1: Optimization Steps to Reduce Heat Demand**

**Step Description**  
The three recommended optimization steps that should be performed prior to conducting a thermal energy assessment are: 1) setpoint optimization, 2) de-steaming potential, and 3) implement no-regret heat recovery.

**Step Objectives**  
a) Ensure that thermal energy demand has been minimized where practically possible prior to assessing electrification opportunities.  
b) Introduce some OPEX savings from these no-regret projects which can mitigate any increase in OPEX from electrification.

**Practical Implementation Considerations**

- **Stakeholder engagement.** Adjustments of setpoints, changing heating medium, or implementing heat recovery projects may have some production / product quality implications, so engaging closely with all relevant parties to gain sign off for approval is necessary.
- **Risk mitigation.** Related to the above point, outlining how any product quality risks can be eliminated or mitigated in implementation and operation will be important.
- **Align with strategy to ensure actions are no-regret.** Ensuring that any actions undertaken in this

**Step 2: Thermal Energy Mapping to Identify Heat Pump Applications**

**Step Description**  
Assessing heating and cooling requirements in a plant to assess and identify potential heat recovery and heat pump projects

**Step Objectives**  
a) Establish baseline thermal energy balance b) understand opportunities for heat recovery c) understand opportunities for heat pump deployment

**Practical Implementation Considerations**

- **List of heat sinks and sources should be exhaustive.** This exercise is most effective when all heat sources and sinks across the facility are considered, to maximize potential for heat recovery and heat pump deployment.
- **Matching heat sources to sinks.** The three key factors to consider are:
  1. **Quantity and quality.** The amount of available heat and temperatures between sources and sinks are drivers for feasibility and efficiency.
  2. **Intermittency.** Is the heat available constantly or

**Step 3: Heat Pump Evaluation and Selection Process**

**Step Description**  
The selection of a suitable heat pump is important for achieving optimal efficiency benefit, and thus OPEX savings.

**Step Objectives**  
a) Ensure that a suitable heat pump is chosen for the required purpose, b) optimize efficiencies and OPEX savings, c) identify preferred heat pump supplier based on their techno-economic proposal, d) develop a pre-FEED & identify relevant grants and funding schemes, e) Implement solution

HEAT PUMP TECHNOLOGY	DESCRIPTION	COP RANGE	FOOD AND BEVERAGE EXAMPLE APPLICATIONS
Mechanical Compression	Involves the use of mechanical compression of a working fluid to achieve temperature lift. The working fluid is typically a common refrigerant. This can be a multistage system to achieve higher temperature lift.	1.6 - 5.8	• General: Used for heating process and cleaning water • Soft drink manufacturing: Used for the concentration of effluent
Absorption	Involves the use of a non-compressant working fluid and the principles of boiling-point elevation (the boiling point of a mixture is higher than the boiling point of the pure volatile component) and heat of absorption to achieve temperature lift.	0.5 - 3	• General: Used for chilling and cooling applications
Mechanical Vapor Recompression (MVR)	Involves the use of a mechanical compressor to increase the pressure and the temperature of waste vapor.	10 - 30	• Brewery: Used for the concentration of waste liquid • Dairy: Used for the concentration of milk and whey
Thermal Vapor Recompression (TVR)	Involves the use of energy in high pressure motive steam to increase the pressure of waste vapor using a jet-ejector device.	10 - 30	• Wet corn milling: Used for the concentration of steep water and syrup

**Success Factors**

- Sufficient onsite and offsite grid infrastructure; distribution network operators should be engaged as early as possible during the project.
- Selection of qualified heat pump supplier and installer
- Education of operations staff on heat pump optimization
- Grants, funds, and incentives to reduce upfront capital cost required. See [page 37](#) for the expansion of addressing barrier 2, project cost.
- See [Developing an Implementation Plan](#) for the organizational approach to support technical steps.

# Barriers and Recommendations to Adoption and Implementation

**1. Lack of Operational Track Record**

**Pilot Projects and Case Studies**

**2. Project Cost**

**Cost Share Programs**

**3. Insufficient Grid Infrastructure**

**Grid System Planning and Assessments**

**4. Utility Pricing Structures**

**Rate Structure Reforms**



# Get Involved

WASHINGTON, DC | OCTOBER 19 & 20



# SUMMIT 2023

Register to attend the RTC 2023 Summit later this week:

Contact us:

[Cihang.yuan@wwfus.org](mailto:Cihang.yuan@wwfus.org)

[Ruth@dgardiner.com](mailto:Ruth@dgardiner.com)

