• The National Association of Regulatory Utility Commissioners (NARUC) is a non-profit organization founded in 1889.
• Our Members are the state utility regulatory Commissioners in all 50 states & the territories. FERC & FCC Commissioners are also members. NARUC has Associate Members in over 20 other countries.
• NARUC member agencies regulate electricity, natural gas, telecommunications, and water utilities.
THE NARUC CENTER FOR PARTNERSHIPS & INNOVATION

Background & Focus

• NARUC staff dedicated to providing technical assistance to members.

• CPI identifies emerging challenges and connects state commissions with expertise and strategies to inform their decision making.

• CPI builds relationships, develops resources, and delivers trainings.

• All CPI support is federally funded via cooperative agreements with DOE and NIST.

Newly updated CPI fact sheet with recent publications, upcoming events, new member working groups located under Quick Links at: www.naruc.org/cpi
MODERATOR
COMMISSIONER TYLER HUEBNER, PUBLIC SERVICE COMMISSION OF WISCONSIN

Speakers:
SARA BALDWIN, ENERGY INNOVATION
BLAINE COLLISON, RENEWABLE THERMAL COLLABORATIVE
ED RIGHTOR, INFORMATION TECHNOLOGY AND INNOVATION FOUNDATION
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 multiple RTC workstreams to:

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

Facilitated by:
RTC Members
RTC Technology Workstreams

- Renewable Natural Gas
- Beneficial Electrification
- Green Hydrogen
- Thermal Energy Storage
- Solar Thermal
Industrial Energy Use in 2019 (trillion Btu)
Beneficial Electrification

Download the report:
https://www.renewablethermal.org/state-electrification-report/

Download state factsheets:
https://www.renewablethermal.org/state-electrification-factsheets/

• Alabama
• California
• Colorado
• Florida
• Georgia
• Illinois
• Indiana
• Iowa
• Kentucky
• Louisiana
• Michigan
• Minnesota
• North Carolina
• Ohio
• Oklahoma
• Oregon
• Pennsylvania
• Texas
• Washington
• Wisconsin
## Sectors Included in Study Scope

Table 1. U.S. industrial subsectors analyzed in this study

<table>
<thead>
<tr>
<th>No.</th>
<th>Industry subsector</th>
<th>No.</th>
<th>Industry subsector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminum casting</td>
<td>7</td>
<td>Steel</td>
</tr>
<tr>
<td>2</td>
<td>Pulp and paper</td>
<td>8</td>
<td>Beer</td>
</tr>
<tr>
<td>3</td>
<td>Container glass</td>
<td>9</td>
<td>Beet sugar</td>
</tr>
<tr>
<td>4</td>
<td>Ammonia</td>
<td>10</td>
<td>Milk powder</td>
</tr>
<tr>
<td>5</td>
<td>Methanol</td>
<td>11</td>
<td>Wet corn milling</td>
</tr>
<tr>
<td>6</td>
<td>Recycled plastic</td>
<td>12</td>
<td>Crude soybean oil</td>
</tr>
</tbody>
</table>
Electrification of the Container Glass Industry – Energy Saving (>30%)

Change in the container glass industry’s total final energy use after electrification (Technical potential assuming 100% adoption rate)
CO₂ emissions reductions can be achieved today using grid electricity in Washington, Oregon, California, Illinois, Oklahoma, North Carolina, Pennsylvania, Georgia, and Alabama.

Plant-level CO₂ emissions reductions can be achieved today in any state through electrification projects that are tied with sufficient renewable electricity supply.
Energy cost is only a small portion of total manufacturing cost for many industrial subsectors. Therefore, a moderate increase in energy cost per unit of product resulting from electrification will have a minimal impact on the price of final product and final consumers.
Increase in electricity load after industrial electrification in 2030, 2040, and 2050 assuming 100% adoption rate (MW)
RTC Resources

Convenings:

Annual Summit (Oct 19-20, 2023 - Washington, DC):
https://www.renewablethermal.org/rtc-summit/

Monthly Community Calls: Second Tuesday, 11a-12p ET

Working Groups:
– Electrification, Green Hydrogen, RNG, Solar Thermal
– Greenhouse Gas Accounting and Claims
– Policy

Tools:

Policy Finder:
https://www.renewablethermal.org/policy-finder/

Partner Locator:
https://www.renewablethermal.org/partner/


Electrification Road Map (update pending):
https://www.renewablethermal.org/electrification-road-map/

Publications:

Renewable Thermal Vision:
https://www.renewablethermal.org/vision/

Case Studies:
https://www.renewablethermal.org/category/publications/case-studies/

Industrial Electrification:
https://www.renewablethermal.org/state-electrification-report/

Green Hydrogen Technology Assessment:
https://www.renewablethermal.org/gh2-tech-assessment/

Communications:

Monthly newsletter:
https://www.renewablethermal.org/contact-us/

LinkedIn and Twitter
Thank You!

For more information, please contact:

Blaine Collison
blaine@dgardiner.com

Ali Hasanbeigi, Ph.D.
Hasanbeigi@globalefficiencyintel.com
Industrial Electrification: Hurdles to GHG Reductions

Edward Rightor
Director
Center for Clean Energy Innovation, ITIF

NARUC Webinar on Electrification for State Regulators
May 25, 2023
Spark Spread

• Ratio of electricity/natural gas price varies by state

• Where the ratio is high electrification has higher hurdles

Rightor et al.
Interconnections @ Scale are Crucial to Adoption
Grid Transformation & Bidirectional Needs

Aman et al.
Electrification Needs

Address spark spread and lower hurdles for;

- Backend integration, electrical substations, busbars, transformers outside/inside fence lines
- Interconnections with energy storage (thermal, electrical, chemical, mechanical...) at scale
- Sensing/bidirectional response (know when clean electricity is available, competitively priced, responsive to dynamic needs)
- Effectively handling variable demand, generation, AND storage.
- Price and performance parity, reliable, and resilient.
Thank You!

Ed Rightor | erightor@itif.org | @ITIFdc
Industrial Electrification: Implications for State Regulators

NARUC CPI Innovation Webinar
May 25, 2023

Sara Baldwin
Senior Director, Electrification

ENERGY INNOVATION
POLICY & TECHNOLOGY LLC®
Energy Innovation Policy & Technology LLC®

- Non-partisan climate policy think tank working towards a climate safe future where people and the planet thrive with economic, security, and equity benefits.

- We provide objective research based on scientific assessments to identify the most effective economywide emissions reduction policies.

- We prioritize the largest emitting nations and sectors, focusing on policies that accelerate technology-neutral zero-carbon solutions at the speed and scale necessary to fight climate change.

- Our policy recommendations are grounded in data, driven by our open-source and peer-reviewed Energy Policy Simulator model and our book Designing Climate Solutions.

Our research is accessible under the CC BY license. Users are free to copy, distribute, transform, and build upon the material as long as they credit Energy Innovation® for the original creation and indicate if changes were made.
U.S. Greenhouse Gas (GHG) Emissions by Economic Sector, 2021

- Electric Power: 25%
- Transportation: 28%
- Industry: 23%
- Commercial & Residential: 13%
- Agriculture: 10%

Source: U.S. Environmental Protection Agency
Industrial Sector GHG Emissions Vary Across States

Modeled Policies for Industrial Decarbonization (example)

- Electrification for low- and medium-heat processes
- Other electric technologies and decarbonized fuels, such as green hydrogen, for high-temperature processes and feedstocks
- Energy efficiency upgrades

Figure 2. U.S. industrial heat demand by temperature range by industry in 2021. “Nonmetallic minerals” include cement, lime, glass, brick, tile, etc. Excludes heat for non-process uses, such as HVAC services for the comfort of workers.4,5

<table>
<thead>
<tr>
<th>Activity</th>
<th>Temperature Range (°C)</th>
<th>Example Industries</th>
<th>Electrical Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting metals</td>
<td>430-1650</td>
<td>Iron and steel, non-ferrous metals</td>
<td>Electric arc furnace, induction furnace</td>
</tr>
<tr>
<td>Producing steam, boiling, distillation</td>
<td>70-540</td>
<td>Chemicals, food processing</td>
<td>Heat pumps, electric resistance</td>
</tr>
<tr>
<td>Smelting (extracting metal from ore)</td>
<td>430-1650</td>
<td>Iron and steel, non-ferrous metals</td>
<td>Electrolysis, electric resistance, green hydrogen combustion</td>
</tr>
<tr>
<td>Calcining</td>
<td>800-1100</td>
<td>Cement, lime</td>
<td>Plasma torch, electric resistance, green hydrogen combustion</td>
</tr>
<tr>
<td>Melting non-conductive materials</td>
<td>800-1650</td>
<td>Glass, ceramics</td>
<td>Plasma torch, electric resistance, green hydrogen combustion</td>
</tr>
<tr>
<td>Welding</td>
<td>900-1500</td>
<td>Machinery, vehicles, construction, metal products</td>
<td>Electric arcs, lasers, electron beams</td>
</tr>
<tr>
<td>Cutting, drilling/boring</td>
<td>Very high</td>
<td>Machinery, vehicles, construction, metal products</td>
<td>Electric arcs, lasers, electron beams</td>
</tr>
<tr>
<td>Warming non-conductive, heat-sensitive materials</td>
<td>70-300</td>
<td>Food processing, plastic products, wood products</td>
<td>Dielectric heating, infrared heating</td>
</tr>
<tr>
<td>Curing adhesives and coatings</td>
<td>100-150</td>
<td>Vehicles, misc. products</td>
<td>UV light, infrared heating</td>
</tr>
<tr>
<td>Molding/forming</td>
<td>120-300</td>
<td>Plastic products</td>
<td>Electric resistance, dielectric heating</td>
</tr>
<tr>
<td>Sterilizing/pasteurizing</td>
<td>100-370</td>
<td>Food processing</td>
<td>Heat pumps, UV light, dielectric heating</td>
</tr>
<tr>
<td>Baking, thawing, drying</td>
<td>100-370</td>
<td>Food processing, rubber, some mineral and construction materials</td>
<td>Infrared heating, dielectric heating</td>
</tr>
<tr>
<td>Heat treating of metals (annealing, tempering, etc.)</td>
<td>100-800</td>
<td>Metal products, vehicles</td>
<td>Induction, infrared heating</td>
</tr>
<tr>
<td>Exceptionally high-temperature processes</td>
<td>2000-3000</td>
<td>synthetic graphite, specialty metals, vapor deposition coatings</td>
<td>Electric arcs, induction, lasers, electron beams</td>
</tr>
</tbody>
</table>
In the U.S., shifting to industrial heat pumps for low-temperature process heat would...

...reduce GHG emissions by 16% in 2050, relative to BAU.

...increase electricity demand 12% in 2030 and 41% in 2050.

Regulatory Considerations for Industrial Electrification

- Impact on utility forecasts, planning, and investment needs
- Implications for future demand of gas and electricity
- Opportunities to adopt or update energy efficiency programs
- Rate design to encourage energy efficiency and electrification
- Inflation Reduction Act support
  - $10 billion for the 48C Manufacturing Tax Credit that could be used to accelerate industrial heat pump adoption; eligibility for the tax credit includes re-equipping an industrial or manufacturing facility with equipment designed to reduce greenhouse gas emissions by at least 20 percent through the installation of... low- or zero- carbon process heat systems.
  - The Advanced Industrial Facilities Deployment Program authorizes $5.8 billion to support the purchase, installation, retrofits, or upgrades to industrial facilities to use “advanced industrial technology.”
Thank you!

Sara Baldwin
@Sara_Baldwin2 (twitter)
@Sara E. Baldwin (linkedin)
Industrial Electrification Technologies

1. Heat pumps
2. Electrical resistance heating
3. Induction
4. Electric arcs / plasma torches
5. Dielectric heating (radio waves or microwave heating)
6. Infrared heating
7. Lasers
8. Electron beams
9. Thermal batteries
10. Electrolysis
11. UV light

Electrified heat

Heat storage

Heat replacement
DISCUSSION AND Q & A
NARUC Innovation Webinar Series

One webinar most months

All NARUC members and stakeholders are invited

Incorporating AI into Resilience-Informed Utility System Planning

June 20, 2023 | 3:00 – 4:00 PM EST

Topic TBD

July 27, 2023 | 3:00 – 4:00 PM EST

More webinar information will be added soon!

https://www.naruc.org/cpi-1/innovation-webinars/

NARUC thanks the U.S. Department of Energy for its support of this series.