Turbo Heater

Innovation in Process Heating Technology
September 2025
Af Lars H. Riis, Market and Business Development Manager
Siemens Energy

Siemens Energy is a trademark licensed by Siemens AG.

Restricted © Siemens Energy, 2024

Decarbonized Heat & Industrial Processes

Focus Areas of Siemens Energy

Electrification of Heat

- Induction Heater
- Turbo Heater
- SE compressors for HP use*
- MVR
- Classic electrode or resistive heater

Waste Heat Utilization

- Industrial Waste Heat Recovery
  - ST (SRC)
  - ORC
- Waste heat use from compressor heat

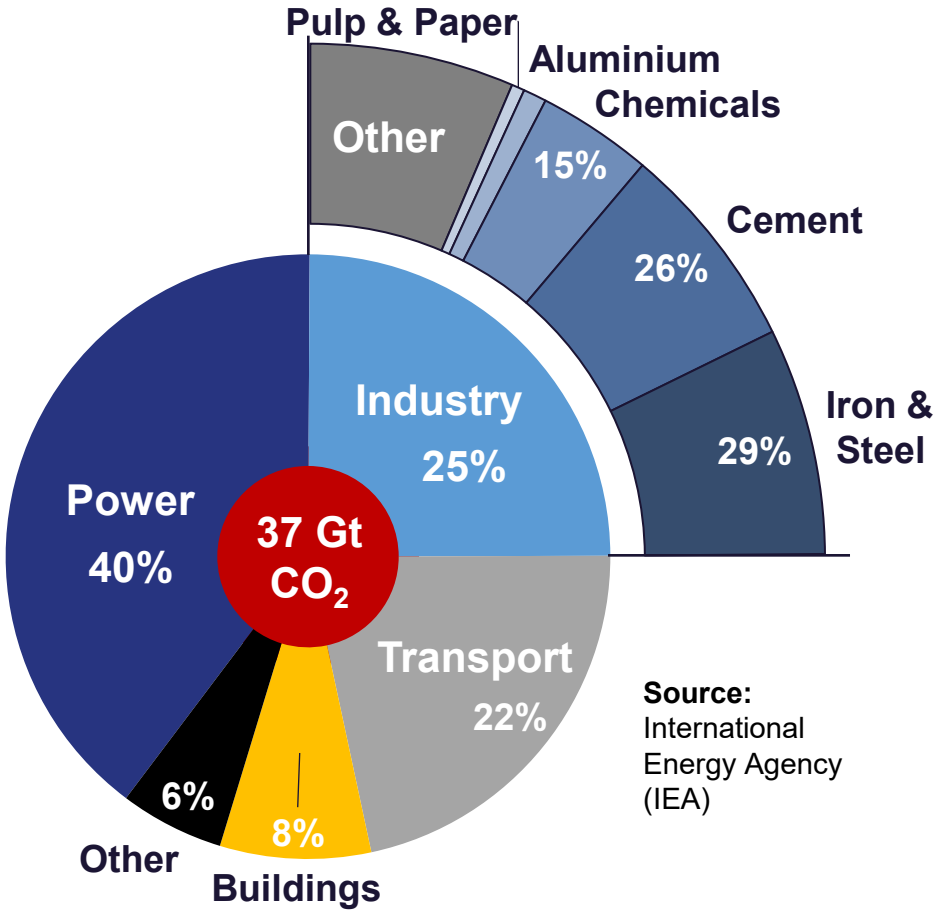
Decarbonize Industrial Processes

- Fuel shift to low carbon fuels
- ST conversion to extraction/backpressure
- Electrification and Electrical Drives
  - Industrial Synchronous condensers
  - Electric heated storage with power and heat generation
  - Stabilizing Grid/Electric systems on site

ST – Steam Turbine; ORC – Organic Rankine Cycle; SRC – Steam Rankine Cycle; MVR – Mechanical Vapor Compression;
* SE offers compressors which can be utilized in Heat Pumps

Industrial Heat is a major factor for decarbonization

Global energy-related emissions (2022)

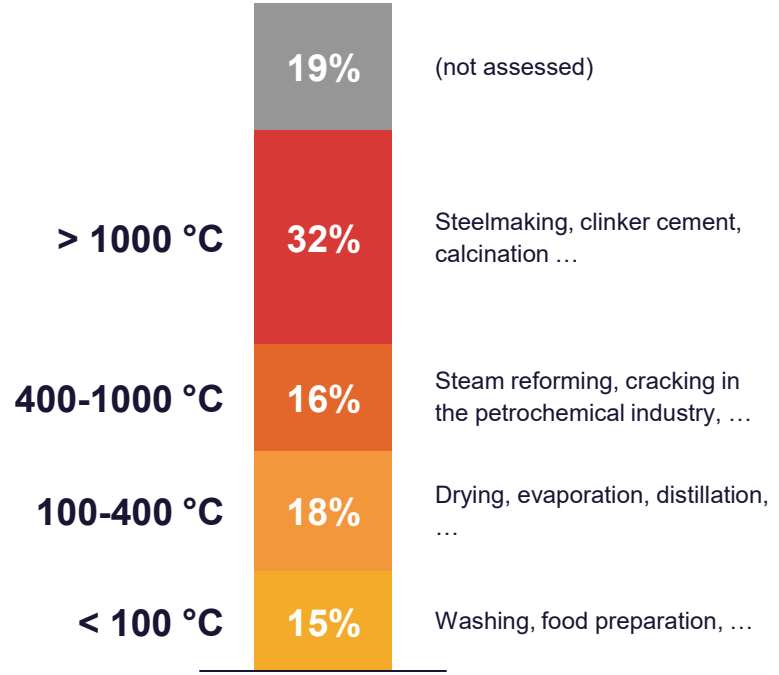


Source: International Energy Agency (IEA)

74% of industrial energy consumption is heat

90% of that is produced from fossil fuels

Industrial heat use by temperature level



Source: McKinsey - Plugging in: What electrification can do for industry (2020)

Siemens Energy is a trademark licensed by Siemens AG.
Restricted © Siemens Energy, September 2024

Introducing the Turbo Heater technology

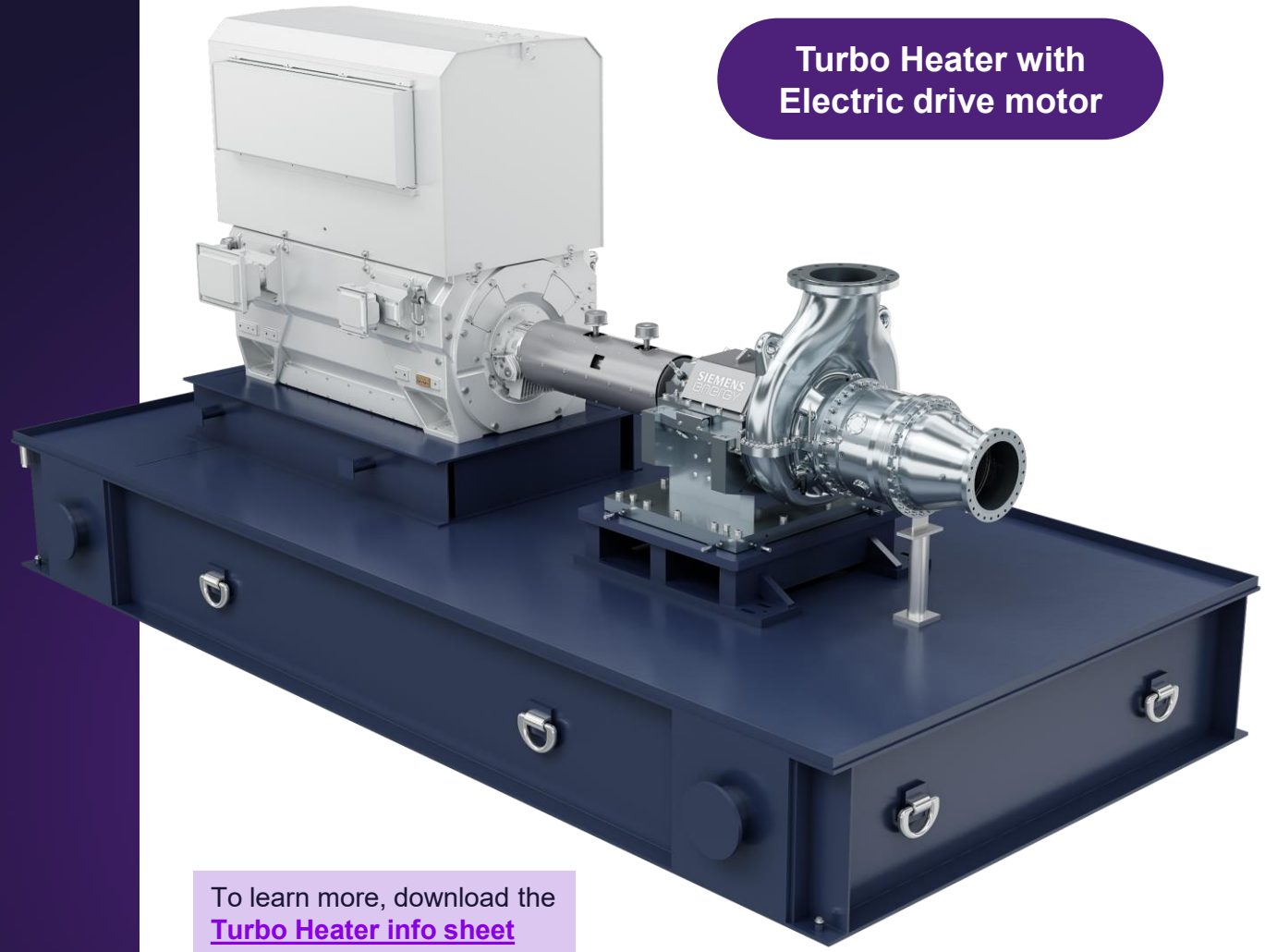
Decarbonize high-temperature heat at scale for hard-to-abate industries

- **Eliminate fuel** burn (electrification)
- **Highly scalable** Turbomachinery technology (double & triple -digit MW)

- **Direct heating** of process flow to elevated temperatures via shock wave
- **No heat exchangers** → size & operating gains

- MW-scale **demonstrator tested** (> 700 °C)
- Higher temperature in development with **capability > 1000 °C**

August 2024



Turbo Heater with Electric drive motor

To learn more, download the **Turbo Heater info sheet**

Restricted © Siemens Energy, 2024

Turbo Heater Technology
How it works

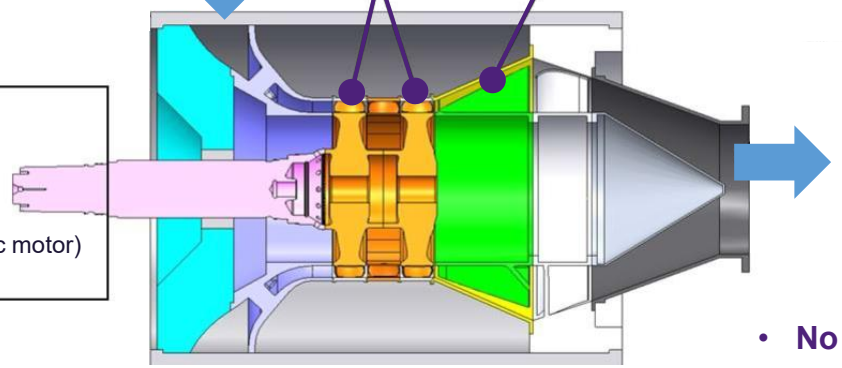
Rotating stages accelerate flow to supersonic

Mechanical work → Kinetic energy

Static diffuser decelerates flow back to subsonic (shock wave)

Kinetic energy → Thermal energy

Process Flow



Driver

(e.g. electric motor)

- **No fuel combustion**
- **High Temperature**
- **Direct heating**
- **Energy-dense**
- **Highly scalable**

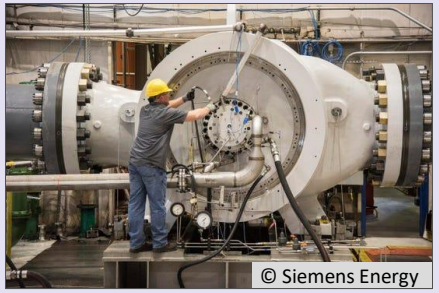
Key Benefits

GHG Emissions	Rotating machinery can utilize carbon-free energy (e-drive or H_2 GT drive)
Direct Heating	Eliminate combustion emissions, contamination, fouling of heat exchangers. High energy efficiency > 95%.
Process Optimization	• No combustion products added (H_2O, CO_2) • Uniform temperature profile – no hot spots • Provide heat + flow in a single device • Very rapid heating → control residence time
Size	Compact turbomachinery, heat input not constrained by exchanger surface area
Scale-up	Technology inherently capable of high throughput, 2x flow << 2x size

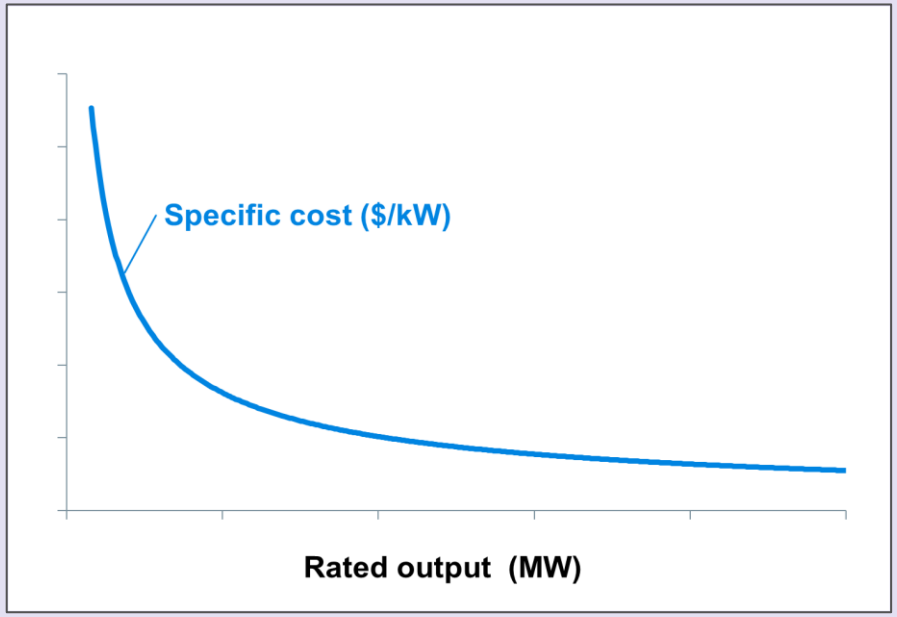
Restricted © Siemens Energy, 2024

Valuable attributes of Turbomachinery technology

Scalability

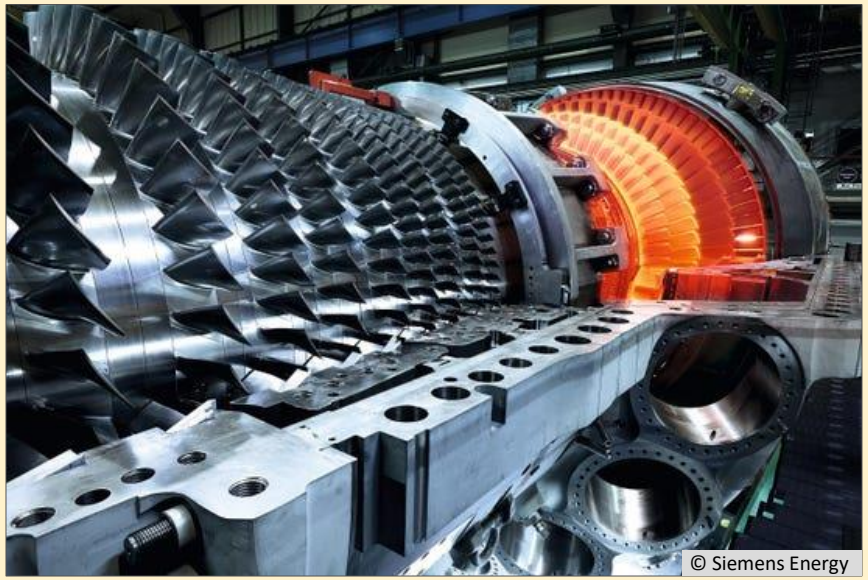


- Technology of choice for energy-dense applications
- Favorable cost scaling curve



High-temperature capability

Materials and know-how proven by millions of operating hours in Gas Turbine products

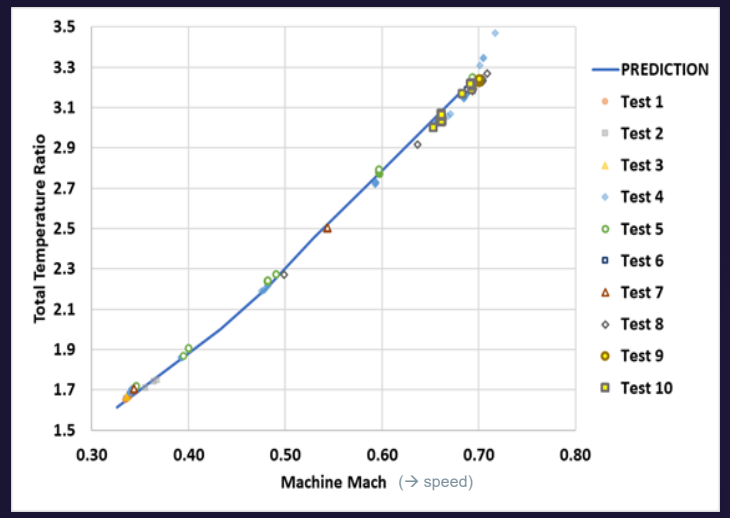


Siemens Energy is a trademark licensed by Siemens AG.
Restricted © Siemens Energy, 2024

Aero Demonstrator Test Completed

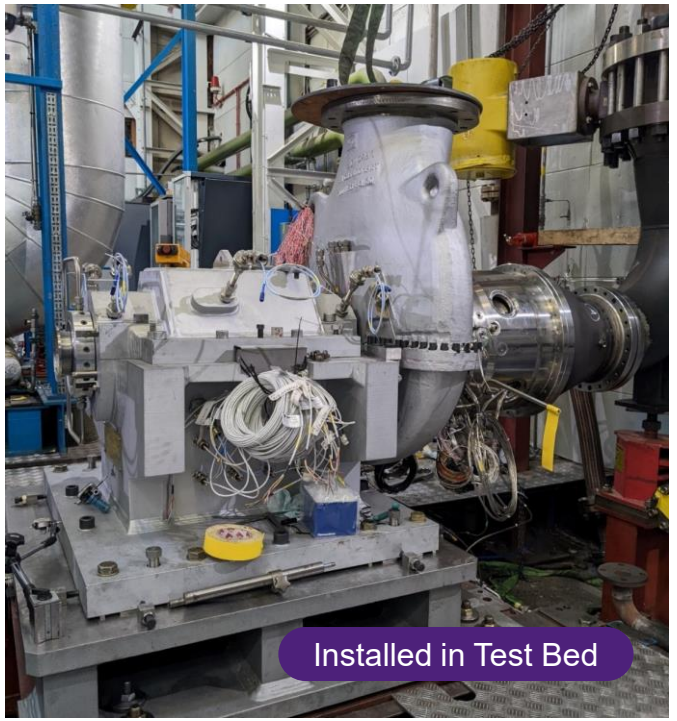
Successful Campaign @ Siemens Energy Test Rig

- Prototype unit 1.6 MW (5.5 MMBTU/h)
- Air heating to > 700 °C (1,300 °F)
- Nominal air flow 2.2 kg/s (3,880 scfm)
- Demonstrated Total Temp. ratio >3 (air)

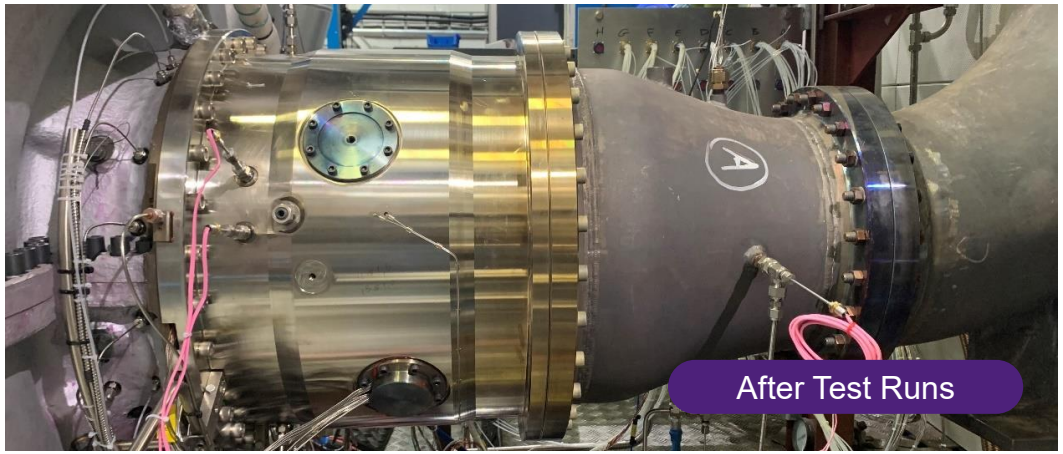


Extensively instrumented for validation

- Aero & Mechanical as expected
- Fully stable in operating range 60% – 100%
- Robust rotor dynamics
- Blade vibrations well within limits
- Successful Mechanical Run test (API procedure)


Installed in Test Bed


Aerofoil


After Test Runs

Restricted © Siemens Energy, 2024

Technology Development Roadmap

Shock Tube Test
Shock Wave Cracking

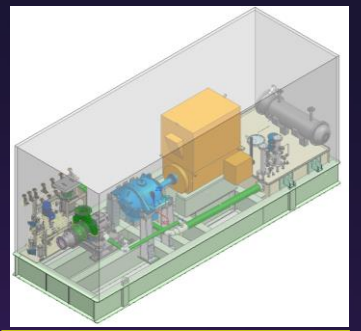
TRL 3

Aero Demonstrator Turbomachinery Proof-of-Concept

TRL 5

Demo Unit factory test
Siemens Energy factory

TRL 6



Field Demonstration
Industrial Site

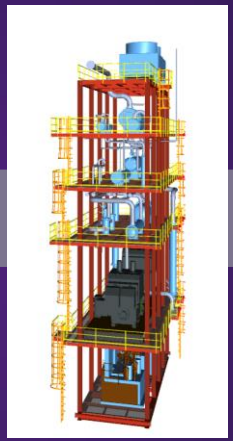
TRL 7

Scale-up deployment
Commercial Operations
TRL 8 & 9

Turbo Heater Development

Rotating Olefins Cracker [1] (ROC)

Application to steam cracking process to produce olefins (e.g. ethylene) [1]



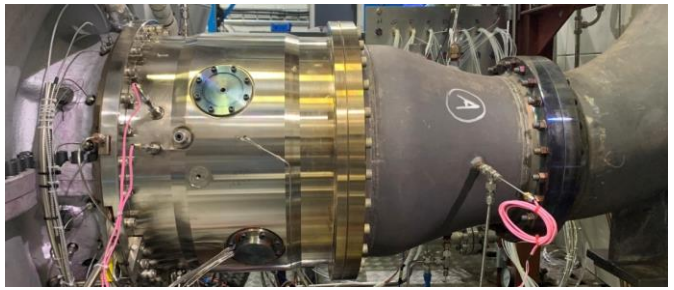
1 Joint development partner Technip Energies

End-user partnering opportunity

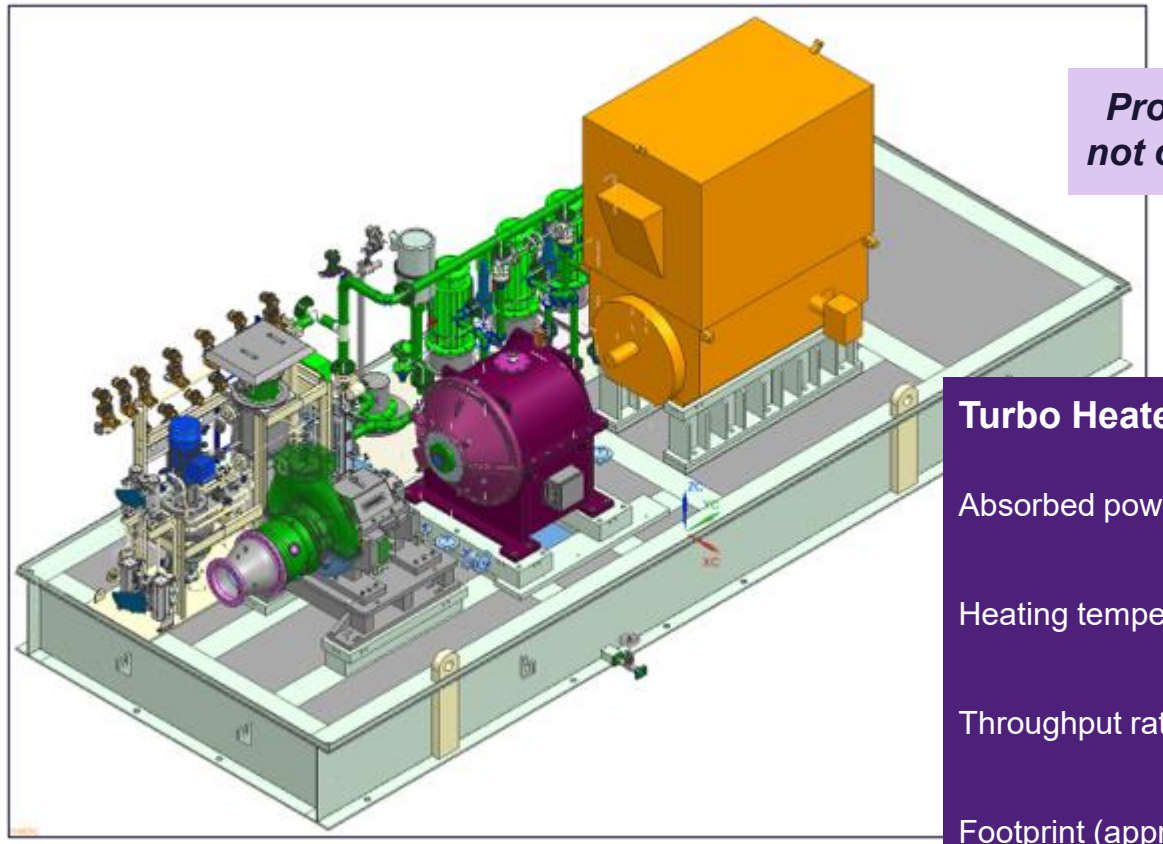
Restricted © Siemens Energy, 2024

Turbo Heater Package for Field Demonstration

Turbomachine Prototype – Tested



Demo Package – ready for site deployment early 2025



Prototype package, not optimized for size

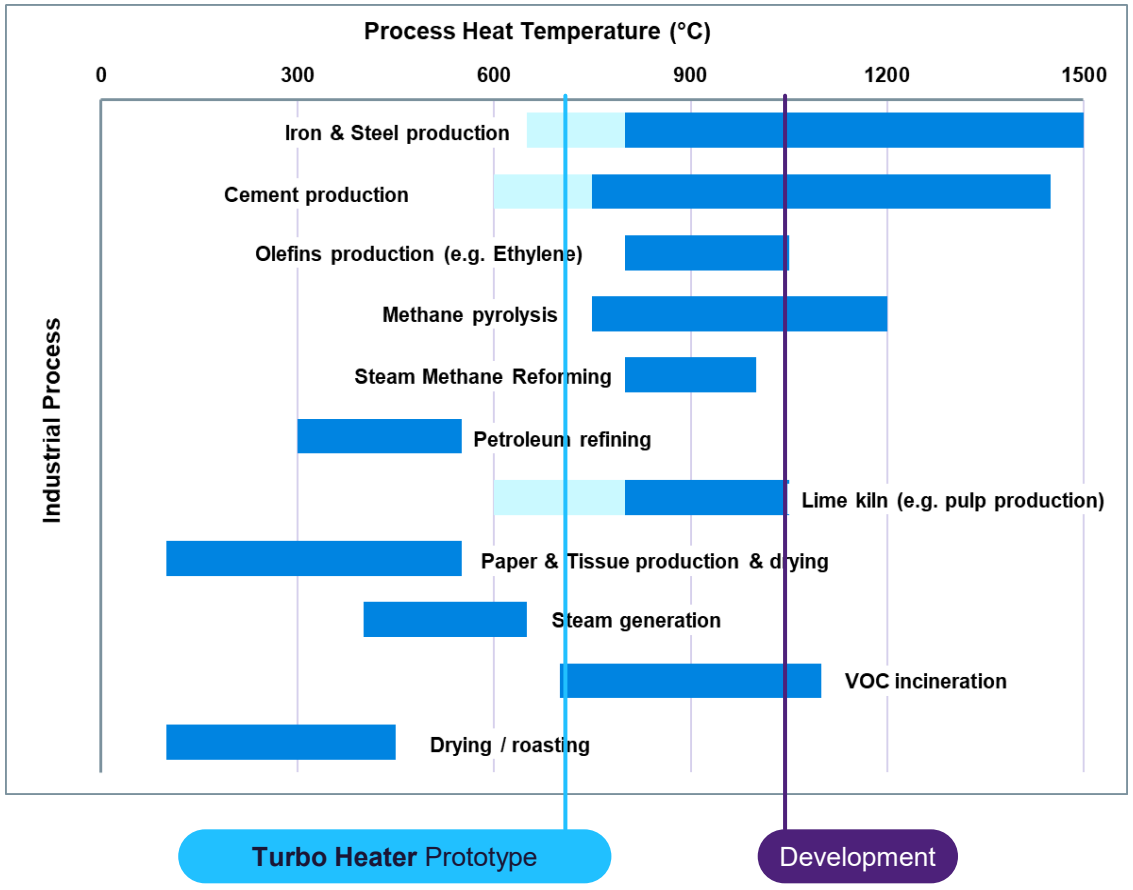
Turbo Heater Demo package	
Absorbed power	~ 2 MW ~ 2,600 hp
Heating temperature	710 °C 1,310 °F
Throughput rate (air)	2.2 kg/s 3,880 scfm
Footprint (approx.)	3.5 x 9 m 11.5 x 29.5 ft

* Preliminary specifications, to be confirmed for site conditions

Siemens Energy is a trademark licensed by Siemens AG.

Restricted © Siemens Energy, 2024

Turbo Heater Application Areas



Turbo Heater integration – Areas to explore

1 **Replacement or repowering of fired burners for mid-to-high- grade process heat**
- Walk the process, focus on primary heat sources
- Next, opportunities for optimized heat integration

2 **Utilization of Turbo Heater for steam production**
- Hot air for repowering of fired steam boilers
- Direct steam superheating

3 **Leverage of Turbo Heater scalability**
- Multi-unit replacement (many to one)
- Lower temp, high flow (e.g. flow by-pass)

4 **Potential hybrid/cascaded solutions**
E.g., Heat Pump + Turbo Heater for max energy efficiency

Collaboration opportunities:
- Process deep-dive, application studies
- Industrial Demos/access to external funding

Restricted © Siemens Energy, 2024

For More Information

Published by Siemens Energy

Lars H. Riis

Market & Business Development
Denmark

Fiskergade 1,9
7100 Vejle
Denmark

Mobile: +45 29 31 34 64
lars.riis@siemens-energy.com

www.linkedin.com/in/lars-riis

siemens-energy.com

Siemens Energy is a trademark licensed by Siemens AG.