

Pre-Heating of Industrial Burners

Temperature range of potential pre-heating:

- 200°C - 1,000°C. Note, even reaching 200°C -500°C of pre-heat would be valuable

Typical size of a burner system:

- 100kW – 10s MW

Industry field:

- Several e.g., petrochemical, food and beverage, pulp and paper, cement and glass

Countries with high potential:

- Several e.g., United States, UK, Germany, India, China



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Industrial burner in a glass production facility

Why is heat important in industry? How are burners used today?

The use of low-pressure steam, hot combustion gases or a heat transfer fluid (HTF) generated by the combustion of fossil fuels is common today to provide process heat for industrial facilities. Industrial natural gas burners are the most common source of heating for industrial process heat (IPH).

Where are industrial burners used?

Industrial natural gas burners are used in almost every industry e.g., petrochemical, food and beverage, pulp and paper, cement and glass. To note, due to the ease of access to natural gas (e.g., via pipelines), and the relative low-cost, natural gas burners can be used across a large temperature range e.g., 50°C to 1,500°C.

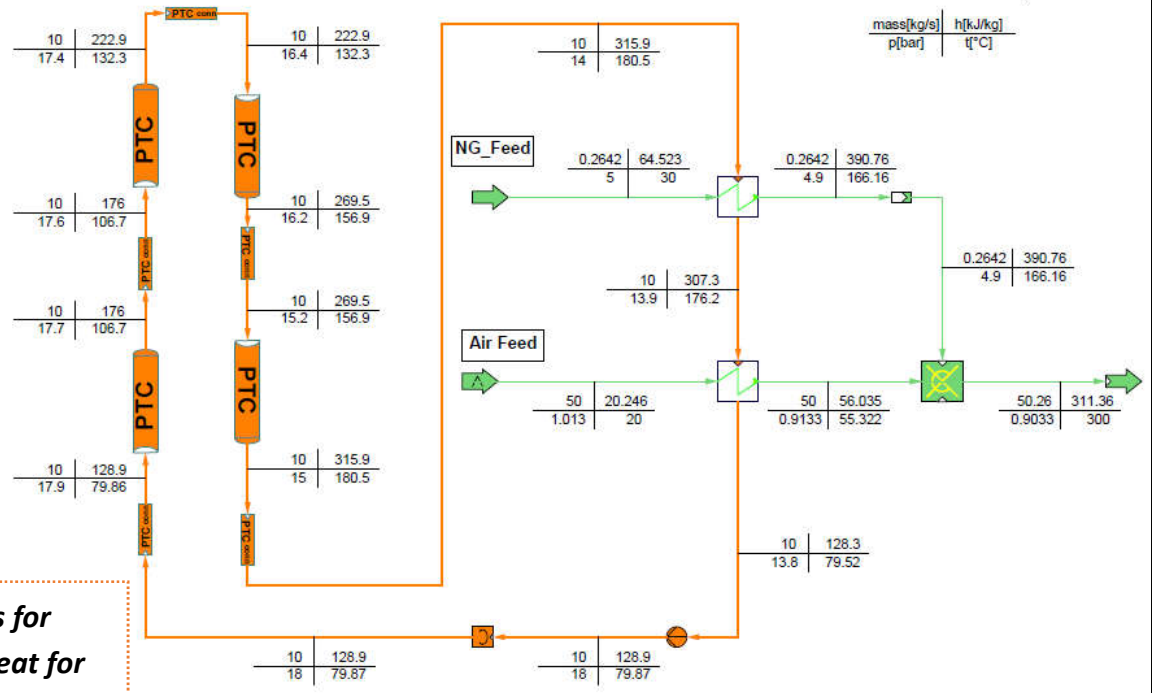
What makes it suitable for solar and TES integration?

Solar IPH (SIPH) technologies such as concentrated solar thermal (CST) and TES, could potentially economically replace the steam or heat needs at many industrial sites by providing high-temperature pressurized hot water, a HTF such as synthetic-oil, or direct steam. A key application would be the use of SIPH and TES for pre-heating of natural gas burners. This could be with a solar field providing the HTF to the burner or via TES.

Currently, SIPH or TES solutions for pre-heating can be considered 200-1000 °C depending on the type of solar or TES used.

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Model of parabolic trough collectors (PTCs) and natural gas (NG) combustor up to 300 °C



Summary of requirements for solar systems providing heat for this process:

User side heat transfer fluid:

- Air, HTF or steam as heat for a natural gas pre-heat

Final temperature:

- Dependent on the industry, but on average 100-400°C for medium temperature processes, and 400°C + for higher temperature process

Return temperature:

- 50- 250°C

Power level required:

- low MW

Required continuity of heat supply:

- Dependent on process for natural gas burner. High continuity needed for continuous processes

Available backup heat supplies:

- Site's current natural gas supply

Heat storage options:

- Depends on whether solar and TES is used, yes

| Heating from solar field | No Heating | 180°C | 200°C | 250°C | 300°C |
|----------------------------|------------|-------|--------|--------|--------|
| NG mass flow (kg/s) | 0.301 | 0.262 | 0.256 | 0.242 | 0.223 |
| Change in NG mass flow (%) | 0.0 % | -13 % | - 15 % | - 19 % | - 26 % |

Solar integration options

There are several options for the use of solar, CSP, or TES for integration into pre-heating natural gas burners. Options include e.g., pre-heating the natural gas itself, pre-heat of the air prior to the burner, and both.

NREL has investigated the use of pre-heat supplying heated gas (e.g., either the natural gas or the air) to industrial burners. For example, by pre-heating both the gas and air to from the PTC solar field, could reduce the natural gas consumption by 26%. This could be improved with TES.

Kurup et al. 2021. "Hybrid Solar Heat Generation Modelling and Cases". EuroSun2020

Status quo in solar and TES integration

At present, few examples of operating solar or TES based solutions for pre-heating natural gas burners exist.

The natural gas pre-heat via solar or TES is a viable, near-term solution for industries looking to take steps in decarbonization.