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CO2 emissions are prevented when changing to an electric system from a fossil-fired system

This document contains a comparison of the electric-powered system and corresponding fossil-fuel combustion systems like a heat exchanger or boiler

Better Profits
Lower Energy Use
Prevent Emissions

Synopsis
A 10 MW electrical device can prevent emissions of 0.8-2.2 Tons of CO2 every hour.

CTO MHI

Why is reducing CO2 emissions necessary?

Industrial and other excess CO2 emissions cause much of the climate-related damage to the infrastructure.

Although our output of 36 gigatons per year of CO2 is small compared to the ~760 gigatons moving through the carbon cycle each year, it adds up because the land and ocean cannot absorb the excess CO2. Only about 60% of this extra CO2 is absorbed. The rest remains in the atmosphere. Consequently, atmospheric CO2 is highest in 15 to 20 million years. This accumulation leads to global warming.

Decarbonized hot convective air and clean steam generators can make an impact on the CO2 problem	
	
Hot Air Generators	Steam Generators

Climate Impact

The Airtorch® does <u>not</u> make any CO_2, SO_2, Soot, or NO_x.

A 10 MW electrical device can prevent emissions of 0.8-2.2 Tons of CO2 every hour.

This is a large amount of carbon reduction when using electric heating compared to combustion.

Combustion gases contain CO_2, NO_x, SO_2, or Soot- particularly of concern in large MW installations.

<u>What is the growth rate of CO_2 emission?</u>

Emissions increased by over 2.0 GT from 2020 to 2021 (post-pandemic recovery). Very rough numbers indicate that the CO_2 increase averages between 0.4-0.9 GT/year over the past 20 years. The annual growth rate in atmospheric carbon dioxide over the past 60 years is about 100 times faster than previous natural increases.

<u>Is global warming tied to the CO_2 increase</u>?

Yes. With the current acceleration in the atmospheric content of CO2.
Consequently, atmospheric CO2 is the highest in 15 to 20 million years.

<u>Can CO_2 emissions be quickly mitigated?</u>

Yes, by changing to electric heating in the industrial sector.
For example, let us compare Electric Heating vs. Fossil Fuel Fired Heating for Gases.

Hot gases are used in several industries. Energy-intensive heat treating, ore-drying, and the production of cement, aluminum, steel, chemicals, fuels, and fertilizers all use fossil fuel flame heating. The heating should change to electric energy instead of heat produced from the combustion of fossil fuels.

Airtoch® Specific General Comparison

What is the difference in the heating principle between electric process gas heaters and fuel-fired combustion heaters?

In combustion heating, the gas is first burnt. This warm gas is then pushed into a tube that is heated by the burnt gas. The process air, which must be heated, flows against the direction of the burnt gas flow in a separate enclosure (i.e., in the opposite direction). That is why it is called a counter-current flow for a combustion heat exchanger. Such elaborate two-phase flows are not required for an electrically powered heater.

In an electric heater, the air flows over-energized electrical heaters. Electric energy is directly converted to thermal energy without requiring two different flows. One of the benefits of electric heating is that one does not have to waste energy to push so many flows. Additionally, the expected pressure drops of electric heaters at mid-flow volumes are lower than gas heaters. This low-pressure drop represents a substantial saving in energy.

Energy Price and Efficiency

Parameters that contribute to better energy efficiency for electric heaters:

- The pressure drop required for the flow is less for electric heaters.
- Easier to insulate an electric heater to prevent heat loss. No long pipes to insulate as in gas heat exchangers.
- The ramp-up rate to the final temperature is shorter for electric heaters than for fossil-fuel heaters.
- The cool-down rates are also less for electric heaters. Heat exchangers have many tubes that need to heat and cool.
- Electric systems can use modern electronics that allow adjustment to specific conditions, so the energy used is only the amount required. Fossil fuel combustion units often cannot have similar feedback controls. In fossil fuel burners, the control system is a primitive on-off type.

How does one compare the energy price for electrical and fossil-fuel-fired systems?

- Energy Cost: When one includes the social cost of CO_2 production, the price of one KWh of electric or combustion energy starts converging. The social cost of making CO2 is $50-$414/ton of CO2 made. The CO2 emissions per million kilojoules of energy used range from 50.4 Kg for natural gas to 68.8 Kg for jet fuels.

Why is the Electric Airtorch® Efficient?

It all comes down to the ease of heat transfer between the source and gas. Unlike a combustion counter-current heat exchanger, the patents-protected Airtorch® contains well-insulated heaters in the gas flow and heated surface. Typically, a 15-30% improved efficiency is noted in electric devices over combustion (fossil-fuel) heaters. If the efficiency of Airtorch® devices is even 25% better than combustion heat exchangers, then the operational cost of the electric Airtorch® could be lower than the combustion heat exchanger devices. For example, a 16 MW combustion gas heater could be replaced with an 11 MW electric Airtorch®. Considering the above factors, in typical fossil fuel-fired heaters, around 30% of the energy put into the unit is lost during heating. The Electric Airtorch® typically loses less than 5% of input energy during heating.

Typical energy conversions:

Energy conversion efficiency comparison between the MHI electrical convective heater and Fossil-fuel-fired Combustion heaters.

>95%	~70%
Electric Airtorch® (MHI Modular Unit)	Fossil fuel-fired Heat Exchanger (typical only)

MHI Quality Control

Custer manufacturer relationships road-map https://mhi-inc.com/customer-centric-quality-solutions/

Total Quality Management https://mhi-inc.com/mhi-proprietary-tqm/