

industry: energy and environmental technologies

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Decarbonization, Electrification and the Case for Modern Electric Process Heaters



Summary:

Companies in liquified natural gas (LNG) and other industries have been taking bold steps to reduce their carbon footprint. The overall strategy of these companies is to tackle carbon emissions not only through alternative energy investment and increased efficiency, but also through converting key industrial processes (like process heating) to electric (rather than fuel-fired). This paper explores pressures to electrify process heating, as well as the role that electric heat exchangers are playing, particularly in light of innovations in the design of these heaters.

The Pressure to Electrify: Climate Change

Though there are still passionate debates about the scope and causes of climate change, governments and industry leaders are already taking huge steps to meet climate change goals, especially with regard to decarbonization. According to the We Mean Business Coalition, over 700 companies have made far-reaching climate commitments, including many big players in the LNG industry.¹

What is striking about the pressure to address climate change is that it does not come from one segment of the population, or from one international agreement. This means that, even if one of the following drivers were to disappear, there would still be significant pressure to decarbonize and thus larger capital investments in electrification and decarbonization are still completely justified.

¹ We Mean Business Coalition. "700+ leading companies are now driving climate action," [wemeanbusinesscoalition.org](https://www.wemeanbusinesscoalition.orgblog/700-leading-companies-now-driving-climate-action/), April 24, 2018. <https://www.wemeanbusinesscoalition.orgblog/700-leading-companies-now-driving-climate-action/> Accessed 2/18/2020.



The Paris Agreement

The watershed event that caused many LNG companies to consider decarbonization strategies more seriously was the 2015 Paris Climate Conference, organized by the United Nations Framework Convention on Climate Change (UNFCCC), which led to a broad consensus about climate change and what needed to be done to combat it. The UNFCCC Parties agreed that, in order to avoid the most catastrophic effects of climate change, the increase in global average temperature would need to be kept to less than 2°C above pre-industrial levels.

This conference resulted in the “Paris Agreement,” adopted by all UNFCCC Parties, which was a first-of-its-kind legally binding global climate agreement. For its part in the agreement, the U.S. committed to reducing its net greenhouse gas emissions by 26% (compared to 2005 levels) by the year 2025.²

While the Trump administration signalled its intention to withdraw from the Paris Agreement in 2017, it did not do so officially until 2019. Article 28 of the Paris Agreement states that a country cannot give notice of withdrawal from the agreement earlier than three years beyond its adoption date, which was 2016 in the case of the U.S. and the Trump administration clarified its intention to comply with this article. Even after official notice, the withdrawal takes 12 months to take effect. All of this means that, despite the administration signalling its withdrawal, the Paris Agreement will continue to be in effect until at least November 2020. Industry leaders have been acting in accordance with this timeline.



The Deep Decarbonization Pathways Project

The Deep Decarbonization Pathways Project (DDPP) is a global research initiative seeking realistic “pathways” for countries to transition to a low-carbon economy. It includes domestic research teams from 16 countries worldwide, including some of the heaviest carbon emitters.

One of the most significant findings from the DDPP’s 2015 report, Pathways to Deep Decarbonization was that, in addition to energy efficiency/conservation and decarbonizing the production of electricity, enabling fuel switching options for industry and transportation was one of the key ways to transition to a decarbonized economy.³ As industry has contributed roughly 50% of carbon emissions to date, low-carbon electrification represents a significant potential driver of overall decarbonization.

These findings have prompted energy companies not only to explore alternative low-carbon sources of power, but also to further decarbonize their own processes, even when (especially when) it comes to LNG processing.

U.S. Domestic Laws

While the U.S. federal government has not pursued an aggressive climate agenda, the actions taken by individual states might give a better idea for where the political winds are blowing, so to speak. Increasingly, U.S. domestic legislation is beginning to follow the international consensus.

For example, in early 2019, Colorado passed a law giving counties and municipalities more direct control over energy laws. The law in effect grants these local governments the power to, for example, regulate drilling impact (i.e., noise and pollution) and the distance that oil wells must be from homes and schools. This has created some

² Rebecca Harrington, “Here’s what the US actually agreed to in the Paris climate deal,” *Business Insider*, June 1, 2017. <https://www.businessinsider.com/what-did-us-agree-to-paris-climate-deal-2017-5>, Accessed 2/2/2020.

³ Deep Decarbonization Pathways Project (2015). “Pathways to deep decarbonization 2015 report,” SDSN - IDDRI. http://deepdecarbonization.org/wp-content/uploads/2016/03/DDPP_2015_REPORT.pdf



uncertainty around emissions standards. In response, companies running large gas-fired heaters have been looking to convert to electric heat exchangers.

More directly, Wyoming's Department of Environmental Quality (DEQ) has passed new standards aimed at reducing emissions from new and modified oil and natural gas facilities in the state. It joins states such as California and New Mexico in passing laws specifically aimed to lower emissions from such facilities.

While local laws are often in flux, varying from state to state and county to county, there is a general prediction that more state governments will seek to step in with environmental legislation even in the absence of leadership from the federal government.



Changing Sentiment

Finally, one cannot ignore the reality that sentiment around climate change, both public and professional, is changing.

On the public side, fossil fuel companies have been facing mounting pressure from advocacy groups. Royal Dutch Shell, for example, has had its headquarters swarmed by protesters and one advocacy group even brought a lawsuit on behalf of 17,000 Dutch citizens. Another example is the Dakota Access Pipeline protests at Standing Rock, which became not only a sensational news story, but a viral movement on the internet.

Public concern over climate change is mirrored by concern from financial professionals who see less of a future for an energy industry dominated by fossil fuels. In 2018, Moody's warned that the need to transition to alternative forms of energy represents "significant business and credit risk for oil companies." Likewise, Bank of England head Mark Carney warned that the financial sector was being much too slow in divesting investments into fossil fuels, saying that unless firms woke up to the climate crisis, "many of their assets would become worthless."⁴ Most recently, the world's largest fund manager, BlackRock, joined Climate Action 100+ after losing \$90 billion on fossil fuel investments in the past decade; in a letter earlier this year, CEO Larry Fink identified that "climate change has become a defining factor in companies' long-term prospects."⁵

These are just a few of the more well-known news stories about the pressure being put on LNG companies. They are likely part of what is driving these companies to make very public declarations of their strategy to further decarbonize operations.

The Pressure to Electrify: Offshore Automation

Even if we were to put climate change aside, there are still several good reasons to seek electrification of key LNG facilities. All-electric unmanned platforms, using an absolute minimum of flames or combustion, offer an improved fault-free service for remote unmanned operations specifically.

According to a recent article in *Offshore Technology*, electric process heaters are seen "as a cost-effective option thanks to their smaller footprint and thermal efficiency rates of up to 99.5%, meaning that minimal maintenance is required."⁶

⁴ Roger Harrabin, "Bank of England chief Mark Carney issues climate change warning," *BBC News*, December 30, 2019. <https://www.bbc.com/news/business-50868717>, Accessed 2/12/2020.

⁵ Larry Fink, "A Fundamental Reshaping of Finance," *BlackRock.com*, January 2020. <https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter> Accessed 2/12/2020.

⁶ Choosing the right industrial process heater," *Offshore Technology*, September 16, 2019. <https://www.offshore-technology.com/sponsored/choosing-the-right-industrial-process-heater/> Accessed 2/12/2020.

The Role Electric Heat Exchangers Play in Electrification

A review of the publicly available strategy statements of large LNG companies reveals that there are many steps being taken both to address climate change concerns and to increase automation. Electrification of industrial processes is one of the key pillars of many of these strategies.

As it stands, many industries use large gas-fired heaters but are switching over to large electric heat exchangers. One challenge is that electric heaters need to be able to accommodate the larger wattage and amperage requirements of these processes. This has to be balanced with another challenge: Control. Adequate control of the heater is needed to ensure that processes can be performed safely.

Qualities of Cutting-Edge Electric Heat Exchangers

Process heaters generally and electric process heaters specifically, have seen a number of innovations and improvements over the past decade. Enhanced fluid dynamics, Continuous Helical Flow Technology™, higher (and safer) watt densities and more have all contributed to a heater with a smaller footprint, less fouling and better safety features.

Enhanced Fluid Dynamics

Modern electric heat exchangers are engineered for advanced flow throughout the system without compromising the integrity of the media being heated, nor the integrity of heating elements and vessel. This can provide significantly improved heat transfer rates and more consistent performance across the vessel.

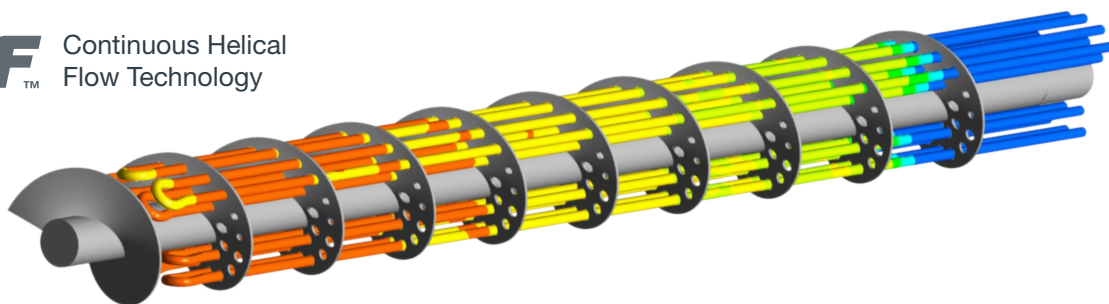
Continuous Helical Flow Technology™

Some heat exchanger design methods, like segmental baffles, have known dead zones where hot spots can occur. This exacerbates the coking process, leading to fouling and the need for further maintenance. Continuous Helical Flow Technology, on the other hand, can have ultra-high heat transfer rates with minimal fluid bypass, which virtually eliminates these dead zones. Continuous Helical Flow Technology also allows for a smaller overall footprint.

Higher Watt Densities

Newer technologies incorporated into electric heat exchangers allow for designs that take advantage of increased heat flux—i.e., watt density—for a given gas composition and a set of application conditions. Higher watt densities can help to make processes more efficient and less costly while still meeting critical temperature requirements, reducing overall footprint and providing for safer operation. (For more on this, see our white paper [“How Watt Density Specifications May Be Holding Back Optimal Electric Heat Exchanger Design.”](#))

CHF™ Continuous Helical
Flow Technology



Best-in-Class Control Systems

Matching the appropriate temperature control system to the heater is imperative both for safety and for the longevity of the heater. Ideally, two separate control systems should be used: One for process temperature control and one for high limit control. PID-type process temperature controllers in particular offer more stable control and faster response than ON/OFF switching controls or thermostats. Given how quickly an event can escalate in a typical LNG process, it pays to have fast, reliable control systems designed for the electric heat exchanger in question.

A Reliable Manufacturer with Experience

While all of the above innovations are great, their inclusion in any system should be accompanied by extensive testing in both the lab and the field. An even better scenario is when the manufacturer designing and creating the heat exchanger has a proven track record of providing safe, reliable heating solutions for decades. Watlow has taken great pains to develop, test and validate designs of electric heat exchangers like our own OPTIMAX® and HELIMAX™ heat exchangers.

Takeaways

Companies in LNG and related industries have been taking bold steps to reduce their overall carbon footprint and thus to electrify their processes. Switching to electric heat exchangers is a good step to take in this process. There is a lot of conflicting information available in the market today; however, regarding the best heaters for this approach, more modern electric heaters with advanced fluid dynamics, Continuous Helical Flow Technology, higher watt densities and best-in-class control systems should be considered for future electrification needs.

