Best Practices for Implementing Net Zero Strategies in Process Plants.

By Fluensys | Aug 23, 2024 | Net Zero Strategy

With the growing number of mandatory ESG regulations, having a Net Zero strategy is now a must for organisations. A comprehensive plan allows businesses to continue to create value while optimising energy use and abating carbon emissions. The aim of these regulations is to promote greater sustainability and ethical practices but also help businesses identify climate-related risks and opportunities for innovation.

Investor pressure, cost saving and realignment of brand value, are known drivers for adopting sustainable practices. But now, regulations are likely to put greater pressure on businesses to be transparent and more ambitious in their approach.

There are a number of frameworks, such as TCFD and IFRS, and international standards, ISO 50001/2, to guide businesses on their disclosures and targets. In the UK, ESOS is the guiding framework driving energy improvement in large entities.

It is worth noting that in the EU, CSRD not only applies to Scope 1 & 2, but also Scope 3 emissions across the value chain, and will extend to listed SMEs in the coming years. Hence, businesses, from beyond the EU shores, will have to align to its requirements where applicable.

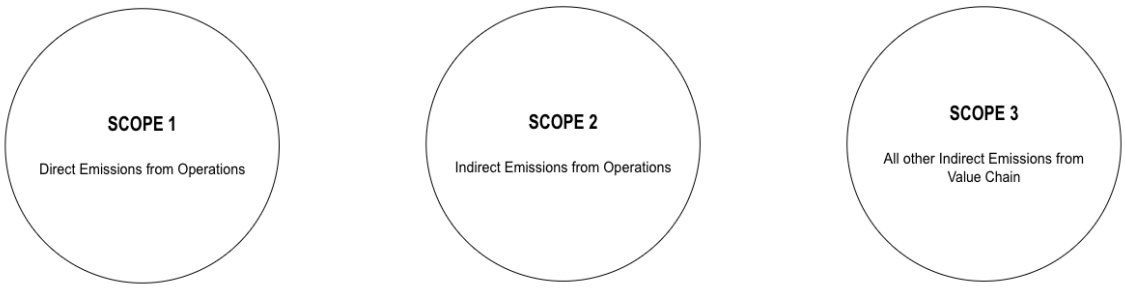

Fig 1: Emissions Scope Classification

Though the urgency of climate action and energy transition are well understood and accepted, implementing Net Zero strategies is challenging and requires substantial investment and commitment.

Challenges in Implementing Net Zero Strategies in Plants

Looking at process plants, the main challenges are:

- **Technology Lock-ins** – Having invested in prior carbon intensive technologies can make it hard to transition to low carbon alternatives and thus delay Net Zero implementation.
- **Complexity of Process Systems** – Relating mainly to hard-to-abate and energy intensive industries, such as steel and cement plants, high energy consumption and carbon generating processes make it harder to reduce carbon intensity.
- **Economic Constraints** - The high cost of low-carbon technologies and retrofitting existing plants can also be a significant barrier.

- **Technological Limitations** – Many of the technologies required to become Carbon Neutral are either too expensive or not yet mature and widely validated.
- **Supply Chain Issues** - The availability and cost of low-carbon raw materials and fuels make it hard to transition away from current ones.

Nevertheless, as the regulatory landscape evolves, we see an increasing uptake of sustainable practices amongst businesses.

Components of A Net Zero Strategy

The latest consensus on claiming Net Zero is that businesses must strive to become as 'green' as they possibly can, through aggressive emissions cuts and then offset of residuals within their value chain in the latter years of the plan.

Net Zero strategies, driven by science-based targets (SBTs), generally comprise of:

(i) carbon emissions avoidance through substitution with non-emitting technologies,

(ii) emissions reduction through efficiency improvements, waste minimisation through 'circularisation' of the value chain and,

(iii) carbon offsetting of residuals, preferably with long term removal solutions (long carbon cycles).

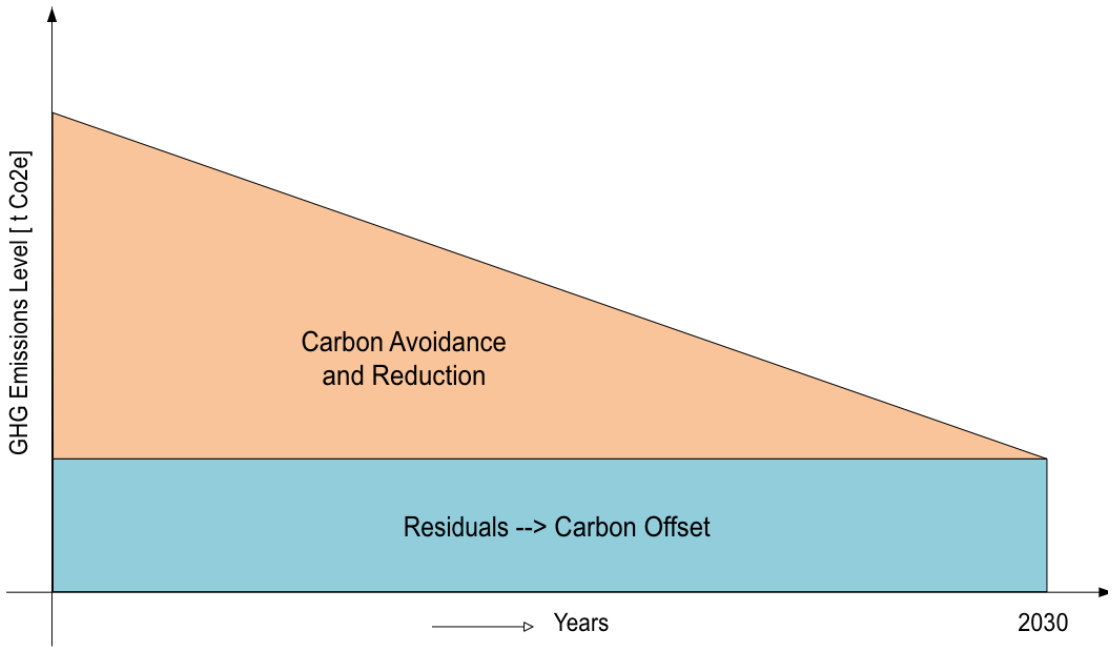

Fig 2: Typical Net Zero Plan

Carbon Avoidance, Reduction and Offset

Prioritising electrification, over fossil fuel systems, and opting for 'clean' power sources, is a common approach to drastically cut carbon emissions. Grid electricity have varying levels of carbon intensity among countries and PPAs, with private producers of renewable power, may be required to align with sought targets.

Energy use and emissions reduction can be achieved through adequate predictive maintenance programmes, operational changes and system efficiency improvements. It should be noted that due to the gradual wear of system components, inefficiencies increase over time. Adequate monitoring and data analysis of Significant Energy Users (SEUs) should be performed to identify potential equipment issues and operational anomalies.

Using Circular Economy (CE) principles, to reduce material intensity, and technologies such as Waste to Energy (WtE), to reduce carbon intensity, can also provide sizeable relief. Industrial symbiosis is an option to consider when businesses can synergise to find mutual benefits through waste valorisation.

Focusing on process plants, we detail the main approaches being employed to improve efficiency and decarbonise systems. The solutions are summarised below.

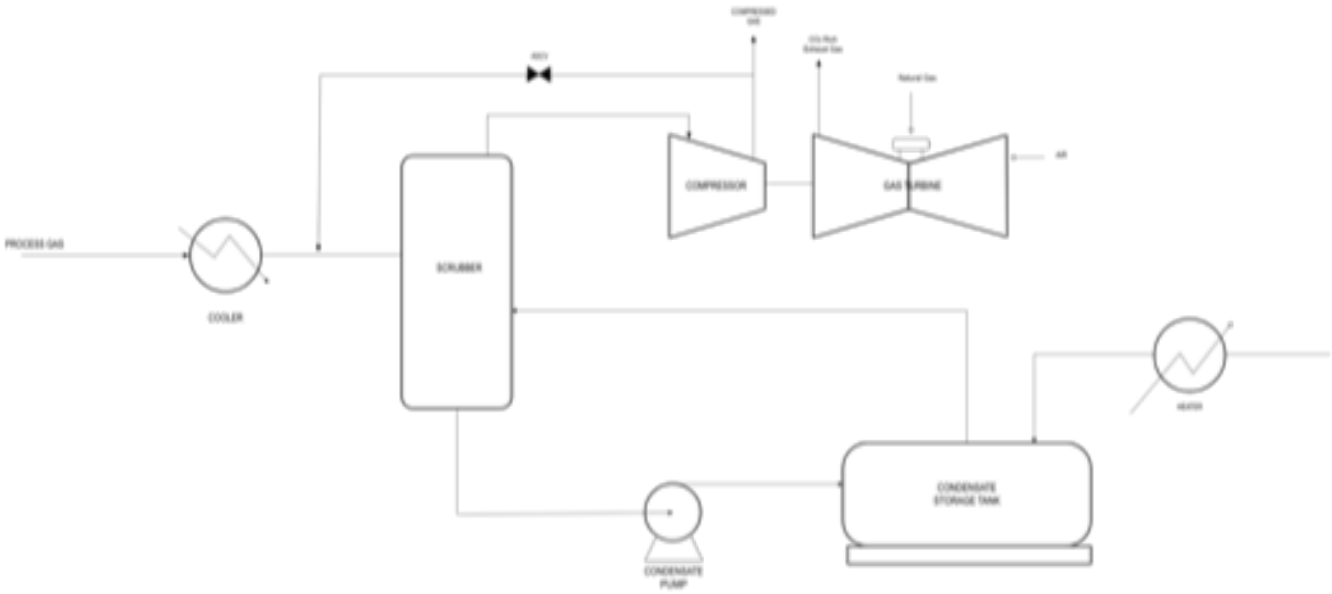

Fig 3: A Typical Process System

Heating Systems (Furnaces, Boilers, Heat Exchangers)

Heating systems make up the main carbon sensitive static components while generally, all rotating equipment can be considered as carbon intensive and with potential for efficiency improvement and emissions reduction or avoidance.

Pinch analysis is a common method to identify opportunities for heat recovery. It allows for optimisation of heat exchangers and aims to minimise the amount of external heat requirements (cooling and heating).

Fouling and coking of tubes are sources of inefficiency in heat transfer equipment. These inefficiencies can be addressed with design and operational changes, use of inhibitors, filtration and regular cleaning.

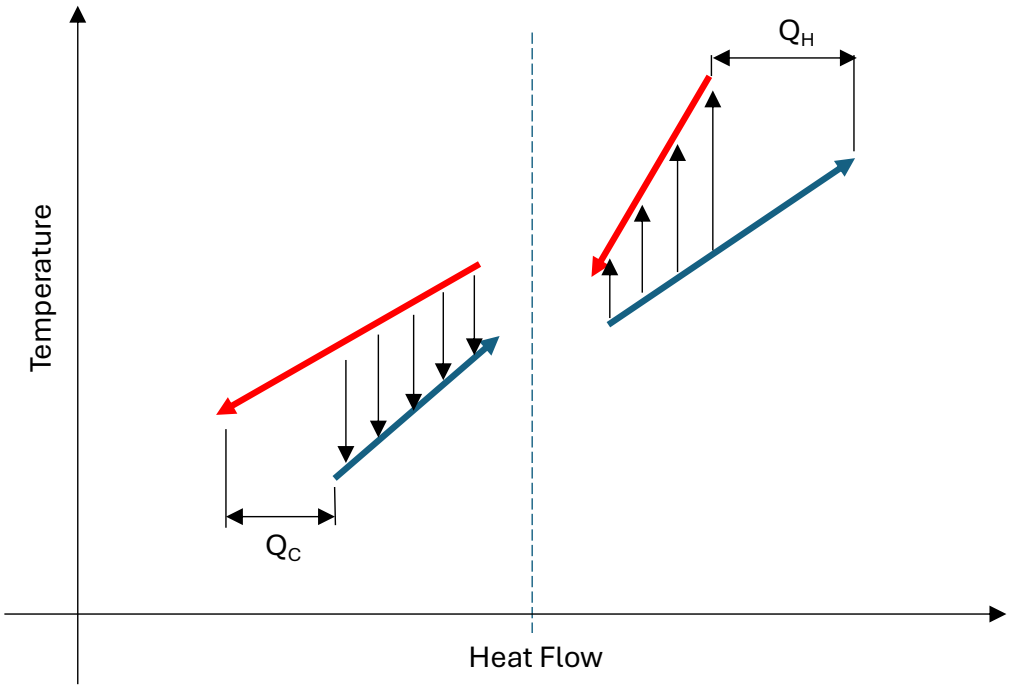

Fig 4: Heat Energy Optimisation using Pinch Analysis

For boilers and furnaces, looking for opportunities to reduce excess air use and retrofitting waste heat recovery units are potential solutions. Carbon capture and storage (CCS) units on the exhaust stacks can drastically improve flue gas quality and reduce emissions, however, the technology has not yet reached widespread adoption for the reasons mentioned above.

It is worth mentioning that CCS presents an opportunity to create added value as many innovative solutions are aiming to achieve permanent carbon sinking (low risk of reversal) while producing circular secondary products. Investing in those emerging technologies can prove of great reward in the longer term.

Rotating Machinery (Pumps, Compressors, Turbines & Motors)

Rotating equipment are generally characterised by their best efficiency point (BEP) and preferred operating range (POR). One of the key approaches is to avoid operation outside their POR, where the machine is subject to excessive forces, flow recirculation and heat loss. If a machine selection is constrained, a VFD solution should be considered.

Where fitted with recycle lines, continuous operation in full recycle should be avoided as it adds another source of inefficiency. Unless used in intermittence, a re-rate of the machine would be recommended to better match operational duty and minimise energy losses.

It is worth noting that upstream heating/cooling systems can have an impact on the performance of the machine, especially in compressible systems; hence adopting a holistic approach to the system audit and energy optimisation is necessary.

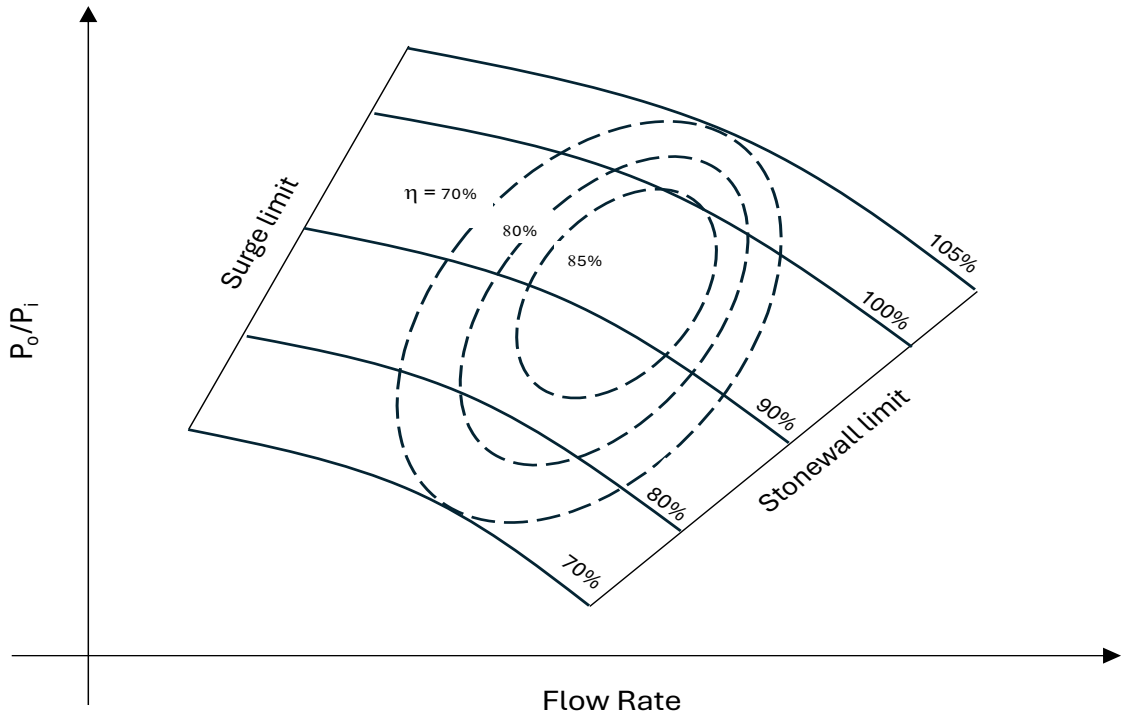

Fig 5: Typical Compressor Performance Map

Developing Your Own Strategy

Navigating the Net Zero landscape can be challenging with the evolving regulations and taxonomy. It is unlikely that similar strategies will work for all businesses and transition pathways can be very different; the complexity of production and process systems makes it, sometimes, necessary to involve experts to identify those optimal pathways and support the implementation phase and qualified carbon footprint and energy auditors to provide an accurate baseline year performance and inventory assessment.

Developing a Net Zero strategy is a collaborative effort involving all key stakeholders and requires the support of top management, in both the definition and implementation phases of a Net Zero strategy, with clear targets and timelines.

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