

Decarbonisation in the process industries:

What can manufacturers do now?



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Introduction

Lis Thodberg, Sustainability Director, NIRAS

The industrial sector is a pivotal player in the global economy, driving progress and prosperity. However, it also bears a significant responsibility for greenhouse gas emissions, contributing to the urgent challenge of climate change.

As the world moves towards a more sustainable future, the process industries must take bold steps to decarbonise their operations.

This transition is not just an environmental imperative but also a strategic business move, as stakeholders increasingly value sustainability.

The path to decarbonisation is fraught with challenges, but it also offers opportunities for innovation and growth. By embracing new technologies, improving energy efficiency, and adopting cleaner production methods, industries can reduce their carbon footprint while enhancing their competitiveness.

This paper lays out a strategic framework for decarbonisation, providing insights and guidance for industries ready to make the big decisions that future demands necessitate.

In the following, we will explore the various aspects of decarbonisation, from planning and value calculation to execution and looking ahead to the future.

Our journey begins with understanding the importance of envisioning a future state that aligns with sustainability goals and the practical steps to get there.

The industrial sector is the second highest contributor to global emissions



Future state planning

What is future state planning?

Future state planning is a methodical process that starts with a detailed analysis of current practices and culminates in a structured plan with defined milestones and objectives.

In the journey towards decarbonisation, future state planning serves as the strategic blueprint to guide industries towards their emission reduction targets.

This approach not only sets the direction for change but also provides a framework for measuring progress and ensuring accountability. Through diligent planning, industries can navigate the complexities of decarbonisation and achieve their sustainability goals.

The planning process begins with a thorough assessment of the current state: the emissions footprint, energy sources, and production processes.

This baseline serves as the starting point from which progress can be measured. The next step is to envision the desired future state. What does a decarbonised operation look like? How does it function? What are the benefits, both tangible and intangible? Answering these questions helps to define the targets and milestones that will mark the journey towards decarbonisation.



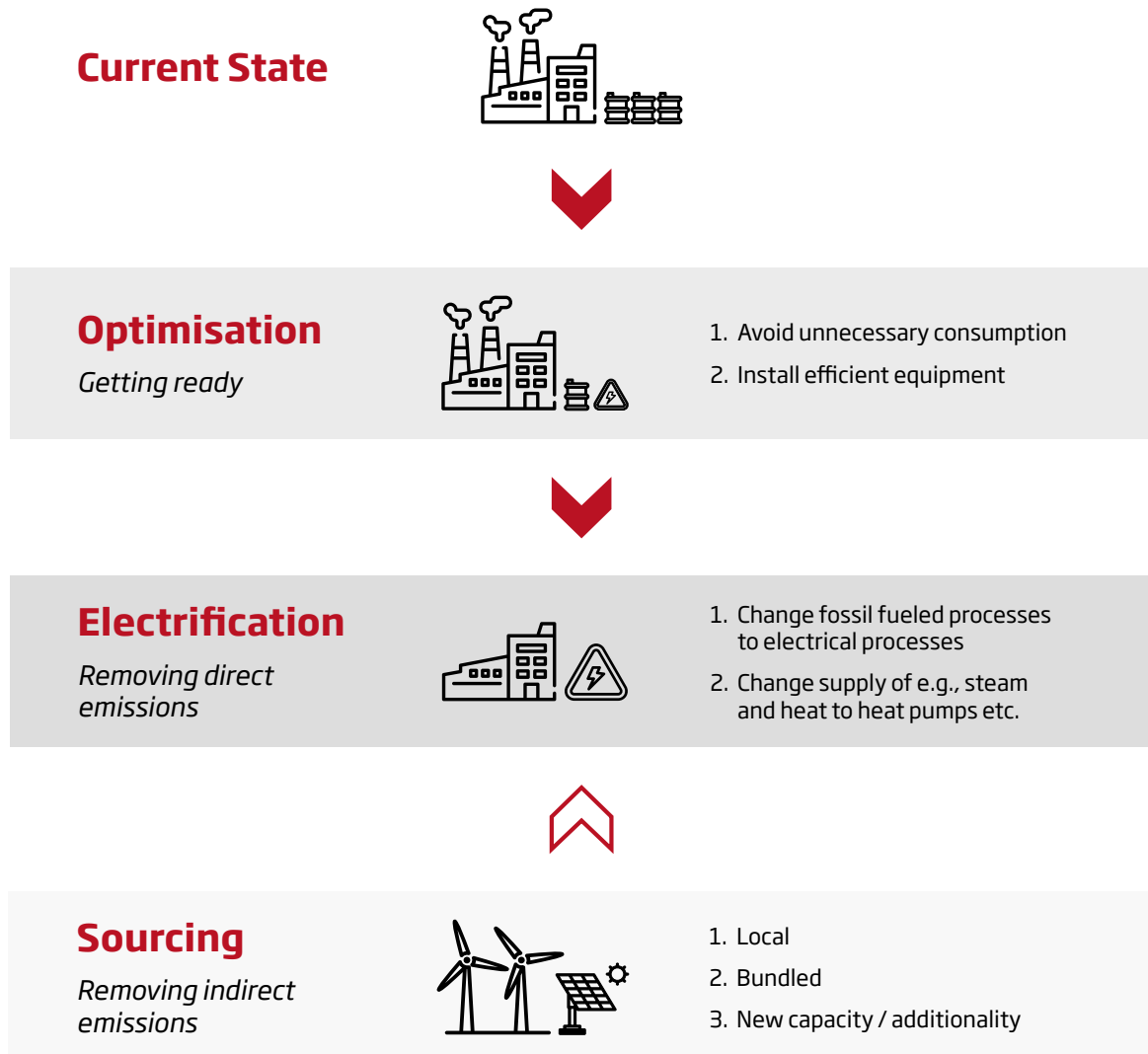
Decarbonisation roadmap

Setting targets is not enough. A roadmap is essential too. This detailed plan outlines the steps, timelines, and resources required to achieve the targets. It must be flexible, able to adapt to new technologies, changing regulations, and evolving market conditions. It should also consider the broader impacts of decarbonisation, such as the potential for job creation, economic growth, and the development of sustainable communities.

Future state planning is not a one-time effort; it is an ongoing process that requires regular review and adjustment.

As industries progress along the decarbonisation path, they will learn and adapt. They'll refine their strategies to ensure they remain on course to reach their ultimate destination - a sustainable, low-carbon future.

NIRAS approach to decarbonisation



Calculating value

Calculating the value of decarbonisation initiatives is a multifaceted exercise that involves quantifying not only the direct economic benefits but also the indirect advantages that accrue over time.

Financially, the value can be assessed in terms of cost savings from energy efficiency, revenue generation from sustainable products, and the avoidance of carbon taxes or penalties. These tangible benefits are relatively straightforward to calculate, often requiring a detailed financial analysis to forecast return on investment (ROI) and payback periods.

However, the intangible benefits, while more challenging to quantify, are equally important.

These include:

- the enhancement of brand reputation
- the ability to attract and retain talent
- the fostering of innovation.

There is also the value associated with risk mitigation, as companies that pro actively decarbonise can navigate the evolving regulatory landscape more effectively and avoid the costs associated with non-compliance.

Environmental valuation techniques, such as the social cost of carbon, can be employed to put a price on the environmental benefits of reduced emissions. These methods help in translating the impact of decarbonisation into monetary terms, making it easier for stakeholders to understand and appreciate the value created.

Incorporating both the tangible and intangible aspects of value into the decarbonisation strategy is crucial for building a compelling business case.

It demonstrates a commitment to not just the financial bottom line, but also to the planet and future generations. This holistic approach to calculating value ensures that decarbonisation efforts are recognised as an investment in a sustainable future, not simply a cost.

“The concept of value in the context of decarbonisation extends far beyond mere financial metrics. It is a broader spectrum that encompasses environmental stewardship, social responsibility, and long-term sustainability.”

Lis Thodberg, Sustainability Director, NIRAS

Navigating the decarbonisation journey

Embarking on the decarbonisation journey is a commitment to transformative change. It is a voyage that requires meticulous planning, steadfast determination, and the agility to adapt to new discoveries and innovations along the way.

The journey begins with a comprehensive assessment of the current state of emissions, energy use, and operational practices. This assessment forms the foundation upon which decarbonisation strategies are built. Following this, organisations must identify the most impactful areas for emission reduction, which often include energy sourcing, process optimisation, and procurement of goods.

Setting clear and measurable targets is the next critical step. These targets should be ambitious, driving innovation and commitment, yet realistic, ensuring they are achievable within the set time frames. The targets also need to align with broader industry standards and regulatory requirements to ensure compliance and benchmarking.

Developing a robust action plan is where the strategic vision translates into practical steps. This plan should detail the initiatives to be undertaken, the technologies to be deployed, and the resources required.

It should also include a time line for implementation, with short-term wins to build momentum and long-term goals for sustained change.

Stakeholder engagement is essential here. Decarbonisation efforts must be communicated transparently to all stakeholders, including employees, investors, customers, and the community. Without their buy-in and participation, initiatives are unlikely to succeed.

Monitoring progress, and adapting the strategy where needed, are ongoing tasks. Organisations must establish key performance indicators (KPIs) to track their progress against targets.

Regular reporting on these KPIs helps maintain accountability and provides insights into areas that may require course correction.

Finally, celebrating successes and learning from challenges are important for maintaining motivation and commitment to the journey.

Organisations that navigate this journey effectively will not only reduce their carbon footprint but also position themselves as leaders in a sustainable future.

Decarbonising the process industries

The process industries are integral to the global economy, providing essential materials and products that support a wide range of sectors. However, these industries are also among the most energy-intensive and contribute significantly to global carbon emissions. Decarbonising the process industries is not only critical for meeting climate goals but also for ensuring the long-term viability of these sectors in a low-carbon future.

The challenges of decarbonisation in the process industries are multifaceted. They include the reliance on fossil fuels for high-temperature processes; the need for significant capital investment in new technologies, and the complexities of integrating renewable energy sources. Additionally, there are often regulatory and market barriers that can impede progress.

Despite these challenges, there are numerous opportunities for decarbonisation within the process industries. Advances in energy efficiency, process optimisation, and responsible sourcing of raw materials can lead to significant emission reductions. The adoption of circular economy principles, where waste is minimised and materials are reused, can also contribute to decarbonisation efforts.

“Decarbonisation is not a destination but a continuous path of improvement and innovation.”

Jacob Vester, Chief Consultant, NIRAS

“The transition to a decarbonised future will require collaboration across the entire value chain, from raw material suppliers to end-users. It will also require a supportive policy framework that incentivises investment in low-carbon technologies and penalises carbon-intensive practices.”

Lis Thodberg, Sustainability Director, NIRAS

Investment in new energy intensive equipment is another important topic, because it may affect the energy consumption of specific types of fuels and electricity, but also because future planned transitions in facilities energy architecture can affect the equipment (e.g. if steam or gas are discontinued). When investments in decarbonisations are coherent with decarbonisation plans it will be beneficial to both investment projects and decarbonisation efforts.

One of the most promising areas for decarbonisation is the electrification of processes, using renewable energy sources such as wind and solar power. Additionally, the development and deployment of carbon capture, utilisation, and storage (CCUS) technologies can mitigate emissions from processes that are difficult to decarbonise.

So, while the task of decarbonising the process industries is daunting, it is also filled with potential for innovation and growth. By embracing the opportunities and overcoming the challenges, these industries can play a pivotal role in the transition to a sustainable, low-carbon economy.

Managing multiple sites

Managing decarbonisation efforts across multiple sites is a complex task that requires a coordinated and strategic approach.

Each site may have different operational practices, regulatory environments, and local stakeholder expectations, making a one-size-fits-all strategy impractical. Instead, a tailored approach that respects the unique characteristics of each site is needed.

A centralised management system can provide the right level of oversight to ensure consistency in decarbonisation goals, while allowing for local adaptation. This system should include a framework for setting site-specific targets, tracking progress, and sharing best practices. It should also facilitate the exchange of knowledge and resources between sites to drive collective improvements.

Data plays a crucial role in managing multiple sites. Accurate and timely data collection allows for informed decision-making and helps identify areas where interventions are most needed. Advanced analytics can be used to model scenarios, predict outcomes, and optimise strategies for each site.

Engagement with local teams enables successful implementation. Managers and employees on the ground are usually best placed to understand the specific challenges and opportunities at their site. Involving them in the planning and execution of decarbonisation initiatives ensures that strategies are grounded in local realities and have the buy-in necessary for success.

Finally, it is important to recognise and celebrate the achievements of individual sites. This not only motivates teams but also encourages a sense of healthy competition among sites to excel in their decarbonisation efforts.

Managing multiple sites requires a balance between centralised coordination and local autonomy. By leveraging data, engaging with local teams, and recognising achievements, organisations can effectively drive decarbonisation efforts across their entire portfolio of sites.



Heineken[®]

Managing decarbonisation strategies for multiple sites around the world is a key challenge for global brands like Heineken, which is looking to reduce carbon emissions in its breweries across Africa, Europe, Asia and the Americas.

NIRAS is providing technical expertise to Heineken's Net Zero Production programme (i-NZP), which will see the brewer reach net zero in scope 1 and 2 emissions by 2030. Having become the first global brewer to have its net zero and FLAG (Forest, Land and Agriculture) targets approved by the Science Based Targets initiative (SBTi), Heineken has already identified significant energy-saving opportunities in 40 of its breweries, with plans to expand further in 2025.

Heineken has highlighted the importance of external expertise and collaboration in reaching its sustainability targets, emphasising that successful decarbonisation requires a strategic site-specific approach.

Optimisation

Optimisation in the context of decarbonisation is about enhancing the efficiency and effectiveness of initiatives to reduce carbon emissions. It involves a continuous process of evaluating and improving strategies to ensure they deliver the maximum environmental benefit for the least cost.

Key areas of optimisation

Energy management:

By implementing energy-efficient technologies and practices, industries can significantly reduce their energy consumption and associated emissions.

Process optimisation:

This involves reviewing and refining industrial processes to minimise waste and maximise output. Techniques such as process integration and pinch analysis can identify opportunities for reducing energy use and emissions within existing operations.

Renewable energy:

The use of renewable energy sources is also a critical component of optimisation. Transitioning from fossil fuels to renewables not only reduces emissions but can also provide long-term cost savings. Industries can optimise their energy mix by assessing the availability and feasibility of different renewable options, such as solar, wind, and bioenergy.

Supply chain:

By working with suppliers to reduce their emissions, industries can decrease the overall carbon footprint of their products. This might involve sourcing materials from low-carbon providers, collaborating on joint decarbonisation projects, or encouraging suppliers to adopt more sustainable practices.

Continuous improvement:

Industries should foster an environment where innovation is encouraged, and employees are empowered to identify and implement optimisation opportunities. This can be supported by regular training, clear communication, and incentives for achieving decarbonisation goals.



Industrial symbiosis: Collaborative pathways to decarbonisation

Industrial symbiosis represents a paradigm shift in resource management within the industrial sector.

It is a form of collaboration where waste or by-products of one company become the raw materials for another, creating a closed-loop system that mimics natural ecosystems. This approach not only reduces waste and saves resources but also contributes significantly to the reduction of carbon emissions, playing a vital role in the decarbonisation of industries.

Implementing industrial symbiosis

To get started, companies must first identify potential synergies, which can be achieved by mapping out resource flows and identifying complementary industrial partners.

The process often requires a cultural shift towards collaboration and transparency, as well as establishing trust between partners. Challenges such as logistical coordination and regulatory compliance must also be addressed to create a successful symbiotic relationship.

However, overcoming these challenges can have a significant impact on decarbonisation.

By optimising the use of resources, companies can drastically lower their carbon footprint, as evidenced in a number of quantitative studies. For instance, the reuse of waste heat from one process to power another can lead to a reduction in the overall energy demand and associated emissions.

Industrial symbiosis is a key strategy in the transition to a circular economy and a decarbonised industrial sector.

It offers a pathway to not only environmental sustainability but also to economic resilience and competitive advantage. As industries strive to reduce their carbon emissions, embracing the principles of industrial symbiosis will be essential for creating more sustainable and efficient production systems.

Spotlight on: The Kalundborg Symbiosis in Denmark

A pioneering example of industrial symbiosis, the Kalundborg Symbiosis involves a web of exchanges between different entities, including a power station, an oil refinery, and a pharmaceutical plant, among others.

The symbiosis has resulted in the reuse of waste heat, water, and materials, leading to substantial environmental and economic benefits. Other instances of industrial symbiosis, both large and small-scale, demonstrate similar advantages, showcasing the potential for resource efficiency and emission reductions.

For more info visit:

www.symbiosis.dk/en/

Execution

The execution of a decarbonisation plan is a dynamic and iterative process. It requires a coordinated effort across the organisation, a willingness to embrace new technologies and practices, and a commitment to continuous improvement. By focusing on these key elements, organisations can ensure that their decarbonisation strategies are effectively executed and their sustainability goals are achieved.

Successful execution encompasses the following:

1. Project management and governance:

Clear governance structures must be established to oversee the implementation of decarbonisation initiatives. This includes defining roles and responsibilities, setting up decision-making processes, and ensuring accountability at all levels.

2. Technology deployment:

Whether it's renewable energy systems, energy-efficient equipment, or advanced emissions control technologies, careful planning is needed to integrate these solutions into existing operations seamlessly.

3. Stakeholder engagement:

As well as internal stakeholders such as employees and management, it's important to engage external parties like suppliers, customers, and regulatory bodies. Effective communication and collaboration with all stakeholders can facilitate smoother implementation and greater buy-in.

4. Monitoring and reporting:

Regular reporting allows for transparency and provides the data needed to evaluate the effectiveness of the strategy and make necessary adjustments.

5. Adaptation and flexibility:

Unforeseen challenges may arise, and the strategy may need to be adjusted in response to new information, technological advancements, or changes in the regulatory environment.

6. Continuous improvement:

Execution is not a one-off event but an ongoing process. A mindset of continuous improvement should be fostered, encouraging innovation and the pursuit of excellence in decarbonisation efforts.



Evolution of the process industries

As the process industries continue to evolve, so too must the strategies for decarbonisation.

Looking ahead, it is clear that the journey towards a low-carbon future will be marked by rapid advancements in technology, shifts in regulatory policies, and changes in market dynamics.

The future of decarbonisation in the process industries is one of opportunity and challenge. By anticipating and preparing for these developments, industries can position themselves at the forefront of the transition to a sustainable, low-carbon economy.

Here are some of the trends and developments that are likely to shape the decarbonisation landscape in the coming years.

Technological innovation: The pace of technological innovation is accelerating, and new solutions for reducing emissions are emerging regularly. Industries must stay abreast of these developments, from advancements in renewable energy technologies to breakthroughs in materials science that can lead to more sustainable production processes.

Regulatory changes: Governments around the world are intensifying their efforts to combat climate change, resulting in a dynamic regulatory environment. Industries must be prepared to adapt to new regulations, such as carbon pricing mechanisms and emissions reporting requirements, which will impact the way they operate.

Market forces: Consumer preferences and investor priorities are increasingly focused on sustainability. This shift is driving demand for low-carbon products and services, creating new market opportunities for industries that can successfully decarbonise their operations.

Collaboration and partnerships: No industry can decarbonise in isolation. Collaborative efforts, both within and across sectors, will be essential for achieving large-scale emission reductions. Partnerships with governments, research institutions, and non-governmental organisations provide the support and resources needed for decarbonisation.

Resilience and adaptation: As the impacts of climate change become more pronounced, industries must also focus on building resilience and adapting to a changing climate. This includes designing facilities and infrastructure that can withstand extreme weather events and shifting operational practices to account for resource scarcity.

Bridging the execution gap

The execution gap refers to the disparity between decarbonisation plans and their actual implementation. Bridging this gap is crucial for ensuring that the strategic vision for a low-carbon future is realised - here, we set out how.

Bridging the execution gap is a multifaceted challenge that requires strategic alignment, resource commitment, effective change management, innovation, accountability, and a culture of continuous learning. By focusing on these areas, industries can ensure that their decarbonisation plans are not just aspirational documents but are actively guiding them towards a sustainable, low-carbon future.

1. Align goals and actions:

One of the primary reasons for the execution gap is the misalignment between set goals and the actions taken. To bridge this gap, it is essential to ensure that every initiative and project undertaken is directly contributing to the decarbonisation targets. This requires a clear understanding of the goals and a commitment to aligning all actions with these objectives.

2. Resource allocation:

Adequate resources must be allocated to decarbonisation projects to ensure their success. This includes financial investment, human capital, and technological resources. Industries must prioritise decarbonisation within their budgets and strategic plans to provide the necessary support for execution.

3. Change management:

Decarbonisation doesn't happen overnight, and people within an organisation may be concerned about what it means for them. This is why it's important to manage the human aspect of change, with training, communication, and stakeholder engagement. By preparing and supporting employees through the transition, industries can overcome resistance and foster a culture that embraces decarbonisation.

4. Innovation and flexibility:

Industries must be open to exploring new approaches and adapting their strategies in response to feedback and changing circumstances. This agility can help navigate the complexities of decarbonisation and maintain momentum.

5. Performance tracking and accountability:

This not only ensures progress is being made but also identifies areas where additional focus is needed to close the execution gap.

6. Learning and improvement:

Industries should foster a learning environment where insights are shared, and continuous improvement is encouraged. This approach can drive better execution practices and help achieve decarbonisation goals more effectively.

Realising your sustainable potential



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