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Driving resource efficiency through regulation

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TOWARDS A SUSTAINABLE INDUSTRY

Solutions for competitive, efficient and resilient production

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Reduced energy and water use at large iron ore mine

In Australia's resource-rich but water-scarce Pilbara region, a major iron ore mine has cut energy use and emissions by 29 percent while saving over 383,000 m³ of water annually through a decade-long partnership with FLS. The mine replaced traditional vacuum pumps with high-efficiency blowers in its horizontal belt filters, reducing installed power demand from 840 kW to 600 kW. At the same time, it upgraded from air deck belt support systems to water-free roller deck systems, cutting power further and lowering maintenance needs.

These upgrades have led to an annual energy saving of 1.6 million kWh and a CO₂ reduction of 672 tonnes. Water savings are equally significant: Eliminating sealing water for vacuum pumps and lubricating water for air decks has reduced consumption by 383,162 m³ of water (the equivalent of 153 Olympic-sized swimming pools) each year.

Beyond environmental gains, the modernised system has increased operational reliability, reduced maintenance shutdowns, and lowered costs—demonstrating how mining operations can enhance sustainability without compromising productivity. The case underlines the role of targeted efficiency improvements in advancing the green transition across resource-intensive industries.

CONTRIBUTORS

FLS

LOCATION

Pilbara, Australia



Empowering a green and competitive Danish industry

Strong industries are vital for prosperity and resilience. But industry also contributes significantly to global emissions and resource use.

Denmark aims to be among the world's first climate-neutral countries by 2045 and climate negative thereafter. Through ambitious regulation and strong partnerships across public and private sectors, Denmark has created a framework that drives both climate action and industrial competitiveness. Energy efficiency is a Danish tradition. Since the oil crisis in the 1970s, we have worked to reduce energy consumption, resulting in one of the world's least energy-intensive industries. Danish companies provide pioneering solutions for optimising production, electrifying processes, integrating renewables and recovering excess heat.

With volatile energy prices and pressured supply chains, energy efficiency offers a clear business advantage. Through initiatives like energy efficiency obligations, incentive schemes, sector coupling, sector-specific climate partnerships and targeted green R&D funding, we enable Danish companies to reduce energy use while boosting productivity. Since 1990, the Danish economy has grown by 80 percent, while energy consumption has dropped by 17 percent and GHG emissions by 46 percent (2023).

Internationally, Denmark also promotes higher energy efficiency standards—from advancing EU regulations like the Eco Design Directive to driving bilateral government-to-government cooperation on regulatory frameworks. We support global industrial decarbonisation by sharing experience in energy and CO₂ audits, standardisation, industrial symbioses and more. Denmark's green transition of industry is also promoted through CO₂ pricing, coupled with the possibility of transition support,

which contributes to financing investments in, for example, electrification, hydrogen and CCS.

The Danish approach to industrial growth ensures environmental protection and resource efficiency go hand in hand. We pursue a "Water Efficiency First" principle—using no more water than necessary for industrial processes. Ambitious regulation and permitting push industries to reduce emissions and improve water resource efficiency. Innovation is supported by long-term policy and collaboration across companies, utilities and technology providers.

To support the industrial green transition and sustainable resource use, the Danish government has introduced new legislation on "technical water," enabling industries to use, for example, treated wastewater or contaminated groundwater in their processes.

Danish companies are reusing water in closed-loop systems, lowering energy use in wastewater treatment and transforming waste into new resources. The result: industries that view water and waste not as challenges, but as valuable inputs.

By managing and valuing resources efficiently, Danish industries demonstrate that green solutions are good for both the planet and business. A circular economy will also strengthen the strategic autonomy of Denmark and the EU, as reduced material consumption and increased recycling can enhance supply security for Danish businesses and reduce dependence on imported raw materials.

This white paper presents the public and private efforts driving Denmark's competitive green transition, and we hope it inspires new action.



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Driving business-led climate action in a fragmented world

BY PETER BAKKER, CEO, WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT

2025 is a year of transition—politically, economically, and industrially. Geopolitical tensions, trade friction, rising climate risk, and diverging regulations are reshaping the context in which business operates. This turbulence is colliding with the reality of physical climate impacts: 2024 was the hottest year on record, with global temperatures temporarily breaching the 1.5°C threshold and climate-related damages exceeding \$300 billion. The implications are clear: climate risk is now business risk, and long-term competitiveness will depend on how well companies adapt and respond.

In this context, World Business Council for Sustainable Development's 2025 Business Breakthrough Barometer provides a real-economy snapshot of where businesses are accelerating action—and why. The data shows a shift: companies are no longer acting just out of compliance or pressure. A majority, 56 percent, now cite long-term competitiveness as the main driver for investing in the transition. They're acting where conditions support progress: regions with stable policy, affordable clean energy, and growing demand for low-carbon solutions.

Businesses are prioritizing technologies with dual benefits—commercial viability and climate impact.

But ambition alone is not enough. Fragmentation remains a major barrier—across borders, sectors, and value chains. 85 percent of surveyed companies call for stronger international coordination to unlock investment and scale markets for clean technologies. That's why World Business Council for Sustainable Development is proud to partner with State of Green: to explore how innovative public-private partnerships—like those pioneered in Denmark—can inform global collaboration models.

The road ahead requires credible business leadership, smarter regulation, and financial systems that reward action. No company, government or financier can do this alone. That's where partnerships matter. World Business Council for Sustainable Development remains committed to building the platforms, coalitions and tools that help businesses turn sustainability into competitiveness—in every region, and at real economy scale.



Peter Bakker
CEO, World Business Council for Sustainable Development

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The global imperative: Energy

As demand for industrial goods grows, so does the need to rethink industrial energy consumption. With global energy demand rising and emissions climbing, industry must use less, waste less, and switch to renewable energy to achieve climate goals.

In too high demand

Global industrial activity has surged over the past two decades, fuelled by rising demand for industrial goods from an expanding population and a growing economy. Since 2000, industrial CO₂ emissions have risen by around 70 percent, and today, industry is responsible for about a quarter of energy-related CO₂ emissions globally. To curb this trajectory, the consumption of energy and related resources must be addressed.

Industry currently accounts for 37 percent of global energy use, nearly 70 percent of which still stems from fossil fuels. According to the International Energy Agency (IEA), industrial energy demand is expected to increase in coming years at a rate significantly higher than what is aligned with the Net Zero Emissions by 2050 (NZE) Scenario. Thus, the sector must both cut energy use and switch to greener sources.

Efficiency, integration & electrification

Dubbed the “first fuel” in clean energy transitions, energy efficiency is the largest measure to curb energy demand in the IEA NZE by 2050 scenario. By reducing the amount of energy required to provide products and services, industry can reduce their climate footprint in a cost-effective manner.

Also, industry has a crucial opportunity to reduce its energy waste. For instance, the amount of heat wasted in the EU industry corresponds to the heat demand of 10 million single-family households. By pursuing sector coupling,

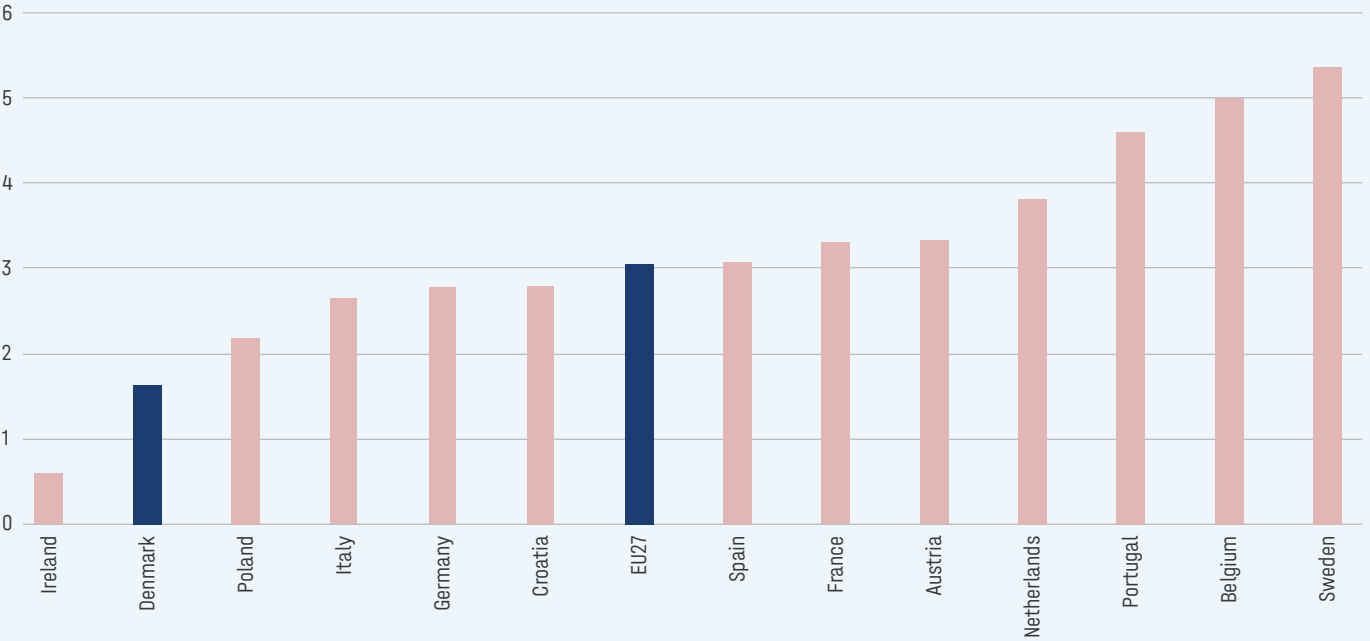
industry can harness its excess heat using it onsite and ensure that any remaining heat is transported, stored or converted into valuable energy in the future integrated energy system.

When it comes to replacing fossil energy sources, electrification wherever possible is paramount, as electrified industrial processes are often far more energy efficient. Studies show that most industrial processes can be electrified either directly or indirectly. There is major potential to electrify heat in industries, particularly for temperatures up to 200°C. This is significant, as today, 47 percent of industrial energy is used for process heat, three quarters of which stems from fossil sources.

Currently, electricity accounts for only 23 percent of global industrial energy consumption. Thus, accelerating the industrial demand for electricity is not only crucial for energy efficiency but also for enabling the transition to renewables.

Decoupling consumption from growth

Historically, the emergence of industry has been considered inseparable from the rise of fossil fuels and increased energy consumption. But, since the 1990s, Denmark has managed to grow its industry and increase its GDP by 80 percent while lowering CO₂ emissions by 46 percent and overall energy consumption by 17 percent (2023). Though this is by no means a global trend, the Danish experience suggests the sustainable growth is possible.



Energy intensity in industry, TJ per million EUR (2023)

Danish industry boasts one of the lowest rates of energy intensity among European countries at approximately half the intensity of the EU27 average. This is in part due to concerted efforts by industry – incentivised through regulation, financing and increased awareness. This effort has reduced energy intensity in industry by 37 percent since 2000, by 19 percent since 2010, and the quest for improving energy efficiency continues.

Source: ODYSEE-MURE



Photo credit: Danfoss

Competitive energy use in factory halls old and new

In Poland, where over 20 percent of GDP comes from industry and the energy mix is dominated by fossil fuels, decarbonising manufacturing is a necessity. Across the three factory halls at Danfoss' production campus in Grodzisk, the goal has been to show how decarbonisation can be done competitively—both in new construction and through retrofitting.

Hall #3, built in 2021, was designed for energy efficiency and CO₂-neutrality. A key measure is Danfoss' Shutting Off Initiative, where idle machines are powered down instead of left on standby. This saves 4,607 kWh of electricity per day without affecting productivity. This initiative is low-cost yet brings substantial energy and economic savings. Once fully rolled out across Danfoss' global sites, the initiative is expected to save the company 80 million kWh and EUR 3–5 million annually.

The hall also uses variable speed drives on air handling units, cutting energy use by up to 40 percent and enabling predictive maintenance. Heating and cooling are handled by electric heat pumps with a seasonal COP of 3.8, which recover and reuse excess heat from compressors and production equipment.

Older halls have also been modernised with minimal disruption. In Hall #1, two air handling units were installed in just 10 days, and an older unit was rebuilt to recover exhaust heat and reduce the need for gas and temporary cooling during summer. Upgrades in Hall #1 save 1.8 million kWh and EUR 420,000 annually, with a payback time under 2.5 years.

CONTRIBUTORS

Danfoss

LOCATION

Grodzisk, Poland





Industrial excess heat used for district heating

Greater Copenhagen Utility HOFOR and biosolutions provider Novonesis have partnered to integrate industrial excess heat into Copenhagen's district heating network. A large-scale heat pump installed at Novonesis' enzyme production site captures waste heat from cooling processes and feeds it into HOFOR's district heating system.

The heat pump has a 4 MW heating and 3 MW cooling capacity, using ammonia as refrigerant. It connects Novonesis' cooling circuit on the cold side and the district heating network on the warm side—delivering both heating and cooling simultaneously. Powered by electricity, increasingly from renewables, the system links the electricity, and heating sectors and strengthens flexibility in Copenhagen's energy mix.

The heat pump produces on average 16,400 MWh district heating and 13,000 MWh cooling annually, with a coefficient of performance of 3.8, resulting in an electricity consumption of 4,200 MWh per year. It reduces CO₂ emissions by 1,000–2,000 tonnes per year and cuts electricity and water use in Novonesis' traditional cooling operations. This sector-coupling approach supports decarbonisation of both industrial processes and urban heat supply, while enabling cost-effective integration of more wind and solar power in the energy system.

CONTRIBUTORS

HOFOR
Novonesis

LOCATION

Copenhagen, Denmark



CHAPTER 2

The global imperative: Water

With rising water stress and industrial demand, holistic water management strategies linking reuse and efficiency are essential to industrial resilience and competitiveness.

A scarce resource

The availability and sustainable management of water are increasingly critical to industrial development and economic resilience. As a fundamental input across nearly all industrial processes—from manufacturing and cooling to cleaning and product formulation—water is indispensable to modern production systems. Globally, industry accounts for 20 percent of all freshwater withdrawals, according to the UN. When corporate supply chains are included, this figure rises dramatically, with estimates suggesting that two-thirds of total global water use can be traced back to industrial value chains.

This dependence on water resources is under pressure. Many companies operate facilities in regions already facing water stress, and over two-thirds of global corporations now report exposure to water-related risks. As industrial demand for water is expected to rise, particularly in rapidly growing economies, the urgency of addressing water scarcity is intensifying.

Smart and holistic water management

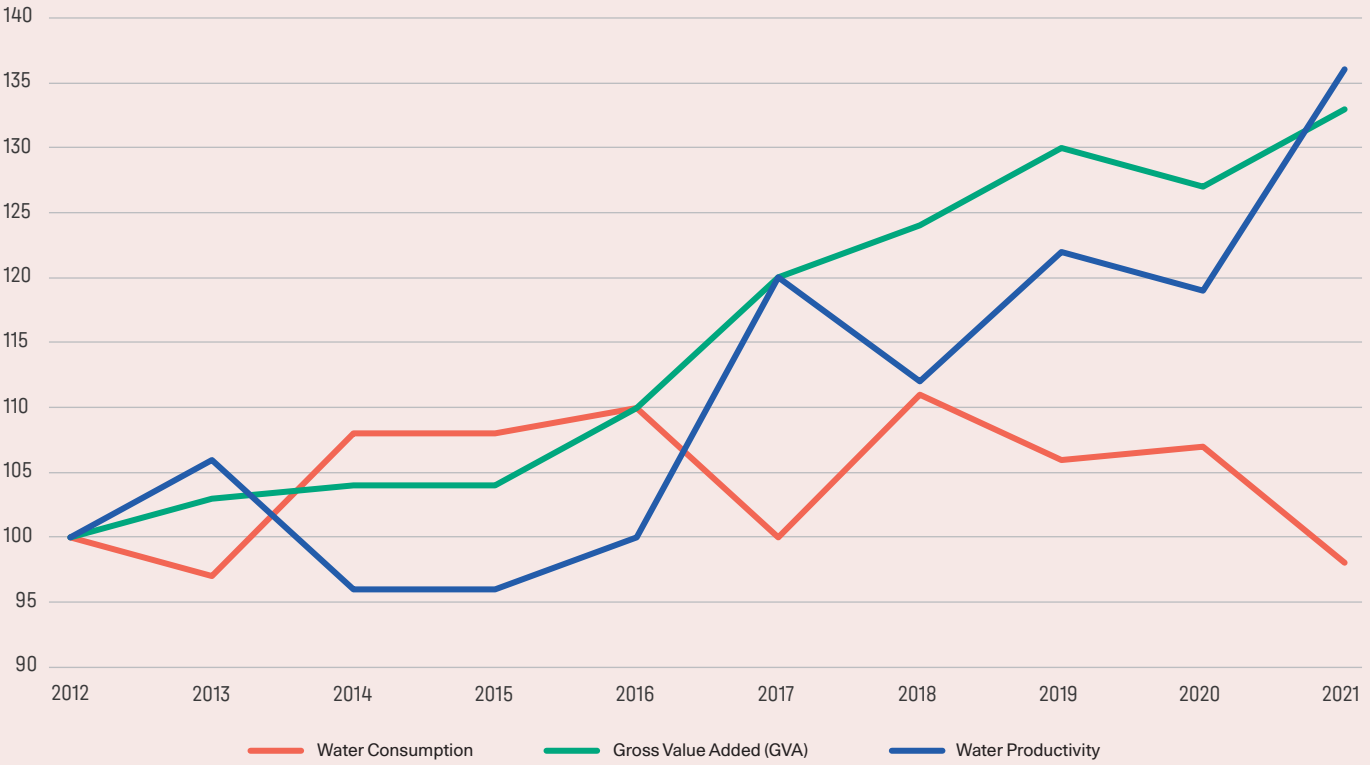
In response, industries are increasingly exploring circular and integrated water solutions to ensure both resilience and resource efficiency. A 2024 report by Danish companies Grundfos and Rambøll shows that, within light industries such as pulp and paper and pharmaceuticals, circular

water strategies—ranging from internal reuse to external recycling—have a savings potential of 50–75 percent.

Alternative water sources, including treated municipal wastewater, also offer promising opportunities to replace high-quality drinking water in industrial processes and power-to-X plants, where such quality is unnecessary.

The drive for smarter water use must be approached holistically. Water and energy are deeply interconnected: water is essential for energy production, such as cooling and storage, while energy is required to pump, treat and transport water. According to the IEA, energy production alone accounts for around 10 percent of global freshwater use. Addressing water in isolation risks unintended inefficiencies or trade-offs elsewhere in the system.

Denmark offers a stronghold in addressing these dual challenges. Through a combination of technology, regulation and collaboration, Danish industry improved its water productivity by 36 percent between 2012 and 2021. This progress reflects an integrated approach that links water reuse, process optimisation and energy efficiency. In total, Denmark has reduced its water consumption by 41 percent since 1990 while simultaneously experiencing economic prosperity.



The trajectory of Danish industrial water consumption

The development in water productivity shows that the industry improved its water use efficiency by 36 percent between 2012 and 2021. During this period, both absolute and relative decouplings between water consumption and gross value added have occurred. The development is based on index figures, where 2012 = 100. Water productivity is measured as the gross value added per cubic metre of water used. Calculation: Gross value added (GVA) / total water consumption.

Source: The Danish Academy of Technical Sciences



Photo credit: Grundfos

Saving enough water for 500 homes

Carlsberg Britvic partnered with Grundfos to reduce water use at its bottling plant in Beckton, East London. Producing 14 million cases of beverages annually, the company targeted its high water-use bottle rinsing process for improvement.

The Grundfos Bottle Rinse Reuse System captures, filters, and treats rinse water to a high quality for reuse in the bottle rinse carousels. The modular system combines micro and carbon filtration, UV AOP, Grundfos Digital Instrumentation Dosing (DID) control, patent-filed valving, SCADA monitoring, and custom tanks in a closed-loop design.

The compact unit stands beside one of the bottling lines, automatically diverting poor-quality batches to the drain, and required no shutdown during installation. Its unique combination of technologies and control system is patent pending.

With the new system, Carlsberg Britvic saves about 64 million litres of water annually—the equivalent used by 500 UK households—while maintaining high production standards. The system operates with minimal CO₂ impact, using just 0.5 kWh per 1,000 litres treated.

The solution also proved economically viable, achieving a return on investment within two years, and is significantly more resource-efficient than traditional wastewater treatment methods

CONTRIBUTORS

Grundfos

LOCATION

Beckton, United Kingdom





Photo credit: Aquaporin

Biomimetic membranes for efficient water treatment

Reverse osmosis (RO) is a proven technology for treating industrial wastewater, but its high energy demand remains a challenge. In Japan, a global provider of water treatment chemicals and systems aimed to reduce the energy use and carbon footprint of its RO system, which recycled 50 percent of wastewater from its R&D facility.

To achieve this, the company adopted Aquaporin Inside® CLEAR Ultra membranes, developed by Danish company Aquaporin. Inspired by natural water channels found in living cells, these proteins act like molecular gatekeepers, enabling clean water to pass through while blocking everything else. Just one gram of aquaporins can filter up to 700 litres of water per second - far beyond what synthetic membranes can achieve. The biomimetic membranes allow ultra-low-pressure operation without compromising water quality. Installed in a three-stage RO system, 15 CLEAR Ultra 8040 membrane elements replaced conventional membranes.

The upgrade led to a 60 percent reduction in operating pressure, significantly lowering the energy requirement of the system. The facility now saves approximately 28,000 kWh of electricity annually, equivalent to a reduction of 20 metric tons of CO₂ emissions. Importantly, the system maintained stable water quality, demonstrating that nature-inspired innovations can drive both environmental and operational efficiency in industrial water reuse.

CONTRIBUTORS

Aquaporin

LOCATION

Japan



The competitive imperative

Green business is good business. Beyond compliance with regulatory standards and risk mitigation, companies that invest in sustainable practices are experiencing significant cost savings, operational efficiencies, and enhanced market positioning.

The imperative for pursuing a green transition of industry is not just about climate targets and resource preservation – it is about competitiveness. More and more companies around the world are already turning their transition into a driver of value creation and the business case is clear.

Efficiency equals resilience

One of the most compelling reasons for industries to invest in green solutions is the potential for significant cost reductions. Energy efficiency, water conservation, and waste minimisation are all areas where companies can achieve substantial savings with attractive returns on investment.

In Europe, for instance, The European Commission has reported that water recycling can reduce water-related costs by 50-70 percent in manufacturing sectors through better water management and technology integration. Further, it estimates that energy efficiency in the industrial sector could lead to cost savings of up to EUR 60 billion annually in Europe, driven by improved technologies and processes.

Considering the volatile energy prices of recent years coupled with concerns about security of supply, efficient energy management should also be seen as the foundation of resilient business models. The same goes when it comes to water and other scarce resources.

The energy systems of tomorrow will be highly integrated and powered by renewable electricity primarily. One of the key challenges in electrifying industry is maintaining

competitiveness – particularly in the short to medium term, as electrification can be costly. However, increased flexibility and sector coupling offer promising solutions, helping to unlock efficiencies and bring down costs as part of the broader green transition.

The time to move is now

The business case for an industrial green transition is further strengthened by the increasingly green expectations put on companies from consumers, investors and regulators.

With growing demand from consumers for environmentally responsible products and services, sustainable practices can help businesses capture new market shares. Importantly, this consumer preference is not limited to individuals; investors are increasingly prioritising sustainability as a criterion in their decisions. Thus, companies that proactively address sustainability not only mitigate risks but also attract funding at more favourable terms, opening doors to new opportunities.

In 2025, a Danish study showed for the first time that there is a positive correlation between companies' green efforts and their competitiveness. Companies reported benefits such as enhanced innovation capacity, improved ability to meet customer demands, and better access to new markets. Those furthest along in their green transition also see positive effects on revenue and exports. In other words, the sooner companies go green, the better.

GREEN BUSINESS IS GOOD BUSINESS

The **green economy** accounts for

5.5%

of Denmark's GDP...

And **green technologies** make up

8%

of Danish export...

Amounting to an **annual turnover** of

44 billion Euro

Source: The Danish Energy Agency, Statistics Denmark (2023)

Driving resource efficiency with regulation

Resource efficiency is an essential part of any governmental strategy to guarantee sustainable economic growth. Denmark displays policies and instruments that can enhance security of supply, boost competitiveness and welfare, and reduce the environmental footprint of industries globally.

Different instruments, one shared goal

Nearly 50 years of Danish resource efficiency policies show that economic growth can be decoupled from resource use. A key lesson learned from Danish experiences is that a multipronged effort using several instruments aligned toward the same goal has the greatest effect on resource use. Denmark's approach includes three types of instruments:

1. **Normative** – regulations like “Obligatory Energy and CO₂-reduction Audits for Large Energy Users”
2. **Informative** – tools and guidance such as SparEnergi.dk
3. **Economic** – CO₂ taxes, subsidies and schemes like the Business Pool and the Voluntary Agreement for Excess Heat

From energy reduction to CO₂ reduction

Initially driven by energy security, Danish energy efficiency efforts now focus on reducing emissions. Still, lower energy use matters in helping Denmark meet its 2030 target to cover all electricity and district heating needs with renewables. To target remaining CO₂ emissions from industry, policies support electrification through heat pumps, excess heat reuse and process optimisation.

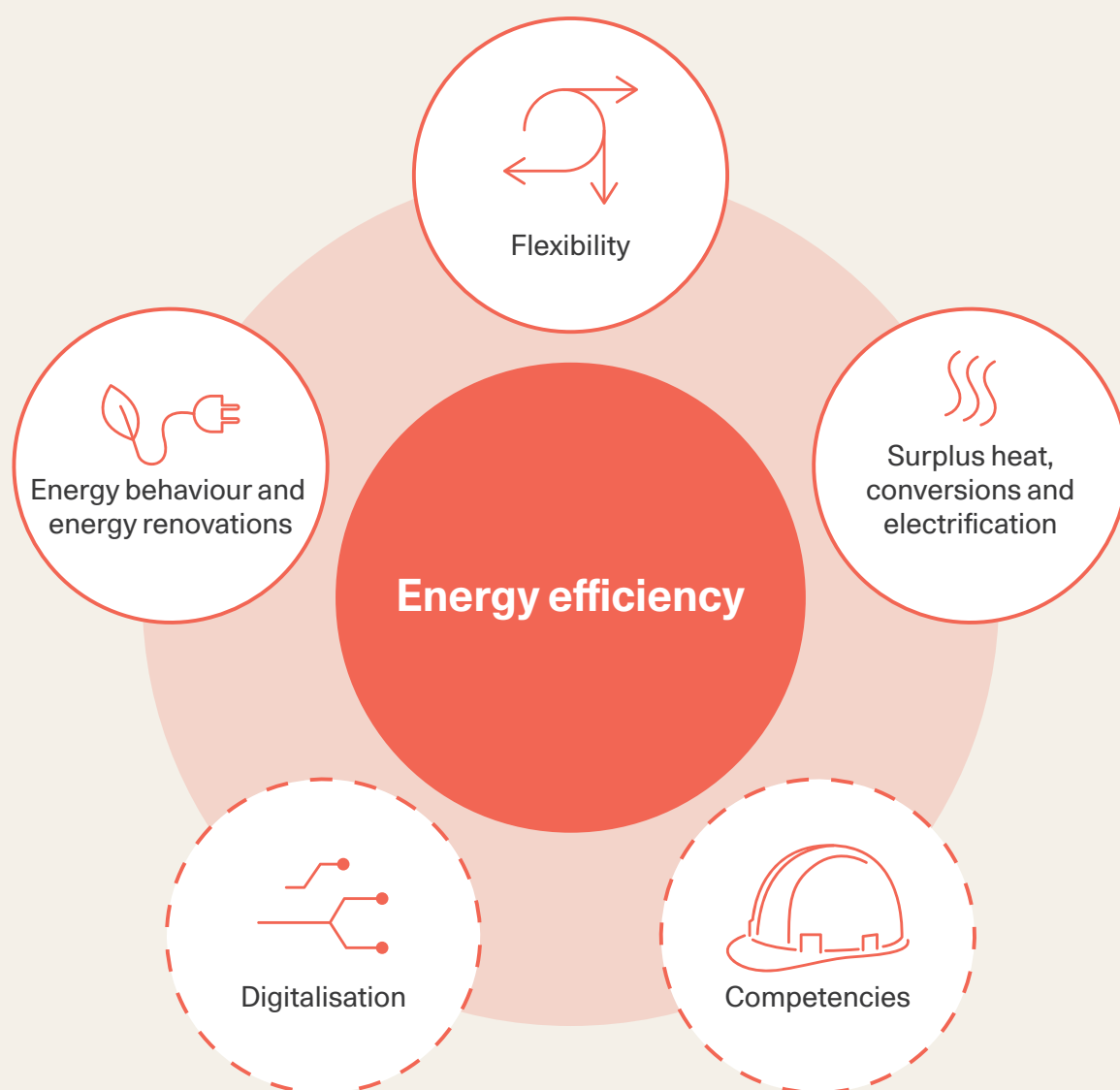
Notably, Denmark now applies CO₂ taxes to industry and agriculture and requires CO₂-reduction audits for large energy users. The latter goes beyond EU mandates by obliging businesses to map emission sources and outline action plans to reduce them.

Circularity in practice

Denmark is committed to driving the green transition through environmental policies that support sustainable industry practices and promote the efficient use of resources. Among the key focus areas is water reuse, where Danish authorities explore opportunities to use reclaimed wastewater. In agriculture, for instance, permits can be granted when wastewater demonstrates agronomic value—either as a fertiliser or to enhance soil quality, ensuring safe and beneficial use.

At the EU level, Denmark supports policies aligned with its goals, including the EU Regulation on water reuse and the Ecodesign for Sustainable Products Regulation. These aim to reduce environmental impacts across product life cycles and strengthen recycling. The upcoming Circular Economy Act, expected in 2026, will hopefully build on these efforts by providing a holistic approach to the circular economy.

As part of its ongoing commitment, Denmark is preparing to update its national Circular Economy Action Plan. Through targeted policies and active participation in EU initiatives, Denmark seeks to foster a resilient, competitive, low-impact industrial landscape rooted in circularity.



The Danish Energy Efficiency Roadmap

The Danish approach to energy efficiency includes reductions in energy consumption (e.g. energy behavior and energy renovations), consuming energy when it is greenest (e.g. flexibility) and shifting industrial energy input to renewable sources (e.g. surplus heat, conversions and electrification). This is supported by digitalisation and competencies in order to get the most out of the overall energy system.

A new model for public-private climate action

The private sector plays an important role in the effort to achieve the Danish government's climate goal. Partly via efforts to reduce emissions in value chains. And partly by developing new products, services, technologies, and business models which support the green transition – both at home and abroad.

Sector-specific recommendations

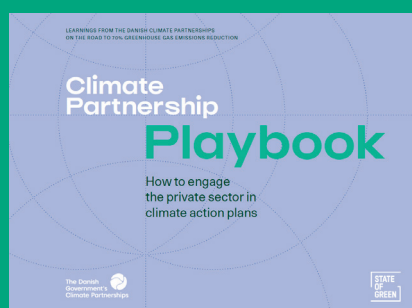
Building on the Danish tradition for public-private partnerships and recognising the private sector as a central actor, the Danish government formed 14 climate partnerships in 2019, each representing a different sector in the Danish economy. The 14 partnerships were tasked with presenting a proposal on how their individual sector could contribute to CO₂e reductions in a just way, supporting Danish competitiveness, exports, jobs, welfare and prosperity.

The proposal had to include measures that the sector itself could adopt to reduce emissions as well as political recommendations to remove regulatory barriers and improve framework conditions in order to support reductions and green competitiveness.

This resulted in more than 400 tangible recommendations, many of which are now being integrated into actual policy initiatives - for instance on carbon capture technologies, electrification efforts and new financial models.

Organisation of the partnerships

Each partnership was chaired by a representative from a private sector company appointed by the Danish government with 1-2 business organisations serving as secretariats. The number of stakeholders involved varied from partnership to partnership due to different structures. Typically, the drafting of the recommendations has been an open process involving several companies and organisations from the entire sector.



The Climate Partnership Playbook

While public-private partnerships are not without their challenges, the urgent need for climate action unites the public and private sector in achieving a shared goal. Denmark's Climate Partnerships show how public and private sectors can supercharge climate action together. This Playbook shares key insights to help replicate successful collaboration models globally.





Benefits of climate partnerships

The benefits of climate partnerships between private and public actors are manifold and tangible. The ability to demonstrate these benefits is a critical first step to unlocking the potential of future green partnerships all over the world

Engagement

The private sector emphasises their commitments to establishing long-term climate targets

Innovation

New technological solutions and business models are unlocked in the process of establishing new partnerships and developing recommendations

Acceleration

Decarbonisation and the development of new technologies are accelerated through concrete initiatives and increased awareness

Co-creation

Collaboration and co-creation across public and private sectors as well as businesses and industries towards one common goal

Manufacturing industry

Manufacturing industries globally are responsible for a major share of economies' emissions and resource use. However, by targeting operational inefficiencies and resource management, true green growth can be enabled in the sector, as shown in Denmark.

Targeting emissions and inefficiencies

According to IEA data, the manufacturing sector's direct carbon emissions accounted for 25 percent of global emissions in 2022—or about 9 Gt CO₂. These figures highlight the significant role of manufacturing industries in the green transition.

Globally, direct emissions in manufacturing come from various sources. Machines used in the manufacturing process often run on coal, oil or gas. Some materials, such as plastics, are made from fossil-based chemicals, and chemical reactions in production processes also contribute to emissions. Additional emissions and energy losses may result from leakages in industrial equipment and inefficient waste treatment.

Add to this the indirect emissions from the sourcing of fossil energy, along with other resources and services beyond the companies' own production and control, and it becomes clear that manufacturing companies have their work cut out. However, sizeable value gains can be achieved by addressing inefficiencies and unsustainable business models.

By adopting cost-effective energy efficiency measures—as described in the IEA's Efficient World Scenario (EWS)—manufacturing industries could almost double the gross value added from each unit of energy used by 2040 globally.

Danish experience shows potential

In Denmark, the manufacturing industry has achieved a 50 percent CO₂ reduction from 1990 to 2023, while increasing its output by 250 percent. Energy and resource efficiency has been a key driver in this decoupling of growth and emissions.

The Danish experience shows that large efficiency improvements can be achieved through optimised production equipment, buildings and workflows, by realising the full potential of digitalisation, behavioural changes and strong managerial focus. Further gains are achieved by switching to greener energy supplies and tapping into surplus energy and water resources that would otherwise be wasted.

Looking ahead, the Danish manufacturing industry is projected to reach a 72 percent reduction in emissions by 2030, aligning with Denmark's overall 2030 emissions target. The main drivers of this expected development are the introduction of a CO₂ tax, adopted in 2022, and the transition of pipeline gas to 100 percent biogas.

Additionally, investments in energy-saving initiatives in manufacturing are increasing, and the Danish government has also allocated resources to support the adoption of energy-efficient technologies. Although the manufacturing sector is expected to grow in the coming years, total energy consumption and emissions are not—underlining the feasibility of green growth in the sector.





Photo credit: ABB

Furniture manufacturer saves 30 percent on energy

To identify areas for optimisation and to reduce its energy consumption and CO₂ footprint, Montana Furniture needed better insight into where and for what usages they were consuming energy in the company.

Therefore, they partnered with ABB and Kemp & Lauritzen to gain real-time insight into their energy use and cut consumption. ABB's building automation specialist presented the company with a solution to record, visualise and control their energy consumption in offices and production areas.

The system connects energy meters from key sources like ventilation and compressors via an M-bus, with data collected through an ABB doGate server that integrates open protocols. Through a KNX-based control setup, actuators automatically switch equipment on and off based on production schedules and holidays.

The building management system (BMS) visualises consumption in real time, helping Montana identify energy-intensive areas and take targeted action. This transparency has led to several improvements: 800 luminaires were replaced with LEDs, compressors were upgraded with energy-efficient models that recover excess heat, and staff were engaged to reduce energy waste in daily operations.

Since implementation, Montana has reduced energy consumption by 30 percent, with further reductions expected. The combination of smart automation, data transparency and behavioural change has created a more energy-efficient and climate-conscious production environment.

CONTRIBUTORS

ABB
Kemp & Lauritzen

LOCATION

Haarby, Denmark





Photo credit: Advansor

90 percent gas reduction with CO₂ heat pump

SBS Friction manufactures brake pads and friction solutions for motorcycles and industrial applications such as wind turbines. Due to being acquired in 2021, their production capacity has rapidly expanded, which has necessitated an update of their heating and cooling systems. Especially because SBS Friction aims to have CO₂-neutral production and become free from fossil fuels by 2025.

To support increased production while reducing emissions, SBS Friction replaced its existing HFC-based systems with a high-efficiency CO₂ heat pump. The new solution supports both cooling and heating needs—delivering 380 kW of heating and 370kW of cooling. Instead of opting for a standalone cooling system, SBS chose a combined setup, making it suitable for both industrial and office use.

From February to September 2023, the system saved 150,000 kWh of energy. SBS expects to reduce gas consumption by 50,000 m³ annually—equivalent to 90 percent of current usage. Only minimal gas use remains during non-production periods. In addition, the switch to natural refrigerant CO₂ drastically cut the system's environmental footprint: from nearly 52 tonnes of CO₂ equivalent with the old HFC units to just 320 kg.

CONTRIBUTORS

Advansor

LOCATION

Svendborg, Denmark





Photo credit: Danfoss

Brewery skims 75 percent off energy use

Industrial process heating is still largely powered by fossil fuels. With the global industrial heat demand set to grow by 16 percent by 2028, it is impossible to reach the Paris goals without transitioning towards green industrial heating. Electrical heat pumps offer a promising alternative.

Gulpener Brewery in the Netherlands has electrified its process heating using high-temperature heat pumps built with Danfoss components. The heat pumps capture and upgrade waste heat from the brewery's cooling processes, repurposing it for heating needs. Typically, cooling is achieved through a refrigeration system that rejects excess heat as waste. Instead of allowing this heat to dissipate into the air, Gulpener has integrated it into their heating system. The heat pumps boost the temperature of this excess heat, making it suitable for reuse in the brewery's heating processes, improving overall efficiency and sustainability.

The brewery's system exemplifies how industrial heat pumps can replace fossil-based process heating. For every unit of electricity, heat pumps can deliver 2 to 5 units of heat, depending on the required temperature. By implementing this solution, the Brewery has saved 75 percent of their total energy use as a result of installing heat pumps and utilising waste heat. Initially concerned about the heat pump solution's impact on beer quality, the brewery is now convinced it has led to an improvement.

CONTRIBUTORS

Danfoss

LOCATION

Gulpen, The Netherlands





Automated CO₂ accounting strengthens climate strategy

Carmo, a Danish manufacturer of plastic components primarily for the medical industry, sought to enhance its climate strategy by improving how it calculated the carbon footprint of its products. Manual calculations were time-consuming and lacked consistency, making it difficult to provide accurate, up-to-date emissions data to support both internal decision-making and customer climate reporting.

In collaboration with Viegand Maagøe and ERP provider Vektus, Carmo developed an automated CO₂ calculator fully integrated into their existing ERP system, Microsoft Dynamics Business Central. The solution follows ISO 14040/44 standards and incorporates life cycle assessment directly into business operations. It calculates emissions from raw materials to finished products, drawing on data from energy consumption, transport, waste handling, and building operations. The system uses established databases like ecoinvent and IPCC methodologies to ensure reliable emissions tracking and allows for regular updates, including supplier-specific data and annual changes in energy factors.

The automation has made carbon accounting significantly more efficient and precise, providing Carmo with a real-time overview of their climate impact. The company can now respond more quickly to changes in production and energy use, while offering transparent and verifiable data to customers for use in their own climate reporting. The system supports continuous improvement and positions Carmo to meet growing market demands for sustainability documentation.

CONTRIBUTORS

Viegand Maagøe
Vektus

LOCATION

Espergærde, Denmark



Food and agriculture industry

Feeding a growing world population while battling worsening climate and environmental conditions is forcing the food and agriculture industry to transform. Denmark is spearheading that effort with ambitious regulation and efficient production.

Growing population and climate challenges

By 2050, the world's population will reach approximately 10 billion, and projections from the Food and Agriculture Organization of the United Nations (FAO) indicate a 70 percent increase in current food production will be necessary.

The global food and agriculture industry faces a significant task, as it accounts for 24 percent of the world's CO₂ emissions and 30 percent of global energy consumption. Agriculture is the largest overall water user globally, responsible for 70 percent of freshwater withdrawals, while food and beverage processing makes up roughly 20 percent of all industrial water consumption.

Moreover, the industry must contend with the challenges of climate change, environmental degradation and biodiversity loss. Food production in all climates faces potential crop losses and reduced yields. To adapt, the industry must adopt resilient practices and technologies. Crops need to be designed to handle unstable weather, and technology must be applied to navigate shifting conditions and ensure efficient use of resources across the value chain.

Efficiency drives competitiveness

These challenges, coupled with pressure to reduce prices and marginal costs, mean that efficiency measures can create a tangible competitive advantage.

Seizing this opportunity is crucial for a small country like Denmark, where the food and agriculture industry accounts for around one-fifth of all exports, and 60 percent of the land area is dedicated to agriculture.

Since 2000, the industry has achieved energy savings of 25 percent in food processing, and agricultural emissions have been reduced by 23 percent compared to 1990. All the while, the volume of food processed has grown, demonstrating that it is possible to produce more with less. Additionally, the sector is contributing to the green transition by supplying biomass for energy production and bio-based materials.

A world first

Still, primary production accounts for around 34 percent of Denmark's CO₂ emissions, making it a key area to address in order to reach the goal of a 70 percent reduction by 2030. This is why, in June 2024, the Danish government, the industry and environmental organisations agreed on the world's first CO₂e tax on agriculture.

From 2030, Denmark will introduce a carbon tax on CO₂-equivalent emissions from livestock—a key step in accelerating the green transition of agriculture. With a 60 percent base deduction, the most climate-efficient farmers can avoid the tax by reducing emissions.

Revenues will be reinvested directly into the sector to support green innovation and sustainable practices, to help ensure that Danish agriculture remains competitive and future-fit. The public-private partnership behind the agreement shows a bold way forward in transforming food systems.



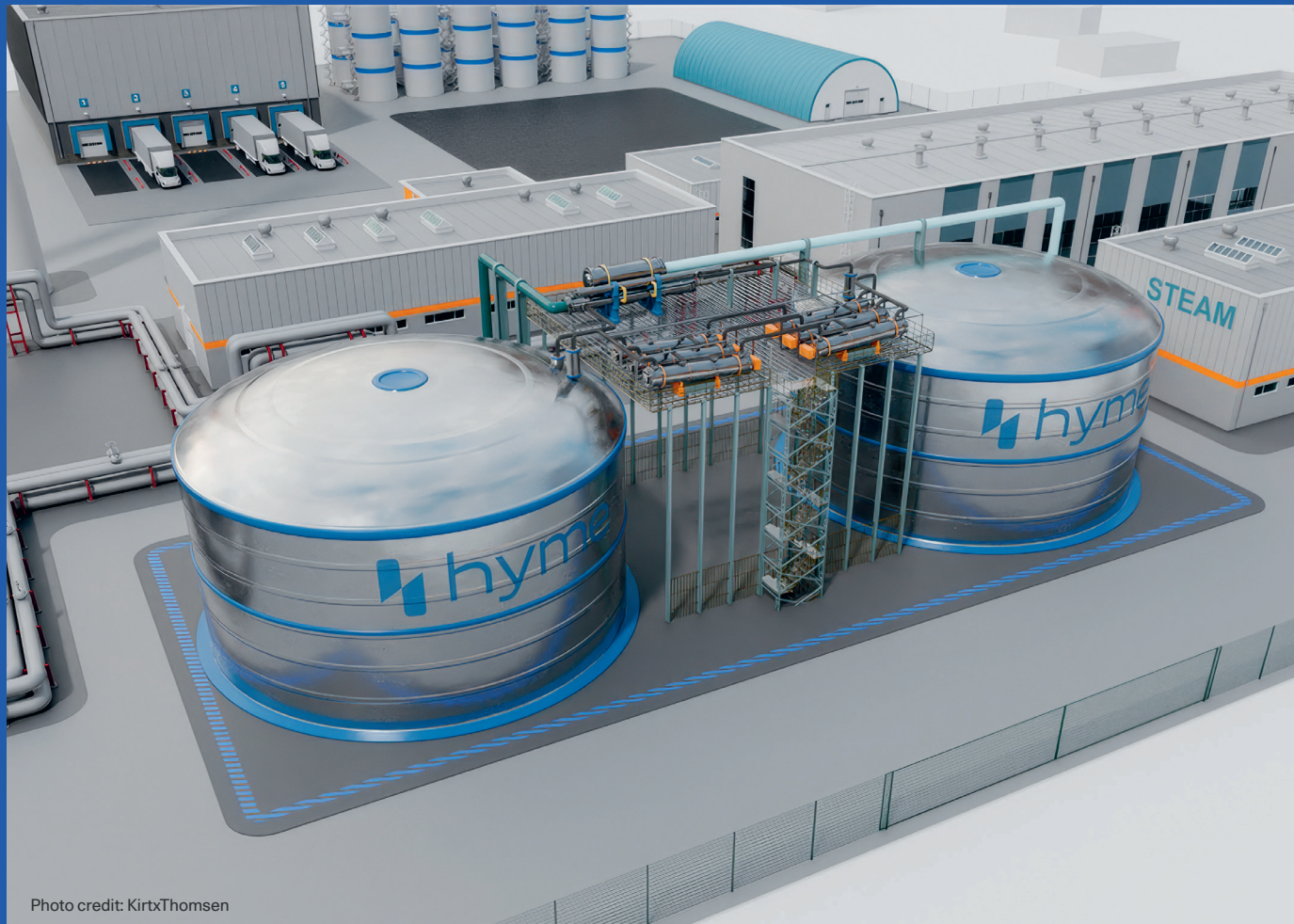


Photo credit: KirtxThomsen

Renewable heat on demand through molten salt storage

Securing stable, high-temperature heat remains a major challenge in the green energy transition, with 90 percent of such industrial heat still supplied by fossil fuels. As EU CO₂ taxes increase and energy price volatility grows, scalable green heat solutions are in demand.

Arla, one of the world's largest dairy producers, aims to reduce CO₂e emissions in scope 1 and 2 by 63 percent by 2030. To meet this target, Arla has partnered with Danish company Hyme Energy to decarbonise heat in milk powder production at its HOCO plant in Holstebro.

Hyme develops thermal energy storage (TES) systems that convert electricity from renewable sources into heat, stored in molten salt at high temperature. This stored heat can then be used on demand, replacing fossil fuels in industrial processes.

Together, Arla and Hyme plan to build a 200 MWh TES plant—the world's largest announced standalone system for delivering green industrial steam. The system is tailored for energy-intensive sectors like food and beverage, where high-temperature, reliable heat is critical.

The TES plant will enable up to 90 percent CO₂ reduction from process heat at the Holstebro facility and is expected to achieve significant energy cost savings as well as revenue from providing grid services to Energinet, Denmark's transmission system operator.

The project is pending EU funding, with operations expected to begin in 2029.

CONTRIBUTORS

Hyme Energy

LOCATION

Holstebro, Denmark





Photo credit: GreenFarm

Carbon-free energy from agricultural waste

An agricultural school and production facility in southern Denmark had the ambition of reducing its carbon footprint and turning the facility's own waste into an energy resource.

In 2023, GreenFarm installed a system that significantly reduces the facility's CO₂ emissions by using manure from its production to generate heat, electricity, and optimised fertilizer, all utilised locally on the farm.

In early 2024, an innovative carbon capture and storage (CCS) system was integrated, capturing the entire biogenic CO₂ stream from the power units' post-combustion exhaust. This will enable carbon-free power and heat generation from the biogas facility.

The GreenFarm system's overall impact includes reducing greenhouse gas emissions, decreasing local water pollution, and creating optimised fertilizer as a byproduct for crop production. Annually, the facility processes 11,000 cubic meters of manure, with initial calculations showing a reduction of 1,500 tonnes of CO₂ emissions.

CONTRIBUTORS

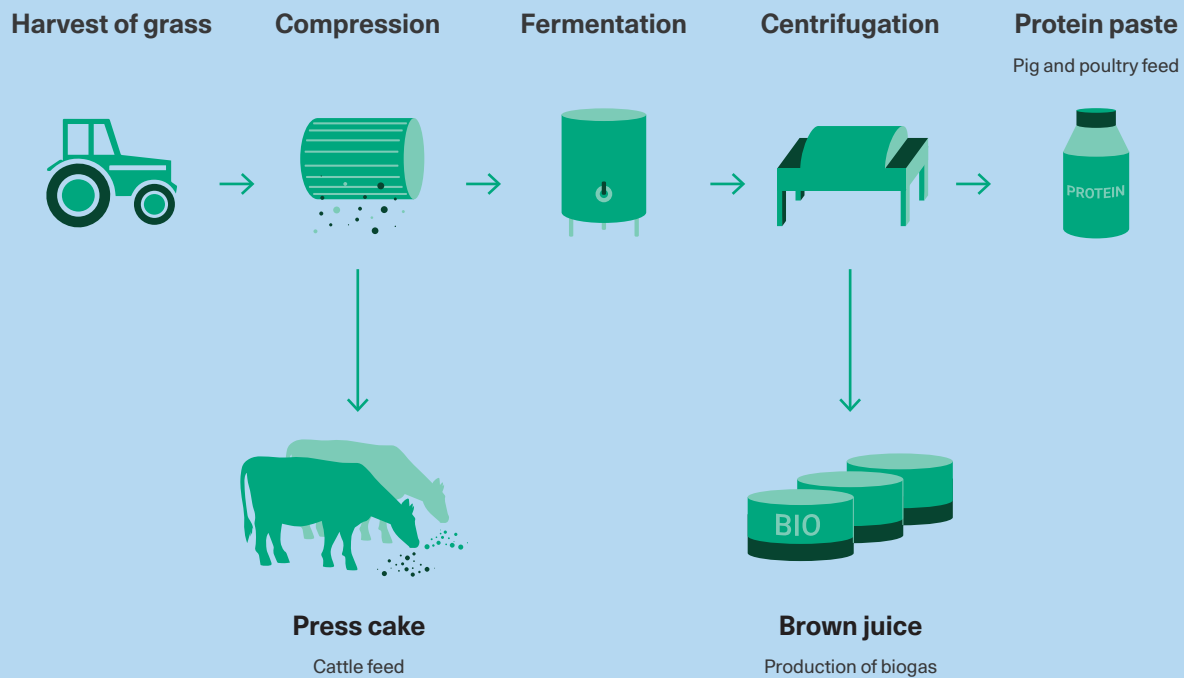
Greenfarm
Graasten Agriculture College
Welltec

LOCATION

Graasten, Denmark



PROCESS OVERVIEW: BIOREFINING OF GRASS



Locally produced protein alternative to soy

The agricultural company Vestjyllands Andel extracts protein from grass at Denmark's first farm plant for biorefining of grass, Ausumgaard, in Northwest Jutland. The grass protein has the potential to replace imported soy from China and South America.

Refined grass is a manageable and locally produced source of protein for animal feed, where all residual production can be used for biogas to limit waste. The new feed will become profitable and thus attractive for plant breeders and farms to convert grain fields to grass. This will lower the industry's climate footprint. Grasslands store more carbon in the soil and lose less nitrate to the aquatic environment compared to annual grain and seed crops. By using grass for protein production, we avoid the large import of soy as well as achieve climate and environmental benefits by growing more grass.

The farm's new, decentralised biorefinery will function as a prototype plant and inspiration for other farms and investors. Now, 1.5 tonnes of pure protein is produced per hectare over a season. The estimated potential is that they can produce 700-800 kg of grass protein per hectare more than the current achievements.

CONTRIBUTORS

Vestjyllands Andel
 Ausumgaard
 R&D Engineering & Automation
 SEGES Innovation

LOCATION

Hjerm, Denmark



Photo credit: Niels Hougaard

Rewarding farmers to motivate climate initiatives

The farmer-owned dairy cooperative Arla creates incentives for the individual farmer to work with sustainability activities by paying out a monthly reward based on a point system. This means that the Arla farmers who take most action receive the highest price for their milk.

The cooperative has introduced a science and points-based model that makes it possible for farmers to earn up to 80 points. Based on which measures that make the largest impact, a system with 19 point-giving levers – such as feed and protein efficiency, manure handling, sustainable soy, renewable electricity, and land use – is used for rewarding the farmers' work with climate and sustainability.

For each point the farmers earn, they receive EUR 0.03 per kilo milk. Additionally, they receive EUR 0.01 per kilo milk for submitting Climate Check data. Arla has earmarked up to EUR 500 million each year to reward and motivate farmers. The size of the incentive depends on the individual farmer's effort. Based on the current points score, EUR 300 million is currently activated on an annual basis, meaning that Arla will pay a total of at least EUR 2.2 billion for sustainability activities on the farm until the end of 2030. However, the amount is expected to increase as farmers, motivated by the incentive, make further climate improvements.

An average Arla farmer with an annual milk production of 1.6 million kilo milk can look forward to receiving close to EUR 40,000 a year, based on the current average point score of Arla farmers.

CONTRIBUTORS

Arla Foods

LOCATION

Denmark

Building and construction industry

It takes a lot of energy and resources to construct and maintain the built environment. Transforming it requires innovation, circularity and collaboration. Danish policies and industry initiatives are paving the way for more sustainable building practices.

Emissions in the built environment

The building and construction sector plays a pivotal role in shaping a more sustainable and competitive future. It is responsible for 36 percent of global carbon emissions, with approximately 10 percent linked to the production of construction materials used in new and existing buildings. Addressing these emissions is crucial to achieving global climate targets and enabling a circular, resource-efficient economy.

Historically, efforts in the sector have focused on reducing operational carbon emissions—those generated during a building's use phase through heating, cooling and lighting. While this has delivered significant progress and continues to be a crucial green frontier, less attention has been paid to reducing embodied carbon emissions. These originate from the design, production and deployment of materials such as cement, steel and aluminium, and solutions to mitigate embodied emissions have lagged.

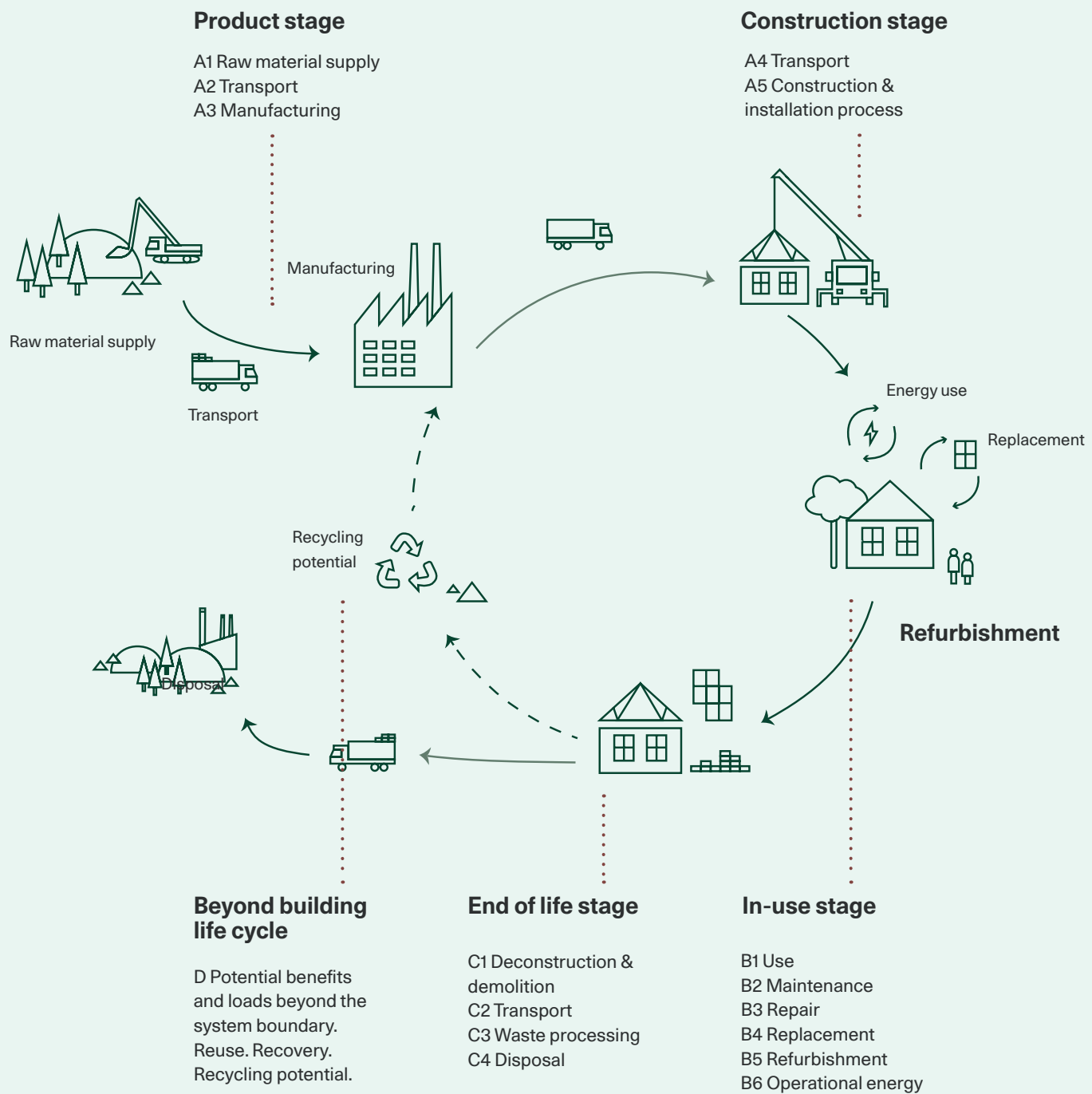
The scale of the challenge is vast. The built environment drives demand across numerous sectors, supports local jobs and directly impacts quality of life. It also consumes around 50 percent of all extracted materials globally and generates over 35 percent of the EU's total waste. Unlocking climate gains in this sector will therefore require innovation in material use, building design, construction processes and end-of-life reuse.

Constructing strong partnerships

Industry collaboration is key to this transformation. In Denmark, the long-standing tradition of public-private partnerships has been harnessed to accelerate the sector's green transition. In 2020, the Climate Partnership for Construction put forward targeted recommendations to this end—spanning intelligent energy management, increased energy renovation rates and fossil-free construction sites. If fully implemented, these measures could reduce emissions by 5.8 million tonnes of CO₂ annually by 2030.

Building on this momentum, Danish industry stakeholders launched the Action Plan for Sustainable Construction in 2023. Developed in collaboration with government, it outlines 32 initiatives to advance low-carbon building practices—from increasing material reuse and improving data quality to standardising life cycle assessments.

To further support this shift, Denmark introduced mandatory Life Cycle Assessment (LCA) requirements for new buildings in 2023, as one of the first countries in the world to do so. These requirements will be tightened gradually until 2029 to drive more climate-conscious design decisions from the outset. Together, these initiatives signal a systemic transformation—anchored in collaboration, innovation and a shared commitment to building a more sustainable future.



The life cycle of buildings

The figure illustrates the division of a building's life cycle into stages and modules according to the European standard EN 15978 for Life Cycle Assessment (LCA). Through all stages, there are opportunities for industry to practice sustainable resource use - from resource efficient manufacturing to energy renovation to recycling material beyond the building's life.



Photo credit: ROCKWOOL

An electrifying solution for melting stone

Stone wool is a great material for insulation: It does not lose its insulation capability over time, it will not burn and it is endlessly recyclable. But the process of producing stone wool insulation is highly energy-intensive, requiring the melting of stone at temperatures exceeding 1,500°C. Traditionally, this has been powered by fossil fuels, leading to high CO₂ emissions. In 2024, ROCKWOOL, a leading producer of stone wool insulation, achieved a significant milestone in its decarbonisation efforts by electrifying the stone melting process at its Flumroc factory in Flums, Switzerland.

The project was a complex engineering challenge, as it involved developing large-scale electric melting technology capable of maintaining the necessary high temperatures and operational parameters. After successful technology development and deployment, the Flumroc factory saw a dramatic reduction of 75 percent in its annual CO₂ emissions, equivalent to 25,000 tons of CO₂ per year. This achievement is crucial to ROCKWOOL's broader strategy to meet its SBTi-approved decarbonisation targets.

The success of the Flumroc electrification project not only delivers significant environmental benefits but also serves as a model for scaling up ROCKWOOL's self-developed electric melting technology across its facilities globally. Access to cost-competitive green electricity is the key to enabling this transition, necessitating continued investment and political support for renewable energy infrastructure.

CONTRIBUTORS

ROCKWOOL

LOCATION

Flums, Switzerland





Photo Credit: Moldow

A symbiosis of wood, waste and energy exchange

By 2030, VELUX aims to eliminate their operational (scope 1&2) emissions without using carbon offsets and halve their value chain (scope 3) emissions in absolute terms compared with 2020. This requires an ambitious and integrated approach across not just VELUX but also working closely with the value chain. To meet its 2030 targets, VELUX has transformed its Østbirk production site through energy efficiency and local energy collaboration. Central to this is the 'Design for Zero' approach, which ensures new production systems are designed for maximum energy efficiency and integration with local energy sources.

The site now operates in symbiosis with Østbirk District Heating Company. In winter, VELUX imports heat from the district system, which is fueled by SBP certified wood waste from forestry. In summer, VELUX exports excess heat, from VELUX's own FSC/PEFC-certified wood waste back into the district heating network, supporting the local community.

A new on-site bio-boiler uses wood chips from production as fuel, replacing natural gas and streamlining waste handling. This transition has cut CO₂ emissions by 930 tonnes annually and turned Østbirk into a near-zero-emissions site. The site has also improved energy performance by a new wood chip extraction plant provided by supplier Moldow, saving around 1,000,000 kWh/year in electricity and 889,000 kWh/year in heat recovery—equivalent to the annual electricity use of 200 households.

CONTRIBUTORS

Velux
Moldow
Østbirk Varmeværk

LOCATION

Østbirk, Denmark



Resource intensive industry

Resource-intensive industries are vital to a futureproof society but face major decarbonisation challenges. Abating these industries will require innovation and investment in clean technologies, as well as responsible sourcing and use of energy and resources.

Industries such as steel, refining, chemicals and cement form the backbone of modern society. They supply essential materials for infrastructure, transport systems, energy technologies and countless other sectors. Yet their importance is matched by the scale of their environmental impact

A complex challenge

Resource-intensive industries account for around 70 percent of global industrial emissions and are among the highest industrial users of water. Reaching climate goals is impossible without targeting these sectors. Yet demand for steel, chemicals and cement is set to grow alongside the development of a futureproof energy system, given their extensive use in the construction of wind farms, power plants, transmission lines, electric vehicles and other clean energy infrastructure.

This means a balance must be struck between reducing emissions and maintaining competitiveness. According to the International Energy Agency (IEA), businesses in energy-intensive industries can reduce their energy consumption by up to 30 percent through energy efficiency measures. Even so, decarbonising these sectors remains technically and economically complex.

Many of the industrial processes associated with resource-intensive products require extremely high temperatures—often exceeding 1,000°C—and rely on raw materials that

inherently emit CO₂ during transformation. Much of the water used in these sectors must also meet strict quality requirements, which complicates efforts to switch to alternative sources like greywater or treated wastewater.

Furthermore, the pathway to deep emissions reductions depends on technologies not yet ready for large-scale deployment. These new production methods often involve higher costs, and in global markets like steel, slim margins limit the ability to absorb them. Lastly, access to critical raw materials—such as rare earth elements, lithium and nickel—rests on global supply chains that are increasingly vulnerable to geopolitical tensions, trade dependencies and resource scarcity.

Innovation and collaboration are key

In Denmark, the resource-intensive sector is relatively small, accounting for 14 percent of national emissions. Still, Denmark is actively investing in and developing solutions tailored to the sector's challenges.

Industrial symbioses across the country are piloting integrated approaches to decarbonisation—combining access to renewable energy with carbon capture, green hydrogen production and sector integration. Through public-private collaboration, these innovations are paving the way for scalable, exportable solutions to some of industry's toughest climate challenges.



Photo credit: Hempel

Driving efficiency in steel use with advanced coatings

Steel is essential for heavy-duty transport and infrastructure but accounts for 7-9 percent of global CO₂ emissions. While highly recyclable, recycling steel is still resource and energy-intensive. Thus, enhancing steel durability is key to reducing environmental impact. TII SCHEUERLE, a leader in heavy-duty transport, needed a coating system that provided superior durability, faster processing, and reduced environmental impact. The aim was to replace conventional coating to improve production efficiency, reduce application times, and achieve sustainability goals without compromising on corrosion protection.

In 2021, TII SCHEUERLE switched to Hempel's Avantguard for all commercial vehicles. Avantguard enhances steel durability through activated zinc primer technology. By fully activating zinc particles, it provides a triple anti-corrosion mechanism - barrier, galvanic, and inhibitor effects - reducing material usage and improving efficiency and sustainability while extending steel's lifecycle and performance.

The Avantguard corrosion protection system has enabled TII SCHEUERLE to reduce energy consumption by 25 percent, improve production speed and lower VOC emissions by 25 percent. This is largely due to its simplified application process, fewer layers, less rework, and the fast curing time. With support from Hempel's global technical service team and coating advisors, a large number of subcontractors in various countries have been trained in the use of Hempel products to ensure uniform coating quality.

CONTRIBUTORS

Hempel

LOCATION

Pfedelbach, Germany





Photo credit: Nobian/Dansk Salt

A balancing partner in the green energy transition

Salt is an indispensable raw material for products such as medicines, textiles, insulation materials, batteries, and wind turbines blades —but its production is also highly energy intensive due to the need for high-pressure steam. At Nobian/Dansk Salt, which produces around 600.000 tons of salt annually, this steam has traditionally been generated by fossil-fuel boilers, driving significant CO₂ emissions.

To decarbonise production significantly while maintaining reliability, the company has installed a 37 MW high-voltage electric boiler at their factory in Mariager. Integrated into the local steam grid, the boiler operates alongside existing units and can quickly respond to electricity market signals. This flexibility allows the plant to participate in grid balancing services and shift between energy sources based on price and availability, improving energy security and lowering costs.

Further gains have been realised through the extension of the salt plant using Mechanical Vapor Recompression (MVR) technology. This fully electric process recycles steam using a 6.4 MW compressor, reducing specific energy use to just one-third of the previous system. Thus, the MVR system not only eliminates fossil fuel reliance but also delivers major energy and cost savings.

Together, these measures demonstrate how electrification and efficiency can transform even energy-intensive industries into key drivers of the green transition, while boosting competitiveness and supporting a stable power grid.

CONTRIBUTORS

Nobian/Dansk Salt
Inopower

LOCATION

Mariager, Denmark

