eit InnoEnergy

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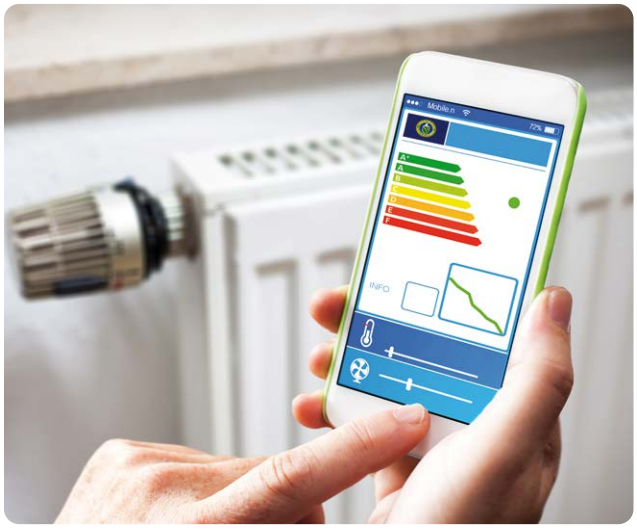
# Innovations driving net-zero progress in industry

# Emerging technologies to tackle industry's toughest challenge: achieving net-zero carbon emissions

The race is on to transition Europe to a clean, circular economy with net-zero greenhouse gasses (GHG) by 2050. Europe's industrial sector, which includes energy, industrial processes, manufacturing and construction, currently accounts for 51% of Europe's total carbon emissions, and on a wider scale, Europe is responsible for 10% of the planet's GHG emissions. Although the EU successfully reduced its GHG emissions by 22% between 1990 and 2017, and is due to meet its 2030 target outlined in the Paris Climate Agreement (reducing emissions by at least 55% compared to 1990 levels), more needs to be done to achieve net zero carbon emissions by 2050.

Energy-intensive industries such as cement, iron and steel, petrochemicals, and paper and pulp, among others, face the biggest challenges in reducing their significant carbon footprints while remaining competitive in a global market. There's no silver bullet for the successful transition — rather, a mix of solutions based on innovative technologies enabling industries to make incremental changes over the coming years. Here, we take a look at some of the emerging technologies that can help industries drive down emissions without stifling their competitiveness.

The technologies are categorised under four areas:
1) Improving energy efficiency;
2) Generating heat from renewable energy;
3) Electrification of industrial processes;
4) Using green hydrogen to decarbonise industrial processes.

# 1

## Improving energy efficiency

Producing existing products with less energy is one of the first steps on the journey to net-zero emissions. Continual operational improvements and effective maintenance of equipment will help to reduce energy wastage, but industries can go a step further and implement new energy-efficient technologies to help reduce their overall energy consumption. Technologies which specifically make use of artificial intelligence and machine learning can help companies to monitor and optimise their energy use, while technologies that capture waste heat and convert the heat back into energy can help companies make significant savings on their energy consumption. Read on to learn about two cutting-edge technologies that demonstrate these capabilities.

## Machine learning & algorithms

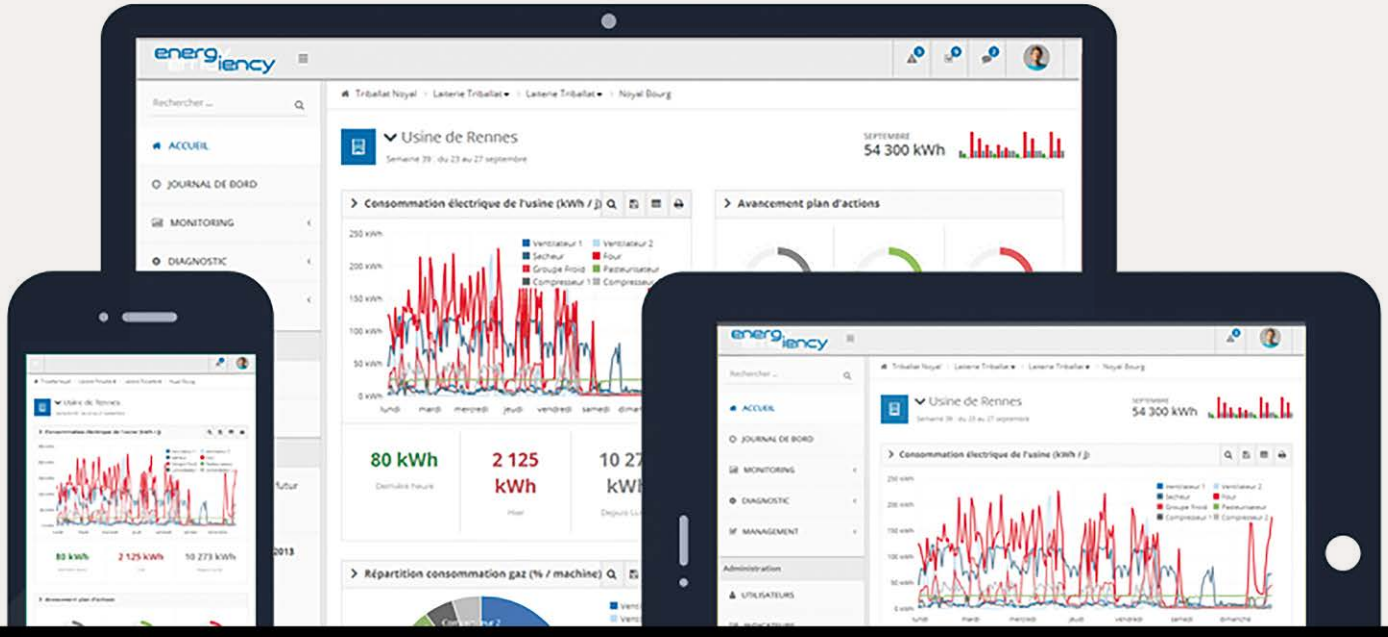
Effective data management and machine learning, or AI, can be vital for improving throughput and optimising energy consumption in industrial processes. By capturing data and utilising algorithms, industries can make accurate forecasts, helping to inform power supply and demand, model utility cost savings and optimise power consumption.

**Energiency** is one company to develop such technology. Its machine-learning software is employed in a steel rolling mill furnace which consumes €5 million worth of gas each year. The innovative technology provides gas consumption modelling and real-time alerts on overconsumption and savings, and has identified energy savings of 4% per year for the furnace, with 5-10 days of avoided shutdowns, and has a return on investment of just six months.

ENERGIENCY
ENERGY INTELLIGENCE FOR MANUFACTURING

Cloud software that enables disruptive big data analytics solutions for the energy industry

**www.energiency.com**



## Thermoelectricity for heat recovery

Between 20-50% of energy consumed in industry is lost in waste heat. **AEInnova** has developed a range of solutions to help generate electricity from waste heat by combining advances in heat and thermoelectric materials with a microelectronic system. Their INDU-EYE sensors don't require batteries, cables, or maintenance and are powered by heat and/or vibrations. A power generation plant can make energy savings of up to 40% by using the INDU-EYE solution compared to using traditional battery-powered sensors. Since INDU-EYE is lithium free (therefore no combustion risk) it's also suitable for industrial sectors such as oil and gas, chemicals and cement.

AEInnova
Alternative
Energy Innovations

### Renewable energy from industrial waste heat using thermoelectric generators

**www.aeinnova.es**

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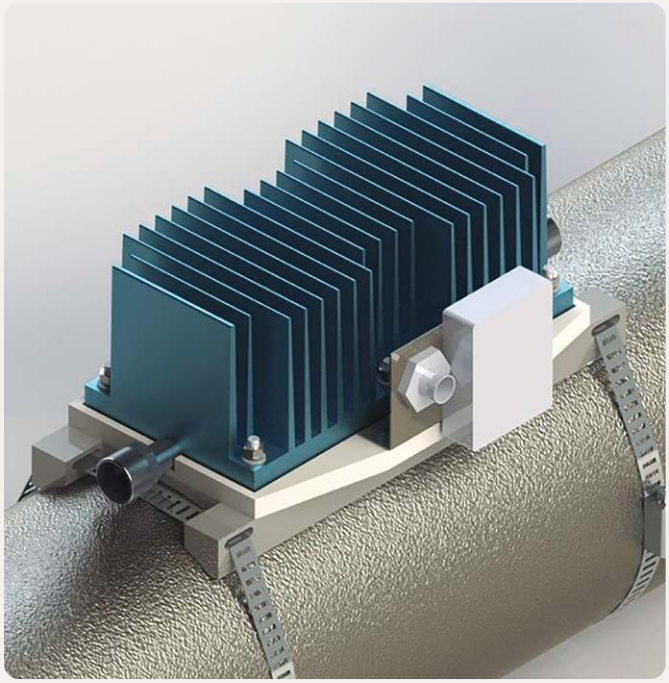

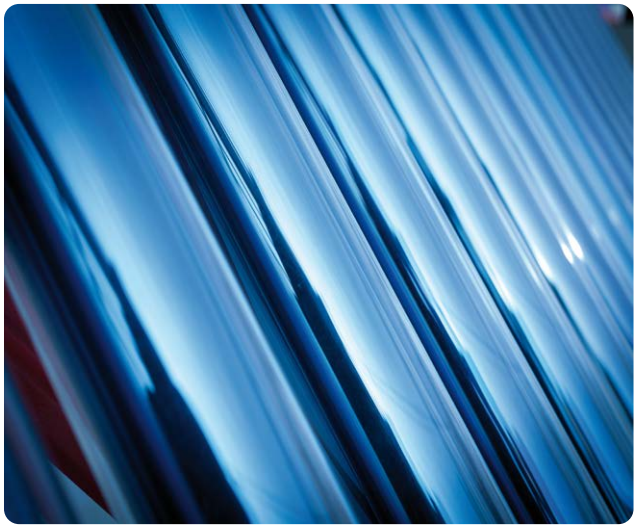

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## Generating heat from renewable energy

Heating and cooling for industrial processes and spaces accounts for as much as 70% of all energy consumed in industry, with the majority (around 75%) being powered by fossil fuels. Utilising renewable sources of heat, such as biomass, geothermal, and solar thermal energy, or powering electric furnaces and heat pumps with renewable sources of energy like hydro or wind are all viable options for cutting carbon emissions. Solar power in particular has become so cost effective to produce, it is now directly competitive with fossil fuels. On the next page we highlight a relatively new form of concentrated solar power, generated from flat, magnifying lenses which can generate temperatures of more than 350 degrees Celsius. We also demonstrate two technologies for converting waste products into heat (and electricity) through micro-gasification.

## Concentrated solar power

Traditional solar plants use curved mirrors to concentrate sunlight onto a receiver to produce solar power. **Heliac** has developed flat lenses which use micro- and nanostructured foils to magnify the heat, at a much cheaper cost of production. The lenses can generate temperatures of more than 350 degrees Celsius, making them suitable for a vast range of industrial processes. Unlike biomass or natural gas, solar heat has no combustion or $CO_2$ emissions, and the costs of production are low enough to allow the technology to compete with fossil fuels. The potential $CO_2$ savings with this technology are huge: if used in China's pulp and paper industry, which produces 125 million tons per year and requires heat in the range of 80 – 200 degrees Celsius for its processes, the solar panels could generate $CO_2$ savings of 75 million tons per year. Heliac has already built a full-scale solar field installation in Denmark for E.ON, capable of producing over 1,500 megawatt hours of district heat annually with 25% greater efficiency than traditional solar panels.

HELIAC

Utility-scale solar heat at a cost below that of fossil fuels anywhere in the world

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**www.heliac.dk**

## Heat from bio energy

Transforming waste products from wood, pallets, dried bio waste and solid refuse fuel into heat and electricity can be achieved through micro-gasification. **Naoden** has designed compact, modular bioenergy plants that produce heat and energy from these waste products, enabling reductions in energy costs by up to 40%, and $CO_2$ emissions reductions of 30-50%. Bouyer Leroux, the French leader in the clay bricks market utilises their technology to power its processes. By installing a **Naoden** power plant it has seen $CO_2$ savings of 1,987 tonnes and cost savings of €240,000 per year, with an expected return on investment of five years.

On a larger scale, **Meva** is building a thermochemical conversion plant for IKEA Industry's largest manufacturing unit in Poland. Power and heat consumption represent the most significant sources of $CO_2$ emissions at the IKEA Industry plant. **Meva**'s technology converts biogenic residue including sawdust and cuttings from MDF and particle board to renewable gas and power. By installing the Meva system directly where the wood residue is collected, a fully circular and decentralised energy system is achieved. With this system, IKEA Industry can reduce its $CO_2$ emissions at the plant by 14,000 tons per year. Since the waste wood residue is being re-used onsite, transportation to dispose of the residue is no longer needed, saving 300 truck journeys per year.

MEVA ENERGY

### Decentralised biomass cogeneration with 2nd generation biomass

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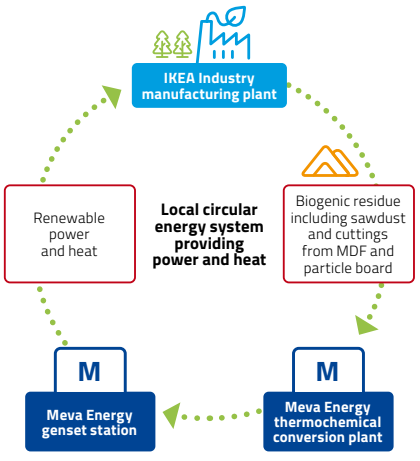


NAŌDEN
*Cogenerating another form of energy*

### Micro bioenergy generation power plants

**www.naoden.com**

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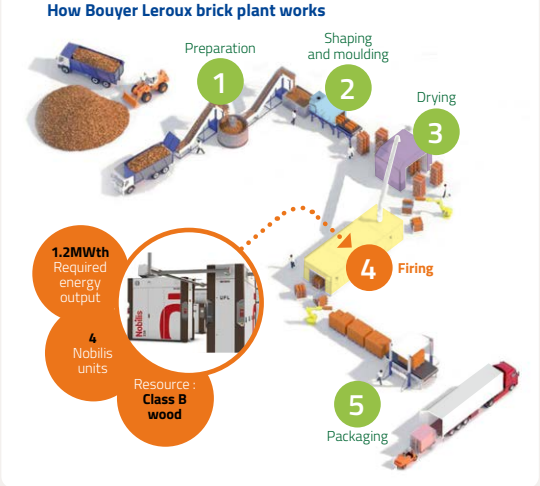


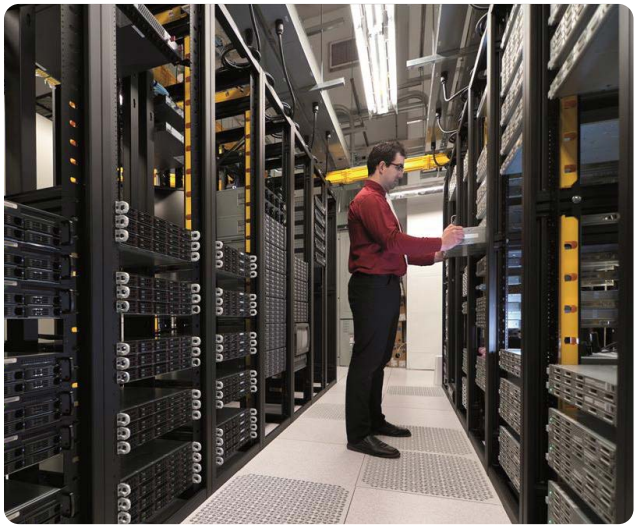

# 3

## Electrification of industrial processes

Aside from heating and cooling processes, many other applications in industry can be partially electrified, adding small but accumulatively significant cuts to carbon emissions. For example, a number of solutions have been developed to capture energy during industrial processes, store the energy, and facilitate the reuse of that energy at a later stage. Technologies have also been developed to replace hydraulics with electromechanical linear drives powered by electricity. Read on to learn more about these technologies and how they are already being implemented in industry.

## Energy storage and recovery

Cranes, elevators, forklift trucks, and propulsion systems in maritime transport are all viable candidates for partial electrification. **Skeleton Technologies** is one of numerous companies to develop ultracapacitors that capture and reuse energy during specific processes.

The port of Rotterdam uses **Skeleton Technologies** to partially electrify their diesel-powered cranes. Full electrification or retrofitting the cranes would be currently too costly, so instead they use technology which captures energy during lowering of freight and then redistributes the energy to power the lifting of freight. With the addition of a storage bank, a DCDC converter and a simple controller, the energy can be efficiently stored and reused. Using this technology generates more than 25% savings in fuel consumption and carbon tax for the port.

## Electrifying linear motion in heavy machinery

Hydraulic cylinders in large and heavy industrial applications require high forces, power and robustness, and much of the fuel used to power them is wasted as heat inside the system, rendering them significantly energy inefficient.

**Cascade Drives** has developed electromechanical linear drives which use minimal energy and have built-in energy regeneration capabilities to replace the need for hydraulics. Unlike any other electromechanical actuators, **Cascade Drives** actuators can handle shock loads, making it possible to electrify heavy-duty applications such as lifting and tilting.

CASCADE DRIVES

Linear drives to electrify linear motion in heavy machines

**cascadedrives.com**

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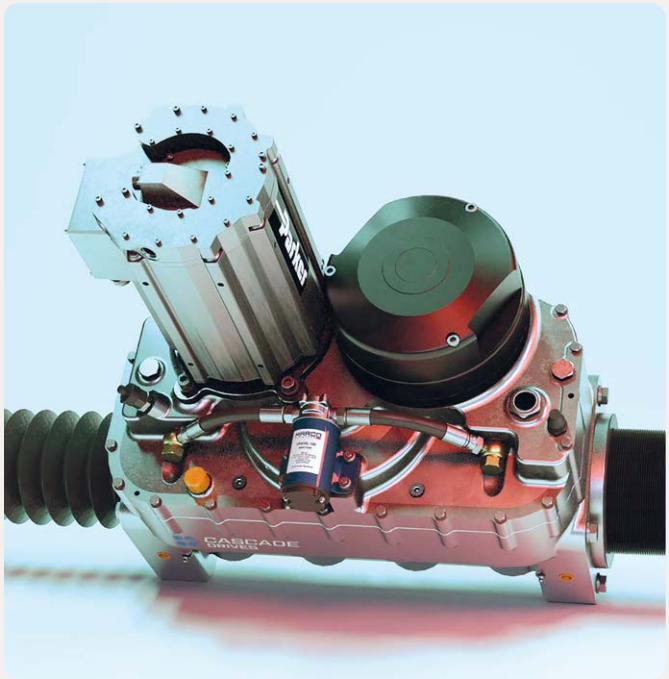

# 4

## Using green hydrogen to decarbonise industrial processes

A front runner in EU decarbonisation strategies is renewable or green hydrogen, with industry experts predicting green hydrogen will account for up to 20% of total energy consumed in industry by 2050. Unlike the majority of hydrogen used today (95%) which is highly polluting, green hydrogen is carbon free and provides a promising alternative for traditionally high carbon emitting processes like steel production, and for replacing fossil fuels as a feedstock for chemicals. There are also hopes for its use as high-grade heat in energy intensive industries in the future. Read on to learn more about the new technologies enabling this greater uptake of hydrogen in industrial processes.

## Green hydrogen to decarbonise steel production

One of the most innovative uses planned for green hydrogen is in steel production – traditionally one of the biggest carbon emitters, responsible for 5.7% of EU carbon dioxide emissions annually. Fossil fuels are used to strip oxygen from iron ore to produce pure iron metal, and to fuel the furnaces which heat the iron or scrap steel, releasing significant amounts of $CO_2$ into the atmosphere. Since 1990, the EU steel industry has reduced emissions by 26%, driven by energy efficiency improvements and higher recycling rates, but fundamental changes in steel production are needed if we are to meet the net-zero carbon targets.

The **H2 Green Steel** Initiative, a flagship project of EIT InnoEnergy's European Green Hydrogen Acceleration Center (EGHAC), is building a flagship plant in Sweden where it aims to produce five million tons of high-quality decarbonised steel by 2030, using green hydrogen and electricity from renewable sources.

H2 green steel

### Accelerating the decarbonisation of steel production

**www.h2greensteel.com**

## Scaling up the use of green hydrogen

Transportation of hydrogen has been notoriously difficult – it must either be pressurised or liquefied at very low temperatures. Both methods are dangerous and expensive. **HySiLabs** have developed an innovative solution by charging and releasing the gas in a unique liquid carrier called HydroSil. This can then be transported anywhere without any specific restrictions and stored for long periods of time, just like conventional fuel. Furthermore, due to its high density, one truck load of HydroSil transports seven times more hydrogen than by high pressure transportation, which reduces the operating expenses and the emissions related to hydrogen transportation. While still in its pilot phase, HydroSil could hold the key to more efficient and safe transportation of renewable hydrogen.

High upfront capital costs of implementing the necessary changes to utilise renewable hydrogen add further barriers to its uptake in industrial processes. To help ease the financial pressures of switching to green hydrogen, EIT InnoEnergy has developed the **Business Investment Platform (BIP)**, which matches industrial green hydrogen projects with investors, helping companies to obtain vital funding to utilise this carbon-free source of power.

HYSILABS

The first liquid inorganic hydrogen carrier that makes hydrogen easy to deliver

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There has already been a remarkable expansion in the number of innovative technologies developed to help industry cut its carbon emissions, with just a few highlighted here, and many more in the pipeline.

Take a look at InnoEnergy's platform of more than 200 innovative technologies spanning the entire energy value chain to discover more cutting-edge solutions that can help drive Europe to net zero emissions.

*View more innovative energy solutions*

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