# energy innovation austria

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Current developments and examples of sustainable energy technologies

klima+ energie fonds

Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

# Climate-neutral industry

## Paths towards clean, competitive manufacturing

Industry, particularly its energy-intensive sectors, accounts for a large part of the energy consumed and greenhouse gases emitted worldwide. Completely new technologies and processes will need to be developed in some areas in order to drive forward the decarbonisation of industry. At the same time, innovations that will facilitate future-oriented, climate-neutral industrial manufacturing are necessary in order to keep Austrian industry competitive over the long term.

HYFOR® pilot plant – hydrogen-based technology for iron- and steelmaking; see page 6
Photo: primetals.com

# Climate-neutral manufacturing

## Strategies for transforming industry

The Austrian and European targets of achieving climate neutrality by 2040 and 2050, respectively, will require a drastic cut in energy consumption and greenhouse gas emissions in all sectors of the economy. Decarbonising industrial processes will be both one of the key steps towards these goals and one of the biggest challenges. Three energy-intensive sectors in particular – iron and steel as well as cement and chemicals – need very high temperatures and large amounts of energy for their production processes. These industries are responsible for over a quarter of global greenhouse gas emissions. Calculations by the International Energy Agency suggest that 60 GT could be saved by 2050.[1]

### DECARBONISING INDUSTRY

New technologies and innovations will need to be developed, scaled up and rolled out quickly in order to be able to harness the potential for reducing $CO_2$ emissions in industry. At the same time, it is necessary for industry to be set on a path of transformation towards climate-neutral techniques and production processes to make Austrian manufacturing companies more competitive in the long term. Demand for sustainable production methods and climate-neutral business models is increasing across the world. Developing and implementing cutting-edge technologies for decarbonising industry offers an opportunity to carve out a successful position over the medium to long term in these growing global markets.

However, complete decarbonisation poses major challenges to the energy-intensive sectors. In particular the process-related emissions from various industrial production processes, such as cement manufacturing, are considered difficult to avoid ("hard to abate" in the jargon). This calls for entirely new techniques, some of which are only just being developed.

The strategies for reducing greenhouse gas emissions in manufacturing include:

> Optimising processes and increasing energy efficiency
> Replacing fossil fuels with direct electrification (provided the electricity comes from renewable sources)
> Switching to new climate-friendly or climate-neutral processes, such as hydrogen direct reduction in steelmaking, replacing of fossil hydrogen with green hydrogen (e.g. in the chemical industry) or using synthetic fuels as energy carriers or raw materials
> Increasing material efficiency
> Digitalising energy use and increasing flexibility
> Separating and permanently storing energy- or process-related $CO_2$ (carbon capture and storage / CCS) and separating and making use of $CO_2$ (carbon capture and utilisation / CCU)
> Engineering a transformation to a circular economy (focusing on durability, reparability, recyclability and the shared use of products)

In this issue, we take a look at some ongoing strategies and activities in Austria as part of international initiatives for decarbonising industry and present a few pioneering projects from research and technology development in the country. ●

[1] www.iea.org/reports/world-energy-outlook-2021

*Both photos: stock.adobe.com*

# MISSION INNOVATION

## Net-Zero Industries

Mission Innovation (MI) is a global initiative founded by countries that are leaders in energy technologies[1] on the occasion of the 2015 UN Climate Change Conference in Paris. Its goal is to combat climate change in cooperation with private investors and to push the development of clean energy technologies forward. This collaboration between public and private sectors is designed to promote knowledge transfer, forge research partnerships and build trial systems. Austria joined the initiative in 2018.

The Net-Zero Industries Mission (NZI), led by Austria together with Australia, is launching in 2022. China, the European Union, Germany, Finland and the United Kingdom are core members.

The aim is to mobilise investments to drive forward the development of key technologies for the complete decarbonisation of industry. The NZI is designed to ensure that reliable, cost-effective and emission-free production is possible by 2030 in high-temperature processes in the steel, cement and chemical industries. Over this period, the participating countries want to develop and trial solutions with a degree of maturity of the technology of TRL 6 or higher. The climate-neutral production methods are expected to be scalable and able to compete with established technologies by 2050.

**OBJECTIVES OF THE NET-ZERO INDUSTRIES MISSION BY 2030:**

- Carrying out at least two large-scale demonstration projects for each field of innovation and each energy-intensive industry sector (steel, cement, chemicals)
- Developing new, low-carbon breakthrough technologies for industrial manufacturing
- Reducing investment spending on innovative low-carbon technologies by more than 15 %

The key fields of innovation in industrial manufacturing include optimising processes and increasing efficiency, switching to new fuels and raw materials, direct electrification, CCS and CCU, digitalisation, flexibilisation, and sector coupling.

The mission intends to connect and pool multinational research and technology development and give it a targeted focus. A large part of this will involve promoting partnerships and technology transfer in order to get innovative technologies to market more rapidly, particularly in developing countries and emerging economies. ●

[1] 22 countries and the European Union are taking part in the global Mission Innovation initiative.

## PETA OLESEN
## DEPARTMENT OF INDUSTRY, SCIENCE, ENERGY AND RESOURCES
## AUSTRALIAN GOVERNMENT

*Photo: private*

*"Australia is supporting research, development, demonstration and early-stage commercialisation of low emissions technology through co-investment with private sector. Under Australia's Technology Investment Roadmap, we are prioritising technologies to reduce emissions from energy intensive industry like steel and aluminium, including through renewable energy and clean hydrogen production. Mission Innovation is important for connecting researchers and industry to work together to accelerate development of low emissions technologies. Co-leading the NZI Mission is an opportunity to cooperate, learn, and progress technology, sharing challenges and solutions."*

# FUTURE SCENARIOS

## for decarbonising Austria's industry

The innovative network NEFI – New Energy for Industry[1] brings together technology providers, industry representatives, scientists, politicians and members of the public with the aim of showing through their joint efforts how Austria's manufacturing and energy-intensive industry can be decarbonised by 2025.

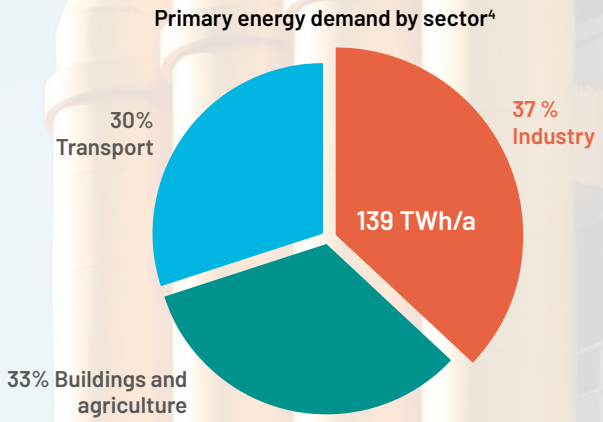
NEFI grew out of a consortium made up of the AIT Austrian Institute of Technology, the University of Leoben, OÖ Energiesparverband und OÖ Wirtschaftsagentur Business Upper Austria and now includes around 80 companies, 14 research institutions and 7 institutional partners. All sectors, including the food, mechanical engineering, plastics, cement and steel industries, are represented in the network by members ranging from major leading companies to innovative SMEs. Upper Austria and Styria, two states with strong industry, are supporting the programme. The partners are developing numerous projects, putting new technologies into practice and getting them market-ready in an open innovation process.

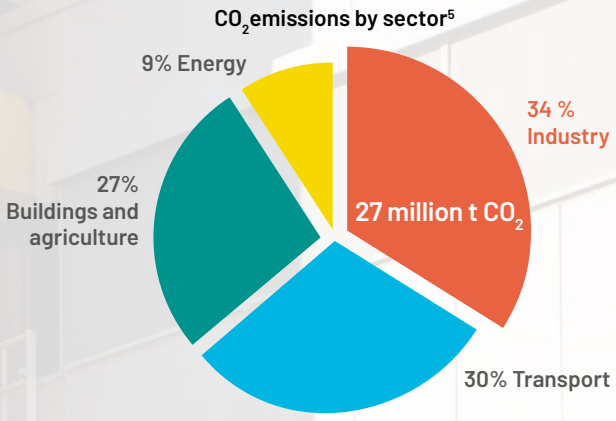
Models and scenarios that light the way towards the complete decarbonisation of Austrian industry are being formulated as an aid to political and industry decision-making as part of the NEFI_Lab[2]. The scenarios developed indicate where projects could be placed within Austria's industry landscape and highlight the infrastructure and framework conditions that will be necessary to supply Austria's industry with up to 100% renewable energy.

### DEVELOPING THREE SCENARIOS

The "Business as Usual" scenario serves as a benchmark for assessing the effectiveness of innovative technologies and measures in the two transformation scenarios. The "Pathway of Industry" (POI) scenario focuses on close dialogue between the industry partners, who are to provide their own assessment of their development in the years until 2030. This estimate can then be used to extrapolate the trend to 2050 using technologies that will become available in the short to medium term.

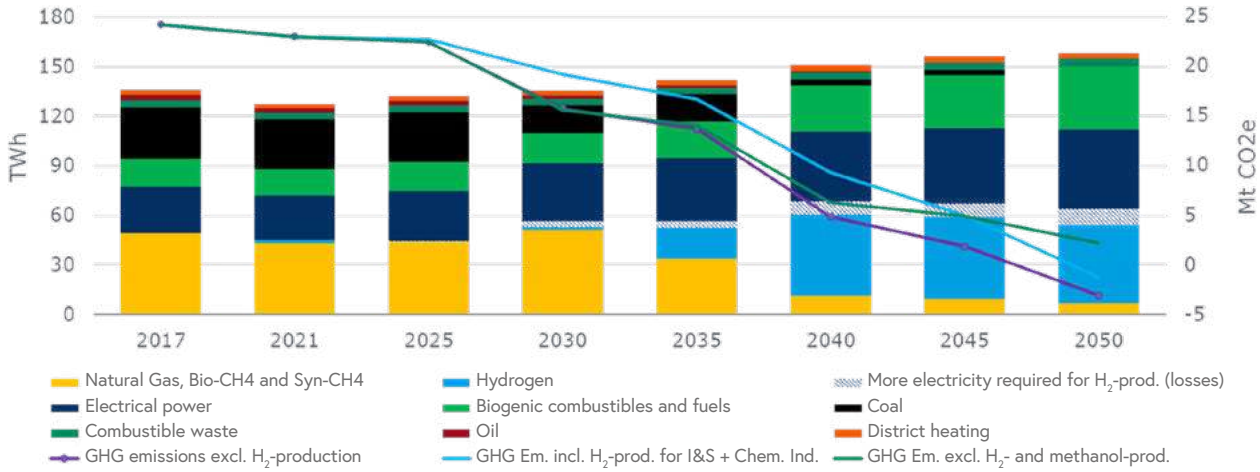
*Percentage of total Austrian energy consumption and greenhouse gas emissions attributable to industry*



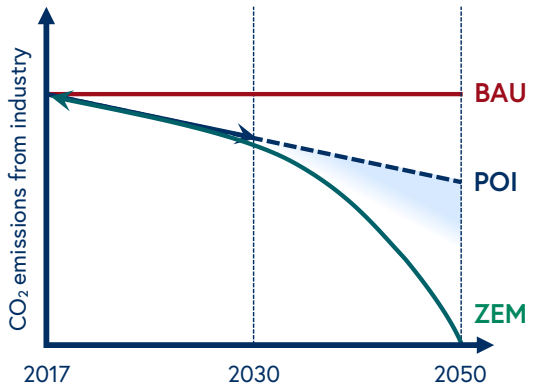

[1] NEFI – New Energy for Industry forms part of the Climate and Energy Fund's "Flagship Region Energy" programme.
[2] The NEFI_Lab involves experts from the Chair of Energy Network Technology at the University of Leoben (lead), the AIT Austrian Institute of Technology and representatives of leading Austrian companies all working together.
[3] The "TransformIndustry" project (AIT Austrian Institute of Technology GmbH, Austrian Energy Agency, University of Leoben/Chair of Energy Network Technology, Energy Institute at JKU Linz) is currently working on more scenario-based transformation pathways for making Austria's industry climate-neutral by 2040.
[4] Sejkora et al., „Exergy as Criteria for Efficient Energy Systems – A Spatially Resolved Comparison of the Current Exergy Consumption, the Current Useful Exery Demand and Renewable Exergy Potential", Energies, 2020
[5] Environment Agency Austria, "National Inventory Report 2021"
[6] www.nefi.at/nefi_lab/

*Total energy demand and greenhouse gas emissions from Austrian industry – ZEM scenario* [6]




The "Zero Emission" (ZEM) scenario is based on so-called backcasting from the target of carbon-neutrality by 2050. Taking this vision for the future as the starting point, the scenario reveals what transformation Austrian industry would need to undergo on a normative level so that it can reach this goal by 2050. The results of the analyses have been presented for all sectors of Austrian industry, including iron- and steelmaking, quarrying and glassmaking, paper and printing, chemicals and petrochemicals, and mechanical engineering.[3]

The analyses show that corresponding measures in industry will only become effective if enough renewable energy sources can be guaranteed to be available. If Austrian industry is to be completely decarbonised, investment in innovative technologies and processes and the switch to renewable energy sources have to start right away. This will require suitable framework conditions that allow industrial companies to plan with confidence. ●




*PROJECTION FOR 2050 IN 3 SCENARIOS*
*Quantifying technology-driven transformation scenarios*
*BAU: "Business as Usual" scenario – current trends continue*
*POI: "Pathway of Industry" scenario – based on industry's own estimates*
*ZEM: "Zero Emission" scenario – backcasting from the assumption of net-zero greenhouse gas emissions in 2050*

www.nefi.at

*Photo: Christopher Glanzl*

## AGNES ZAUNER
## CEO OF GLOBAL 2000

*"Industry is the biggest emitter of greenhouse gases in Austria. So it's vital that all medium to large companies take action to reduce their high level of emissions quickly. On the one hand, this means harnessing all the potential available to save energy and focusing their investment plans on a switch to climate-friendly technologies. On the other, of course, they'll need the right general political framework. Efforts to expand renewable energy in an eco-friendly way must be stepped up and green gas reserved primarily for the processes that need it. As far as heating buildings is concerned, we should abandon gas boilers without delay. We now need legislation on this. We'll only be able to deliver prosperity and protect the environment at the same time if we have an autonomous, climate-friendly and environmentally compatible energy supply."*

# HYFOR®

## Hydrogen-based technology for iron- and steelmaking

Most of the world's iron and steel is produced in blast furnaces. This process consumes a very large amount of energy and generates significant $CO_2$ emissions due to the use of coal. New techniques will need to be developed and rolled out in order to achieve a gradual decarbonisation of iron- and steelmaking. One such alternative technology is direct reduction.

### AN ENVIRONMENTALLY FRIENDLY ALTERNATIVE TO THE BLAST FURNACE

The company Primetals Technologies Austria GmbH[1] has been developing an innovative form of direct reduction for a number of years now. Its HYFOR® (hydrogen-based fine-ore reduction) production route uses a technology that is based on hydrogen. In this method, ultra-fine iron ore is directly reduced to DRI (direct reduced iron) in a fluidised-bed reactor, without any additional agglomeration steps such as pelletisation or sintering. This enables investment and operating costs to be reduced. The process uses green hydrogen instead of coal to reduce the iron ore, significantly lowering $CO_2$ emissions. The aim is to use this new technology to cut primary energy consumption by 20 % and $CO_2$ emissions by up to 100 %, shrinking the carbon footprint of crude steel production by 80 %.

### PILOTING A WORLD-WIDE UNIQUE PROCESS

Following some promising cold and hot testing at laboratory scale, Primetals Technologies Austria GmbH set up a HYFOR® pilot plant on the premises of its project partner voestalpine Stahl in Donawitz. Here the innovative, Austrian-made process has been studied further since 2021 in order to validate the laboratory results under real-life conditions.


*HYFOR® pilot plant, photo: primetals.com*

*Ore loading into the reactor and cyclone circuit, photo: primetals.com*

[1] **PROJECT PARTNERS**: Primetals Technologies Austria GmbH (project management), voestalpine Stahl Donawitz GmbH, Metallurgical Competence Centre K1Met

> **"Primetals Technologies is committed to significantly reducing its carbon footprint and is determined to help the steel sector achieve its zero-carbon target. However, this calls for innovations and for steelmakers, scientists and the public sector to all work together. HYFOR® is an example of such a groundbreaking innovation that combines all of these factors. Such great results from developments like these would not be possible without the support of the Climate and Energy Fund."**
>
> ETSURO HIRAI
> CHIEF TECHNOLOGY OFFICER AND CEO OF PRIMETALS TECHNOLOGIES AUSTRIA

*Photo: primetals.com*

The pilot plant is made up of three parts: the preheating-oxidation unit, a gas purification system and the actual reduction unit. Inside the preheating-oxidation unit, the fine-ore concentrate is heated to over 800 °C and fed into the reduction unit, where 100 % hydrogen is used as the reduction gas. A dry dust extractor prevents any emissions from the processes involved. The hot direct-reduced iron (HDI) leaves the reduction unit at around 600 °C, before being cooled and conveyed out of the HYFOR® pilot plant.

## RESULTS AND POTENTIAL

The tests during the pilot phase have proved to be very promising. The HYFOR® technology is the first method worldwide that can process iron-ore concentrates where 100 % of the particles are less than 0.15 mm in size. This technique can be used on a wide range of ores including haematite and magnetite. During the two-year pilot phase, the plant will be trialling various types of iron ore in order to determine the ideal process parameters for making crude-iron production climate-friendly in the future. The volume of iron ore processed on these test runs is around 800 kg. The direct reduction plant has a modular structure, allowing it to be scaled up or down for each customer to suit steelworks of all sizes. The next step will be to expand pilot operation with the addition of a hot-briquetting test facility for making hot-briquetted iron (HBI).

The aim is to validate the HYFOR® process and use the trial runs as a basis to gather the data required for implementing a prototype on an industrial scale. ●

energieforschung.at/projekt/fluidred-hot-bench-scale-plant

*Top ore/DRI bunker, photo: primetals.com*

*Discharge line to the product cooler, photo: primetals.com*

# IEA Industrial Energy Technologies and Systems (IETS TCP)

The International Energy Agency's IETS technology programme is all about industrial energy technologies and systems, focusing on research and technology development for more efficient energy use in industrial production.The international partnership is driving forward research i. a. into integrating renewable energy sources, using industrial waste heat, biorefineries, separation processes and industrial carbon capture and storage.

The programme supports collaboration between the industry-relevant research disciplines and promotes networking within industrial sectors and for cross-sectional technologies as well as the transfer of information and knowledge amongst experts from industry, science and technology policy.

nachhaltigwirtschaften.at/de/iea/technologieprogramme/iets

## INDUSTRIAL WASTE HEAT UTILISATION

This project is pursuing a multidisciplinary approach to the integrated use of industrial waste heat and is geared towards optimising energy efficiency on a global scale with the aim of fine-tuning and (further) developing energy- and cost-efficient technologies. Austrian participation enables national stakeholders to engage in partnerships at international level and offer their expertise in industrial energy-relevant technologies and systems all over the world.

nachhaltigwirtschaften.at/de/iea/technologieprogramme/iets/iea-iets-annex-15-phase-3.php

## DIGITALISATION, ARTIFICIAL INTELLIGENCE (AI) AND RELATED TECHNOLOGIES FOR ENERGY EFFICIENCY AND GHG EMISSIONS REDUCTION IN INDUSTRY

Efforts to further develop and use digitalisation, artificial intelligence and related technologies are intended to improve the economic and environmental performance of energy- and greenhouse-gas-intensive industries. Amongst other things, the project is focusing on helping to implement digital twins in industry by establishing the necessary foundations and framework conditions.

nachhaltigwirtschaften.at/de/iea/technologieprogramme/iets/iea-iets-annex-18.php

## INDUSTRIAL ELECTRIFICATION

Electrifying industrial processes can make a major contribution to reducing $CO_2$ emissions if the electricity is supplied from renewable sources. At the same time, switching to electricity as the energy carrier can improve both economic and energy efficiency. The project aims to promote knowledge transfer between international and Austrian stakeholders and analyse existing technologies, programmes, roadmaps and measures.

nachhaltigwirtschaften.at/de/iea/technologieprogramme/iets/iea-iets-annex-19.php

# REGAS4INDUSTRY

## Gases from biogenic residues and waste materials for industry

*Test facility for fluidised-bed methanation, photo: TU Wien*

The ReGas4Industry project[1] investigated a method for generating high-quality synthetic secondary energy carriers (such as synthetic natural gas) from biogenic residues and waste materials. These synthetic gases can be used as a replacement of fossil fuels in industry and enable significant amounts of $CO_2$ to be saved. Compared to the direct generation of electricity and heat from biogenic residual material, gas generation has the advantage of providing an energy source that can be stored. Several years ago, the Institute of Chemical, Environmental and Bioscience Engineering at TU Wien developed a gasification process using two interconnected fluidised beds. Although this innovative and carbon-neutral technology was originally developed to produce gas from wood chips, cheap biogenic residues and waste products are now being used instead, as wood chips are expensive. As well as fitting the concept of the sustainable circular economy, this approach also provides an opportunity to make the innovative method more cost-effective.

### DEVELOPING AND TESTING ON A PILOT SCALE

The project focused on producing renewable natural gas (synthetic natural gas, or SNG) and Hythane (a blend of methane and hydrogen) but also analysed processes for making liquid Fischer-Tropsch (FT) products. The researchers started by investigating potential alternative fuels (biogenic residues and waste products) and rating them in terms of quantities available, prices, compositions and suitability for the new method.

The innovative process features the latest-generation dual fluidised bed (DFB) gas generation with subsequent gas cleaning and catalytic fluidised bed methane synthesis or FT synthesis. The entire process chain was set up and operated on a pilot scale in the Technikum at TU Wien. A 100 kW DFB gasifier was used to run extensive gas production experiments employing various fuels and operating conditions and different bed materials and gasification agents.

At the heart of the various synthesis routes is a fluidised-bed reactor for the single-stage synthesis of methane. Gas cleaning equipment such as a biodiesel scrubber and a three-stage fixed-bed adsorber were also developed and built as part of the project. This enabled the operation of the entire process chain from residual material to raw-SNG. Two extensive testing rounds successfully demonstrated the "live" production of raw-SNG in combination with the 100 kW DFB gasifier.

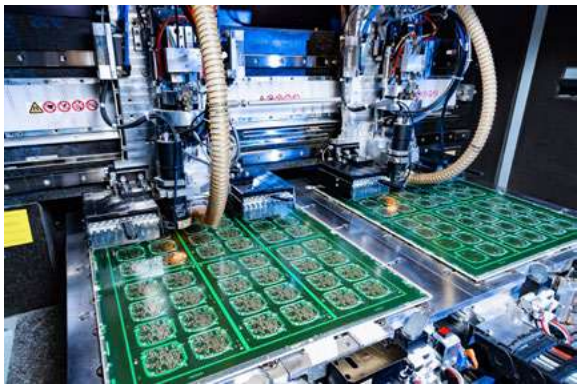
### TWO HIGHLY PROMISING BIOGENIC RESIDUES: BARK AND SEWAGE SLUDGE

The pilot plant investigations at TU Wien show that biogenic residues such as bark, lignin, sewage sludge and residues from fermentation processes can technically be used to produce gas. A very high product gas quality can be achieved with bark, a classic by-product in the woodworking industry. Bark offers the highest potential as a fuel for producing renewable natural gas, while sewage sludge is also suitable for gas generation and SNG production despite its ash content and high percentage of impurities. As sewage sludge costs money to dispose of and thus has a negative price, it offers an economic advantage compared to both SNG production from high-quality biomass and fossil natural gas. As the existing potential for harnessing sewage sludge in Austria is limited, however, its exploitation on an industrial scale would only make sense in main conurbations. Other biogenic residues that could also be used to produce gas are fermentation residues from biogas plants and by-products of the paper and pulp industry.

The findings from the pilot phase and extensive literature research were used to formulate concepts for applying the method on an industrial scale and carry out techno-economic and environmental assessments. ●

energieforschung.at/projekt/gase-aus-regenerativen-reststoffquellen-fuer-die-industrie

[1] **PROJECT PARTNERS**: TU Wien, Institute of Chemical, Environmental and Bioscience Engineering (project management), SMS group Process Technologies GmbH, Energy & Chemical Engineering GmbH



*Manufacturing circuit boards at AT&S, all photos: AT&S*

# Digital Energy Twin

## Optimising industrial energy systems

To enable the efficient and sustainable energy supply of industrial manufacturing, both the demand of individual processes and the availability of thermal and electric energy must be aligned. Industrial companies need tools and methodologies for designing and optimising their energy supply systems, particularly with a view to integrating a high percentage of renewable energy. Industrial energy supply is currently largely set up to use a handful of supply technologies and cannot respond in the best possible way to fluctuating, process-driven demand or the volatile availability of renewable energy.

### MODELLING ENERGY-RELATED PROCESSES

A concept and suitable software tool for optimising the design and operation of industrial energy supply systems is being developed as part of the Digital Energy Twin[1] lead project, which is being led by AEE – Institute for Sustainable Technologies (AEE INTEC). It is employing a method known as a digital twin, which was previously used mainly to optimise production workflows and logistical issues in industry. The digital twin enables detailed models of selected energy-related processes and renewable energy supply technologies to be developed, validated and simplified for the first time.

### OPTIMISATION BASED ON LIVE OPERATING DATA

The main purpose of the project is to develop a holistic optimisation algorithm based both on operating and process data from standardised examples and on real-life manufacturing industry operating data from the printed circuit board manufacturer AT&S. This company will be applying the new tools that are being developed with the vision to extend the Digital Energy Twin to the whole system at AT&S in Hinterberg/Leoben and finally all production sites worldwide.

The Digital Energy Twin offers a solution for the need to balance fluctuating energy demand at process level, a volatile supply of renewable energy and the use of process and supply technologies that are as efficient as possible.The digital twin method can also be combined with augmented and virtual reality (AR/VR), two technologies that could be used to monitor and control production and energy systems efficiently in the future.

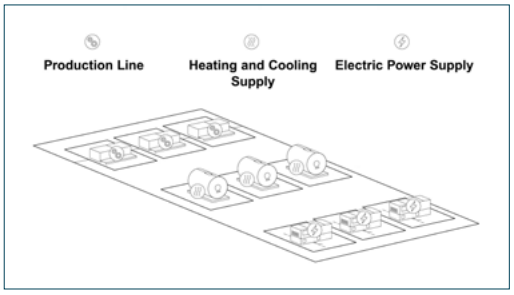
### LOW-COST APPLICATION

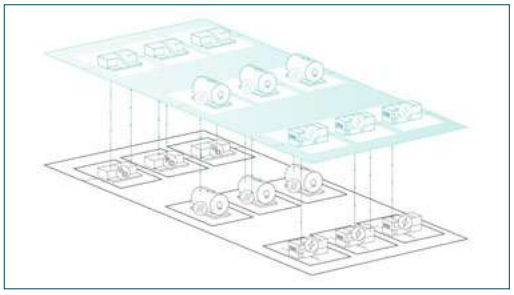
The project is developing standardised models for energy-related process and supply technologies, thus ensuring that the method can be reproduced and applied at low cost in many other industry sectors. This optimisation method will help companies to better gauge and reduce the risks involved in investing in sustainable energy systems. The project is thus making a key contribution to broadening the scope for using energy-efficient process and supply technologies and integrating renewable energy sources in industrial manufacturing. ●

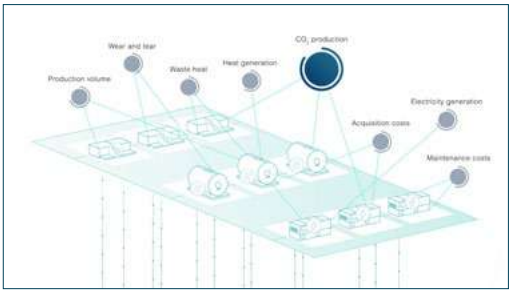
energieforschung.at/projekt/optimised-operation-and-design-of-industrial-energy-systems

[1] **PROJECT PARTNERS:** AEE INTEC (project management), AT&S Austria Technologie & Systemtechnik Aktiengesellschaft, FH Vorarlberg University of Applied Sciences: Research Center Digital Factory Vorarlberg / Research Center Energy / Research Center User Centered Technologies / VR Lab, FH Salzburg University of Applied Sciences / Information Technology & System Management, Graz University of Technology / Institute for Software Technologies / Institute for Interactive Systems and Data Science, University of Leoben / Chair of Energy Network Technology, Eberle Automatische Systeme GmbH & Co KG, Enertec Naftz & Partner GmbH & Co KG, Schmoll Maschinen GmbH, VTU Energy GmbH Bravestone Information-Technology GmbH

*Using a digital twin to optimise an energy system, all images: AT&S*



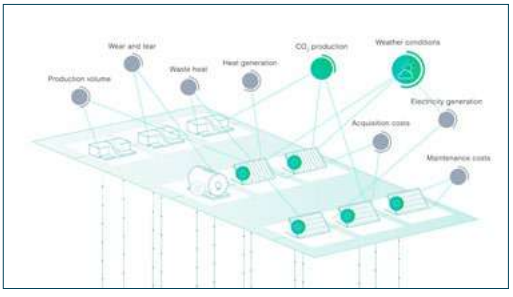


*Photo: AT&S*

**“To make our circuit boards, we at AT&S use highly specialised facilities and processes that also need a complex energy system. All manufacturing steps and the associated processes are monitored very closely and optimised continuously so that we can make our production efficient, sustainable and high quality. This also means embracing innovative solutions: having a Digital Energy Twin of one of our manufacturing facilities lets us identify further opportunities for optimisation along the production and energy supply chain and make the most of them. This is increasing flexibility and efficiency in our production further while also going a long way towards making circuit board manufacture even more environmentally and resource-friendly.”**

ANDREAS GERSTENMAYER
CEO OF AT&S

## PROJECT GOALS

- Developing a holistic optimisation algorithm for industrial energy systems
- Developing and validating the Digital Energy Twin tool and methodology
- Enabling holistic modelling of the industrial energy system including both conventional and renewable technologies
- Validating data security and data management between software and hardware components
- Devising a standardised model to make Digital Energy Twin transferable
- Incorporating augmented and virtual reality for human-machine interaction as part of the Fourth Industrial Revolution

www.youtube.com/watch?v=e8UspsEbyic

# DSM_OPT

## Operation optimisation for industrial energy systems

Industry is one of the biggest energy consumers in Austria, but there are various ways to optimise the operation of its facilities and systems. One is demand-side management (DSM), which is about regulating demand for services connected to the power grid. DSM can help companies uncover areas of potential for increasing flexibility in order to integrate renewable energy sources into their production processes more effectively and relieve some of the pressure on energy infrastructure by planning energy generation units and consumers in the best possible way. This reduces the capacity necessary for storage systems and improves overall system efficiency.

*Image: iStock/Irina Strelnikova*

### DEVELOPING THE DSM TOOLBOX

The NEFI project "DSM_OPT" [1] is developing a DSS (decision support system) toolbox that encompasses the use of various demand-side management applications, including energy efficiency (EE), time-dependent tariffs ("time of use", or TOU) and incorporating changing market conditions ("market demand response"). The project is led by the Chair of Energy Network Technology at the University of Leoben, project partners are the research institution AEE INTEC, the software developer ENEXSA GmbH, the steel and rolling mill Marienhütte GmbH and the bakery Albin Sorger „zum Weinrebenbäcker" GmbH.

Different methods are used to solve the problems depending on the process design and customer requirements involved. For example, "what-if tools", which mainly cover the areas of energy efficiency and time-dependent tariffs, are suitable for simple process layouts and manual, interactive product planning. Meanwhile, optimisation methods that support automatic process planning are used for complex systems and markets.

*Stahl- und Walzwerk Marienhütte GmbH, all photos: Mathias Kniepeiss*

[1] DSM_OPT is part of the NEFI (New Energy for Industry) model region, which is promoting the decarbonisation of industrial companies driven by innovation and technology development.

## PRACTICAL TESTING AT TWO INDUSTRIAL SITES

The user-friendliness of the toolbox is being tested as part of case studies at the sites of the two industry partners (steel and rolling mill and bakery) in Styria. Marienhütte steelworks is hoping to achieve cost savings of between 2 % and 5 % per tonne of steel as a result in the short term. The long-term aim is to increase energy efficiency by 10 %. Sorger, the bakery, is planning to cut its electricity costs by 15 % to 20 % and likewise to improve its energy efficiency by 10 %.

## COURSE OF THE PROJECT

In the project's first year, the focus was on digitalising the two industrial sites. Digitalisation at the Marienhütte steelworks involved a thorough process analysis as well as data extraction, preparation and evaluation. Any gaps in the data were closed by installing new measuring devices. On Sorger's industrial site, the relevant measurement points and process parameters on which the modelling was to be based were successfully identified. The load profiles of the main units in the bakery are available and can be put to use in further process analyses.

An optimisation framework was also developed that encompasses process modelling followed by embedding in an optimisation routine. The implementation phase is currently under way, focusing on process modelling at both industrial sites. This will be used as a basis for developing the what-if tool for time of use applications and the optimisation routine for market demand response applications. ●

www.nefi.at/dsm_opt

*www.sorgerbrot.at, photo: Lupi Spuma*


*www.sorgerbrot.at, photo: Christian Repnik*

## PROJECT MILESTONES

- Developing a reliable method for forecasting energy consumption at the industrial sites over a specific time horizon
- Developing an optimisation framework for implementing the DSM tools for operation optimisation
- Developing various DSM tools (energy efficiency, time of use, market demand response)
- Implementing and testing the DSM DSS toolbox at two industrial sites

**"Steelmaking is a very energy-intensive process for which we at Marienhütte use electricity and natural gas. Armed with a suitable demand-side management tool, these forms of energy can now be used even more efficiently and in a synchronised way. We're also expecting to identify various areas where we can make savings. As well as improving use, therefore, this will also take some of the pressure off the energy networks as a whole."**

HERBERT FOHRINGER
MANAGING DIRECTOR OF STAHL- UND WALZWERK MARIENHÜTTE GMBH

# EDCSproof

## Concept for the future: decarbonising industrial energy supply

*Industrial energy supply system of one of the project partners; left: thermal energy storage systems; right: heat generation and distribution system; photos: Climate and Energy Fund/Krobath*

Taking the food industry as an example, an innovative concept for decarbonising industrial energy supply systems has been developed and tested as part of the EDCSproof[1] NEFI project based on digital applications as well as heat pumps and energy storage systems.

EDCSproof stands for "Energy Demand Control System – PROcess Optimization For industrial low temperature systems". The project focused on developing a regulation concept that is online, predictive, holistic and reconfigurable and that is to be used to implement sustainable energy concepts in industry in the future.

### EDCSPROOF PERFORMS VARIOUS ROLES:

- The system supports the integration of renewable energy sources using energy storage systems
- It acts as a flexible consumer for power grids (demand-side management, taking account of dynamic tariffing)
- It increases efficiency by optimising control of the overall system
- It enables waste heat to be harnessed using high-temperature heat pumps (<150 °C), meaning that energy demand can be reduced while maintaining production at the same high level

A user-friendly human-machine interface enables the efficient input of production schedules as well as the visualisation of current and forecast plant conditions and allows operators to intervene in the processes.

### WORK STEPS

Three sites operated by the project partners from the food industry (Wiesbauer Holding AG, Fischer Brot GmbH) were analysed as part of the project. This analysis then served to determine a reference energy system, targets for optimisation and framework conditions for integration in energy markets. Models for energy supply, storage and consumption were produced and used as a basis for devising and testing the energy demand control system (ECDS) in the laboratory. This was followed by techno-economic and environmental analyses. Scalability for additional industrial applications was also investigated, and the latent heat storage technology was developed further and tested.

### OUTCOME OF THE PROJECT

An energy supply system with defined boundary conditions (energy prices that fluctuated over time, emission factors and availability of waste heat sources) was used as an example to demonstrate in the laboratory that the EDCS can help cut emissions by up to 57 % and energy supply costs by 8 % compared to a standard controller. Integrating the EDCS allows the potential for added flexibility to be leveraged to the full without modifying the existing infrastructure.

[1] **PROJECT PARTNERS**: AIT Austrian Institute of Technology GmbH (project management), Montanuniversität Leoben/Chair of Energy Network Technology, TU Wien/Institute for Energy Systems and Thermodynamics und Institute of Mechanics and Mechatronics, Control and Process Automation, evon GmbH, ILF Consulting Engineers Austria GmbH, kleinkraft OG, Wiesbauer Holding AG, Fischer Brot GmbH

[2] www.nefi.at/industry4redispatch/

EDCSproof is part of the NEFI (New Energy for Industry) model region

**“The EDCSproof research project clearly demonstrates economic benefits of data collection and analysis in manufacturing industry. Together with partners from industry and research, we worked on efficient solutions toward a climate neutral manufacturing plant. By developing an Energy Demand Control System we are a big step closer to reach this goal. Now it's time for implementation.”**

MAGDALENA TEUFNER-KABAS
MANAGING PARTNER, KLEINKRAFT OG

*Photo: Johannes Zinner*

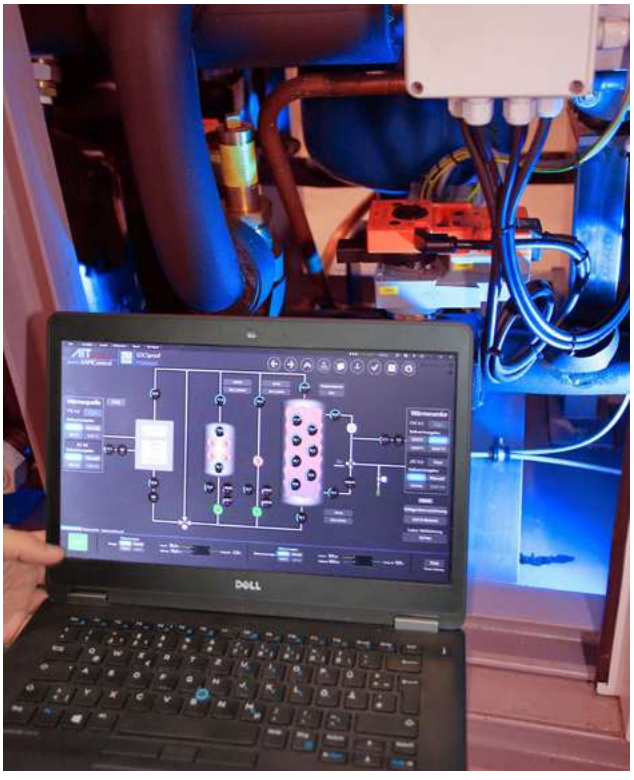
The actual savings potential will depend on the individual situation facing each company and, specifically, on the structure of its energy supply system, the possibilities for storing energy and the scope for flexibility in consumption. The project produced an energy concept spanning across all sectors and with a broad field of application, which can be implemented at the project partners' sites as well as at other companies. The system is making a major contribution to increasing energy efficiency and thus the competitiveness of the manufacturing sector and is paving the way for a switch to renewable energy sources in industrial energy supply.

## FURTHER DEVELOPMENT

The follow-up project "Industry for Redispatch" [2], which is currently under way, aims to further develop and implement the EDCS controller in industrial plants while also giving them flexibility in terms of the power grid. Its partners are Wiesbauer Holding AG, the paper manufacturer Mondi, voestalpine Stahl GmbH, Siemens AG and APG Austrian Power Grid as well as several distribution network operators and research organisations. ●

www.nefi.at/edcsproof/

*Tests were carried out as part of the project in the laboratory at the AIT Center for Energy; left: using XAMControl to visualise the EDCS test setup; right: measurements on the latent heat storage, photos: Climate and Energy Fund/Krobath*



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