

SCOPING PAPER

ELECTRIFICATION & ENERGY EFFICIENCY

A NEFI Innovation Hub

NEFI – The Innovation Network for Industrial Transformation

NEFI – New Energy for Industry is an innovation network consisting of over 100 industry partners, 8 research partners, and 4 institutional partners. With 25 research and innovation projects dedicated to industrial transformation in Austria, an investment volume of nearly €100 million has been mobilised.

The goals of NEFI are:

- **Climate Neutrality** – Supplying selected sites with up to 100% renewable energy.
- **Value Creation and Location Security** – Promoting technology development and exports “Made in Austria”.
- **Industrial Resilience** – Ensuring energy supply, optimising processes, and improving infrastructure for Austrian industry.

The solutions developed within NEFI address 53% of the CO₂ emissions expected by 2040 and have the potential to generate an economic benefit of €2.2 billion. Additionally, by 2040, more than 25% of fossil energy imports could be avoided.

Achieving a climate-neutral industry by 2040 requires significant research and development efforts. Essential technologies are not yet fully developed, tested, or scalable to a sufficient extent. To bridge technological gaps and strategically drive innovations along realistic, scenario-based transformation pathways, six Innovation Hubs have been established.

NEFI Innovation Hubs

The NEFI Innovation Hubs are specialised networks led by renowned research institutions. Their goal is to initiate high-impact research and innovation projects that support the transition to a climate-neutral industry and position Austria as a technology leader in renewable energy and industrial innovation.

Both large corporations and small and medium-sized enterprises (SMEs), as well as research institutions, are invited to participate in the Innovation Hubs.

NEFI Innovation Hubs: value proposition for partners

- ☑ Regular networking and information events: The NEFI Technology Talks present current technologies, trends, and developments.
- ☑ Support throughout the innovation process: From project idea to funding application and impact assessment.
- ☑ Dissemination of results: Effective communication and visibility.
- ☑ Access to state-of-the-art laboratory infrastructure.

The NEFI Innovation Hubs focus on the following key areas: CCUS, Circular Economy, CO₂-neutral Gases & Hydrogen, Electrification & Energy Efficiency, Flexibility, and Industrial Symbiosis. These topics have been identified as crucial for achieving industrial climate goals across different industries and scenarios ([NEFI Pathway to Industrial Decarbonisation](#) and [transform.industry - in German](#)).

1. Electrification and Energy Efficiency – Current developments and trends

The key drivers for electrification and efficiency improvements are the **European climate targets** (e.g., expansion of renewable energy generation, decarbonisation of process heat supply, resource efficiency). These targets lead to specific regulations and laws for transformation at both the European and national policy levels. In addition to regulatory requirements, market demands (e.g., cost reduction, resilient production) and technological innovations also play a central role in achieving these goals.

Key trends in electrification and energy efficiency are:

- (1) Integration of renewable energy into industrial processes** (especially PV and wind power): This includes both the direct use of electricity from renewable sources and the storage and conversion of energy.
- (2) Decentralisation and flexibility of energy supply:** There is a general shift towards decentralised energy systems, where companies generate and manage their own energy, supported by smart grids and demand response technologies.
- (3) Electrification of process heat supply:** Process heat is the most significant energy consumption factor in industry. Electrification enables the use of renewable energy such as PV and wind in industrial processes. Electrification technologies vary according to temperature level and application and include, for example, heat pumps, electric boilers, arc furnaces, resistance heating, induction, plasma, etc.
- (4) Process adaptations to improve energy efficiency:** Achieving significant energy savings requires new approaches to industrial processes, such as lowering temperatures, improving heat integration, alternative methods, and more efficient machinery. The EU emphasises energy efficiency improvements as a priority measure in its regulations and supports this with industry benchmarks (BREF, BAT).
- (5) Advances in electrical energy conversion:** This includes electrification of non-electrical processes, improving energy efficiency in electrical energy conversion through new technologies (e.g., in semiconductor technology), integration and optimisation of existing solutions, exploration of new areas (e.g., high-frequency insulation in medium- and high-voltage applications), and analysis, optimisation, and reduction of the CO₂ footprint in electrical energy conversion.
- (6) Digitalisation and smart manufacturing:** The digitalisation of industry through the use of IoT, big data, and AI to optimise energy efficiency and production processes.

2. High-Potential Technologies and Innovations in Electrification and Energy Efficiency

Based on the general trends in the fields of electrification and energy efficiency, the following high-potential technologies and innovations can be identified:

- (1) Electrification through the use of heat pumps for processes up to approximately 200°C:** High-temperature heat pumps are crucial for the efficient utilisation of waste heat from production processes. The waste heat can be elevated to a higher temperature level (e.g., 200°C) based on the technological process of the high-temperature heat pump.
- (2) Electricity-based process heat generation for high-temperature applications (>500°C):** Electrified heating systems, such as inductive or resistive heating elements or the use of plasma technology, enable the utilisation of renewable electricity sources for process heat generation, leading to significant emissions reductions.
- (3) Integration of thermal and electrical storage systems to increase efficiency:** Storage systems serve both to provide peak power and to shift energy consumption over time, allowing industries to respond to availability and market price fluctuations. This enables flexibility in energy procurement while thermal storage allows the use of waste heat from discontinuous processes to supply heat to processes running at different times.
- (4) Efficient energy distribution at industrial sites:** The increased use of electrification technologies (heat pumps, high-temperature applications, Power-to-X) leads to efficient adaptations in electrical energy distribution (e.g., DC networks) and supports efficient thermal energy distribution (e.g., optimised steam networks through temperature reductions) at industrial sites.
- (5) Efficiency improvements through process adaptations:** Process modifications to enhance efficiency may be required when applying modern technologies and methods. Examples include lowering temperatures in drying processes using heat pumps, modifying the chemical process atmosphere through electrification or oxygen combustion, and improving heat integration.

3. Main Research Questions in the fields of Electrification and Energy Efficiency

As part of the NEFI Innovation Hub for Electrification and Energy Efficiency, projects will be developed to address the following research questions:

- How can electrification enable an efficient and low-carbon transition of fossil-based industrial processes and how can the integration into the overall process landscape occur?
- How can industrial processes use energy and resources more efficiently?

4. Out-of-Scope Topics and Collaborative Overlaps

The following topics and industries are outside the focus area of the Innovation Hub:

- Technologies and innovations that rely exclusively on fossil fuels or are within their domain
- Industries that do not primarily depend on energy-intensive processes, e.g., the service sector
- Infrastructure-related issues, e.g., expansion of electrical grids, planning of CO₂ networks
- Technologies and innovations without relevance to the manufacturing industry

Through cooperation and alignment between the NEFI Innovation Hubs, synergies can be leveraged, technological trends identified, and innovations accelerated.

The NEFI Innovation Hub for Electrification and Energy Efficiency expects overlaps with the following NEFI Innovation Hubs:

- CCUS Carbon Capture, Utilisation and Storage
- Circular Economy
- CO₂-Neutral Gases & Hydrogen
- Flexibilisation

5. Hub Co-Leads & Contact Persons

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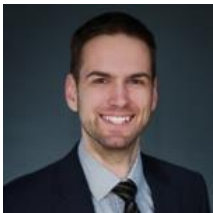


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