Direct electrification of industrial process heat

An assessment of technologies, potentials and future prospects for the EU

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Key Findings, 1 and 2

1 **Achieving climate-neutral industry requires an efficient decarbonization of industrial heat.** Three quarters of industrial CO2 emissions result from burning fossil fuels that provide process heat for the production of industrial goods, such as chemicals, steel, paper, food and beverages. Process heat constitutes the single most significant energy use by industry.

2 **Direct electrification technologies expected to be available by 2035 could meet 90 percent of the energy demand not yet electrified by European industry.** Technologies readily available today, such as heat pumps and electric arc furnaces, could already deliver more than 60 percent of this demand. To tap into this potential, quickly ramping up technologies for the direct electrification of process heat at all temperature levels is key.

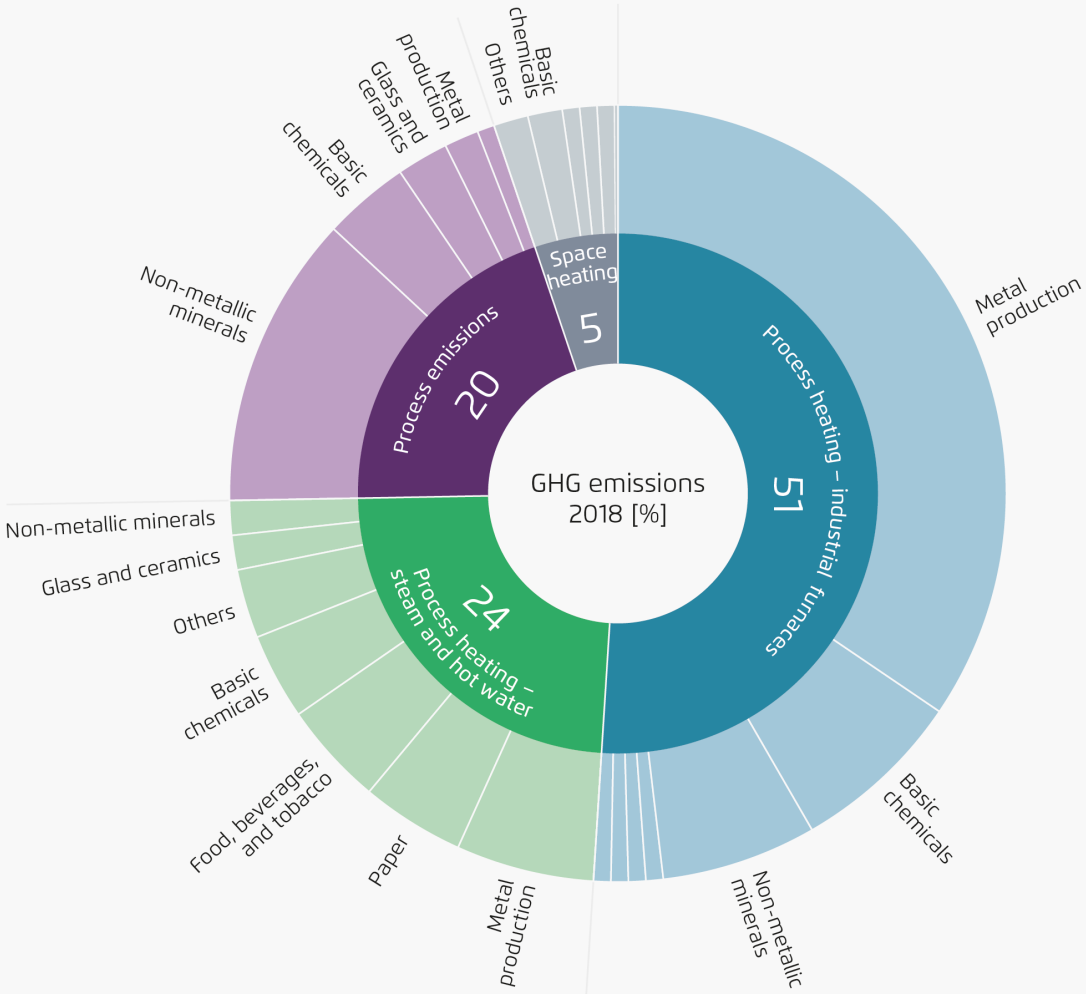
Key Findings, 3 and 4

3 **A broad range of electrification technologies exists to meet specific process needs.** Heat pumps and electric boilers can already generate up to 200 and 500 degrees Celsius, respectively, for chemical processes. Electric arc furnaces are widely employed for steel production at 1,800 degrees. Technologies such as resistance heating, induction heating and electric steam crackers will become available in the coming years and cover all ranges, from 100 to 2,500 degrees.

4 **A targeted EU action plan is needed to address the economic and organizational barriers to direct electrification and ensure it is a key transition strategy for industry across Europe.** Major elements include establishing an industrial alliance to facilitate market introduction of technologies and setting deployment targets to enable investments. Funding schemes should explicitly support direct electrification projects, while regulators should integrate electrification in grid planning and allow industry easy grid access.

Industrial process heat in the EU: a large contributor to GHG emissions…

Approximate structure of GHG emissions in the European industry sector, 2018



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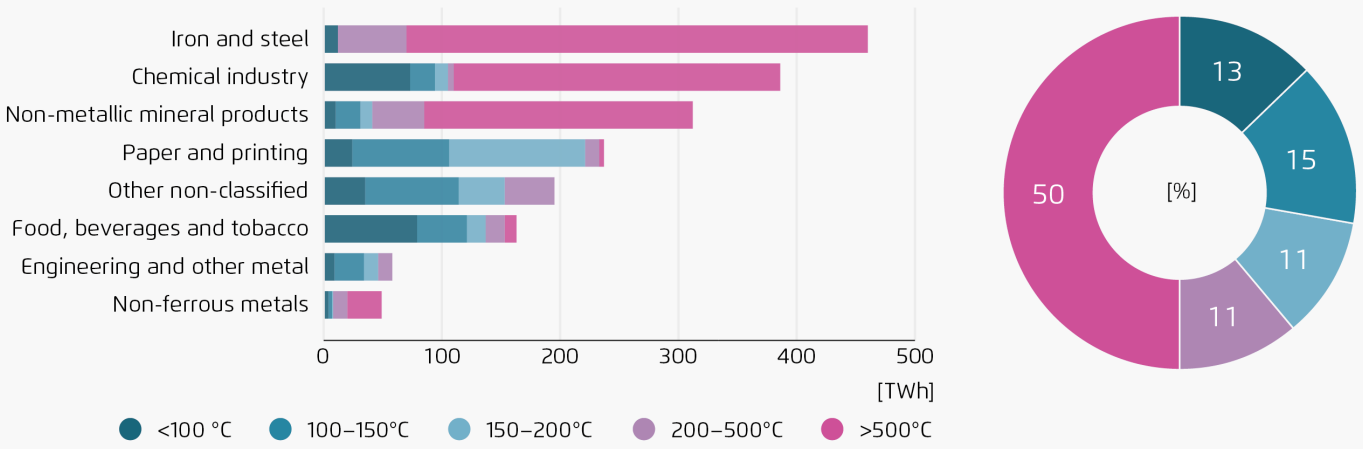
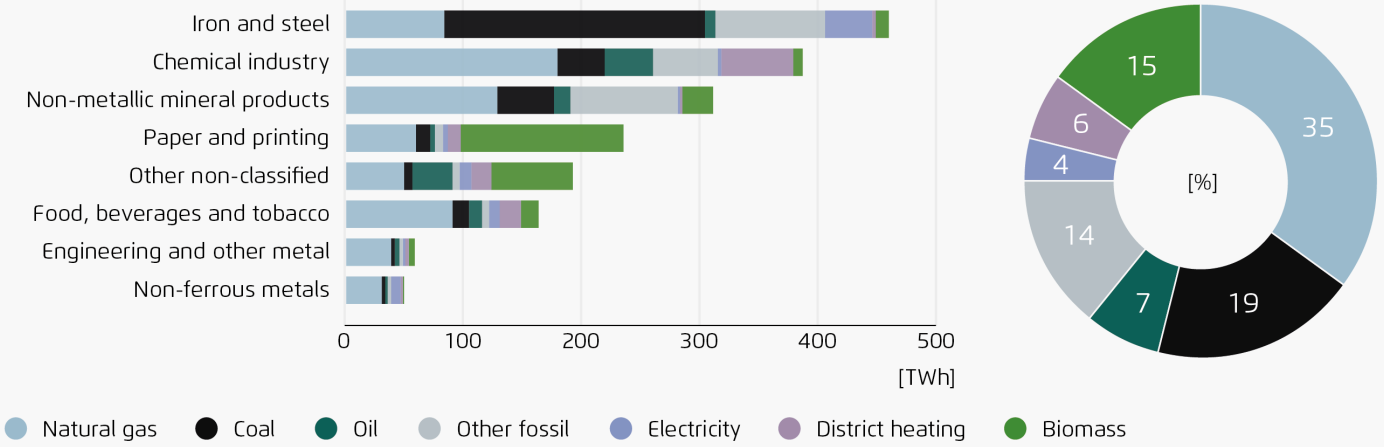
…and energy consumption

Estimated total final energy demand for process heating in 2019 by temperature and energy carrier in the EU-27 countries





Industrial electrification technologies

Selected technologies


Industrial heat pumps


Electric boilers


Resistance heating


Induction heating


Plasma torches


Electric arc furnaces

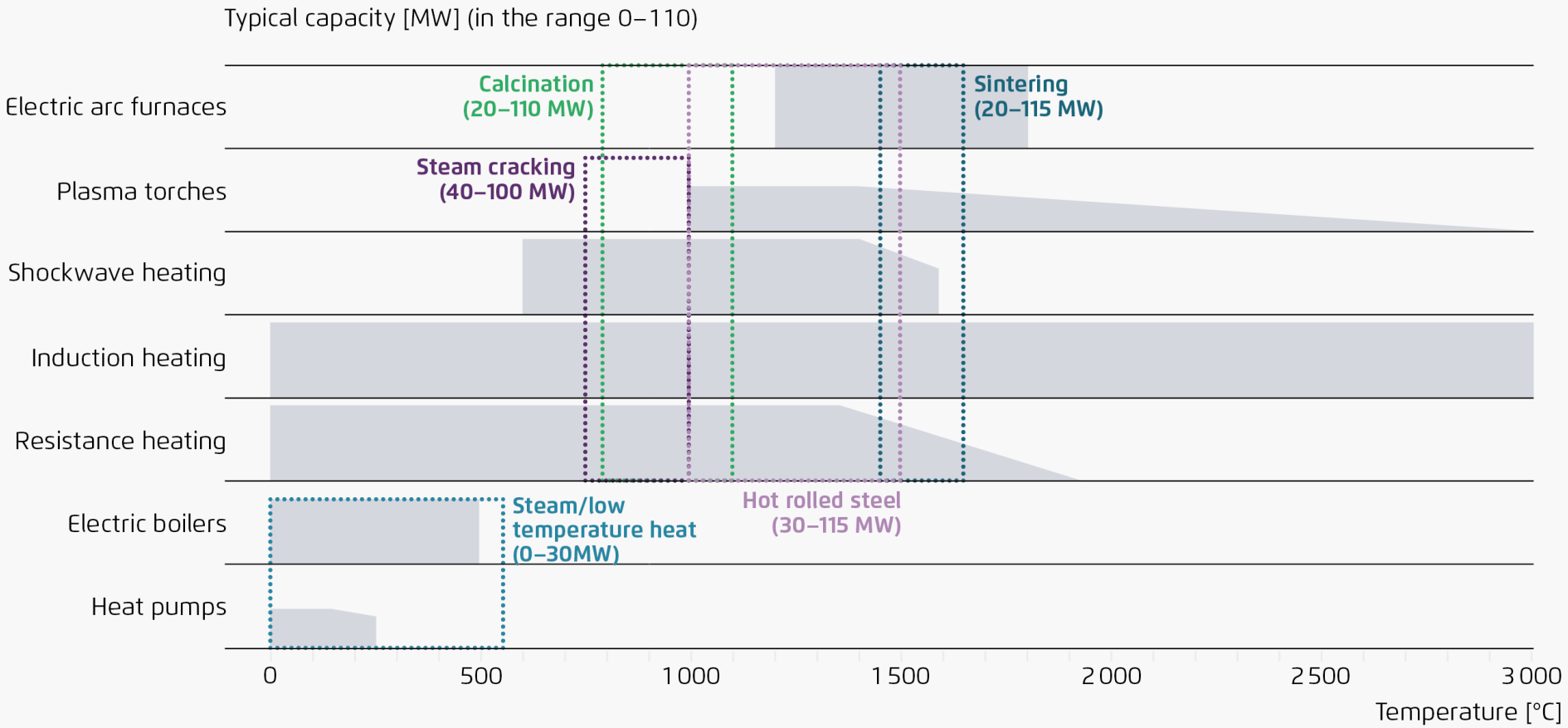

Shock wave heating


(Electro-thermal storage)

Process heat electrification: technologies' application

Potential development of electric heating technologies by 2035 and industrial applications –

expected capacity versus temperature



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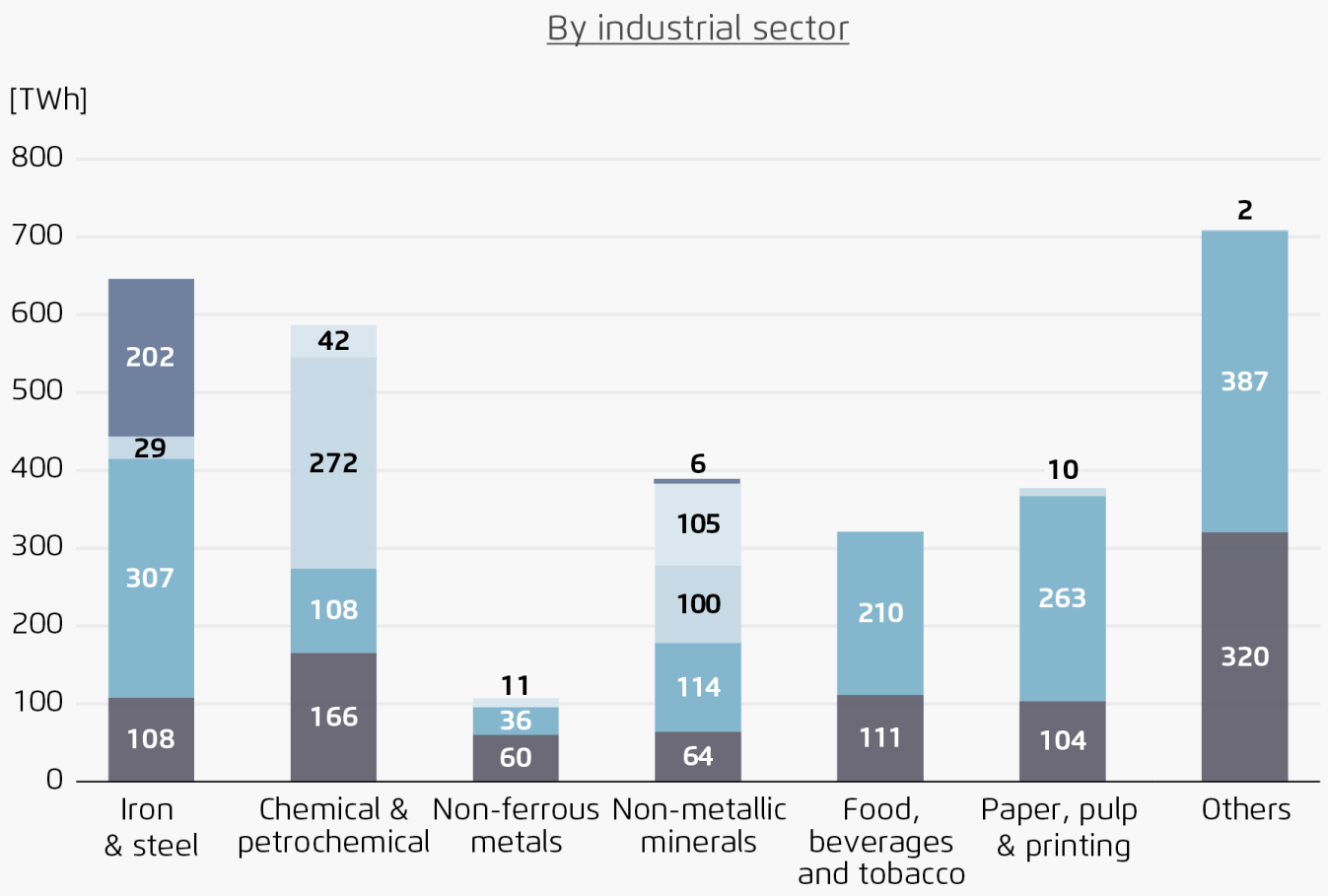
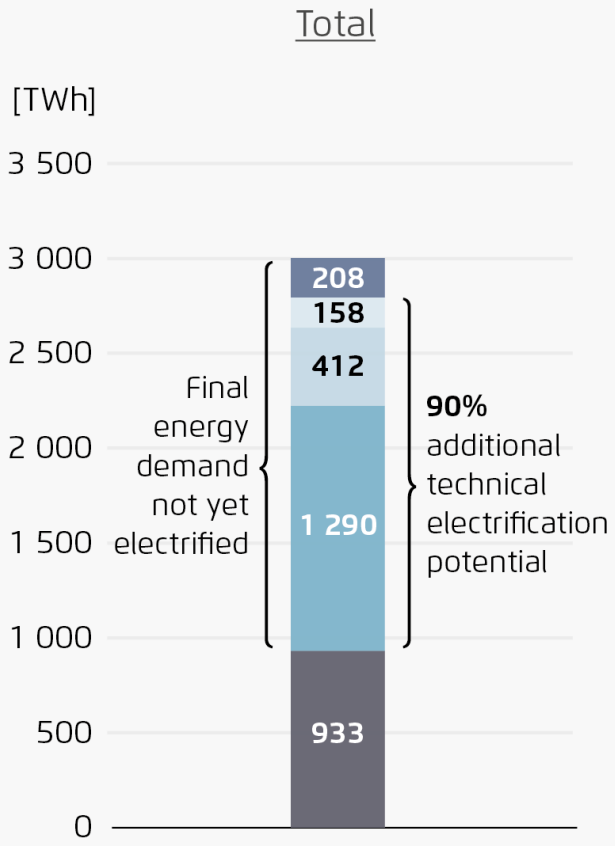
Overall electrification potential of the European industrial sector





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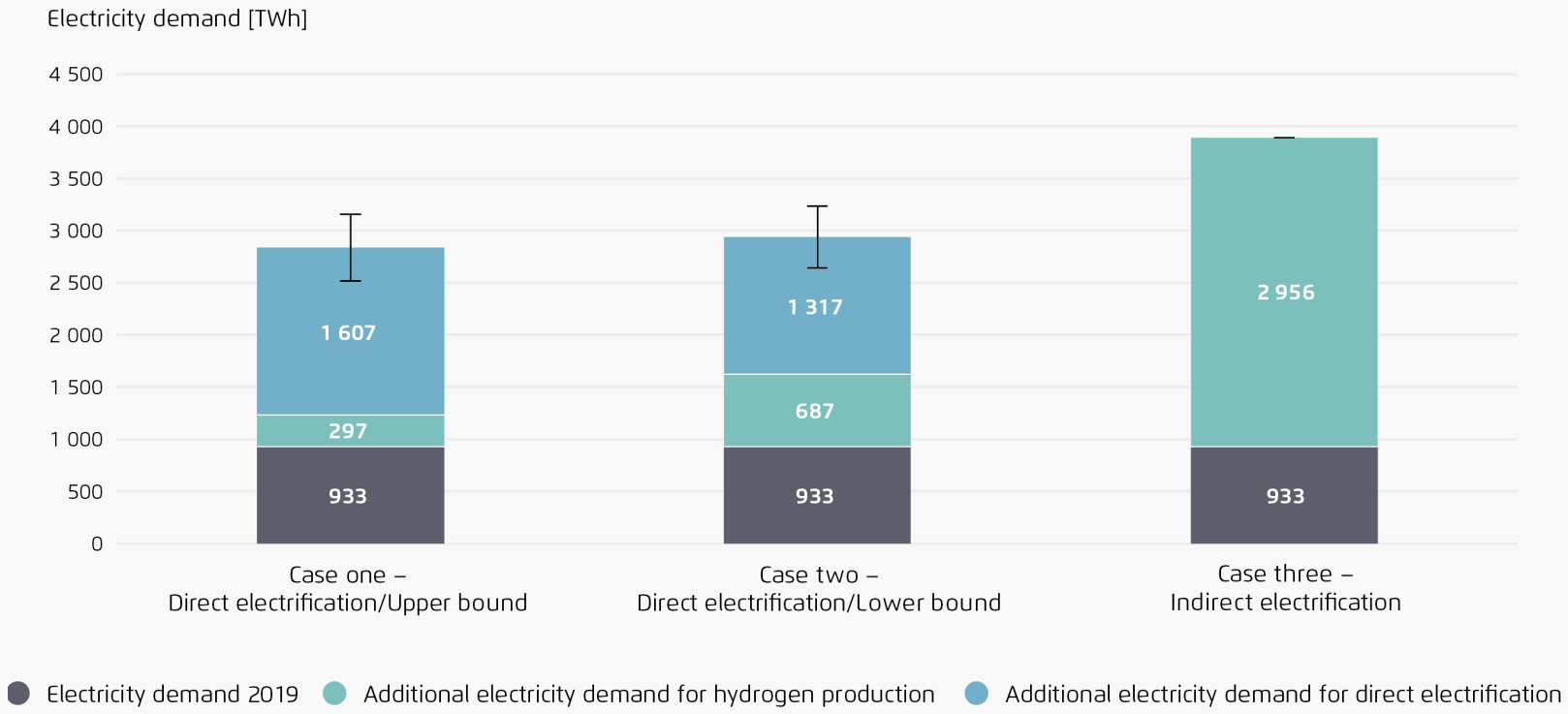
Direct electrification of industrial process heat saves significant renewable capacity additions in EU compared with the use of hydrogen

Resulting total electricity demand for direct electrification and for hydrogen production with lower and upper limits for additional electricity demand, depending on the choice of electrification technology



Limited technical barriers exist to scale up the direct use of renewable electricity; economic and organizational barriers need full political focus

→ **Technical barriers: limited, still present in demand for feedstock, reducing agents and very high density**

→ **Economic barriers: energy prices as the largest component in total cost of ownership of heating installation; high efficiency can offset higher electricity prices in some applications**

→ **Organisational barriers: infrastructure bottlenecks, technical lifetime of legacy installations, challenging integration in on-site production system**

Recommendations for an EU industrial electrification action plan

→ **Establish an industrial direct electrification technology alliance**

→ **Set deployment and phase-out targets, and net zero standards for new installations**

→ **Incorporate industrial direct electrification technologies into EU cleantech funding**

→ **Clarify state aid rules on industrial power prices for strategic sectors**

→ **Integrate industrial electrification in grid expansion planning**

Thank you for your attention!

Are there any questions or comments?

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