Dimensions and modes of action of barriers

→ Fig. 32

Technical

Technology availability (global)
Only limited technical barriers to direct process heat electrification exist

→ **Limited technical barriers** exist to direct process heat electrification after 2035.

→ **They are present in:**
→ demand for feedstock
→ reducing agents and
→ very high energy densities

Economic

Technology competitiveness (national)
Operational expenditures for energy

→ **OPEX** for energy are the largest component in total cost of ownership of process heat installations.

→ **Energy efficiency improvement** as a result of direct electrification can – in some applications – offset higher energy prices for electricity (compared to natural gas).

→ **Attractive direct electrification** in many applications though requires changed market conditions, e.g. higher CO_2-prices and reduced electricity prices.

Organisational

Technology applicability (site specific)
Insufficient deployment of grid infrastructure

→ **Enabling direct electrification** also has to address organisational barriers:
→ Electricity infrastructure
→ On-site production systems
→ Technical lifetimes of installations
→ Knowledge about solutions
→ Uncertainty

→ **Electricity infrastructure** must be extended. Beyond transmission grids, upgrades to site-specific connections are necessary.

→ **On-site production systems.** The integration of electric systems may create challenges around changed logistic and space demand.

→ **Technical lifetime** of existing installations is too long – many installations will have to be replaced earlier than planned.

→ **Knowledge** about already available and upcoming solutions can be scarce.

→ **Uncertainty** hinders or stops investment decisions that are needed for market entry of important technologies.

Fraunhofer ISI (2024), Agora Energiewende (2024)