Power-to-heat: the potential for direct electrification of industry

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The challenge of Industry decarbonisation

• Industry is the major CO₂ emitter: circa 12 billion tonnes CO₂ (including indirect emissions)

• 3 different types of CO₂ sources: fuel combustion (direct), electricity and commercial heat (indirect), process emissions (feedstock and raw materials)
The energy demand in Industry: methodologies

JRC-Idees Database
- EU28 level
- FE & UED
- Energy Services
- End-uses

IEA Energy Balance Database
- Global level
- FE consumption
- Energy carriers

Iron & Steel
- Primary steel
- Secondary steel
- Direct reduced iron (DRI)

Non-metallic minerals
- Cement
- Ceramic
- Glass
- Ammonia
- Ethylene
- Aromatics
- Methanol
- Soda ash
- Chlorine
- Polymers

Non-ferrous metals
- Primary aluminium
- Secondary aluminium
- Primary copper
- Secondary copper
- Primary zinc
- Secondary zinc
- Primary lead
- Secondary lead

Paper & Pulp
- Food
- Textiles
- Machinery & Transport equipment
- Wood

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The energy demand in Industry: results

- >80% of energy demand is supplied with combustible fuels.
- 50% of the energy supplied by combustible fuels is used in thermal processes.
- Chemicals, iron & steel and cement are responsible for >70% of the energy demand.
Industry Electrification

- Comparable or higher efficiencies
- Process control (e.g. digitalisation and automation)
- Flexibility (e.g. hybrid systems)
- Technologies well established in industry
- Potential issues: scalability and integration into consolidate processes

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 °C</td>
<td>Space heating, Hot water, Low pressure steam, Cooling and refrigeration</td>
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<tr>
<td>100 – 400 °C</td>
<td>Energy recovery (e.g. in distillation, evaporation) to provide steam and process heat</td>
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<tr>
<td>400 – 1000 °C</td>
<td>Drying, Paint curing, Plastic treatments, Food processing</td>
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<tr>
<td>&gt;1000 °C</td>
<td>Drying, Ceramics firing and sintering, Cement treatment, Food processing</td>
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<tr>
<td></td>
<td>Metals melting, re-heating, annealing, welding</td>
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<tr>
<td></td>
<td>Metals melting, smelting, Heaters for the chemical industry, Ceramic firing, Glass melting, Calcination</td>
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<td>Metals melting and partial refining</td>
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<tr>
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<td>Metal treatments (e.g. welding), Sintering, Cement production</td>
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</tbody>
</table>
17% of the energy demand in industry is already supplied with electricity

34% of the energy demand for thermal processes <400 °C could be electrified implementing available technologies

The maximum electrification potential achievable in the industry sector is circa 60% (when chemical feedstock are included).

>90% of industrial heat demand can be electrified.

Critical sectors:
- Chemicals
- Cement
- Iron & Steel
Critical industry sectors:

- **Chemicals**
  - Power-to-heat techs still at R&D phase
  - Feedstocks could be *electrified* via power-to-X (e.g. synthetic fuels)

- **Cement**
  - Production scale
  - Power-to-heat techs still at R&D phase
  - Major source of emissions are the raw materials.

- **Iron & Steel**
  - Limited scrap availability for secondary steel production
  - Power-to-heat cannot reduce *process* emissions from coke.
  - Power-to-H$_2$ has great potential for decarbonisation of primary steel.
Conclusions:

• 30 - 60% of industry energy demand could be electrified via power-to-heat.

• >90% of heat demand from industry could be supplied with electricity

• Deep decarbonisation of industry requires the integration of multiple technologies; power-to-heat & power-to-X have complementary roles.
Thanks for the attention!

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