Process Modelling Study on Decarbonization of Steel Production by Integrating High-Temperature Electrolysis

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The road to a sustainable steel industry

- 8% of energy related CO₂ emissions
- Steel makers are committed to decarbonize
- Technology and innovation is essential
Genvia

Company
Public private partnership

Technology
High efficiency solid oxide electrolyzer

Applications
Industrial use cases where excess process heat is available
Is Genvia Solid Oxide technology suited to decarbonize steel?

SLB Process modelling capabilities are the answer

01
Build process models of existing industrial plants

02
Integrate Solid Oxide Electrolyzer with heat recovery and hydrogen delivery unit

03
Assessment of multiple hydrogen applications as fuel, as reactant, as reducing agent
Process Modeling of Decarbonized Steel Plant

Steel Annealing & Galvanizing Process

Hydrogen Processing Unit

Heat Recovery Unit

Solid-Oxide Electrolyzer

Heat

H₂

Raw H₂

Steam
Genvia SOEL Integration and Use Case Scenarios

→ H2 as fuel:
  - Bypass of HPU
  - Raw H2 to Steel process

→ H2 as reducing agent:
  - Required HPU
  - Pure H2 for HNX mix

→ O2 as comburant:
  - For oxycombustion
  - For H2 oxycombustion
# Simulation of Scenarios and Results

For use case of 50 t/h plant capacity

<table>
<thead>
<tr>
<th>N°</th>
<th>Description / Process Coupling</th>
<th>CO$<em>2$ Direct Emission (kg/ton$</em>{steel}$)</th>
<th>Heat Recovery at fluegas (kWh/ton$_{steel}$)</th>
<th>Additional Electricity (kWh/ton$_{steel}$)</th>
<th>Feed Water (kg/ton$_{steel}$)</th>
<th>H$<em>2$ at OSBL (kg/ton$</em>{steel}$)</th>
<th>O$<em>2$-rich gas at OSBL (kg/ton$</em>{steel}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reference Plant</td>
<td>30</td>
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<td>2</td>
<td>Ref. + HRU + SOEL + HPU:</td>
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<td>-19</td>
<td>81</td>
<td>18</td>
<td>2.0</td>
<td>29</td>
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<tr>
<td></td>
<td>$H_2$ for sales</td>
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<td>Ref. + HRU + SOEL + HPU:</td>
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<td>-19</td>
<td>81</td>
<td>18</td>
<td>1.9</td>
<td>29</td>
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<tr>
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<td>$H_2$ as reducing agent</td>
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<tr>
<td>4</td>
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<td>17</td>
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<td>28</td>
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<tr>
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<td>$H_2$ as fuel</td>
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<td>5</td>
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<td>90</td>
<td>21</td>
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<td></td>
<td>$H_2$ as reducing agent &amp; $H_2$ as fuel &amp; O$_2$ as comburant</td>
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</table>
Key takeaways

→ H2 use cases investigations by mean of process modeling using SLB’s Symmetry processing simulation software supports

→ Validation of new alternatives for steel industry decarbonization

Keys metrics from the study

-50% CO₂ emitted → ~20 kWh/ton steel → ~80 kWh/ton steel → ~2 kg H₂/ton steel

For H₂ use as fuel → Heat Recovery → Electricity Needs → H₂ production
Learn more about SLB driving energy innovation for a balanced planet.

Learn more about Genvia new alternatives to decarbonize industry.

Thank you

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