VERBUND at a glance

~ 96 % production from renewable sources
approx. 3,000 employees

128 hydro power plants

Austria‘s leading electricity company

No. 1 in climate change mitigation among European power supply companies

approx. 450,000 residential customers –
market leader in the industrial customer segment

strategic focus on Austria and Germany

51 % owned by the Republic of Austria

Austria-wide charging infrastructure
for electric vehicles

first green bond in German-speaking Europe

large hydro power producer in Bavaria

energy related products and services

largest hydro power producer in Bavaria

more than 2,000 apprentices trained in the past 60 years

social responsibility: € 2.2 million support for „VERBUND-Stromhilfesfonds“ of Caritas since 2009

environmental measures -
€ 280 millions to be invested until 2027

environmental management – top-10-position of 160
energy companies analysed by oekom research

market leader in marketing of flexibility and
green electricity in Austria and Germany

quoted on the Vienna Stock Exchange with
excellent compliance culture

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VERBUND: More than Green Electricity from Austria

- 21 pumped storage plants (3,260 MW)
- 693 million m\(^3\) storage volume (1,800 GWh)
- Largest provider of grid and balancing services in Austria
Worldwide Steel Industry

Global annual steel production: **1.6 billion tons** in 2016 (**160 million tons** in 2016 in EU)

Specific CO₂ emissions: approx. **2 tons per ton of steel**

**Iron and steel industry** globally accounts for **30% of industrial CO₂ emissions**: 3 Gt/year

STEEL PRODUCTION TODAY:
**Blast furnace route** (grey, from iron ore)
or **electric arc furnace** (blue, from scrap)

IN THE FUTURE:
**Direct reduction route with green hydrogen**
Green Hydrogen

Iron and steelmaking: **Hydrogen** is in direct **competition with carbon and natural gas** as reducing agents.

Total **replacement of carbon** results in a significant increase in production costs:

- Blast furnace: 100% production costs
- Direct reduction with natural gas: 130% production costs (higher raw material costs)
- Direct reduction with green hydrogen: 180% production costs (higher raw material and energy costs)

Replacement of carbon by green hydrogen as reducing agent is the only realistic way to **fulfill the CO2 reduction targets in 2050**.

Hugh demand for **green electricity 24/7**.

Alt: \( \text{Fe}_3\text{O}_4 + 4\text{CO} \rightarrow 3\text{Fe} + 4\text{CO}_2 \)

Neu: \( \text{Fe}_3\text{O}_4 + 4\text{H}_2 \rightarrow 3\text{Fe} + 4\text{H}_2\text{O} \)

Source: http://www.nature.com/nclimate/journal/v6/n1/fig_tab/nclimate2870_F2.html
Scenario for Transformation: Decarbonisation of Steel Maker voestalpine Using Green Hydrogen
Installation & Operation of an Electrolysis System at the Steel Production Site in Linz, Austria

Key Data
• 6 MW PEM electrolyser
• Pilot plant commissioning end of 2018
• From 2019: 26-month pilot tests and demonstration

Source: voestalpine
H2FUTURE Objectives

• Design and installation of a 6 MW Siemens PEM electrolyser system at the voestalpine steel plant in Linz, Austria

• Industrial integration of renewable hydrogen production in the steelmaking process

• 26-month demonstration of the electrolyser system including grid services

• Long-term goal of replacing coal and coke by green hydrogen

• Project Budget: 18 million EUR

• Total Funding: 12 million EUR by FCH JU

• Project Duration: 4.5 years
EU Flagship Project

CEOs of voestalpine, Siemens and VERBUND and Executive Director of FCH JU

http://www.h2future-project.eu

- Large demand of green electricity 24/7
- Grid services with electrolyser: prequalification for ancillary services
- Revenues from electricity intraday and spot markets
- Currently green hydrogen route not cost-competitive
Hydrogen operated narrow gauge railway

- Worldwide first hydrogen operated narrow gauge railway in touristic region of Zillertal valley (www.zillertal.at)
- Green hydrogen supply from local hydroelectric power stations of VERBUND
- Extension to green hydrogen-powered coach and bus service (skiing resort) in evaluation
- Early business case for sector coupling using green hydrogen

Motto: „Trains operating on crystal clear water from the Zillertal valley“
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