

VERBUND at a glance

~ 96 % production from renewable sources

approx. 3,000 employees

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

128 hydro power plants

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

Austria's leading electricity company

strategic focus on Austria and Germany

first green bond in German-speaking Europe

51 % owned by the Republic of Austria

largest hydro power producer in Bavaria

**Austria-wide charging infrastructure
for electric vehicles**

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

energy related products and services

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

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

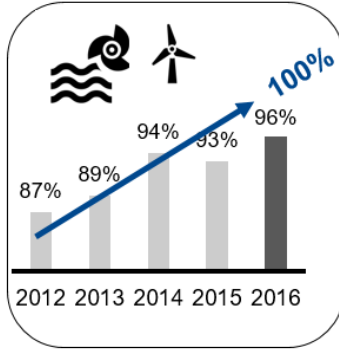
environmental measures -
€ 280 millions to be invested until 2027

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

**quoted on the Vienna Stock Exchange with
excellent compliance culture**

VERBUND: More than Green Electricity from Austria

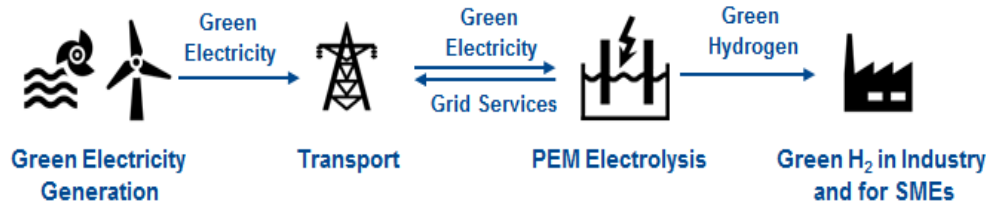
Green Electricity



- **21 pumped storage plants** (3,260 MW)
- **693 million m³ storage volume** (1,800 GWh)

- **Largest provider of grid and balancing services** in Austria

Green Hydrogen



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**

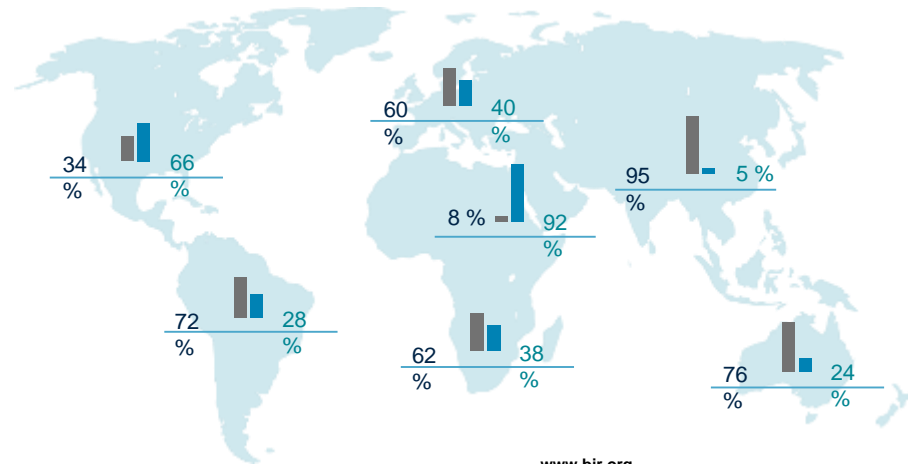
Iron and steel industry globally accounts for **30% of industrial CO₂ emissions: 3 Gt/year**

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



www.bir.org

Green Hydrogen

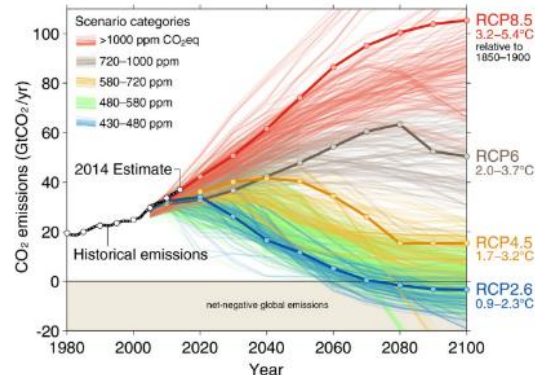
Iron and steelmaking: **Hydrogen** is in direct **competition with carbon and natural gas** as reducing agents.

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)

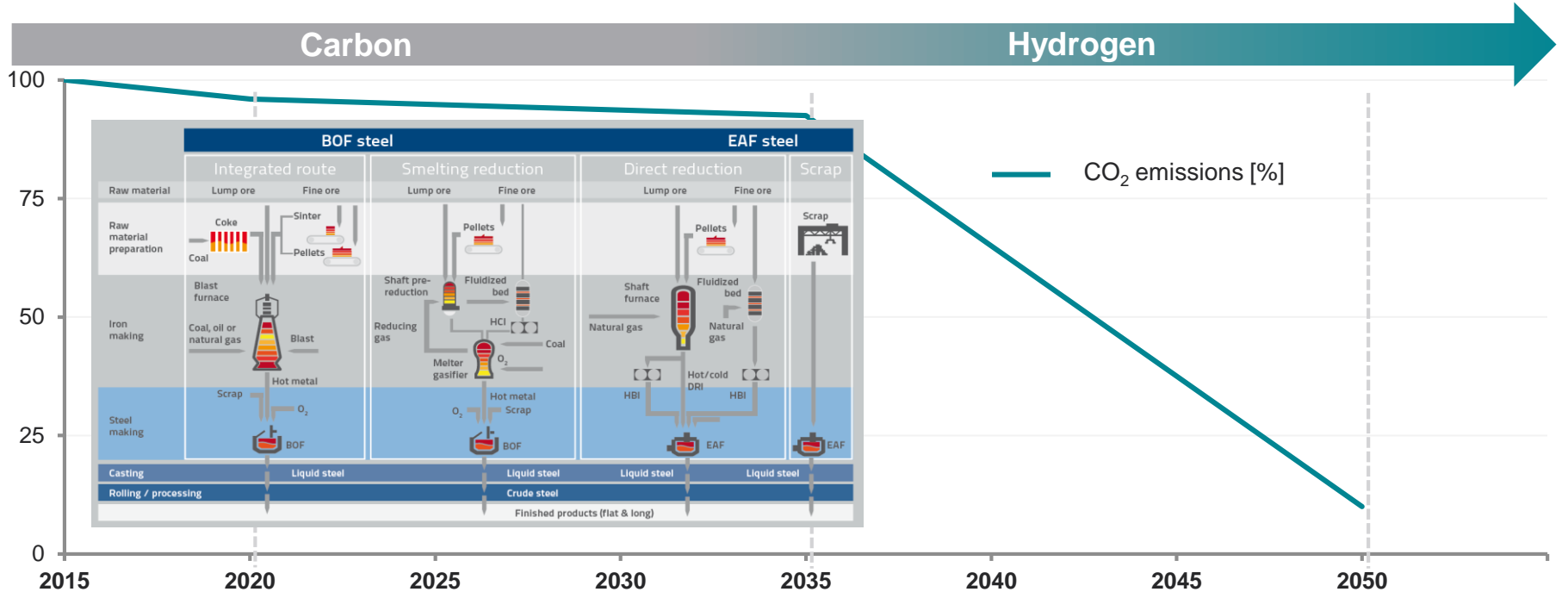
Replacement of carbon by green hydrogen as reducing agent is the only realistic way to **fulfill the CO2 reduction targets in 2050**.

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



Source: http://www.nature.com/nclimate/journal/v6/n1/fig_tab/nclimate2870_F2.html

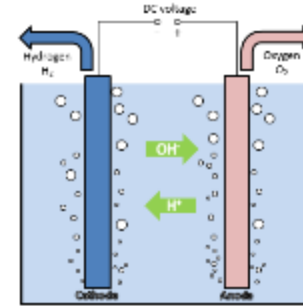
Scenario for Transformation: Decarbonisation of Steel Maker voestalpine Using Green Hydrogen



Installation & Operation of an Electrolysis System at the Steel Production Site in Linz, Austria



Source: voestalpine



Key Data

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



H2FUTURE

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

Verbund

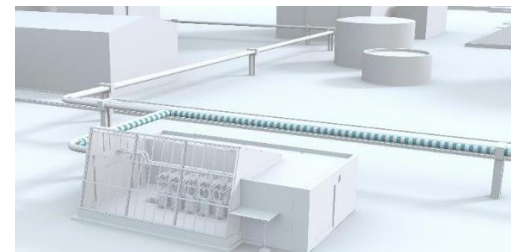
voestalpine
ONE STEP AHEAD.

SIEMENS

ICMET
metallurgical competence center

APG
AUSTRALIAN POWER GRID

ECN





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

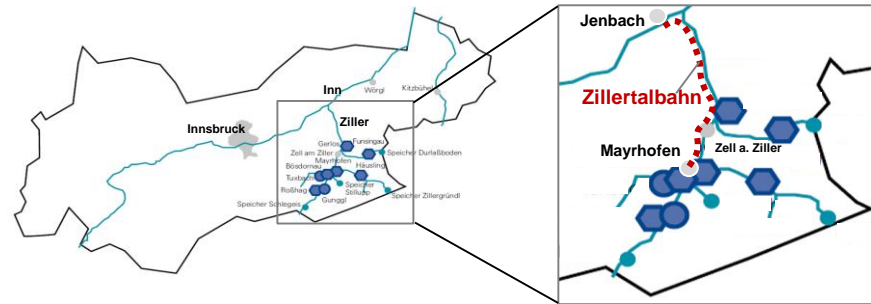
Hydrogen operated narrow gauge railway



Source: ZVB

- 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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