



H2FUTURE
Green Hydrogen



H2FUTURE

Green Hydrogen for the Steel Industry

Robert Paulnsteiner
EUSEW Extended Program, Clean Steel with Hydrogen
October 18th, 2021

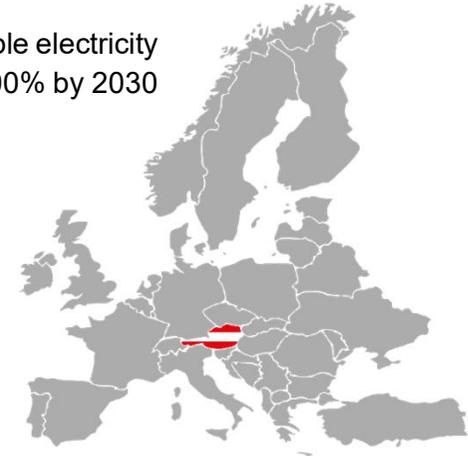
VERBUND



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735503. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY

Verbund VERBUND at a Glance

Austria: 70% renewable electricity
100% by 2030



~ 96% production from renewable sources

128 hydro power plants – 8,500 MW

Austria's leading electricity company

1,800 GWh of pumped storage

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

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

First green bond in German-speaking Europe

Environmental management – ranked in the top 10 out
of 160 energy companies analysed by oekom research

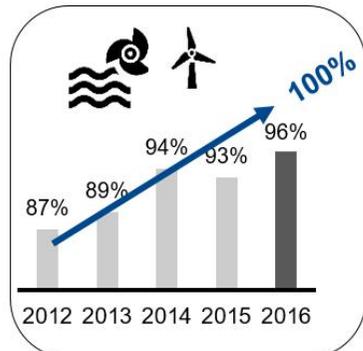
Environmental measures –
€280 million to be invested by 2027

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

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From Green Electricity to Green Hydrogen

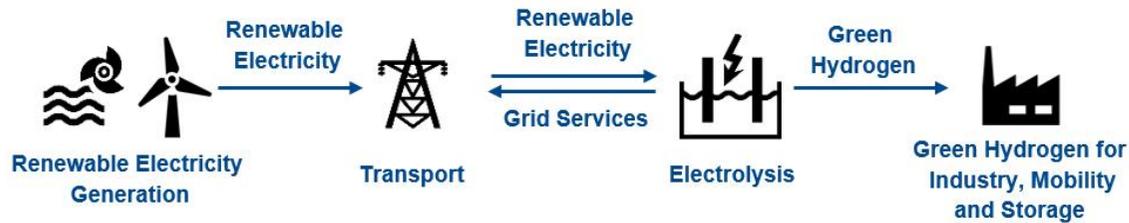
Green Electricity



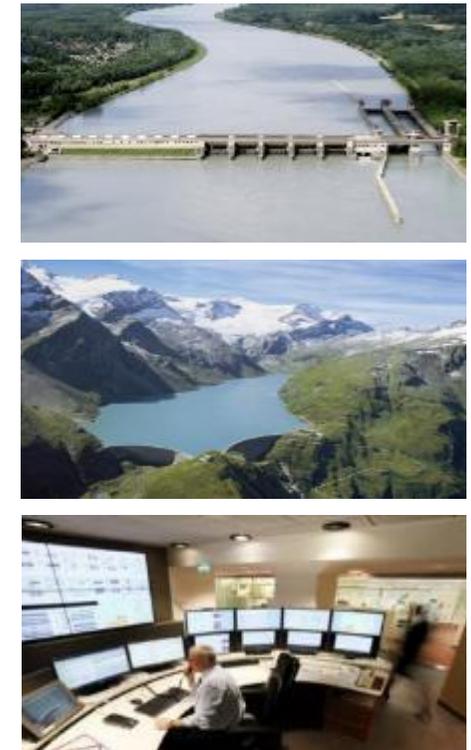
- 21 pumped storage plants (3,260 MW)
- 693 million m³ storage volume (1,800 GWh)

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

Green Hydrogen



VERBUND intends to expand its value chain and establish green hydrogen as a second energy carrier next to green electricity





H2FUTURE – Project Goals

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- **Design and installation of a 6 MW Siemens PEM electrolyser system** at the voestalpine steel plant in Linz, Austria
- **Two-year demonstration** of the electrolyser system, including grid services by VERBUND and ambitious efficiency target



EUSEW Extended Program, Clean Steel with Hydrogen



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

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voestalpine
ONE STEP AHEAD

SIEMENS

IMET
metallurgical competence center

APG
AUSTRIAN POWER GRID

TNO
innovation
for life

- ❑ Project budget: €18 million
- ❑ Total funding: €12 million from FCH JU
- ❑ Project duration: 4.5 (5) years

October 18th, 2021, Robert Paulnsteiner **Verbund**



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



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



Key Data:

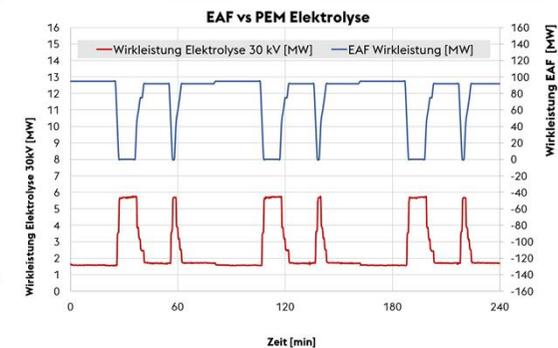
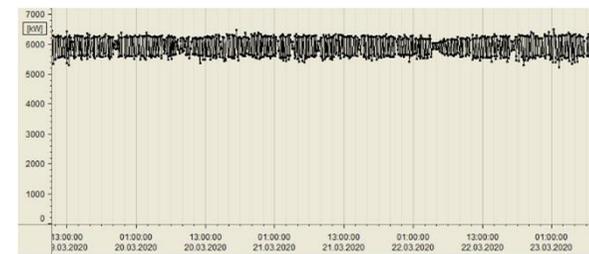
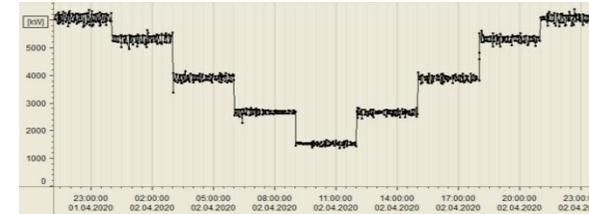
- 6 MW PEM-Electrolyzer from Siemens
- Commissioning of the pilot plant in Nov 2019
- Ongoing pilot- and demonstration operation
- Up to 1.200 Nm³/h H₂ for steel production and ancillary services to the electrical grid



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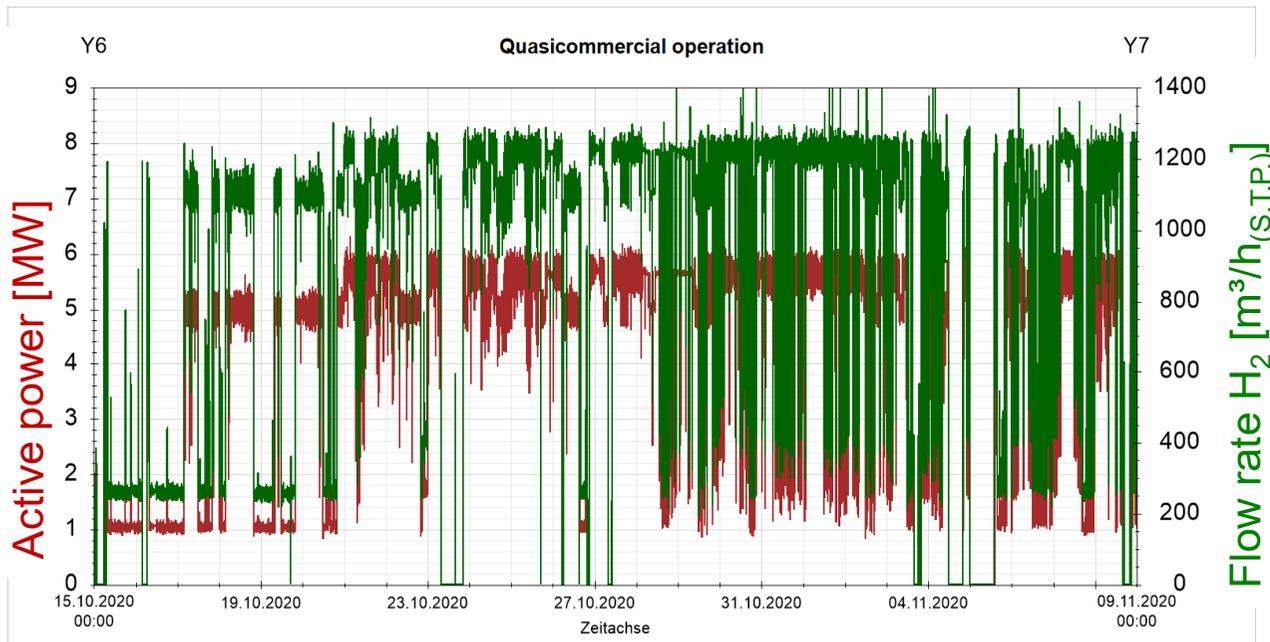
Demonstration operation

- Start of pilot test phase on March 12th, 2020
- ✓ • Use Case 1: **Stress test** – Partial load behavior of the system
- ✓ • Use Case 2: **Continuous operation 24/7** – Full load behavior
- ✓ • Use Case 3: **Balancing services** – Participation balancing market
 - Use Case 4 - **Integration into future steel site** – Following of load profile
- ✓ • Use Case 5 - **Integration into current steel site** – Balancing of load fluctuation
- **Quasi-commercial operation** since October 15th, 2020 (until end of 2021)
- **Final 1-month continuous operation 24/7**



Quasi-commercial Operation

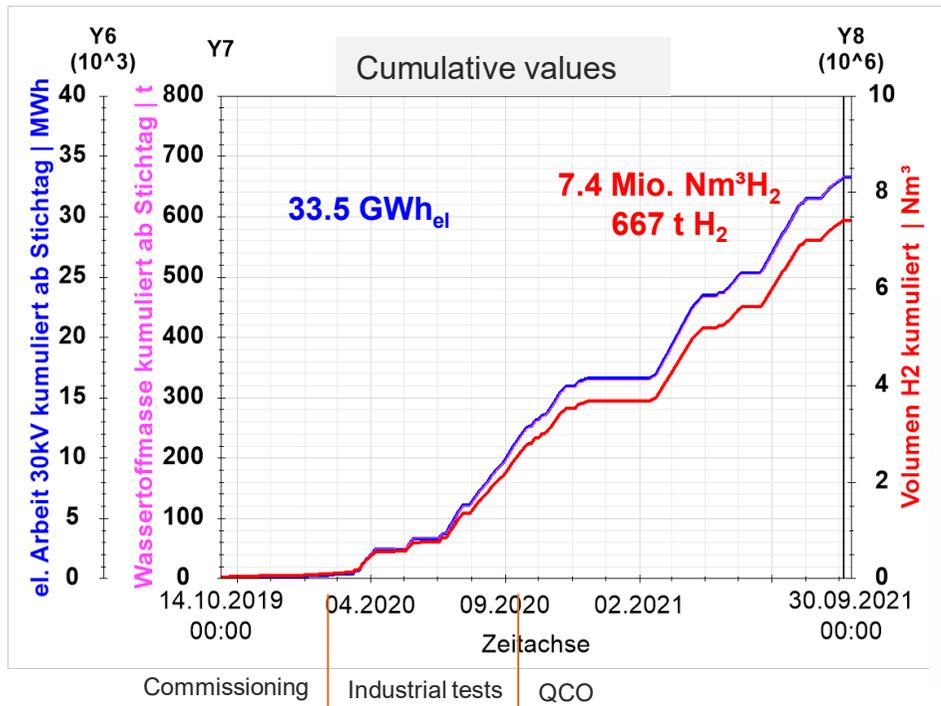
Using price options at the electricity market



- Optimization of production costs
- providing primary and secondary grid services
- intraday trading
- Leading to heavily fluctuating production

H2FUTURE – PEM electrolysis

Operational data



© Siemens AG



- » cells 600 (12 x 50)
- » membrane 0,5 m²/cell
- » cell voltage < 2 V
- » pressure ~100 mbar
- » purity ~ 99,9 Vol.% H₂



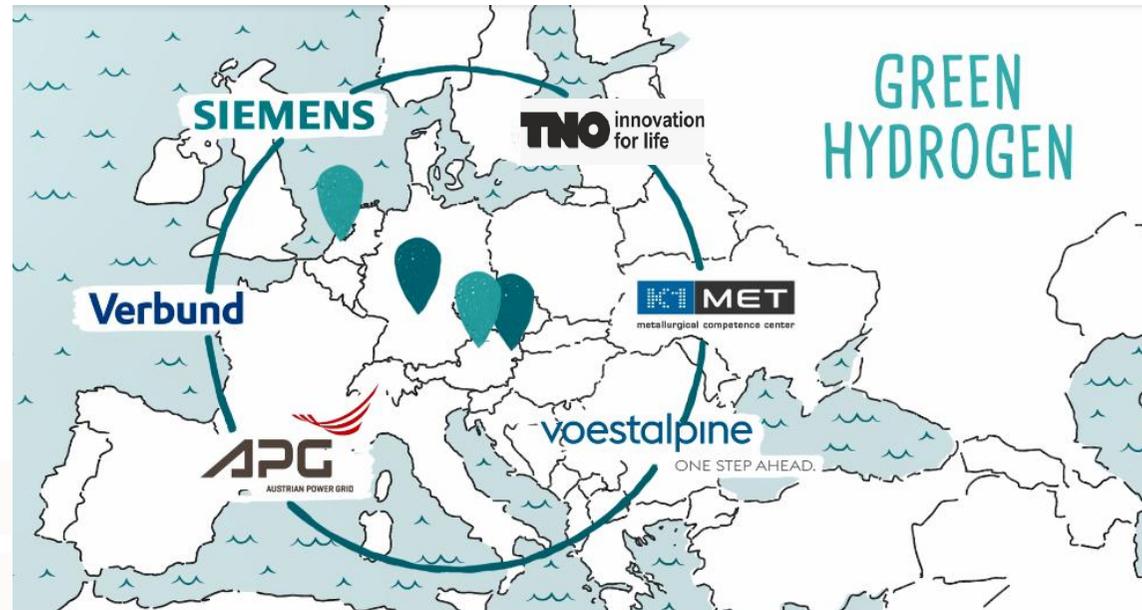
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Conclusion



- Stable plant operation between 1,5 MW and 6 MW (9 MW)
- High quality hydrogen directly from the PEM-Electrolyzer
 - No additional chemicals
 - H₂-purity ~99,8%
 - O₂-purity: ~99,0%
- High efficient process
 - Plant efficiency ~75%
 - Efficiency at stack up to 83%
- Flexible process that can meet load change requirements
 - Prequalified → Participation in all balancing energy markets
 - Large steps in load changes possible





<http://www.h2future-project.eu>

Verbund IPCEI - Green Hydrogen @ Blue Danube

Project Concept



Produce **green hydrogen on a large scale off-grid in South-East Europe** using wind, hydro and solar energy (2 GW renewables, 1.5 GW electrolyzers)



Transport hydrogen via the River Danube to hydrogen users in countries of the **Interreg Danube Transnational region** by ship



Set up the necessary hydrogen infrastructure for the use of 80.000 t H₂ annually in the participating member states along the Trans-European Transport Network (TEN-T) core corridors



Verbund

Kontakt

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