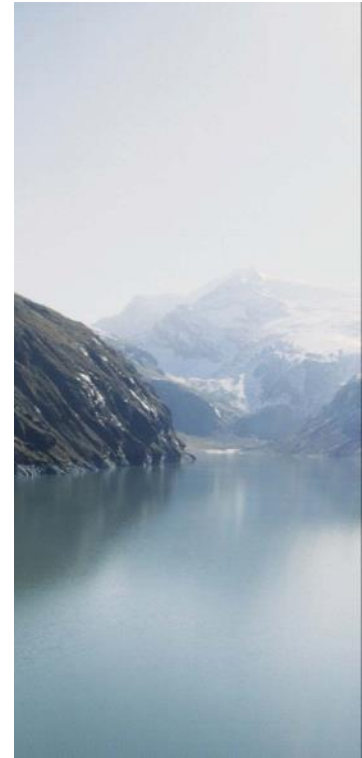


Innovative Use of Clean Hydrogen in an Industrial Application

The H₂FUTURE Project and the Role of Utilities

Rudolf Zauner, VERBUND

27/04/2017



VERBUND at a glance: Largest Electricity Utility in Austria



96% production from renewable energy sources

128 hydropower plants

First green bond in
German-speaking Europe

3,000 employees

Austria's leading electricity company

Strategic focus on
Austria and Germany

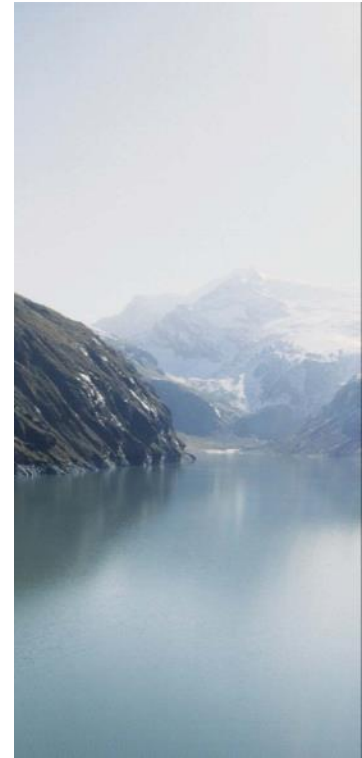
**No. 1 in fighting climate change
among European power supply
companies**

**51% owned by the
Republic of Austria**

**Dual carrier utility: Green electricity
and green hydrogen**

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

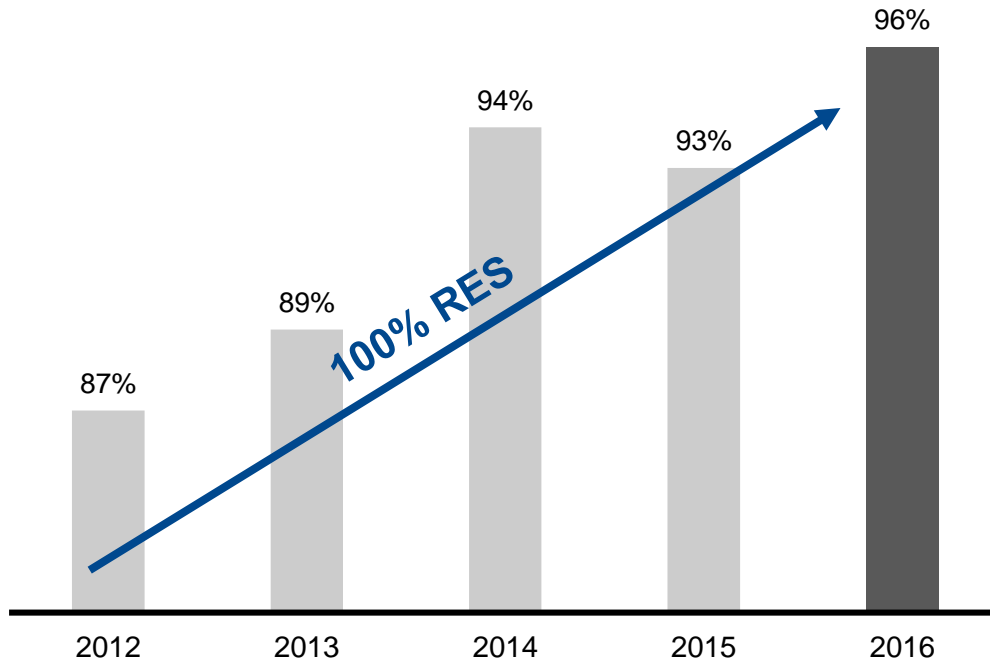
Environmental management – top 10
position of 160 energy companies analysed
by oekom research



VERBUND: Towards 100% renewables



**Green hydrogen from green electricity:
VERBUND aims to increase its RES generation share to 100% by 2020**



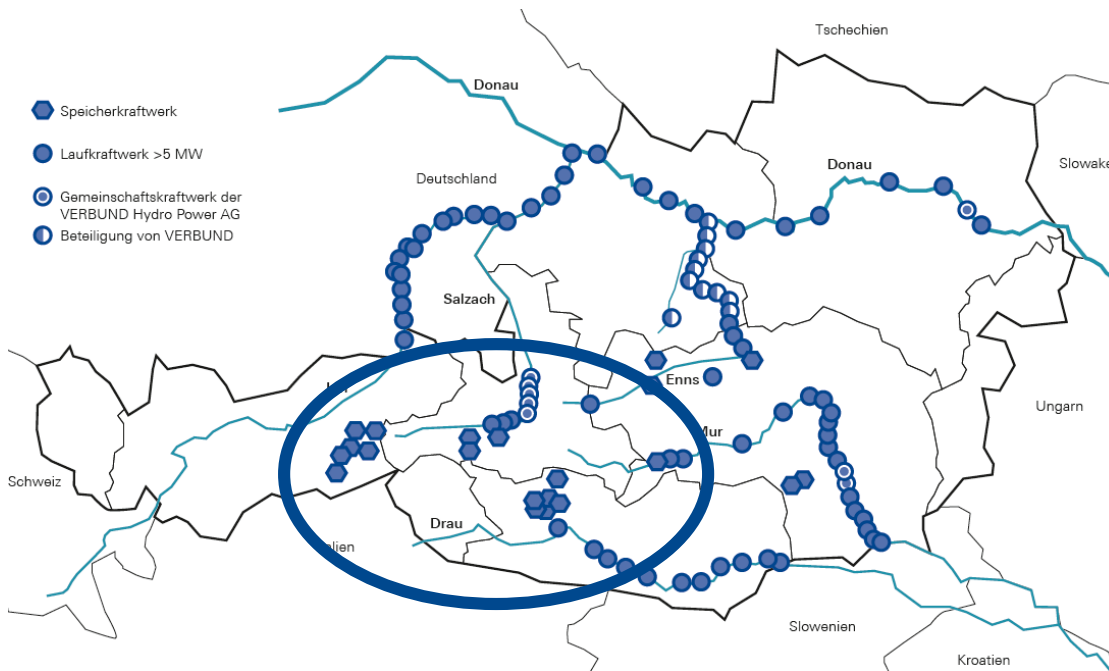
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VERBUND: Storage capacity



Getting a grip on the volatility of renewables: pumped storage

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

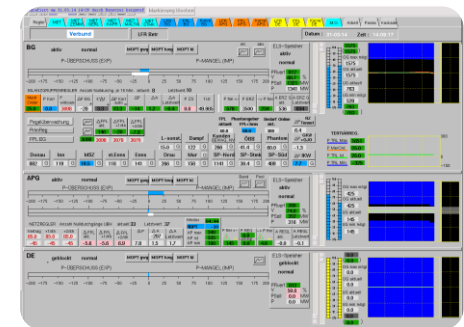
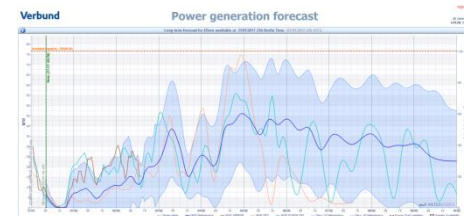


VERBUND: Electricity forecasting, trading and optimisation



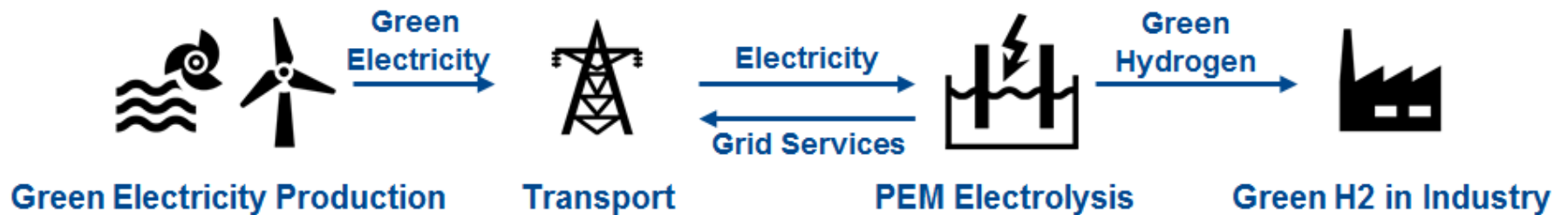
**Trading on a European scale:
12 countries – 24/7 – >100 TWh per year**

- Trading on European energy stock exchanges and OTC
 - Spot markets, intraday markets and forwards/futures
- Primary, secondary and tertiary reserve markets
- Pooling power capacity in a virtual power plant
- Advanced forecasting and optimisation models for renewable energy production (hydro, wind, solar)
- Operation and dispatch of more than 120 hydropower and wind plants in Europe
- Optimisation of revenues through peak shaving, power price opportunities and demand side management



Verbund

Hydrogen@VERBUND



**VERBUND is on the way to becoming a dual carrier utility:
supplying GREEN ELECTRICITY and GREEN HYDROGEN**



H2FUTURE
Green Hydrogen



H2FUTURE – Green Hydrogen for the Industry

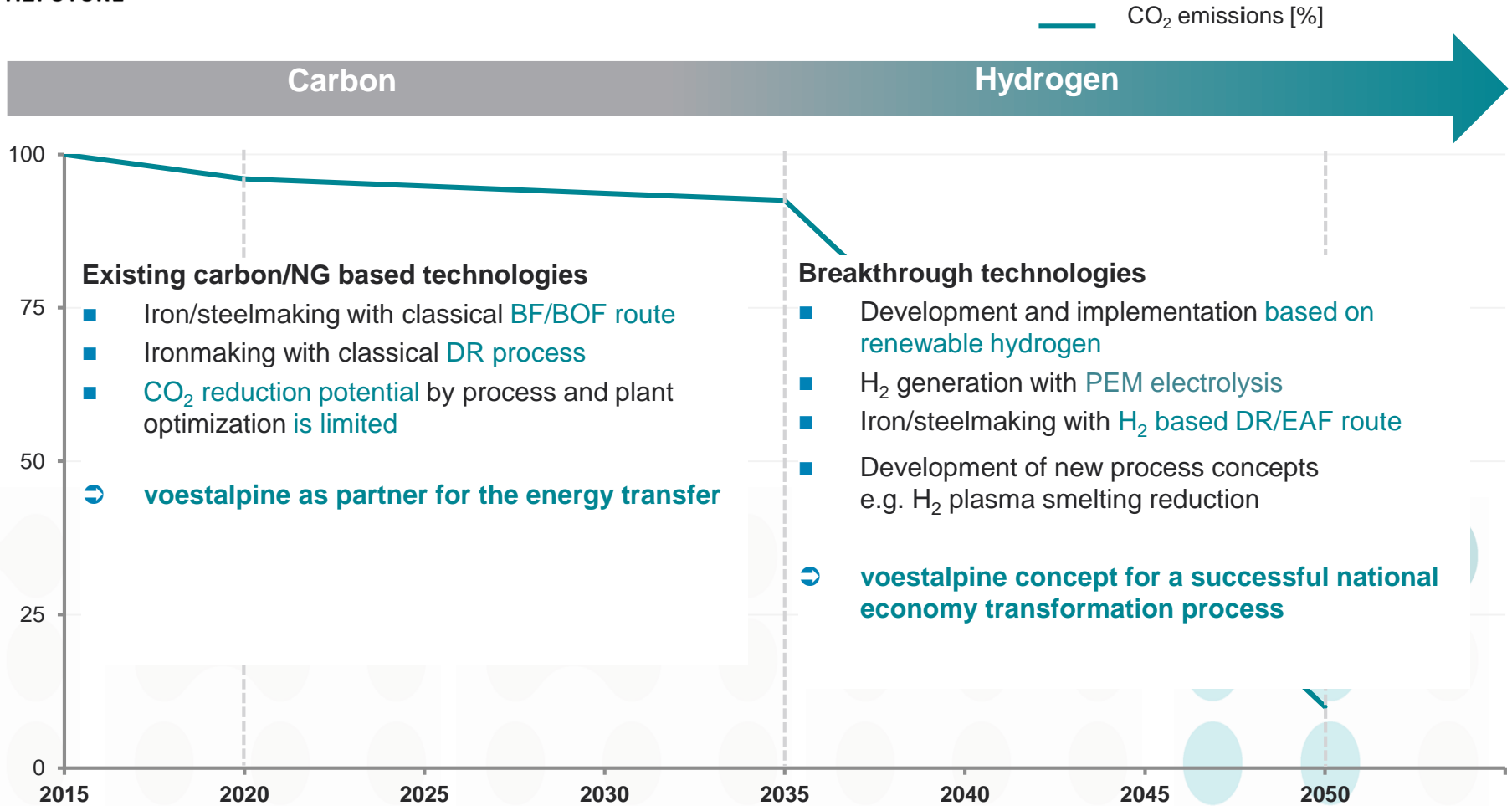


This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 735503. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY



H2FUTURE

Transformation: Decarbonisation of Steel Maker voestalpine



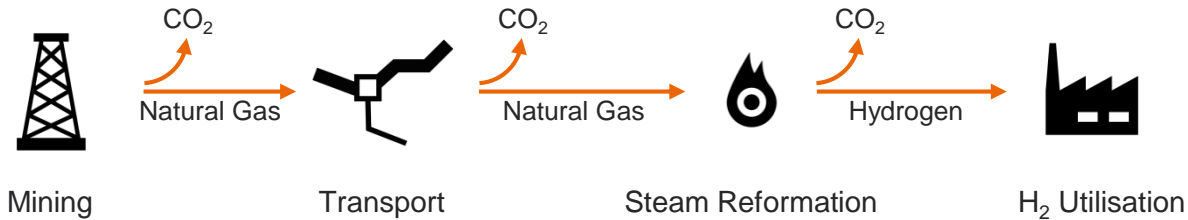
Preconditions: energy, raw materials, global competition, ...



H2FUTURE

Project Idea

TODAY: **Hydrogen is produced via steam reformation** from fossil fuels, mostly from natural gas. This leads to **substantial CO₂ emissions**.



IN THE FUTURE: **Water electrolysis via electricity** from renewable energy sources will be the main source of **green hydrogen** with a minimal CO₂ footprint.





H2FUTURE

Project Overview

- Project Partners:
 - VERBUND (project coordinator)
 - voestalpine Stahl
 - Siemens
 - K1-Met
 - Austrian Power Grid (APG)
 - Energy research centre of the Netherlands (ECN)

- Project Budget: **€17,823,264**
- Total Funding: **€11,997,659** (almost 70% funding rate)
- Project Duration: 4.5 years, starting 1st January 2017

Verbund
voestalpine

SIEMENS





H2FUTURE

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



Source: voestalpine

Key Data

- 6 MW PEM electrolyser
- Pilot plant commissioning: end of 2018
- From 2019: 26-month demonstration and quasi-commercial operation



Source: Siemens, PEM electrolyser



H2FUTURE

Project 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
 - Stress tests
 - Prequalification for power reserve markets (primary, secondary and tertiary control)
 - Integration of the electrolyser system into the steelworks operation
 - Commercial operation on the power reserve and spot markets
 - Quasi-commercial operation with revenue streams from both hydrogen and power
- **Accompanying analysis** of roll-out impact in the steel and fertilizer industries
- **Continued operation of the electrolyser** after the end of the project



H2FUTURE



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

Wind Energy and Hydrogen



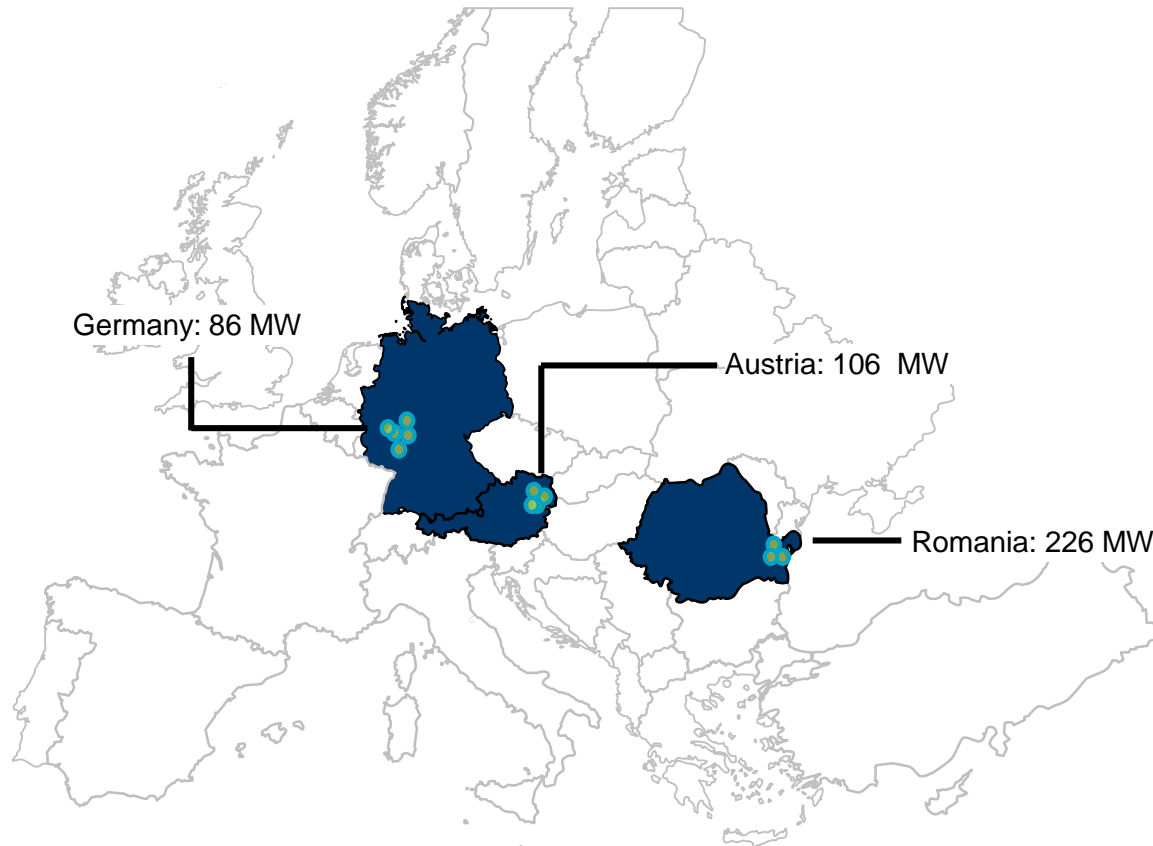
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Source: Siemens, PEM electrolyser

Sectoral integration

VERBUND Wind Energy Portfolio



153 turbines / 418 MW / 1 TWh

Wind Energy in Austria: The Situation

- The **feed-in tariff** for wind energy in Austria is granted **for only 13 years** (around €90 to €97/MWh)
- The current energy price (EEX) is around **€30/MWh**
- With the balance energy deducted, the revenue of wind operators from selling their energy on the market comes to around **€25/MWh**
- The **generation costs** for wind farms are between **€20 and €35/MWh (+financing costs)**
- Some wind operators are on the brink of bankruptcy
- Obtaining permission for repowering is often difficult and very restricted
- Wind turbines are taken **out of operation** early in their lifecycle
- Wind turbines could become “rusting industrial landmarks” with negative publicity
- Doubts about the government’s wind energy subsidy scheme may arise



Wind Energy and Hydrogen in Austria: An Idea

- **Installation of hydrogen electrolyzers in wind farms** (within the wind farm electricity grid) after the feed-in tariff ends
- Remaining operating period of wind farms: approx. **10 years** (equals lifetime of an electrolyser)
- Electricity costs are low (**about €25/MWh** (15% deduction of balancing costs) for the lowest 4,000 hours per year)
- This would be **sector coupling and sectoral integration par excellence**:
 - The grid will be de-congested.
 - The hydrogen produced will be unequivocally green.
 - There will be additional revenues from green hydrogen.
 - Optional utilisation of nearby natural gas pipelines for feed-in of H₂.
- **Incentive for green hydrogen** still necessary (tender, investment incentive, GoO or other)
- **Next step: Discussions with the Ministries** to accelerate sectoral integration using green hydrogen
- **Next step: Discussions with clearing agency and regulators** (gas and electricity) on certification of green hydrogen

Involvement in Hydrogen Europe

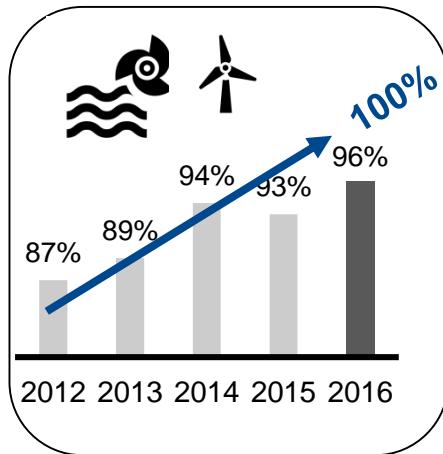


- Recently elected **Board member from VERBUND**
- Head of VERBUND's EU office in Brussels
- **Active role in Eurelectric** and experience in other Brussels-based associations
- **Interface of regulation** between gas and electricity sector crucial: sectoral integration
- Definition of **strategic policy priorities** and dealing with regulatory and advocacy issues
- **Hand-over of a position paper** on accounting for green hydrogen in refineries to EU Commissioner Sefcovic at the Hannover Fair this week



Hydrogen@VERBUND → on its way to a dual-carrier utility

Green Electricity

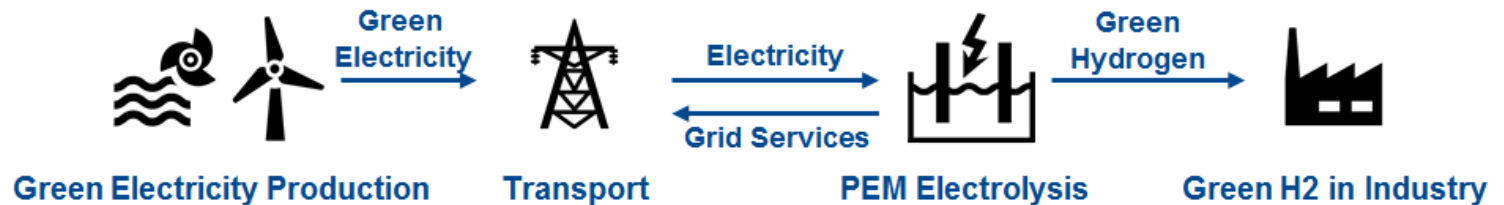


- **21 pumped storage plants** (3,260 MW)
- **693 million m³ storage volume** (1,800 GWh)



- **Trading** in 12 countries (24/7), electricity / gas → 100 TWh per year

Green Hydrogen



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