Erneuerbare Energie trifft auf klimaneutrale Stahlproduktion

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K1-MET GmbH

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Coordinated by

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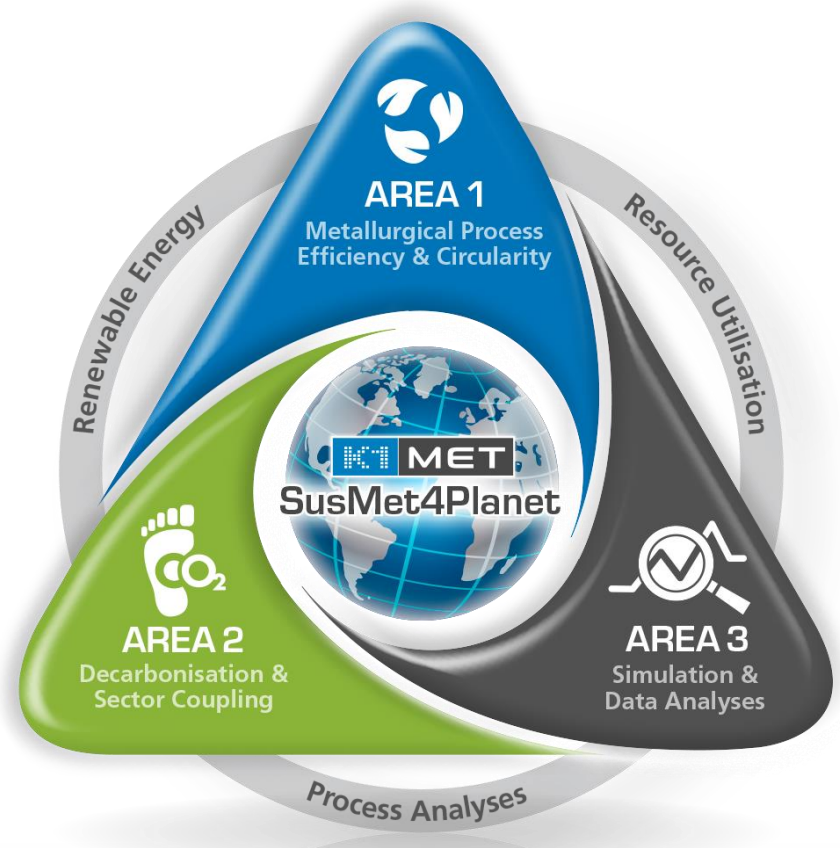
K1-MET overview

SusMet4Planet

Sustainable digitalized Metallurgy for a climate neutral and resource efficient Planet



K1-MET addresses the challenges of the metallurgical industry in staying competitive and reaching climate neutrality

Area 1: Metallurgical Process Efficiency & Circularity

- Enhancement of process efficiency and product quality through analytics and treatment of raw and secondary materials

Area 2: Decarbonisation & Sector Coupling

- Solutions for CO_2-lean metallurgical processes and metallurgy as a source of CO_2 for energy-intensive industries (sector coupling)

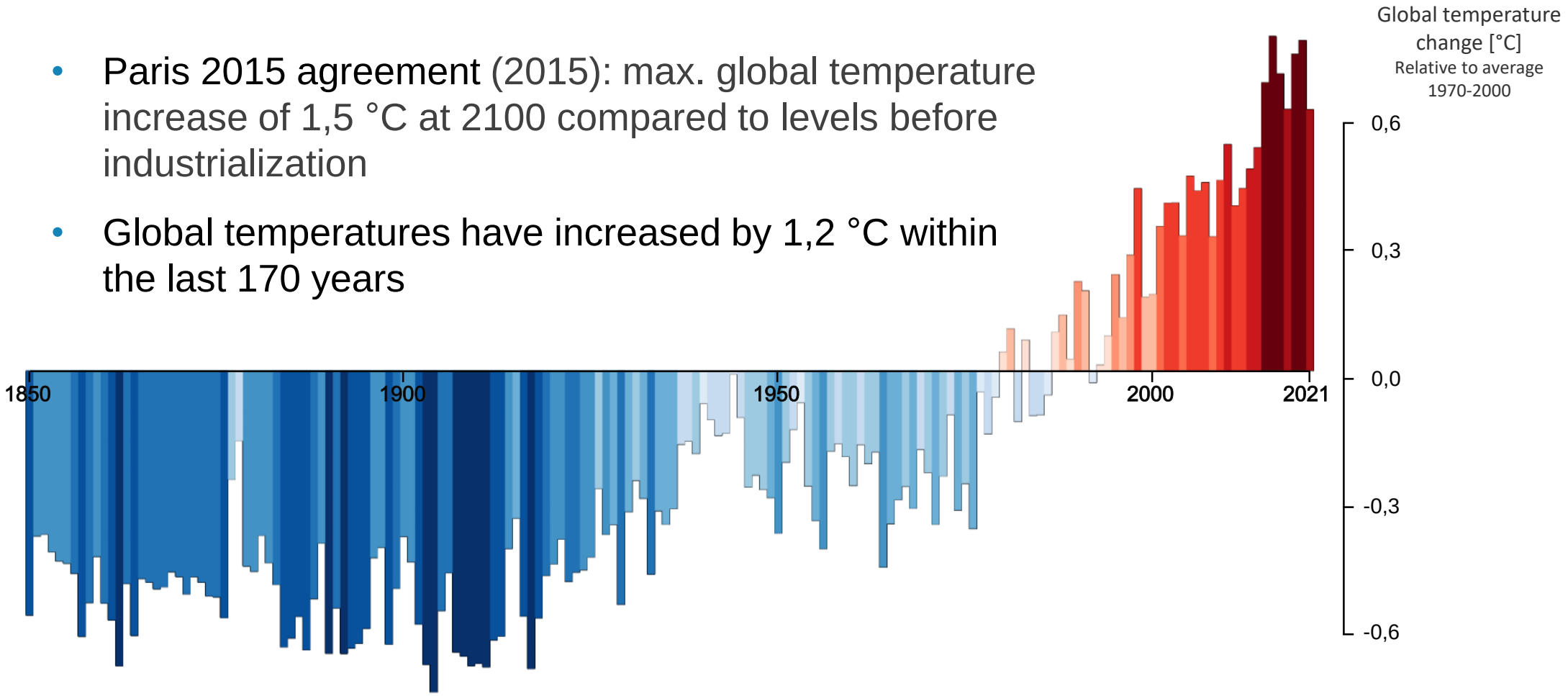
Area 3: Simulation & Data Analyses

- Application of modelling approaches to new processes and data analysis for an increase of process efficiency

Climate goals

Global temperature increase

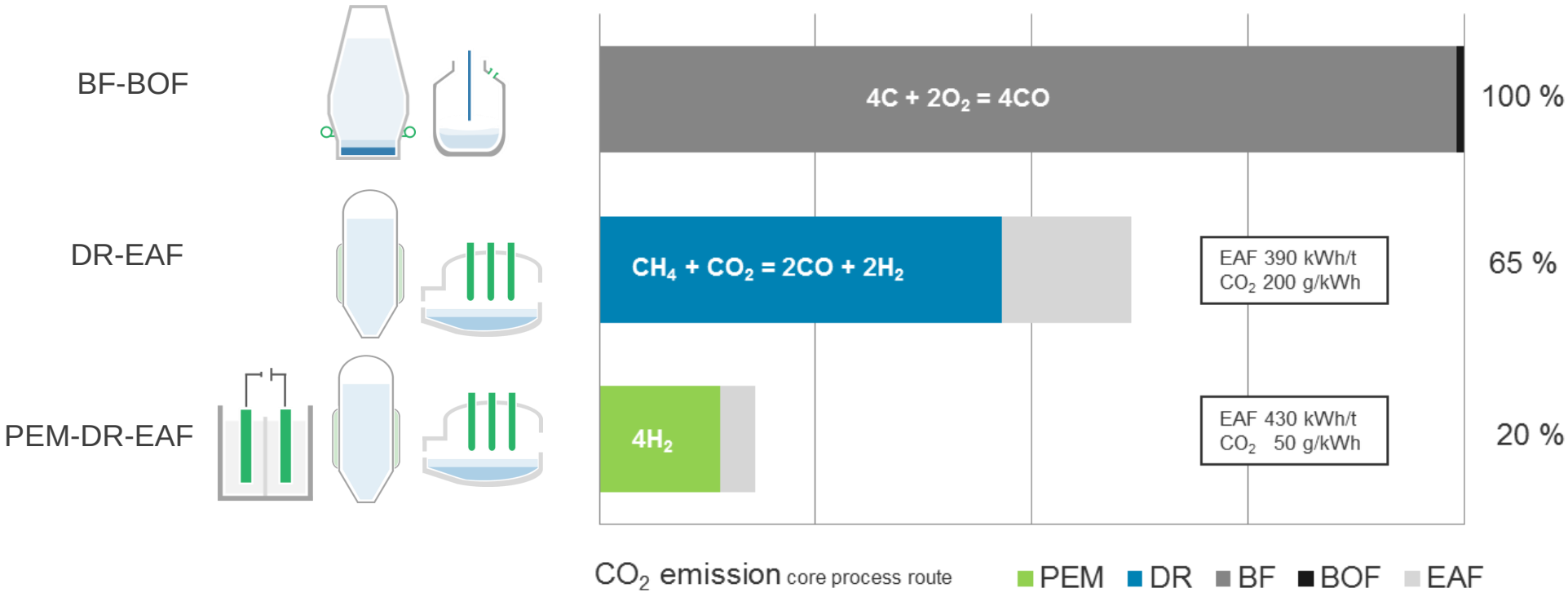
- Paris 2015 agreement (2015): max. global temperature increase of 1,5 °C at 2100 compared to levels before industrialization
- Global temperatures have increased by 1,2 °C within the last 170 years



https://showyourstripes.info/
Professor Ed Hawkins (University of Reading)

Roadmap to CO_2 neutral steelmaking

C, NG, and H_2 in steel production



- Origin and availability of electric energy are essential for renewable H_2 production and use in the DR-EAF route

Breakthrough technology

Process development HYFOR – Hydrogen based Fine Ore Reduction

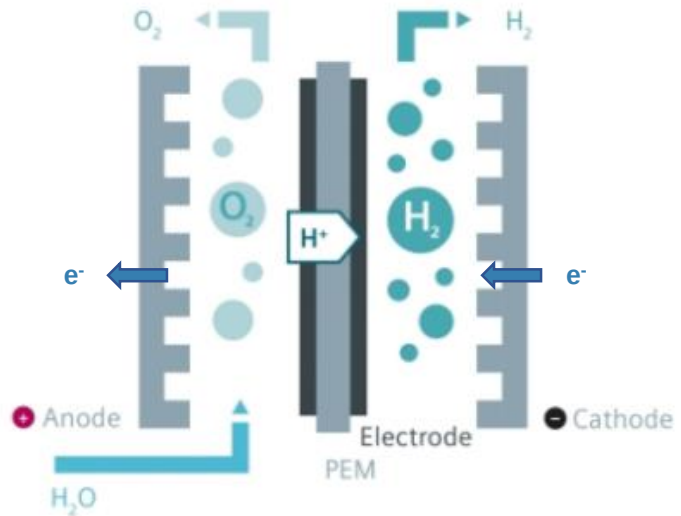
- Reduction process for iron ore concentrates in fluidized state with grain size up to 0,15 mm
- H_2 as reducing agent for a maxium reduction of CO_2 emission in iron and steelmaking
- Development of a breakthrough technology with a demo plant at voestalpine Donawitz side
- Batch operation with 800 kg iron ore concentrate to produce sponge iron
- Creating design parameters for a further upscaling and continuous operation

Sustainable H_2 production for steel industry

European flagship project H2Future

One of the biggest proton exchange membrane (PEM) electrolyser units in the world with 6 MW power and 1,200 m^3/h H_2 production at voestalpine Stahl Linz site for full scale demonstration of H_2 production and grid balancing

- Ambitious efficiency target at nominal power
- W_{el} = 48 - 51 kWh/kg
- η_{System} = 82% - 77%
- To demonstrate a CAPEX of <1,000 €/kW for the PEM technology



PEM reactions

Anode: $H_2O = 2H^+ + 0{,}5O_2 + 2e^-$

Cathode: $2H^+ + 2e^- = H_2$

Project Budget: 17.8M€

Total EU Funding: 12.0M€ (70% funding)

Project Duration: 5 years (2017-2021)

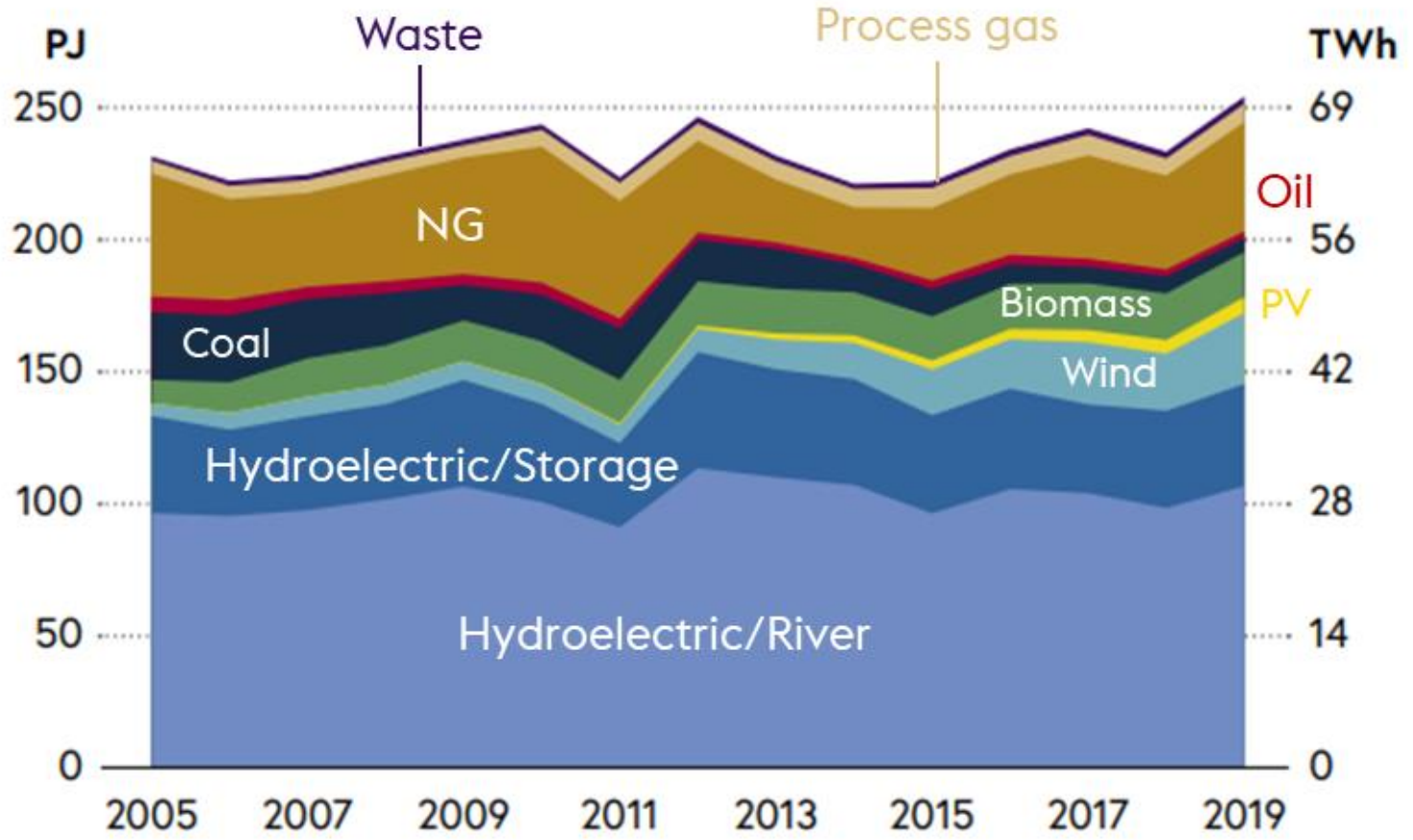
Sustainable H_2 production for steel industry

PEM demonstration plant

- Stable operation tested from 1.5 MW to 9.0 MW
- Dynamic response suitable for all kind of grid services
- Stack efficiency up to 83% at rated load
- H_2 purity ~99.9%, O_2 purity ~99.0%

Replacement of fossil energy

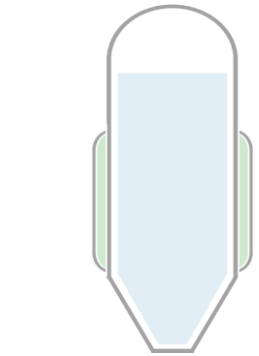
Electrified steelmaking



https://www.bmk.gv.at/themen/energie/publikationen/

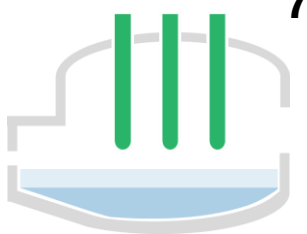
renewable | fossil

Electric energy demand for 7,5 Mt steel/a = 33 TWh_{el}



21 TWh_{el}
H_2 DRI

DRI/Scrap 75/25

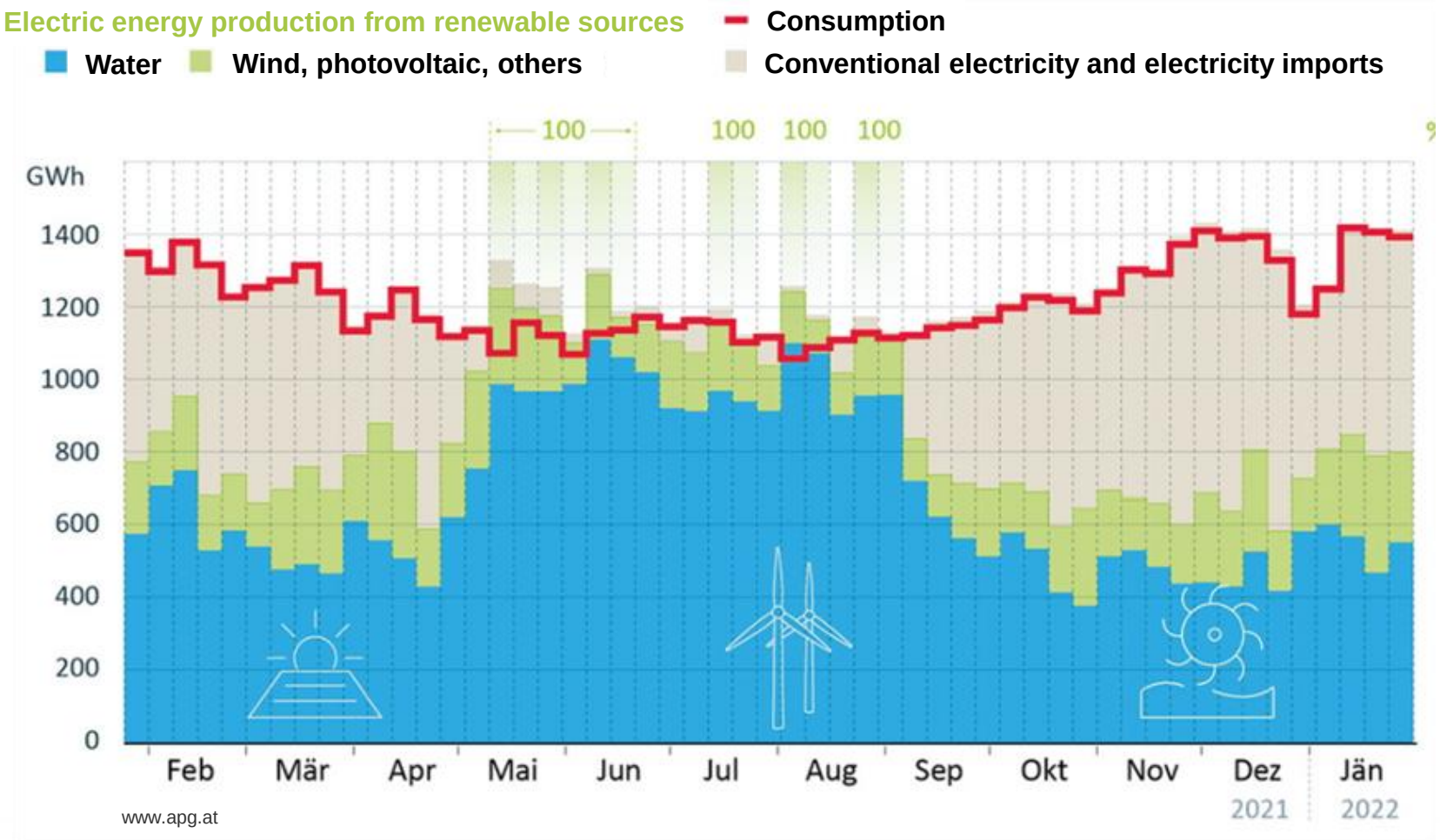


3 TWh_{el}
EAF

9 TWh_{el}
Downstream processes

Energy system Austria 2021

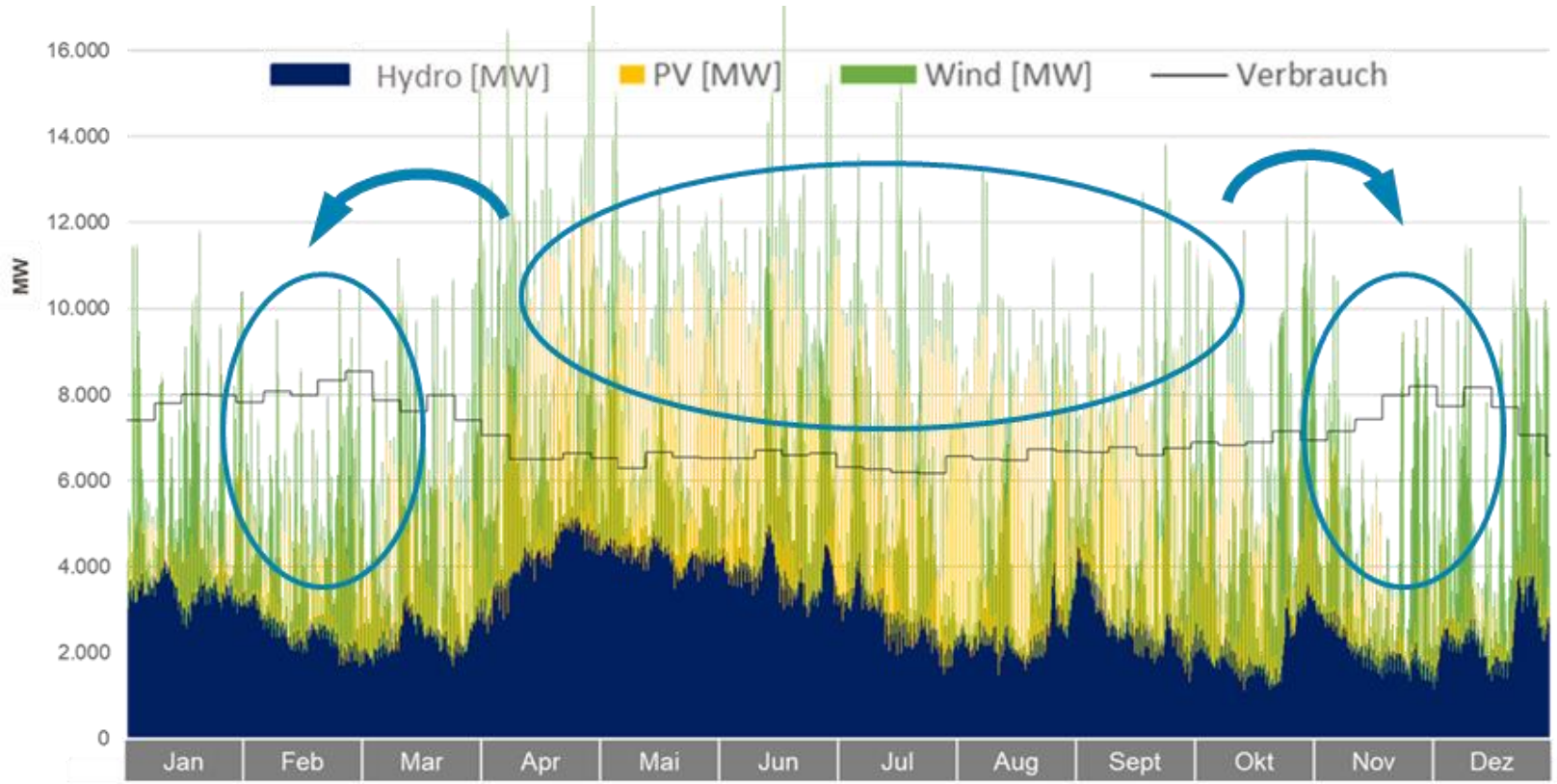
Electric energy production



- Renewable electric energy can fully cover the electricity demand from May to August
- Approximately 20 TWh renewable electric energy necessary for 100% supply in 2021
- Austrian government program 2020: 100% renewable electric energy in 2030, climate neutrality in 2040

Energy system Austria 2030

100 % renewable electricity



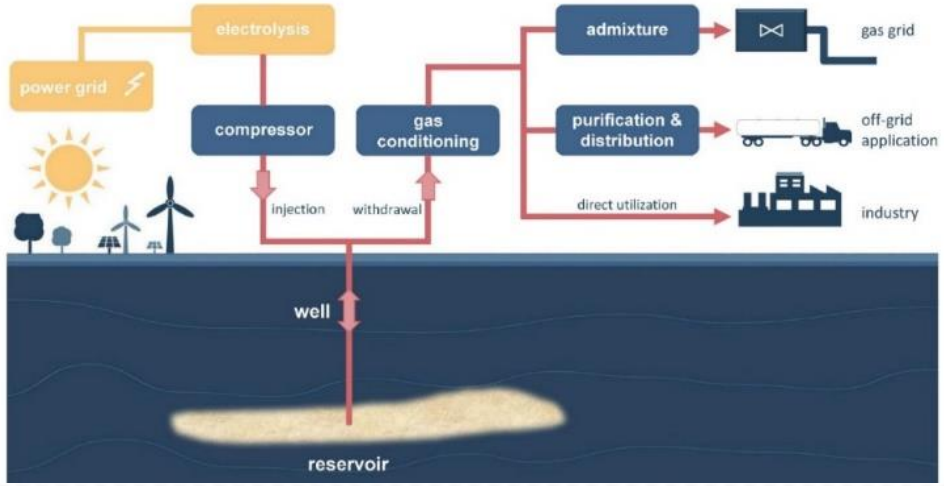
Christiner, G., Die zentrale Bedeutung der Netze beim Umbau des Energiesystems. Presentation at the Renewable Energy conference, Klagenfurt (Austria), 2017

- Additional 27 TWh of new renewable electric energy generation capacities with high seasonal fluctuation in 2030
- 100% renewable sources creates approximately 10 TWh excess energy over 6 months in summer period
- Sector coupling as key for stabilising the renewable energy system and chemical storage for the demand in the winter period

Tranformation scenario
Hydrogen and carbon management

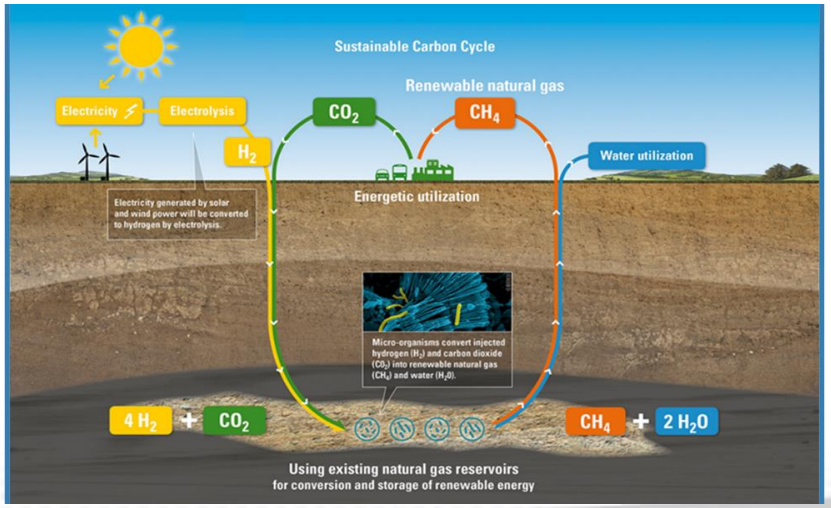
Underground Sun Storage 2030

- Demonstration of hydrogen storage/discharge in depleted natural gas reservoirs, H_2 supply for different sectors
- Inter-seasonal storage and balancing of renewable energies
- WIVA Flagship Project



Carbon Cycle Economy Demonstration

- Demonstration of various CO_2 capture and CO_2 utilization technologies
- Injection of CO_2 from a steelplant and green H_2 from an electrolyser with CH_4 formation by geomethanation
- WIVA Flagship Project



Thank you! Questions??

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