

Sector Coupling using Hydrogen

February 2023

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WASSERSTOFF IST UNSER ANTRIEB
HYDROGEN DRIVES US



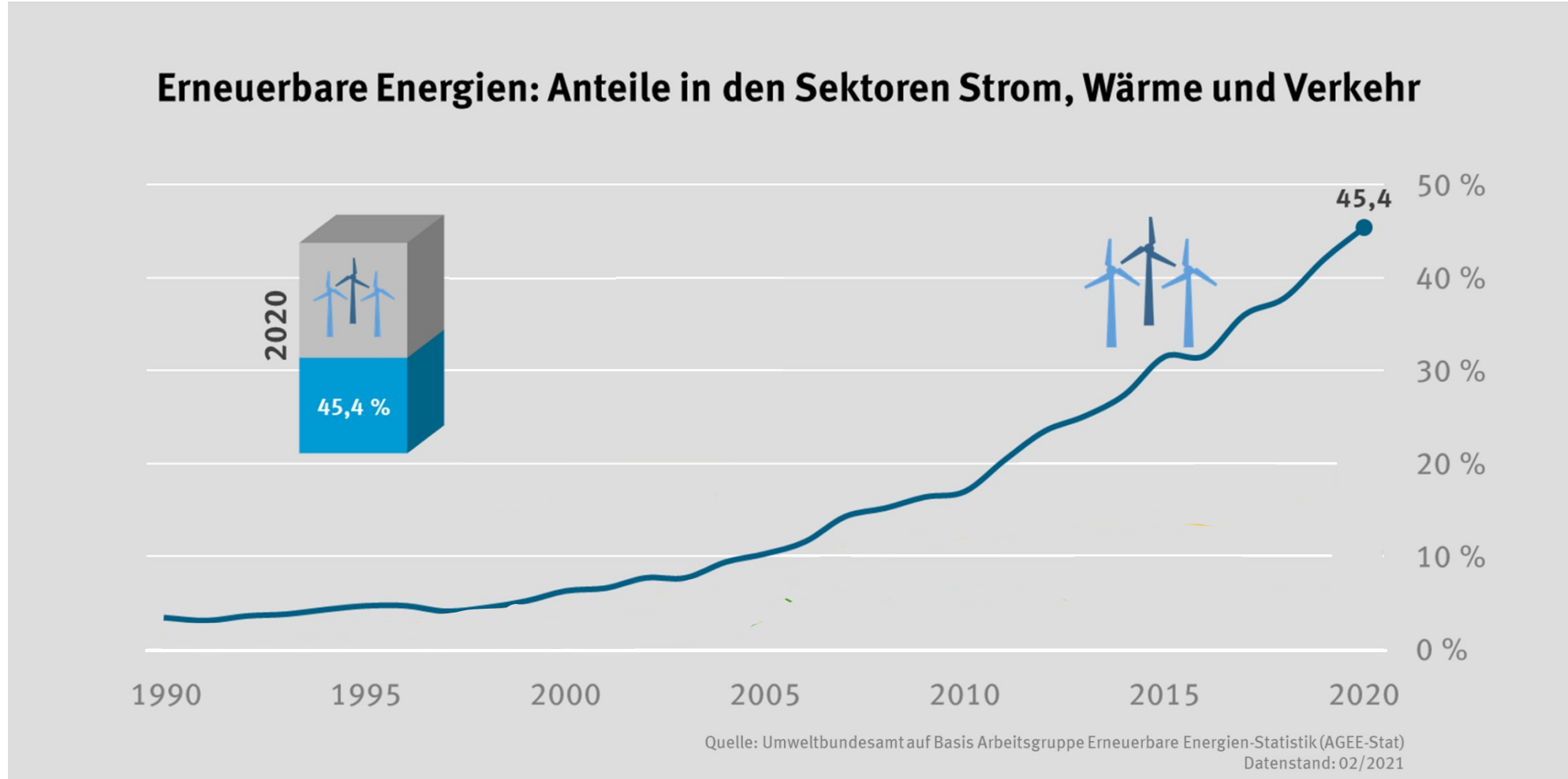
Climate goals

Germany

- By 2020: 40 percent reduction in CO2 emissions compared to 1990.
 - By 2030: 65 percent reduction in CO2 emissions compared to 1990.
 - By 2038: The last coal-fired power plant is to be shut down.
 - By 2040: 88 percent reduction in CO2 emissions compared to 1990.
 - By 2045: Germany aims to be climate-neutral.
-
- To achieve these climate goals, rapid expansion of renewable energy sources is necessary!
 - Rapid establishment of a hydrogen economy through promotion and creation of simplified regulations.

Shares of renewable energy

Electricity, heat, transportation



Question

Main Question

1. Why have so few electrolysis projects been implemented in Germany to date?
2. How can we change that?

Hydrogen Projects

German Hydrogen Projects

- The Lower Saxony cabinet initiated financing for the production and import of hydrogen on February 24, 2023. More than **2.3 billion** euros in state funding are to be mobilized for investments in Lower Saxony hydrogen projects as a result

Hydrogen Projects

German Hydrogen Projects

Brussels approves
€1.6 billion funding for
Lower Saxony
hydrogen projects on
February 15, 2024.

+ Speicher, Pipelines, Produktion: Niedersächsische Wasserstoff-Projekte sollen Staatshilfe von 1,6 Milliarden Euro erhalten



Hydrogen Projects

North-German Hydrogen Projects

- **Clean Hydrogen Coastline:** 320 MW Elektrolyse (2026)
- **GETH2:** 300 MW (2030)
- **Lingen:** 14MW mid of 2023 (RWE / Linde) – **250 kW in operation**

Green hydrogen must be economical !

Hydrogen Production - Today

Costs

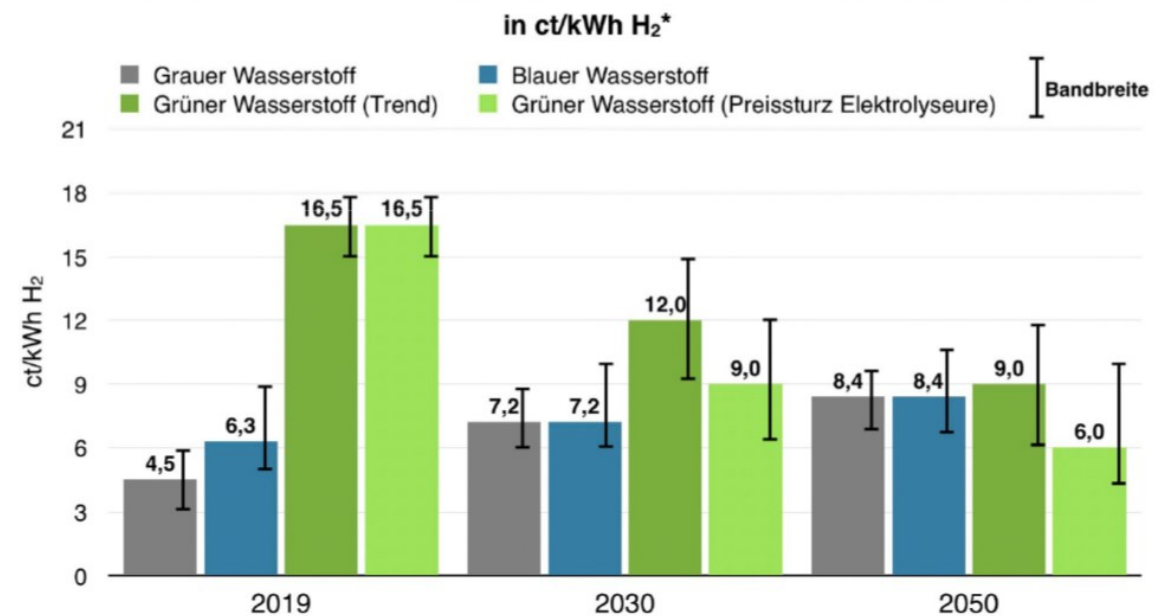
Grey or blue hydrogen

- 2,2 €/kg from Gas
- 1,6 €/kg from Coal

Green Hydrogen

- 6 €/kg from Solar
- 4 €/kg from Wind

Produktion von Wasserstoff: Kosten und Kostentrends



Quelle: Deutscher Bundestag 2020

Hydrogen costs

Simplified calculation example

- 1 MW Elektrolyser, 1 Hour
→ about 200 Nm³ Hydrogen (~18 kg)
- 1 MWh electric Energy
- 600 kWh Energy as Hydrogen

-
- Grid: Hydrogen Costs 50 ct/kWh
 - Fill up (600km): 100 € /
 - Solar/Wind: Hydrogen Costs 18 ct/kWh
 - Fill up (600km): 36 €
 - Coal / Gas: Hydrogen Costs 4 ct/kWh
 - Fill up (600km): 8€



Range 1800 km

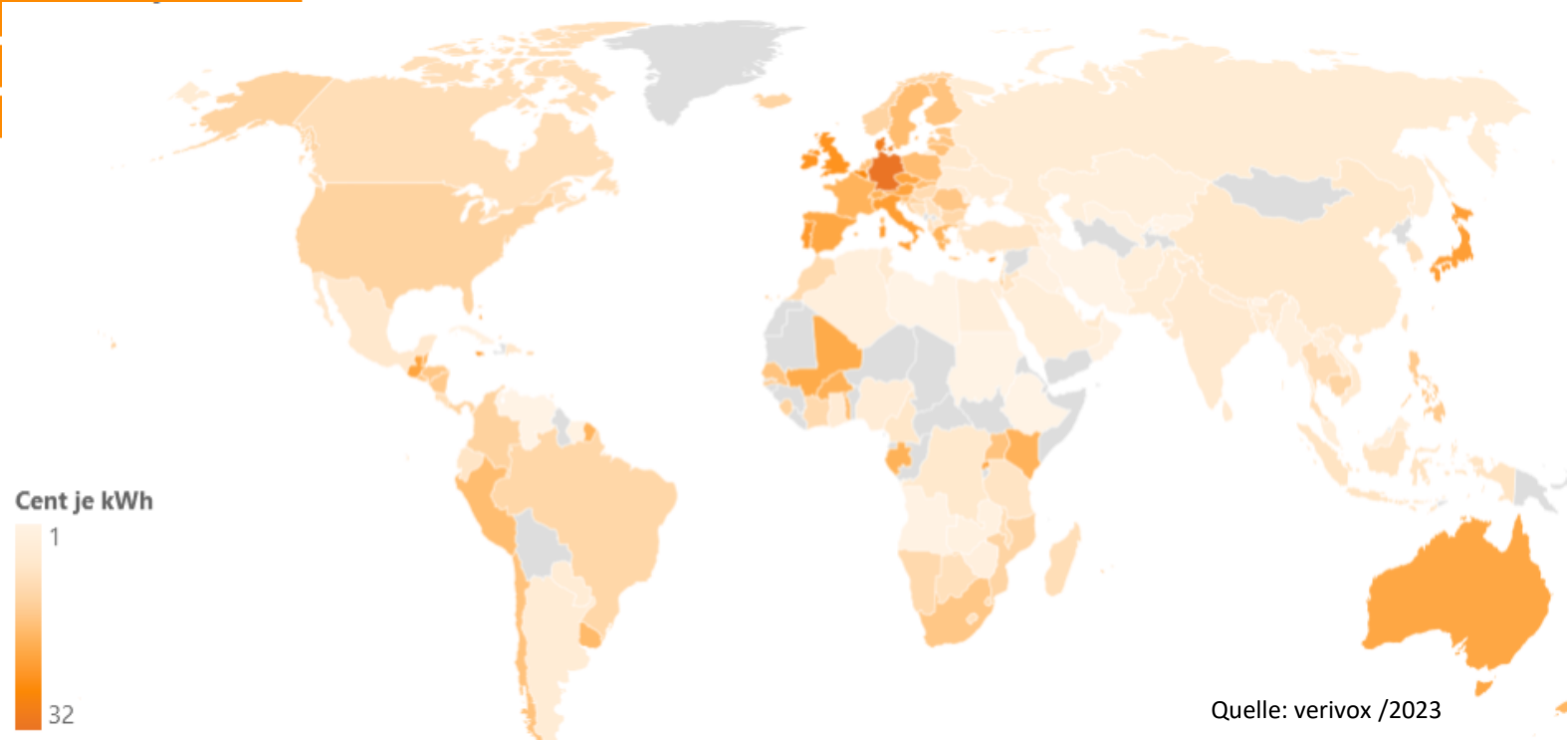
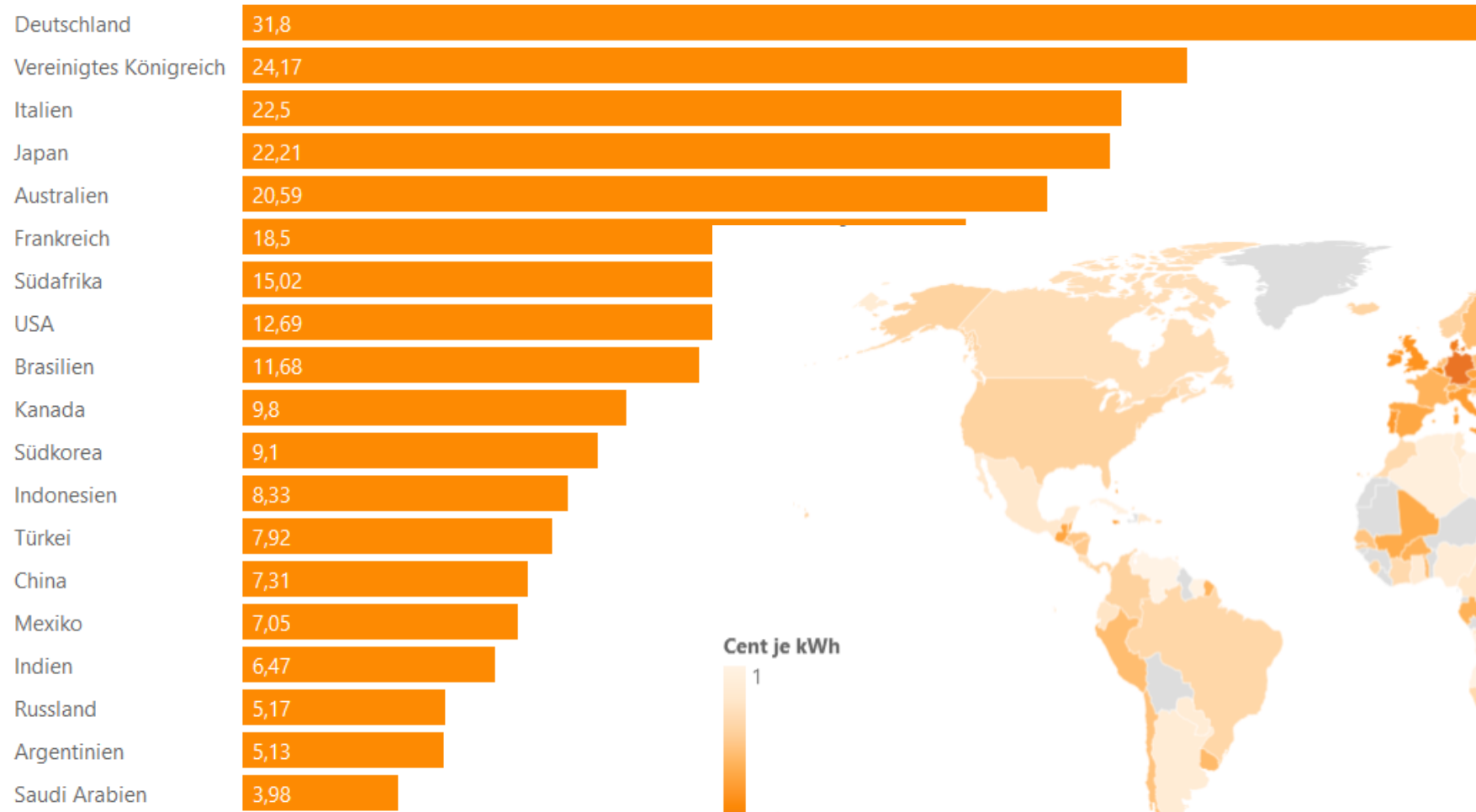


Range 300 km

Electricity costs worldwide

Electricity costs in Eurocents per kWh

in Eurocent je Kilowattstunde



Question

2. Question

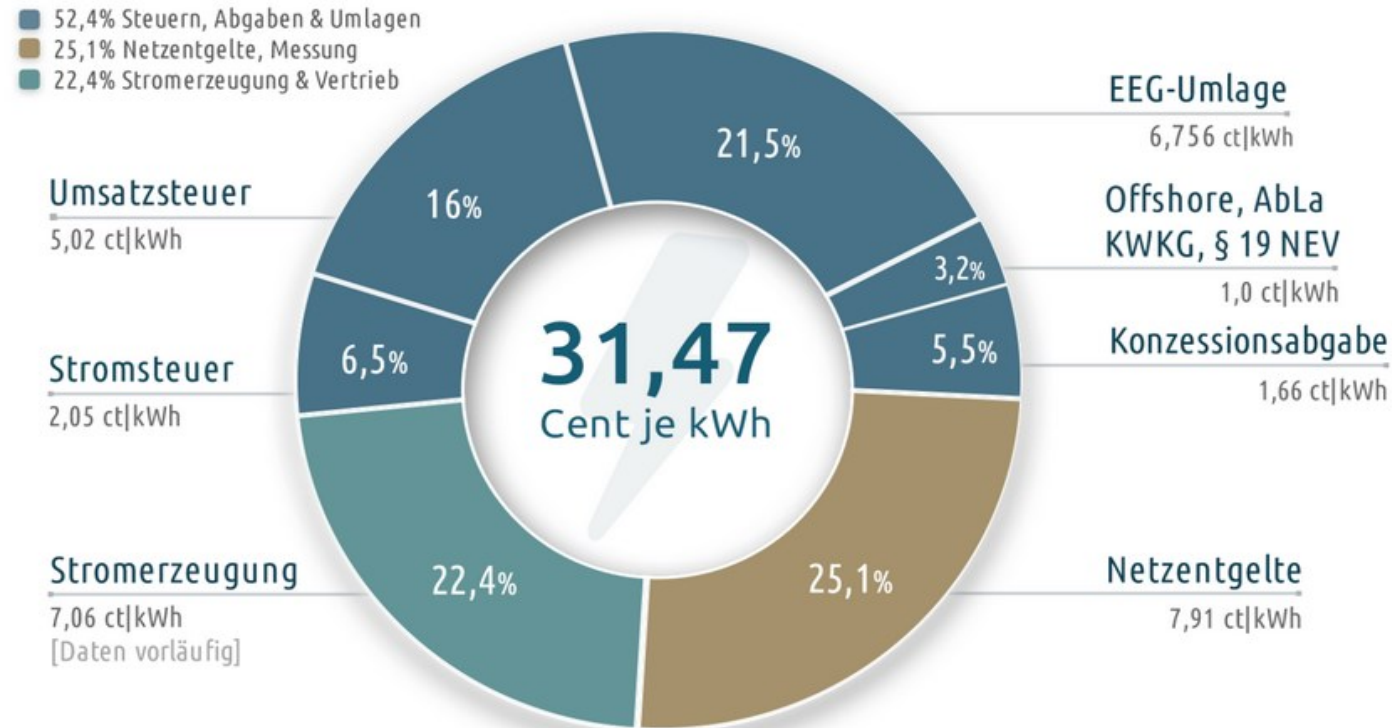
2. How can we change that?

Electricity price

Composition

STROMPREISZUSAMMENSETZUNG 2020

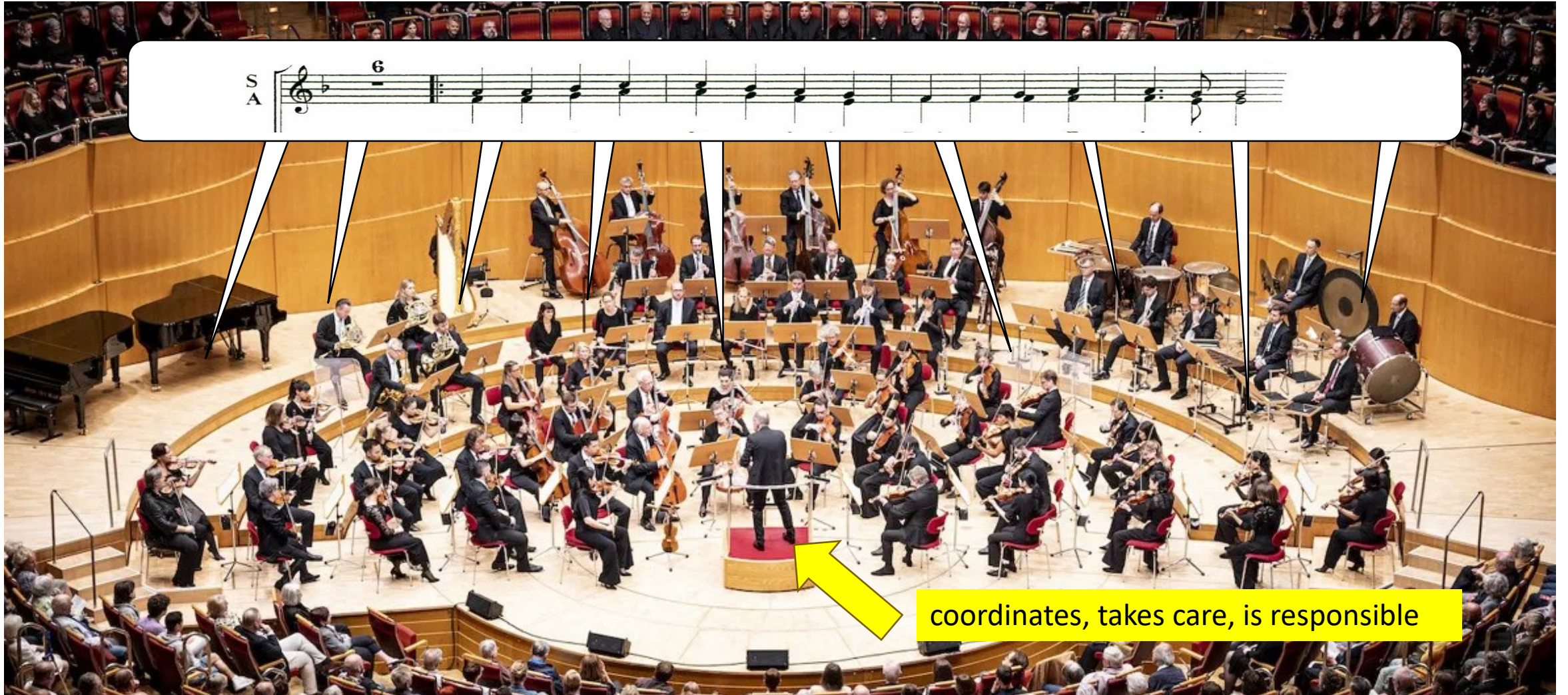
Durchschnittlicher Strompreis für Haushaltskunden in Deutschland*



*pro kWh bei 3.500 kWh Jahresverbrauch [3 Personen]

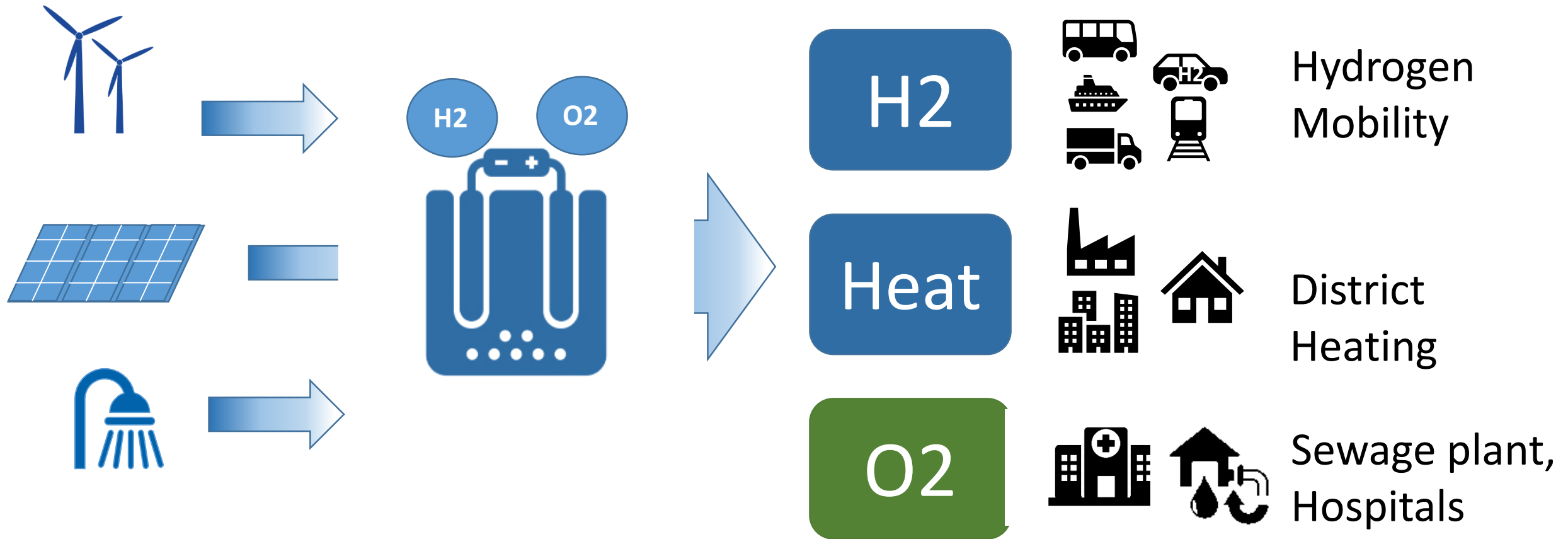
Interaction

With a Conductor



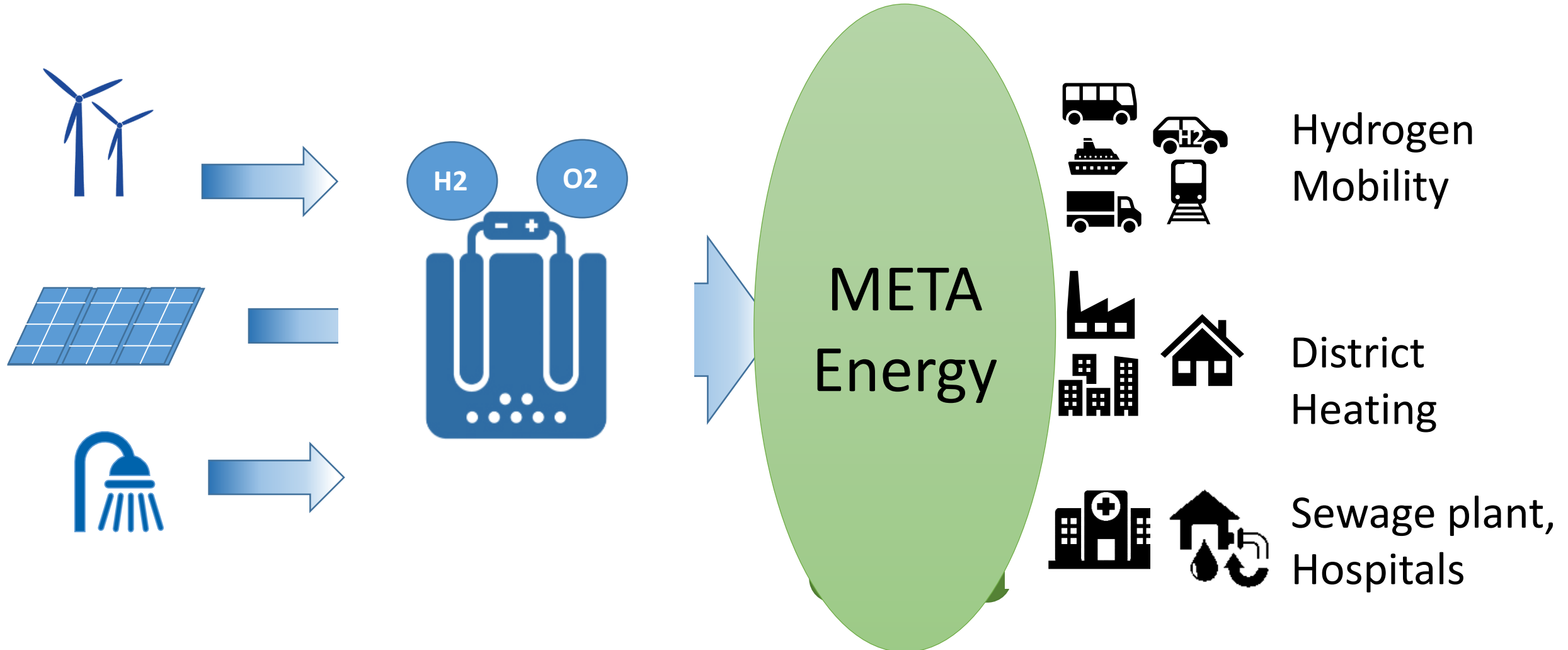
Electrolyser

Products



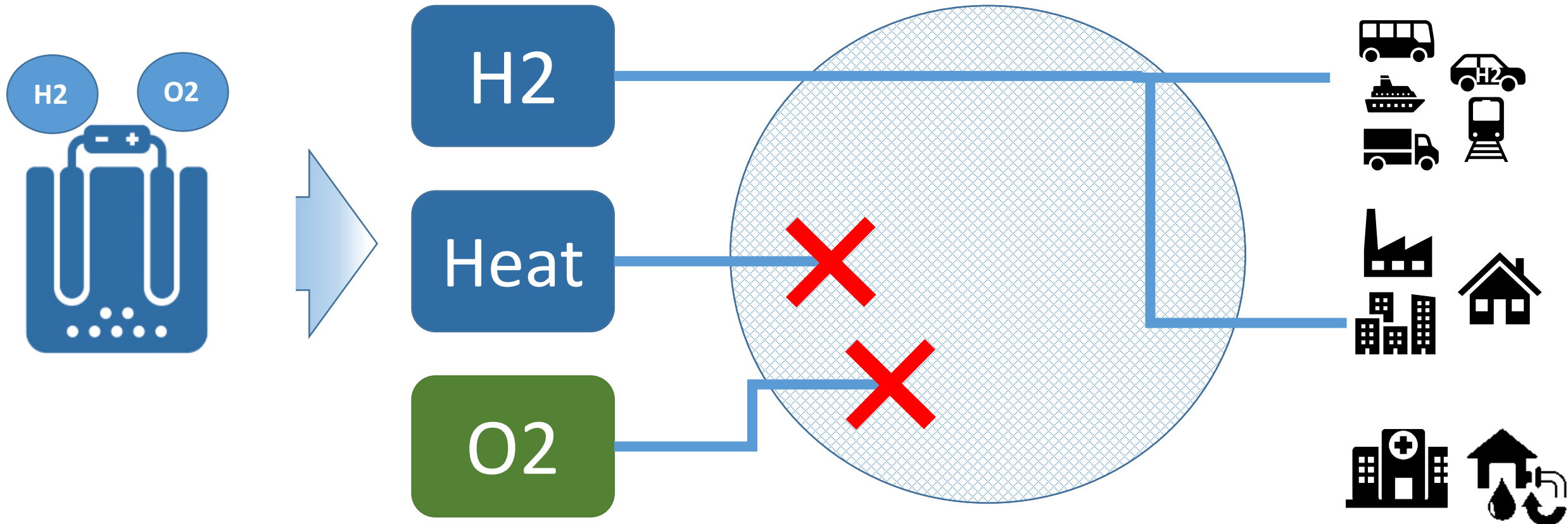
Electrolyser

Products



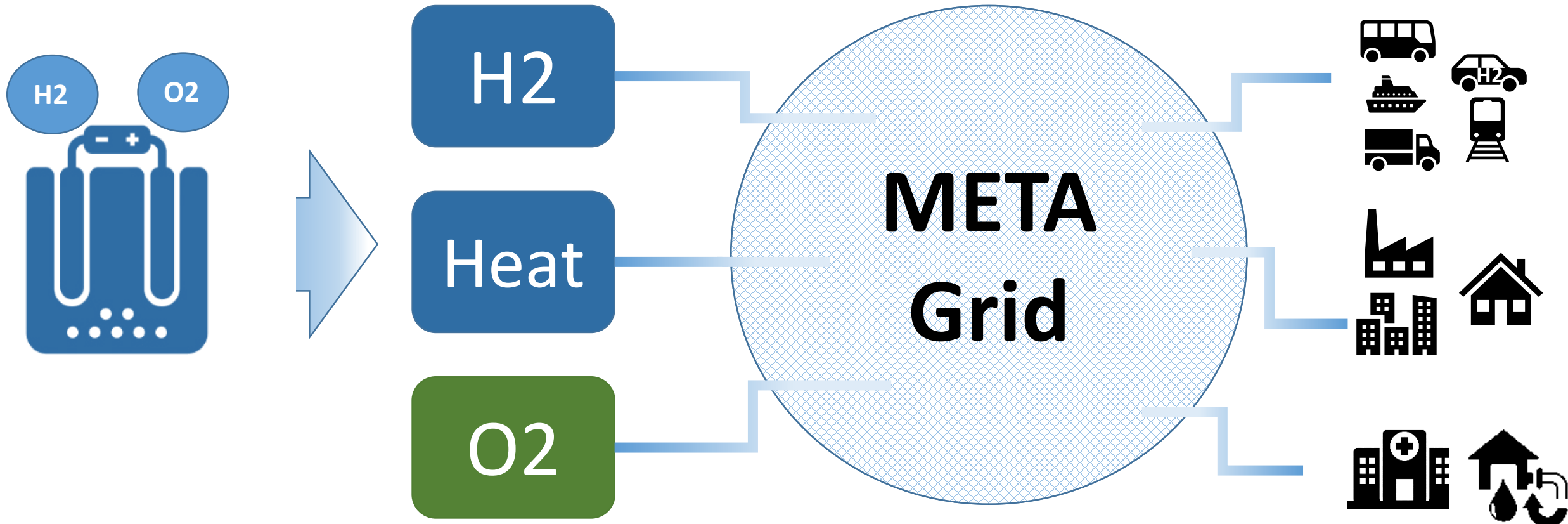
Feed-in to the Grid

Energy Distribution



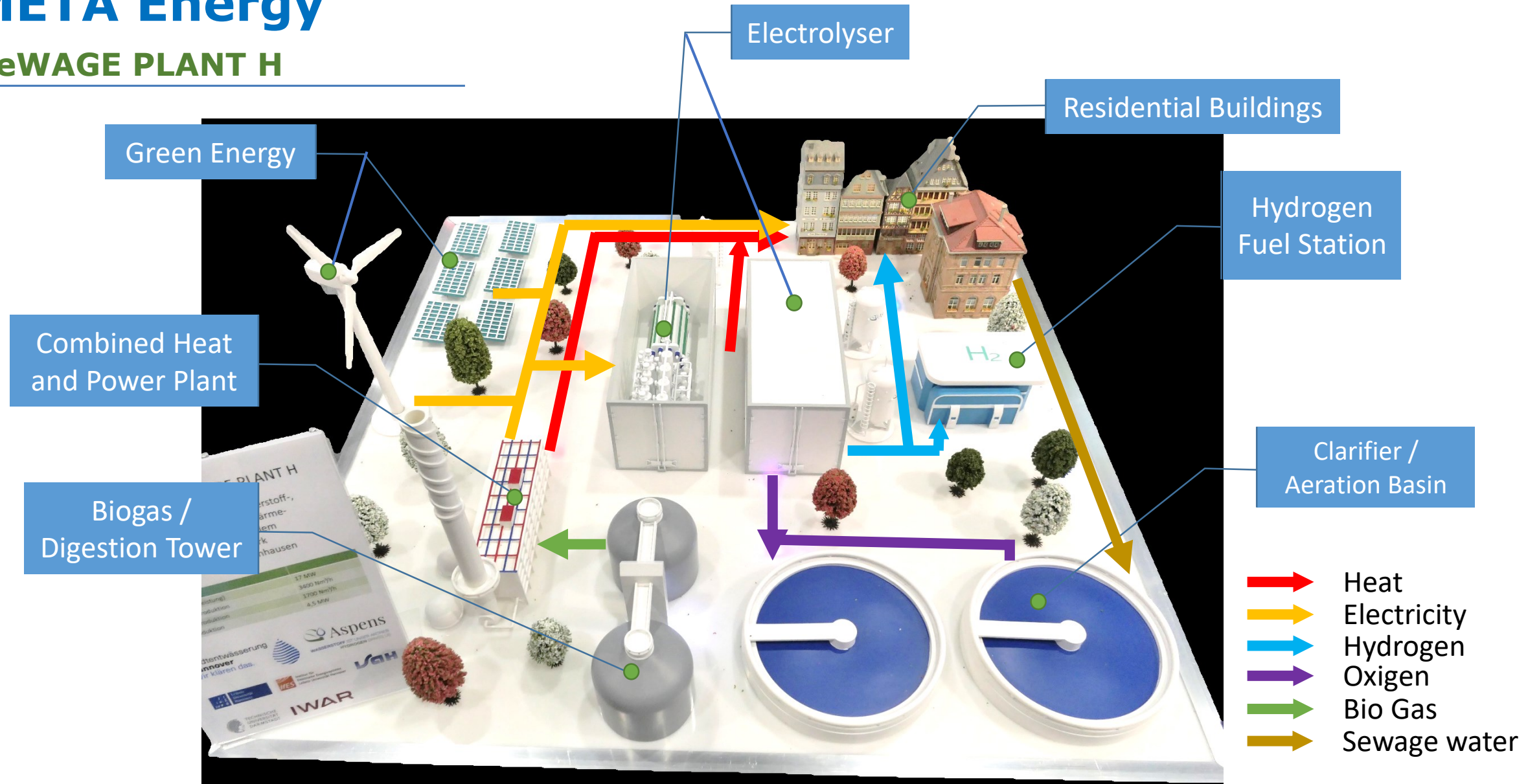
Power Coupling using META Grid

Energy Distribution



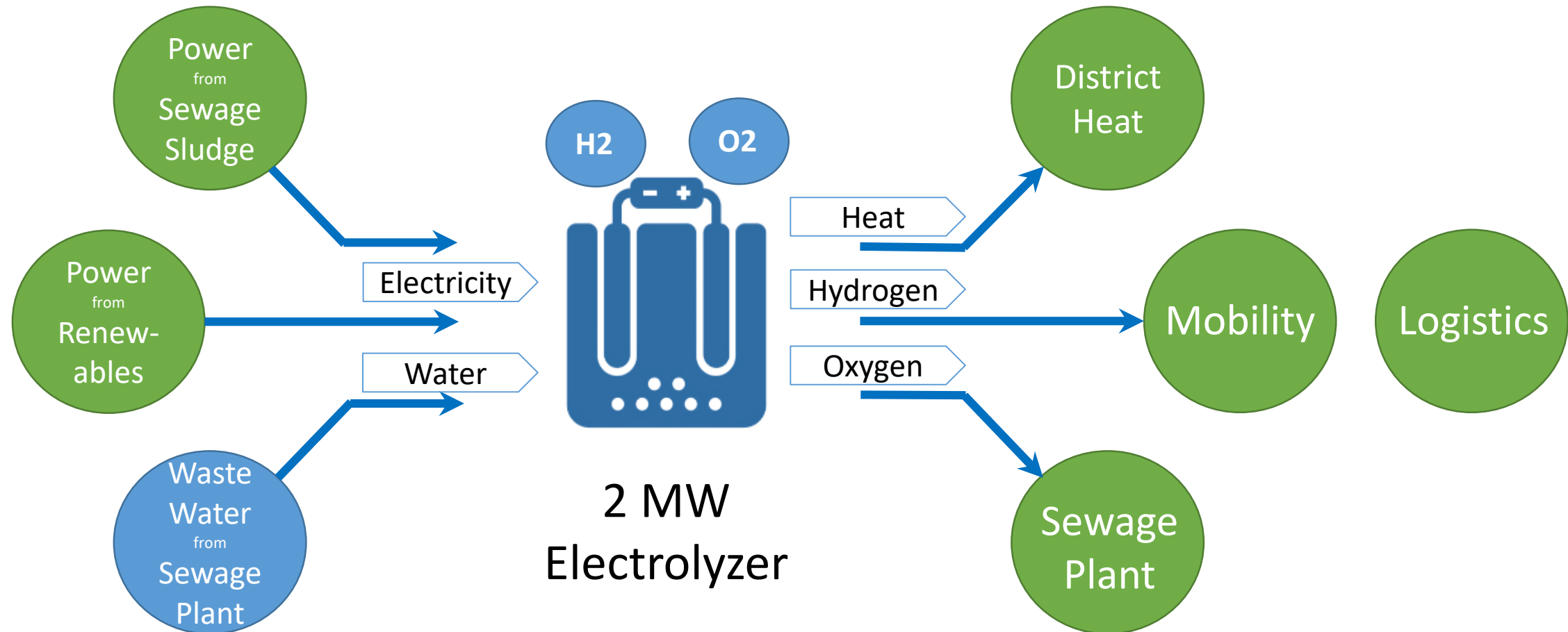
META Energy

SeWAGE PLANT H



Project SeWAGE PLANT H

Overview



Project SeWAGE PLANT H

+ **Kosten explodieren: Stadt stoppt**

Wasserstoffpro + **Kosten für Wasserstoff-Gewinnung im Klärwerk**

Herrenhausen explod

Elektrolyse in Klärwerk gescheitert

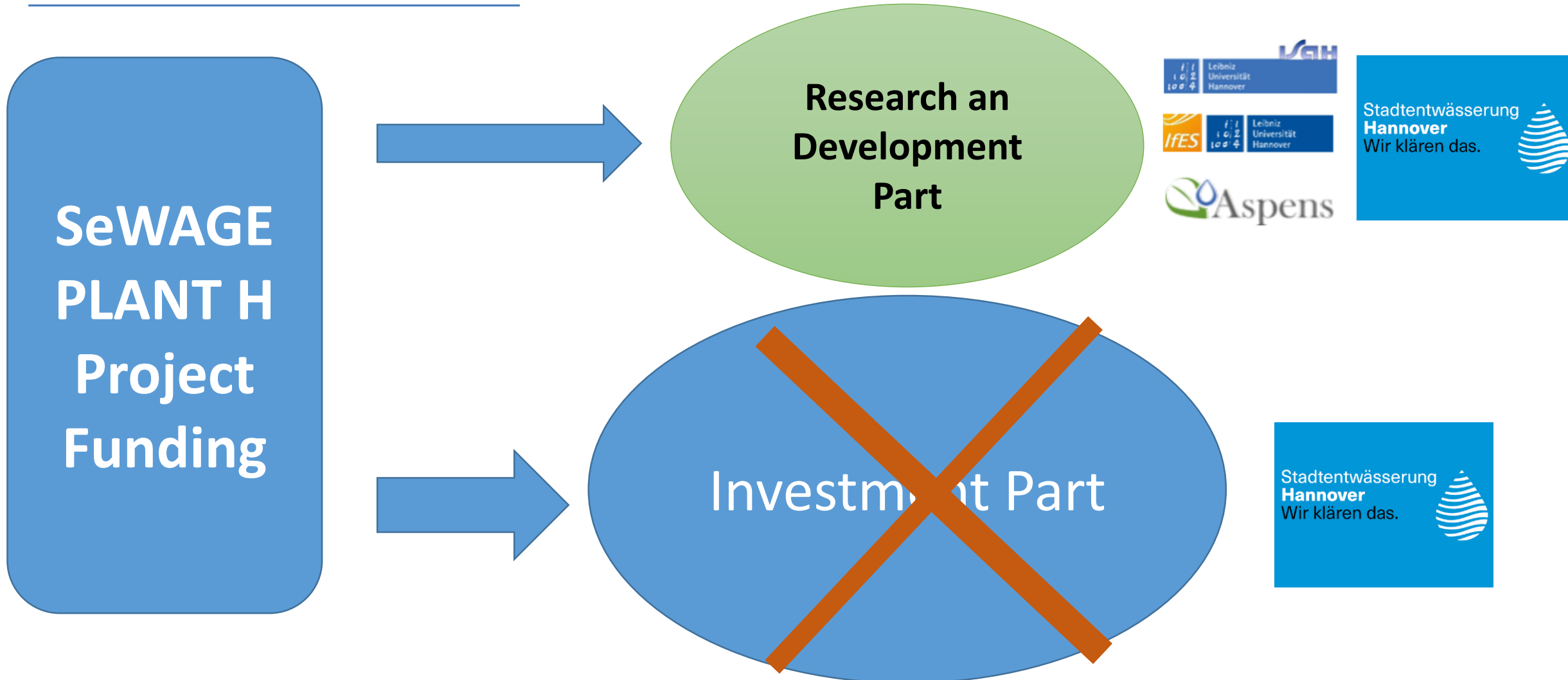
Doch kein Wasserstoff aus Hannover

Die Produktion von grünen Wasserstoff an einem Klärwerk in Hannover sollte ein Leuchtturmprojekt werden. Doch jetzt muss die Stadt es beenden.



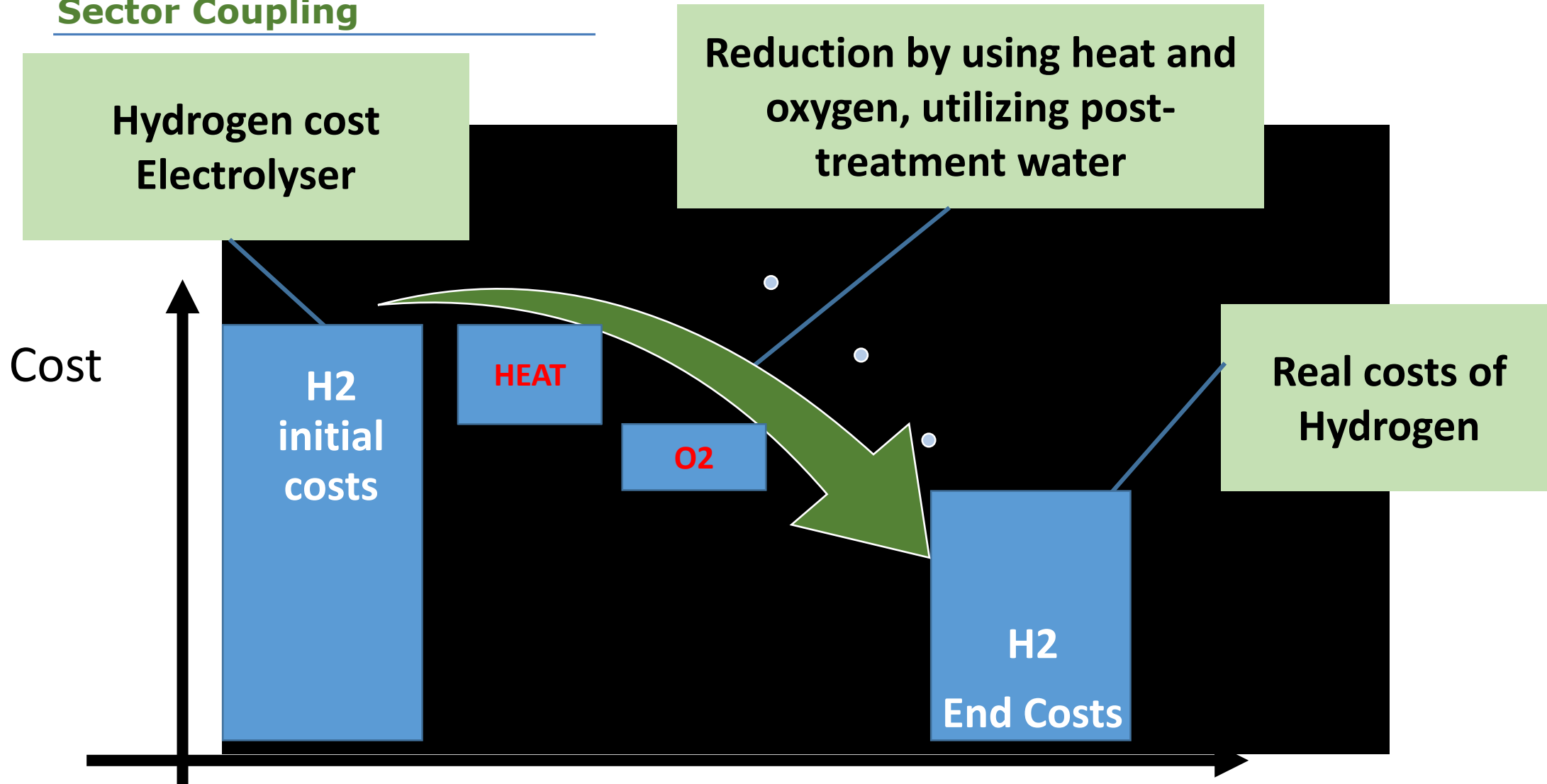
SeWAGE PLANT H Project

Structure



Hydrogen Costs

Sector Coupling



Project SeWAGE PLANT H

Pilot Plant Data

Project Data	
Project Start	Sep. 2021
Project End	Sep. 2025
Electrolyser Power	2 MW
H2 Production	400 Nm ³ /h
O2 Production	200 Nm ³ /h
Heat Power	500 kW)
Drinking Water saving	380 Liter/h

Hydrogen Utilisation



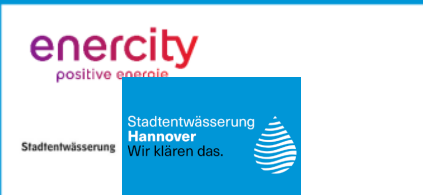
Hydrogen and Component Production



Scientific Validation



Oxygen and Heat Utilisation



Partnering, Coordination, Funding/Subsidies



Electrolyser Plants

Production of green hydrogen

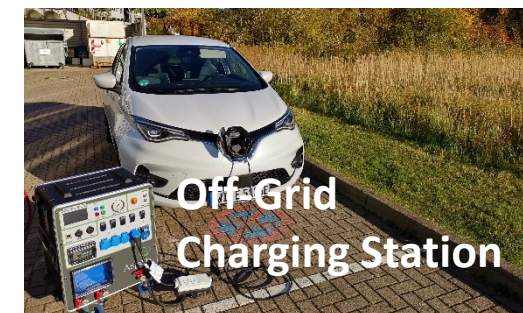
- Our systems utilize PEM and AEL electrolyzer technology.
- We offer electrolyzers ranging from 25 kW to 5 MW (5 - 1000 Nm³/h hydrogen production).
- Our systems deliver hydrogen and oxygen with a purity of up to 99.999 (5.0) and 30 bar pressure.
- Efficiency exceeds 90% when intelligently utilizing all electrolyzer products (heat / O₂ / H₂)



Fuel Cell Systems

HyPowerbank, Leibniz Pick-Up

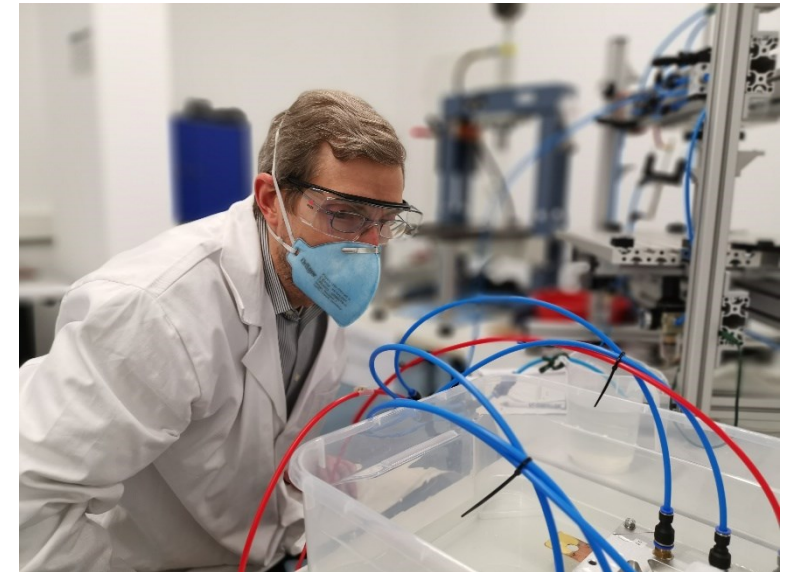
- Our systems utilize metallic PEM fuel cell technology.
- Stacks can be combined to create systems with up to 1 MW of power.
- Our systems can provide electricity and heat where no grid is available.
- Robust, compact, and lightweight design



Service

More than just a Manufacturer

- Consulting
 - From initial idea to turnkey facility
- Planning / Engineering
 - Design, construction, document creation and approval, project management, on-site installation, training
- Maintenance and Service
 - 24-hour plant monitoring, repair and maintenance service



Company Location

Aspens GmbH is a high-tech company in the field of hydrogen technology from Hanover founded in 2011. The goal of the company is to offer solutions for the entire hydrogen ecology chain. Our areas of work are:

- Electrolysis Systems for Generating Green Hydrogen
- Hydrogen Fuel Cell Systems for Mobile and Stationary Power Generation
- Intelligent Energy Distribution



Standort in Hannover

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www.aspens.de