Hydrogen @ Siemens

CO_2-freie Wasserstofferzeugung mit Elektrolyse, ein wesentlicher Baustein für die Energiewende und die Dekarbonisierung der Industrie oder „Strom gibt Gas“

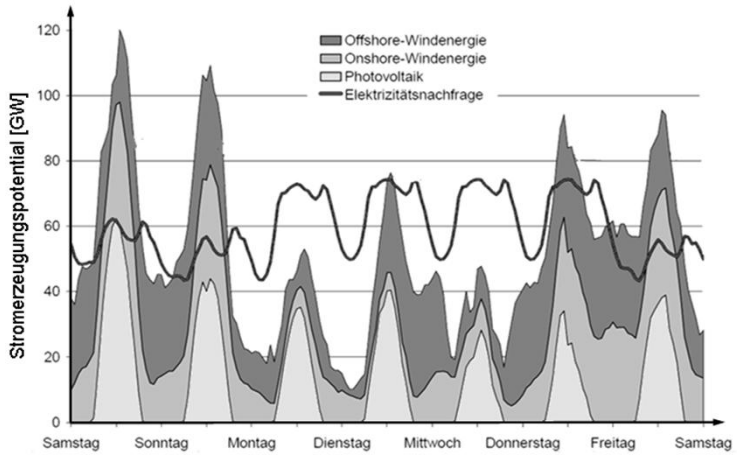
Dirk Schönberger, Siemens Hydrogen Solutions, 14. Symposium Energieinnovation Graz

„Water will be the coal of the future. Energy of tomorrow will be water that was split by electricity“

(J. Verne, 1874)

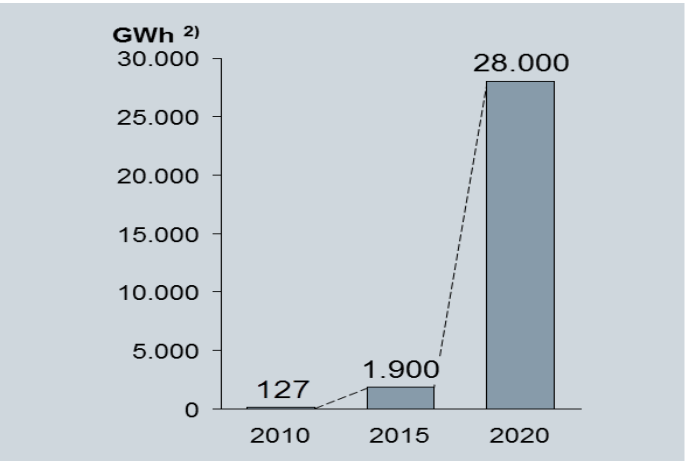
“Energiewende” and integration of renewable energy ...will challenge the energy industry

Power generation and load curves



Source: TU Berlin, Prof. Erdmann, extrapolated for the year 2020

Curtailment [1]

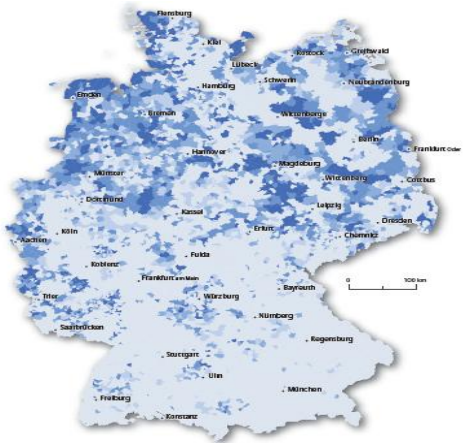


1) EnBW (Münch) at BMU Strategy Meeting, 05.09.12

2) total demand Germany 2011: 615.000 GWh

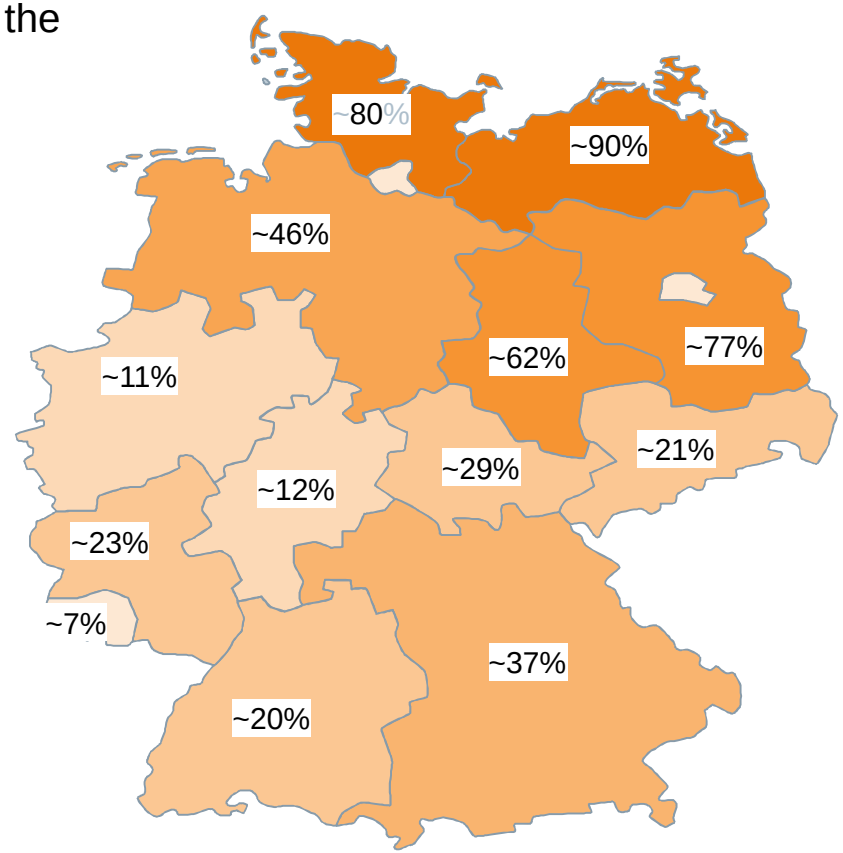
The future CO_2-optimized energy scenario will require smart solutions.

Current situation – already challenges in the integration of renewable energy



Windpower in the north

Solar energy in the south



Percentige of renewable energy production per region*

2014:
Already 40% abandonment of windfarms in high wind areas during the high wind season

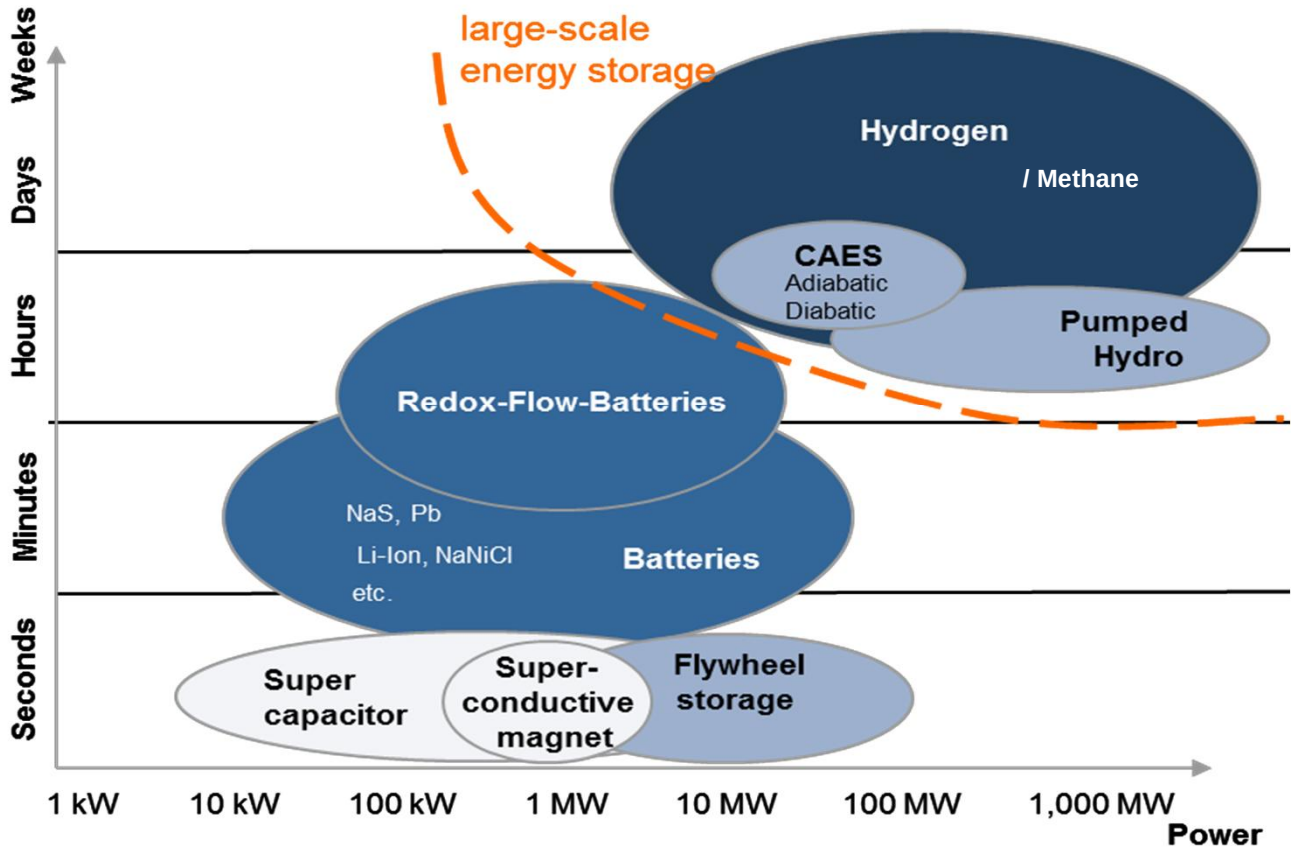
2030 ?

AGENTUR FÜR ERNEUERBARE ENERGIEN

* Source: AGEE-Stat, LAK, extrapolated

Options to address Large Scale “Grid Storage” are limited

Segmentation of electrical energy storage

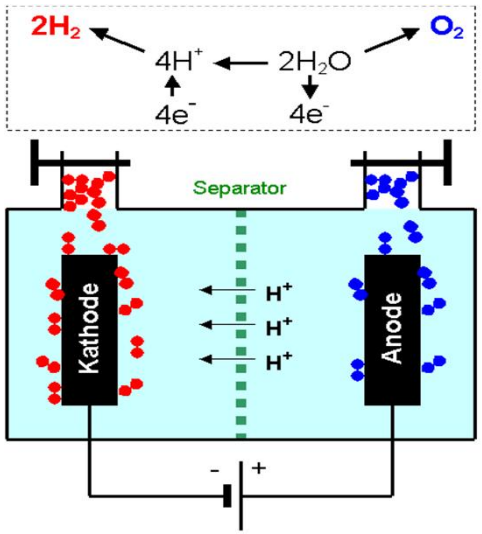


Key Statements

- There is no universal solution for electrical storage
- Large scale storage can currently only be addressed by
  - Pumped Hydro,
  - Compressed Air (CAES) and
  - Chemical storage media like Hydrogen and Methane

Advantages of the PEM Electrolyzer Technology

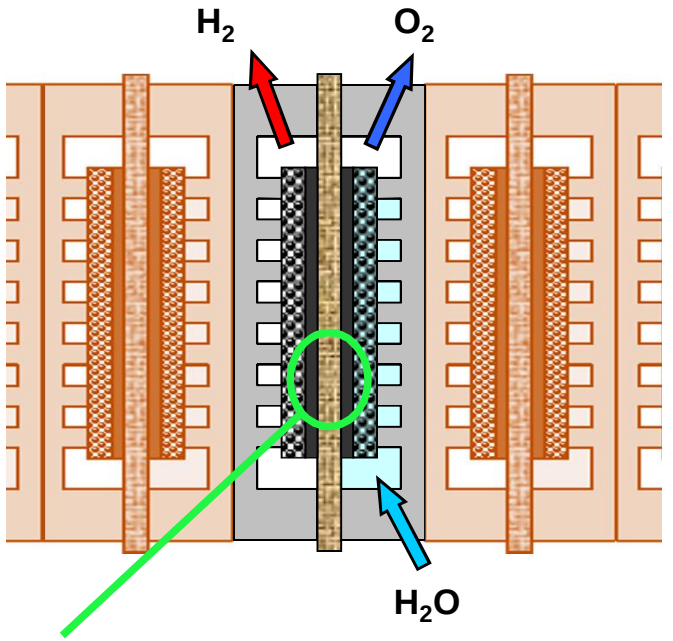
Basics:



Key spec:

- High dynamic operation
- Compact design, small footprint
- Simple cold-start capability
- Pressure operation
- Low degradation
- Pure water handling
- Rapid load changes

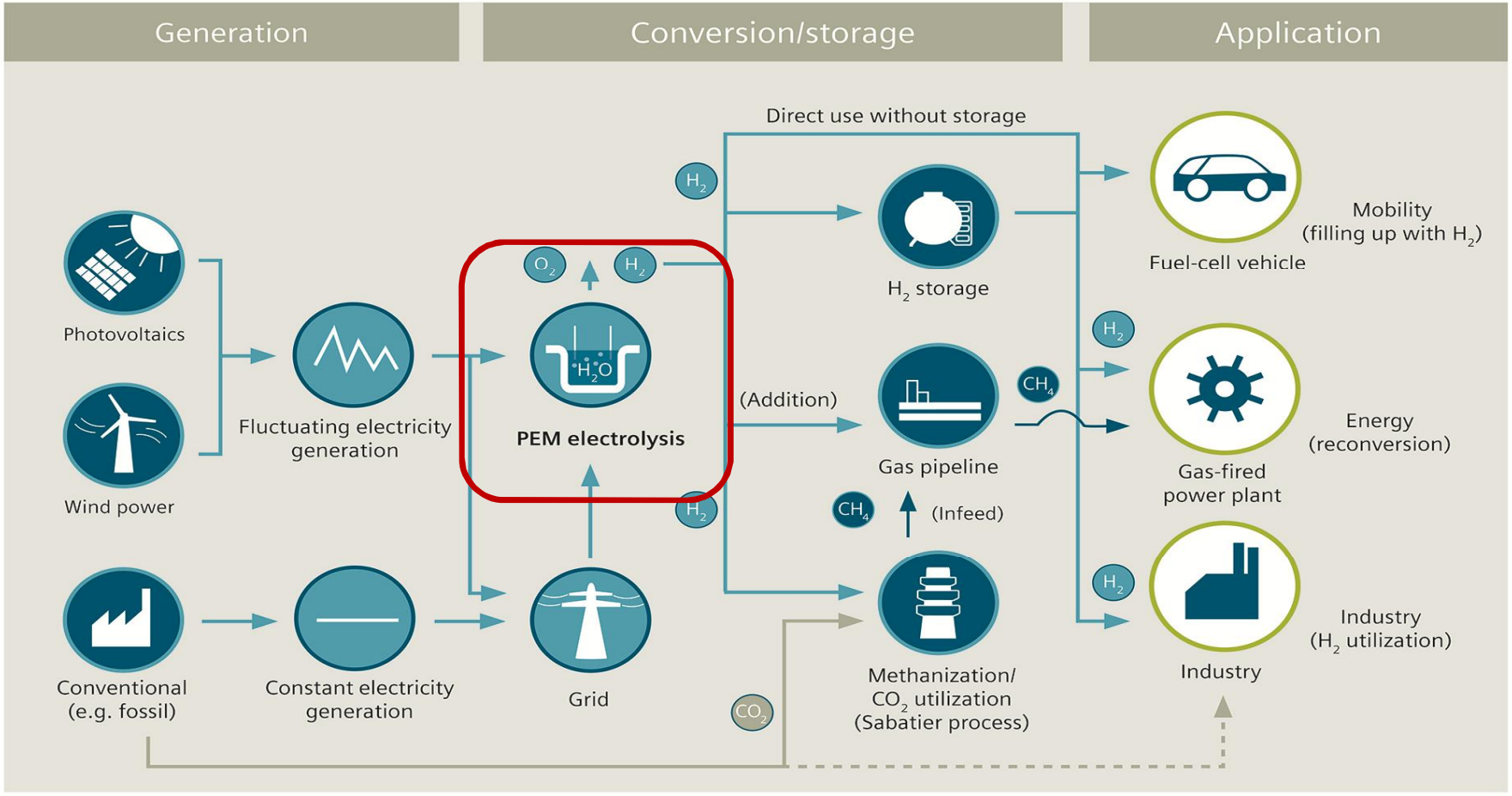
PEM* technology:



MEA : Membrane-Electrode-Assembly

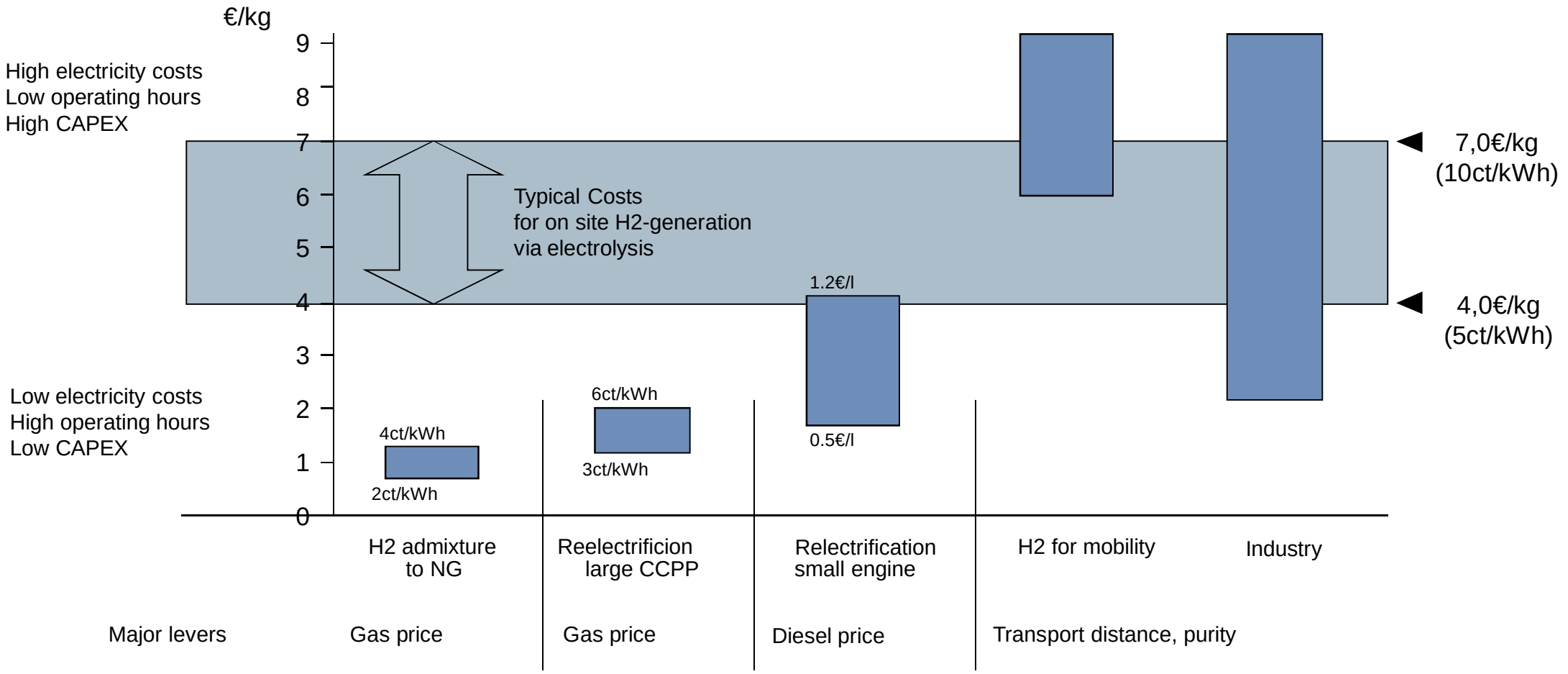
* Proton-Exchange-Membrane

PEM Electrolyzer:
H_2 drives the convergence between energy & industry markets

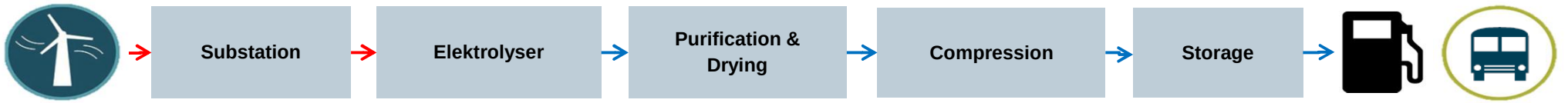


Applications and examples of use of hydrogen electrolysis

Priority applications for Power to Gas will be also decided by benchmark market prices



Application Example
Economic hydrogen production for buses



Electricity Costs	Example: Influence on hydrogen production costs
15 ct/kWh	12 €/kg
10 ct/kWh	9 €/kg
5 ct/kWh	6 €/kg

Bus Operation	Diesel-Bus	Fuel Cell-Bus
Specific Fuel Costs	1,30 €/l	6,…12 €/kg
Consumption	40 l/100 km	8 kg/100 km
Fuel Costs per 100 km	**52 €/100 km**	**48,…96 €/100 km**

Resumé: The business case is mainly dependent on electricity costs.

*Further assumptions: Daily hydrogen demand 400 kg, Depreciation: 10 years

Decentralized energy storage plant
First PEM Electrolyzer in the MW-range worldwide

SIEMENS

Objectives:

- Connection to 10 MW wind-farm and grid (20 kV).
- Energy storage plant in order to provide grid services (balancing mechanisms).
- Injection in local gas grid and multi-use trailer-filling.
- Demonstrating safe handling of hydrogen and create awareness in public, politics

Technical and production aspects:

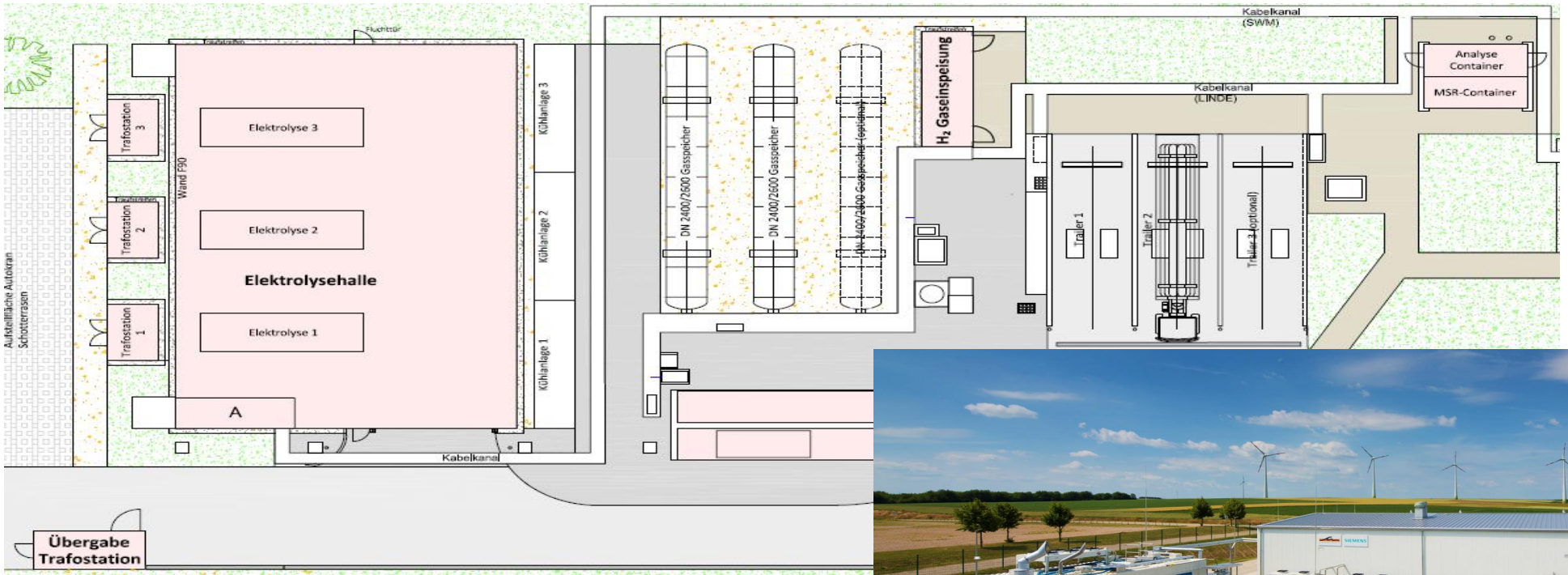
- 6 MW Electrolyzer (3 Stacks à 2 MW peak) delivered in 07/2015
- 1000 kg storage (33 MWh)
- 200 tons target annual output.

Project

“Energy Park Mainz“

STADTWERKE MAINZ AG | THE LINDE GROUP | Hochschule RheinMain University of Applied Sciences Wiesbaden Rüsselsheim | SIEMENS

Energiepark Mainz – Plant layout



Energiepark Mainz – Scope of supply
Hydrogen storage and handling facility

Power grid connection 20kV

Transformer-Rectifier Unit

Electrolysis 2-3.5 MPa

Water purification

DeOxo Unit

Ionic Compressor

Condensate trap

Compressor 1st stage

Compressor 2nd stage

Condensate recycle

Gas storage (max. 8 MPa)

NG grid injection

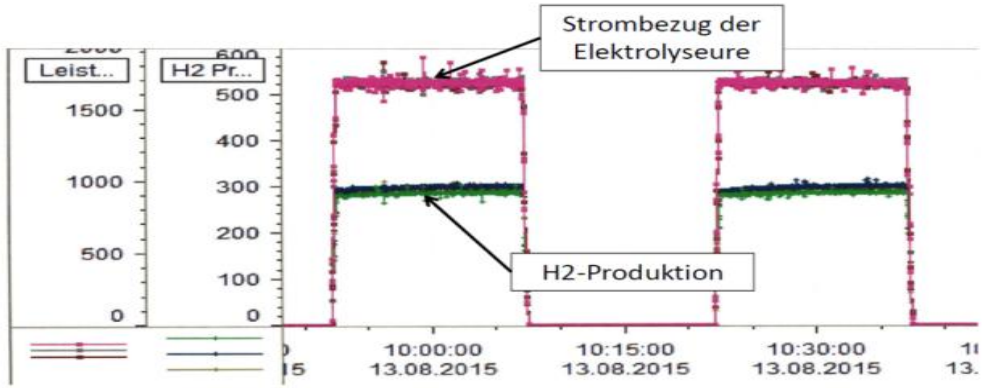
Final drying

Trailer filling 22.5 MPa

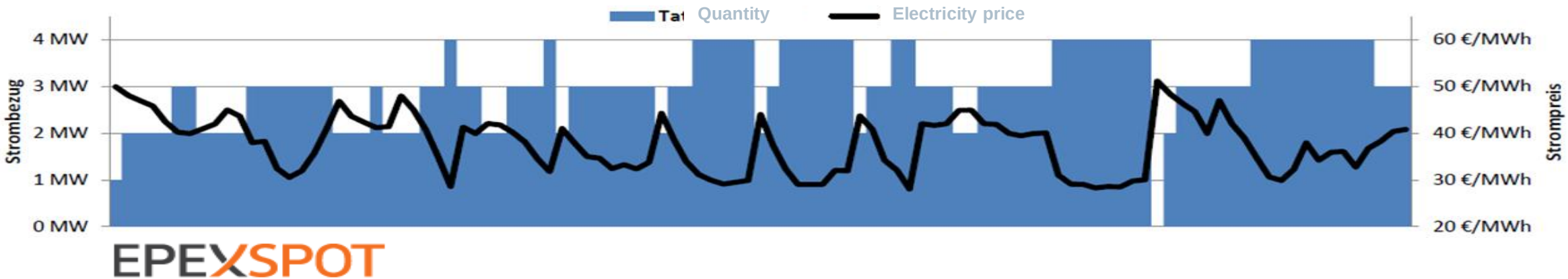
Energiepark Mainz – Status
First experience of operation

→ Normal operation between Sep. and Nov.

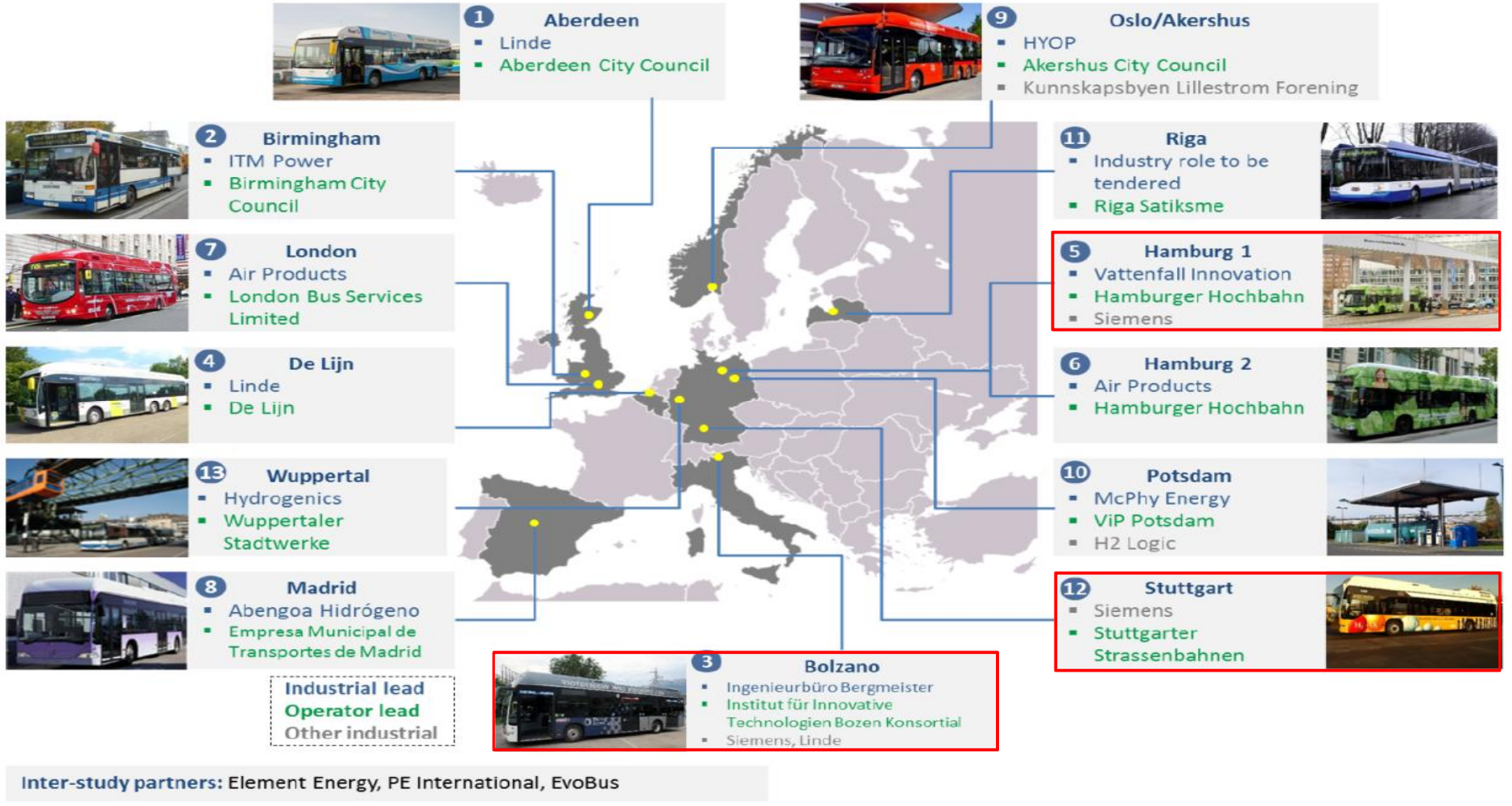
- Electricity supply through EPEX Spot market (during the week 8:00 -18:00)
- Approx. 1 GWh electricity consumed
- More than 40 Trailer filled



→ Expected dynamic and power consumption is achieved



A large European consortium to develop refuelling solutions for fuel cell bus depots



Inter-study partners: Element Energy, PE International, EvoBus

Empfehlungen zu politischen Rahmenbedingungen

performing energy
BÜNDNIS FÜR WINDWASSERSTOFF

dena
Deutsche Energie-Agentur

Strategieplattform Power to Gas

- Für die erfolgreiche Markteinführung […] ist eine rechtliche Klarstellung der Eigenschaft von Power-to-Gas als **Nicht-Letztverbraucher** zwingend notwendig. […] Aus dieser Eigenschaft als Nicht-Letztverbraucher lässt sich eine **Befreiung von der EEG-Umlage**, den Netznutzungsentgelten, der Stromsteuer, der Stromsteuer, den Konzessionsabgaben, der § 19-Umlage und Offshore-Umlage sowie der KWK-Umlage ableiten […]

- Es sind […] zeitlich und im Volumen begrenzte **Markteinführungsinstrumente** zu schaffen, um einen wirtschaftlichen Anlagebetrieb für Power-to-Gas Anlagen während der Erprobungs- und Markteinführungsphase zu ermöglichen […]

- Einsatz von **"Grünem Wasserstoff" in Industrieprozessen** (z.B. im Raffinerieprozess) muss stärker belohnt werden. (z.B. höhere Anerkennung bei der Biokraftstoffquote oder Anhebung der Preise für CO2 Zertifikate)

- Power-to-Gas ist […] in die bestehende **technische Regelungen** für die Erdgasinfrastruktur zu integrieren […]

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