HYDROGENICS

SHIFT **POWER** | **ENERGIZE** YOUR WORLD

Power-to-Gas Developments in Europe

Energy Transition: A multifaceted Challenge for Europe
3rd Symposium: How to foster innovation in a fast changing EU energy landscape?
8th October 2013, Brussels

Filip Smeets
General Manager, Onsite Generation

Hydrogenics is the world leader in water electrolysis products and develops hydrogen fuel cell power systems

Onsite Generation
Electrolyzers

Industrial Hydrogen

Hydrogen Fueling

Power Systems
Fuel Cell Modules

Stand-by Power

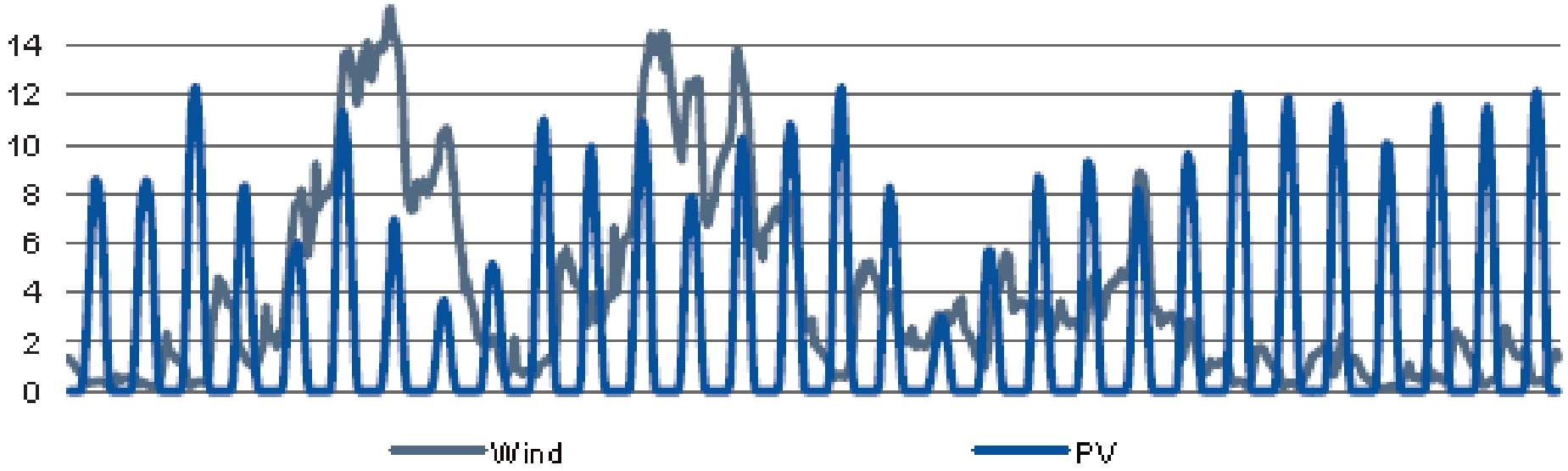
Mobility Power

Energy Storage

Power-to-Gas

The biggest challenge for the energy transition is the integration of the dynamically growing, but also variability intensive, renewable energy sources.

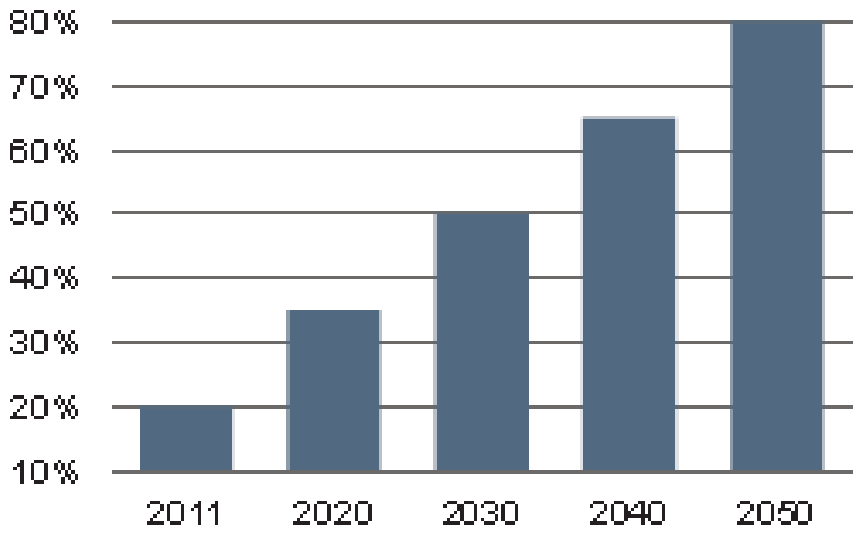
Stündliche Einspeisewerte in GW, Deutschland, September 2011



Quelle: ENTSO-E

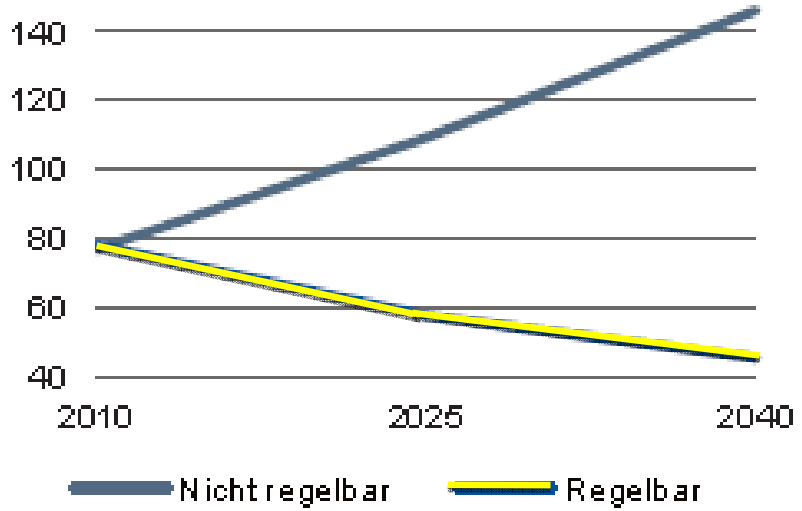
The planned increase in intermittent renewable energy sources will result in a generation portfolio that is more difficult to balance.
Short-term storage demand will double by 2025. Seasonal storage capability will be needed shortly after.

EE an Bruttostromerzeugung, in %



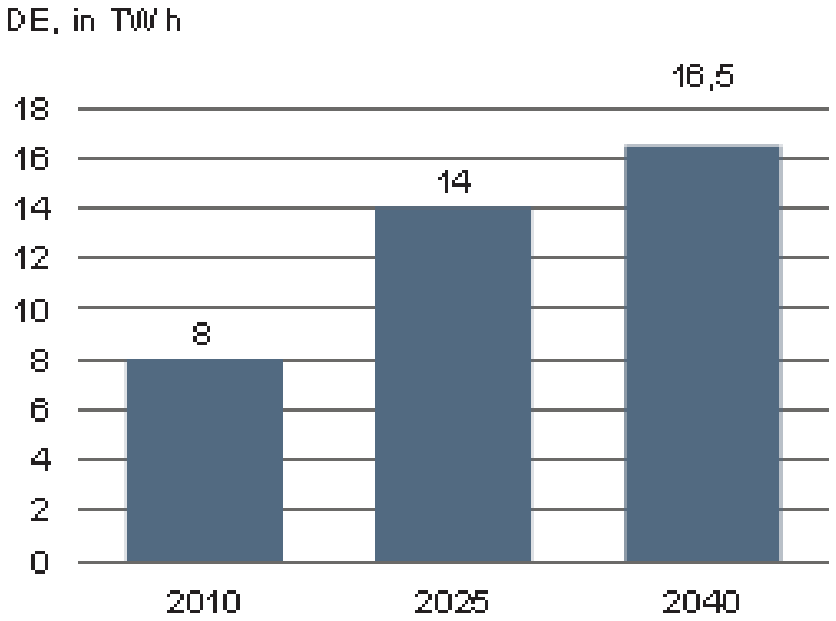
Quelle: Deutsche Bundesregierung

Entwicklung der Nettokraftwerkskapazitäten, 2010, 2025 und 2040, in GW



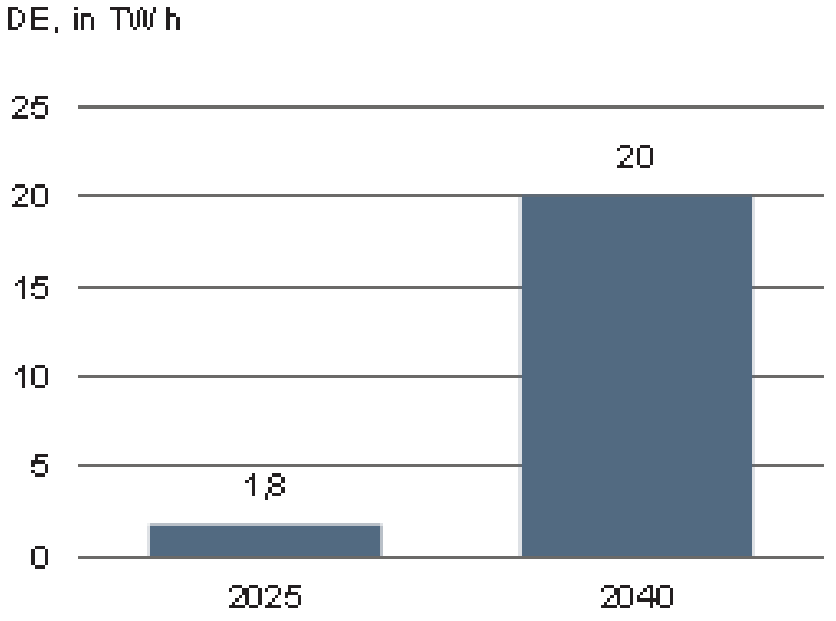
Quelle: DB Research

Growing decentralisation and high volatility of generation will result in steep increase for ancillary services, as well as energy storage potential of significant size.



* positive Regelleistung zum Ausgleich von Prognosefehlern

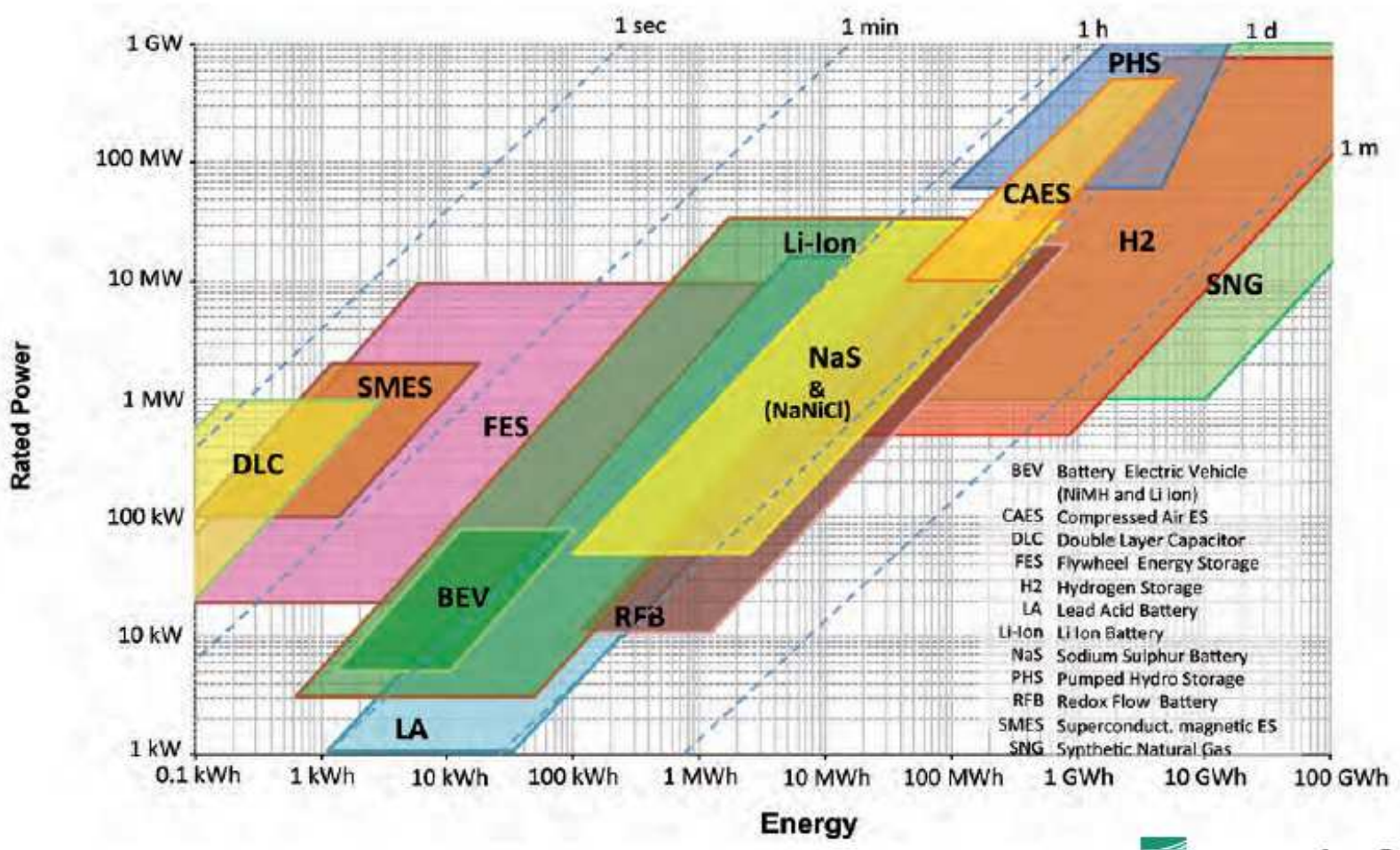
Quelle: DB Research



* Annahme: 50 % aller Stromüberschüsse werden gespeichert

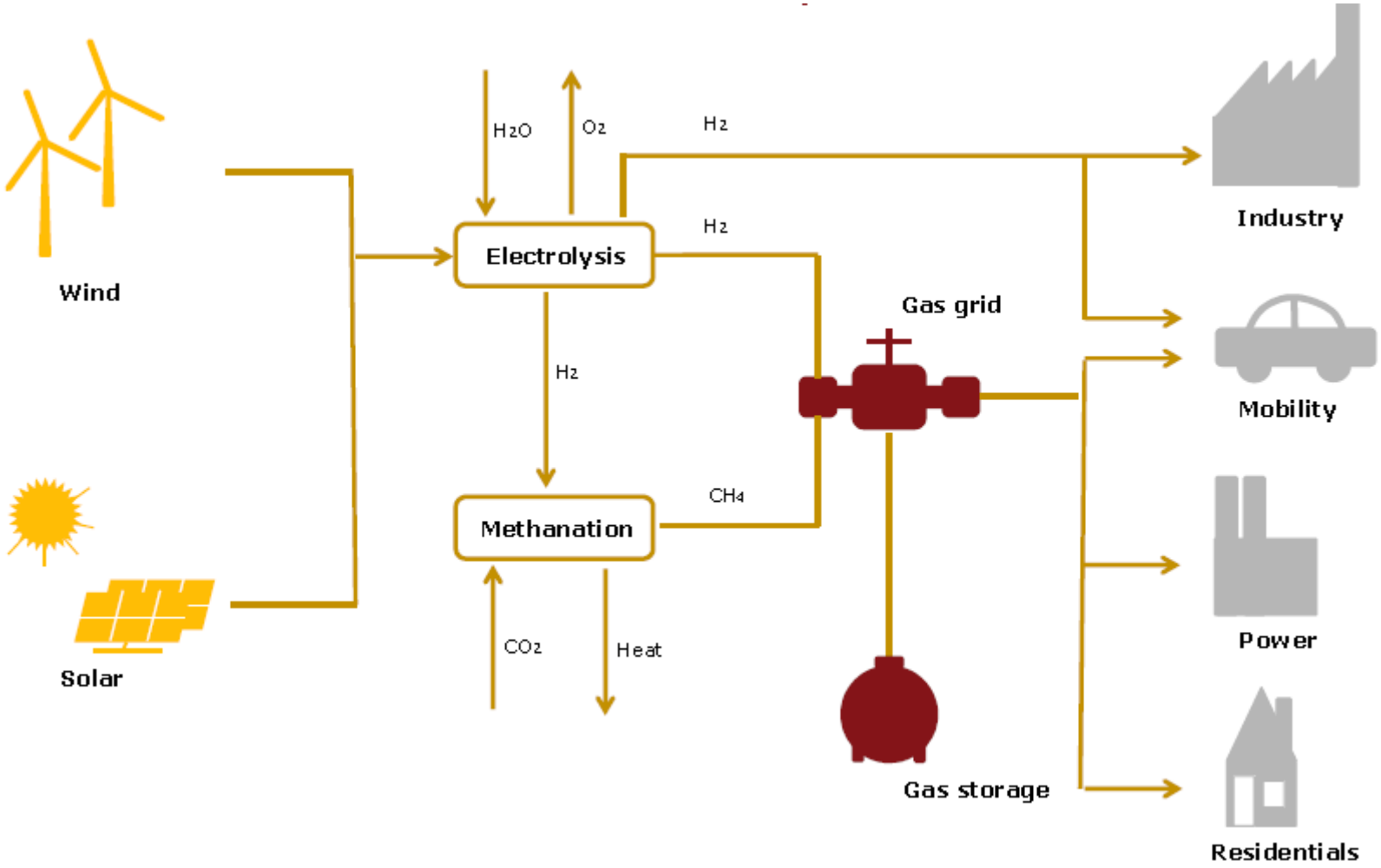
Quelle: DB Research

The mature energy storage technologies cannot offer a solution at scale for seasonal storage capability. Only Power-to-Gas (H_2 or SNG) can close this gap.



Fraunhofer

Power-to-Gas: conversion of electrical power into a gaseous energy carrier such as H_2 or SNG, with the purpose to utilize excess renewable power, store energy, provide long distance energy transportation, and produce a feedstock for industry or mobility.



However, the only element of the Power-to-Gas value proposition that could be monetized today is the energy content of the gas produced

Power-to-Gas Value Proposition

Integrate Renewables

Capacity Value

- Fast dynamic response to load follow profile of intermittent renewables
- Alleviates need for renewable capacity at peak demand levels

Infrastructure Value

- Capital deferral of T&D upgrades
- Reduced ramping of non-peak generators

Conversion by Electrolysis

Renewable Gas

Energy Value

- Hydrogen
- SNG

Climate Value

- Socio-economic costs
- Healthcare costs related to fine particles, etc.

Strategic Value

- EU energy independence
- Military and political cost to secure conventional fossil-rich supplies

There are a few speed bumps on the road to EU 20-20-20…

- Higher Surcharges
- Risk of Stranded Gas-Fired Generators
- Reduced System Flexibility
- Major Grid Build-out

…and Power-to-Gas can help achieve this mandate

E.ON inaugurated commercial operations of the world's first Power-to-Gas direct injection facility in Falkenhagen in August

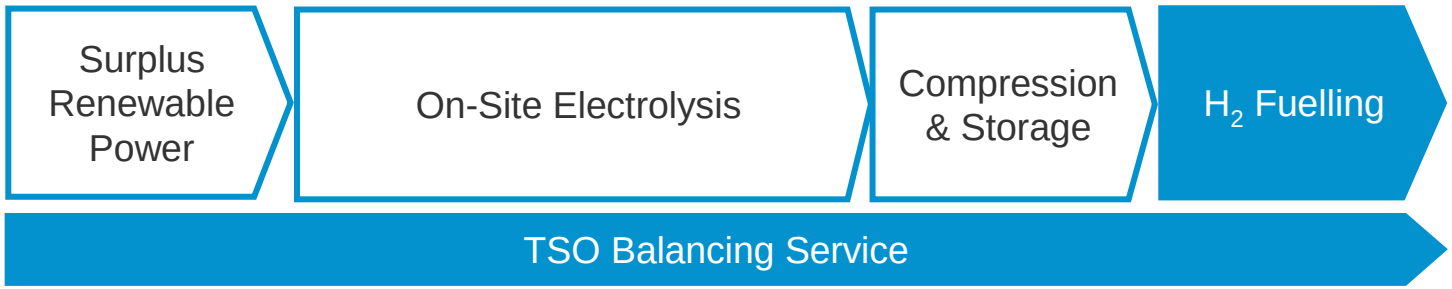
The value proposition for Power-to-Gas is compelling

Value Proposition	Direct Injection	H_2 Fueling Station	Industrial Hydrogen Feed	Biogas Methanation	Offshore Wind
TSO Balancing Service	●	●	●	●	
Flexible Deployment	●	●	●	●	●
Tx Grid Capital Deferral					●
Distributed Solution	●	●	●	●	●
Scalable Solution	●	●	●	●	●
Seasonal Storage	●			●	●
Energy Security	●	●	●	●	●

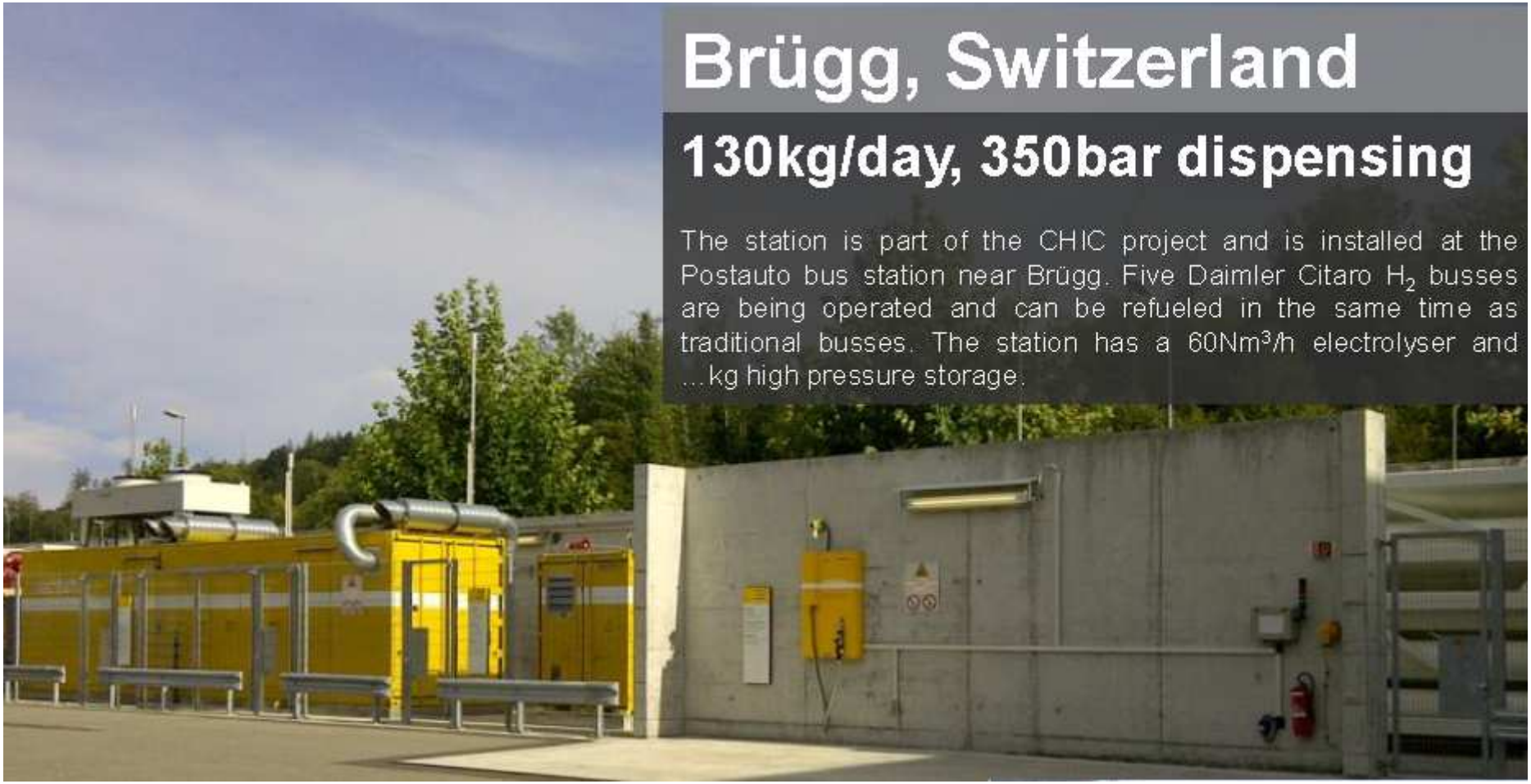
The distributed Power-to-Gas H_2 fueling station utilizes surplus renewable power and can provide a balancing service TSO—two revenue streams

Centralized SMR Plant Supply Chain

Distributed Power-to-Gas Supply Chain



Hydrogen Refuelling Station



Power-to-Gas demonstration plants today will drive commercial scale deployments in the future

Today…

Among the most proven and utilized technology

2 MW Alkaline

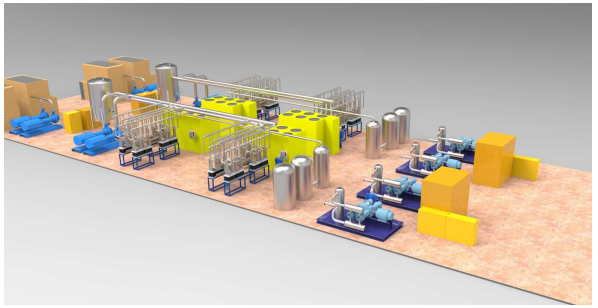
Needs…

Tailored for large scale energy storage

1 MW PEM

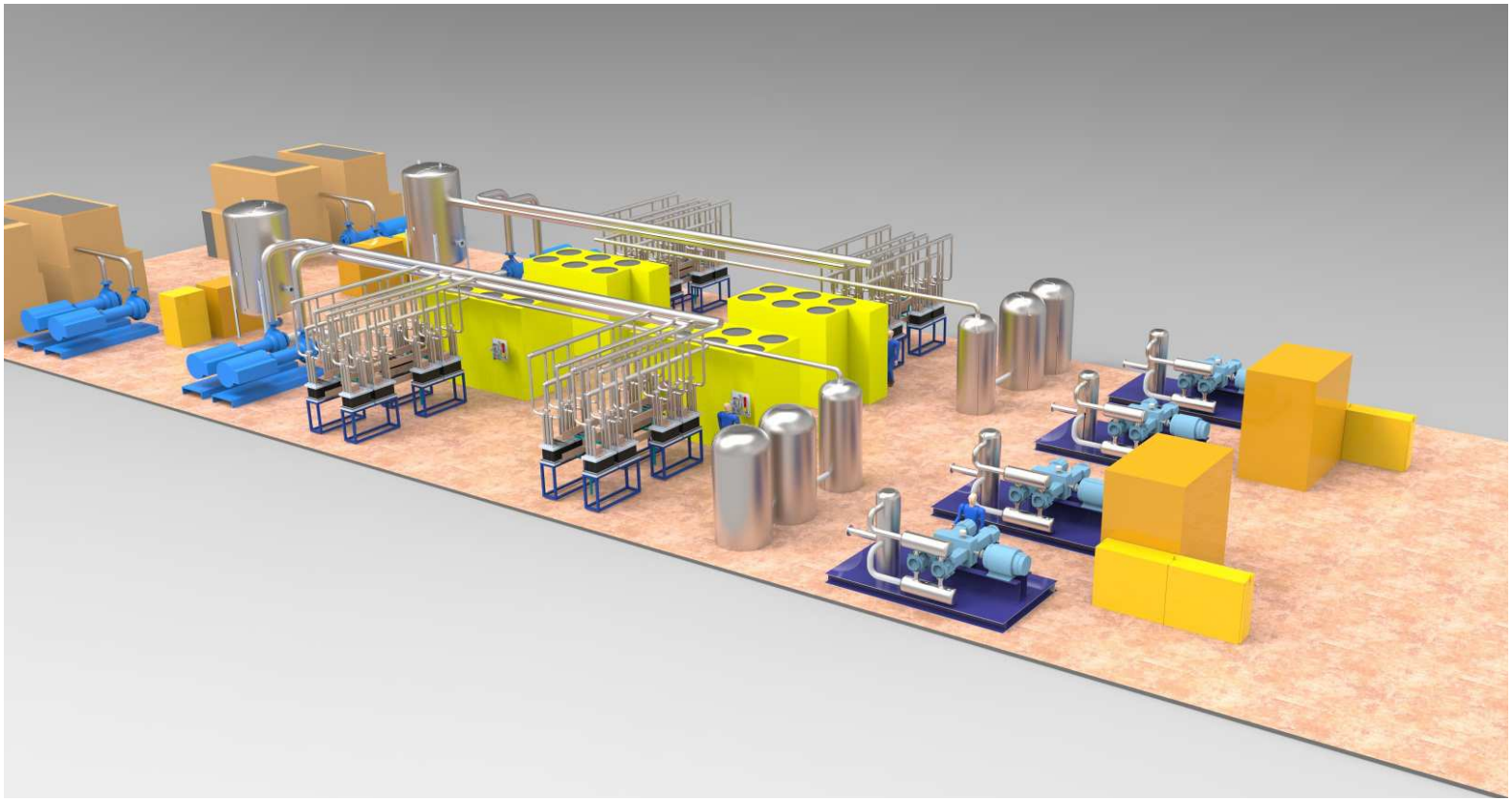
Future…

Advanced MW-scale GEN3 technology plant solutions



40 MW Plant

Illustration of a future 40 MW Power-to-Gas plant



Compact 60m x 25m footprint

Thank you.

Contact Information:

Filip Smeets
General Manager, Hydrogenics
fsmeets@hydrogenics.com