Electromobility and Infrastructure in Renewable Energy Systems

eMove360° Fuel Cell Conference

Jan Michalski

Ludwig-Bölkow-Systemtechnik GmbH (LBST)

Munich

17. October 2019

Both e-mobility technologies have different advantages and disadvantages

ludwig bölkow systemtechnik

In order to achieve the two degrees target the transport sector has to become emission free in the (near) future.

	Battery electric vehicles (BEVs)	Fuel cell electric vehicles (FCEVs)
Advantages	▪ Higher system efficiency → lower demand for renewable energy and costs ▪ Cheaper charging infrastructure (?)	▪ Short refueling time and large driving range ▪ Cheap and simple energy storage → "smooth sector integration" ▪ Comparatively simple transport of large energy quantities
Disadvantages	▪ Long charging time and small driving range ▪ Expensive and complex energy storage → "hard-wired system integration" ▪ Energy transport only via power grid	▪ Lower system efficiency → higher demand for renewable energy and costs ▪ Expensive hydrogen production via electrolysis (?) ▪ Expensive and rudimentary refueling infrastructure (?)

→ Can we combine the advantages of both technologies in an efficient way?

Comparison of the infrastructure costs for e-mobility in a future energy system based on two scenarios & cases

ludwig bölkow systemtechnik

What are the costs of an energy system including the BEV and FCEV supply infrastructure for different GHG emission reduction targets of…

80% (Scenario 1) and 95% (Scenario 2) in

- Case A: 100% BEVs → „All electric with H_2 re-electrification"
- Case B: 50% BEVs & 50% FCEVs → "Synergies BEVs und FCEVs"

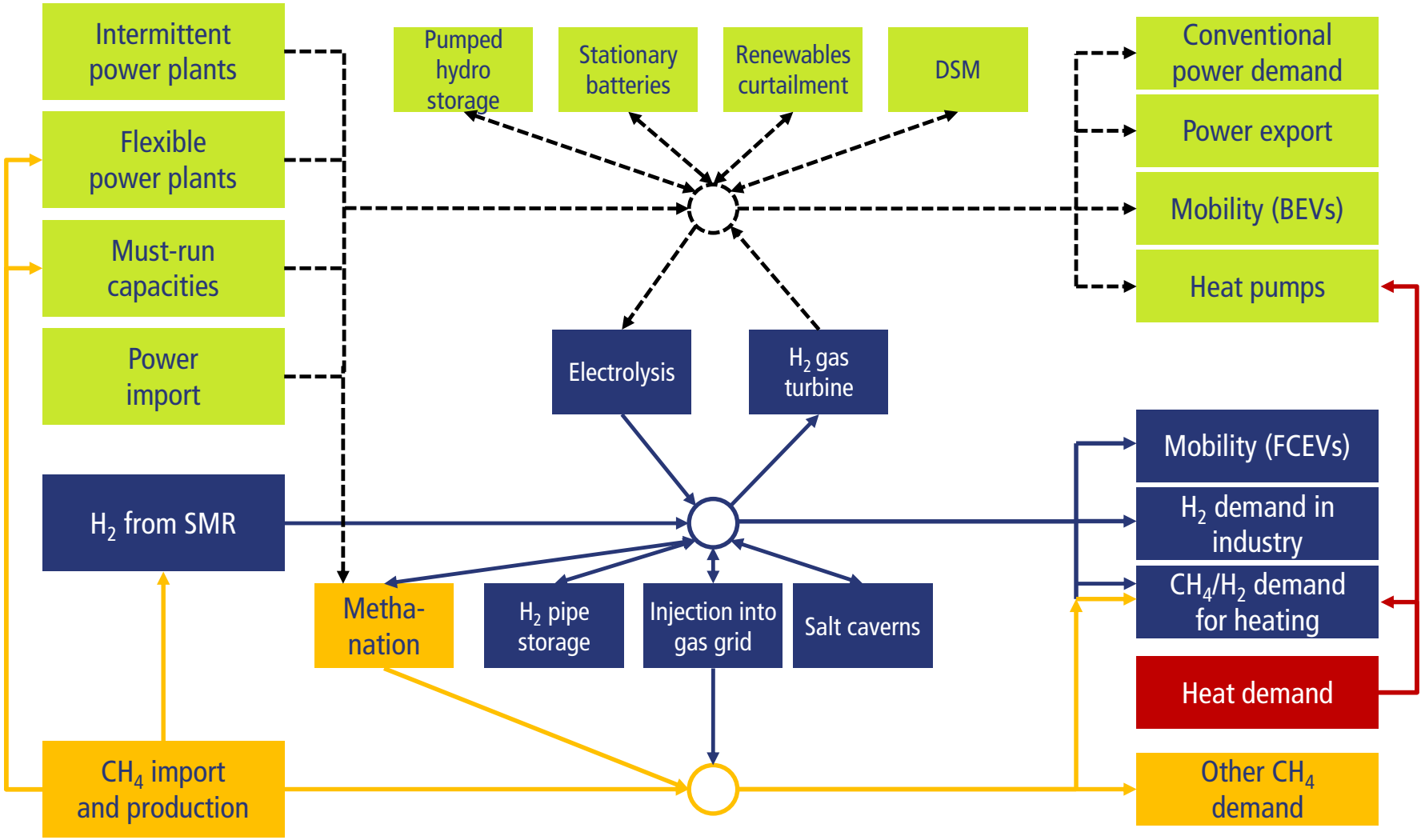
… based on an exemplary analysis for passenger cars* in Germany?

* Case A: 45.8 million BEVs in 2050
Case B: 22.9 million BEVs and 22.9 million FCEVs in 2050

Spatial modeling of different energy carriers in the context of sector coupling on an hourly basis

ludwig bölkow systemtechnik

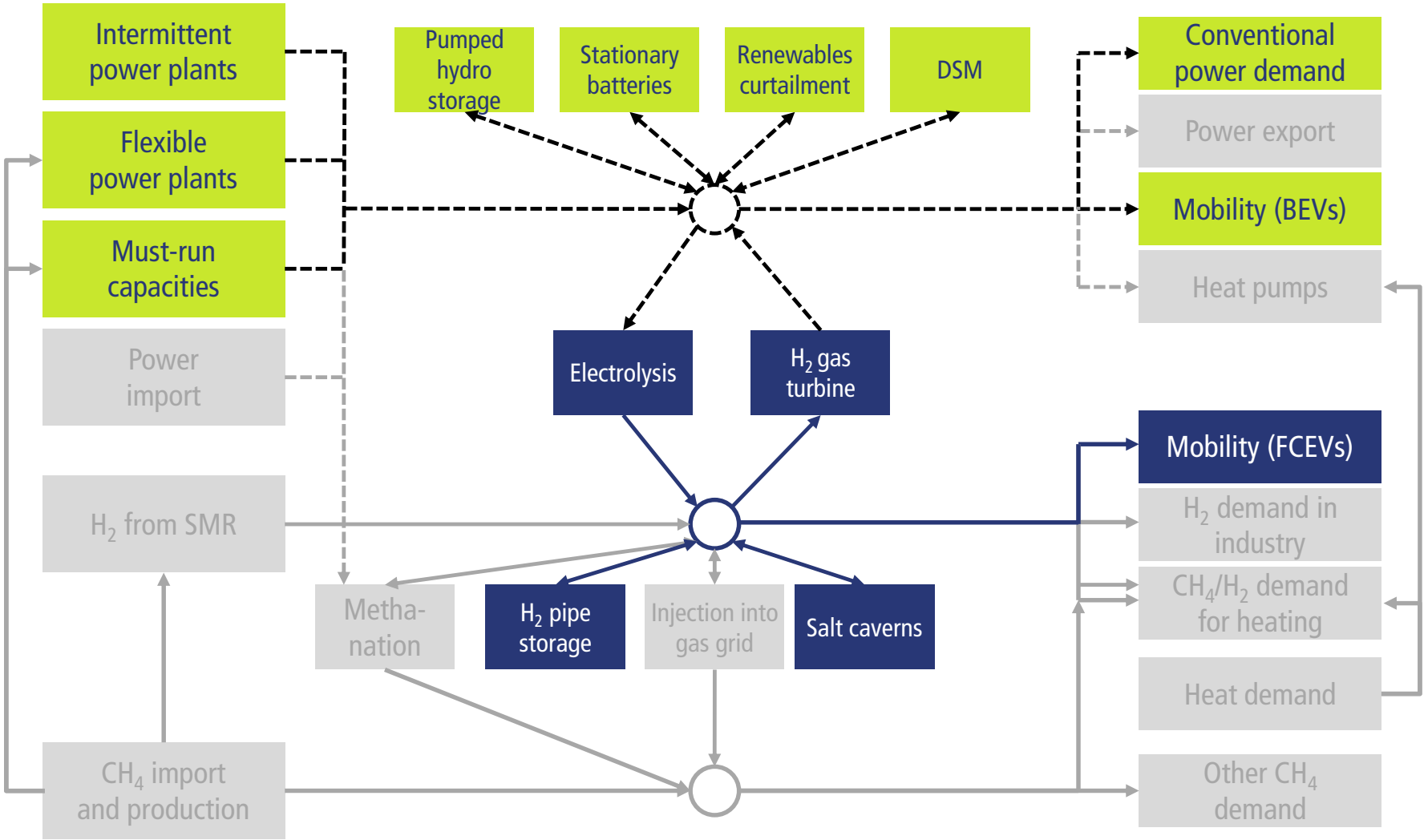
LBST Energy Systems Modelling Platform (LENS)



Spatial modeling of different energy carriers in the context of sector coupling on an hourly basis

ludwig bölkow systemtechnik

LBST Energy Systems Modelling Platform (LENS)

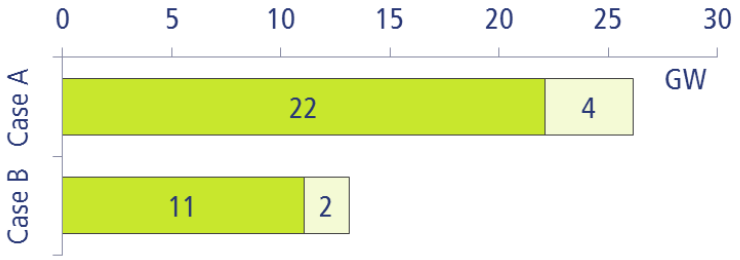


HRS infrastructure for FCEVs requires lower long-term investments than charging infrastructure for BEVs

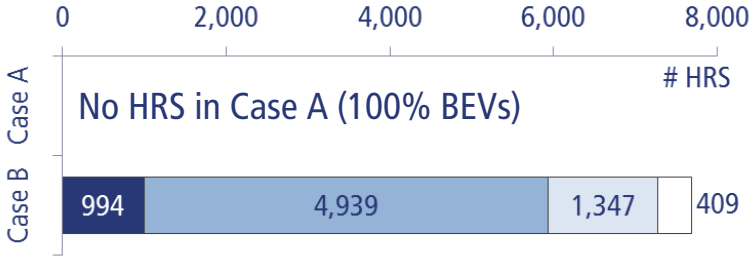
ludwig bölkow systemtechnik

Public charging/refueling infrastructure

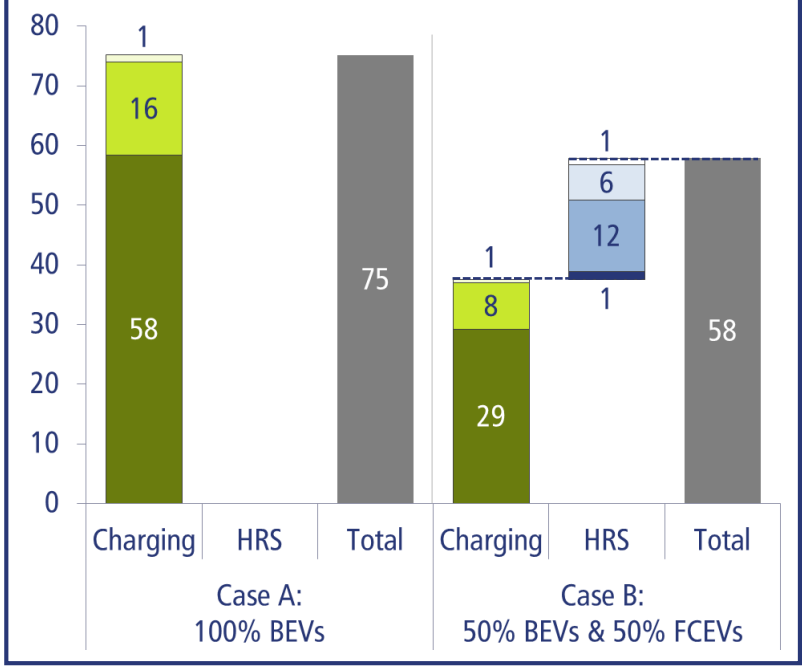
BEVs charging (installed capacity in GW):



FCEVs refueling (number HRS):



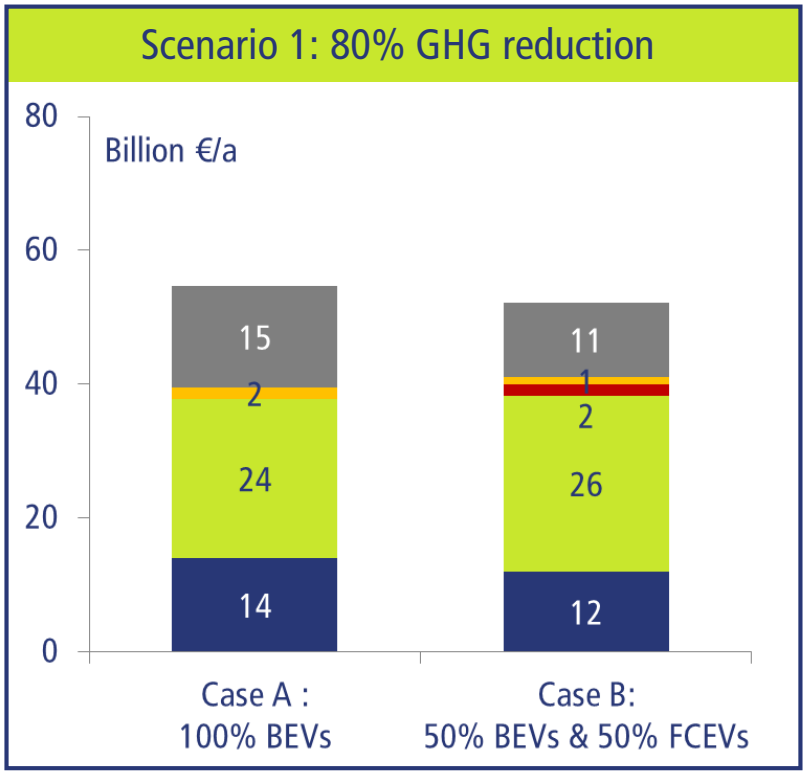
Total investment needs in billion €

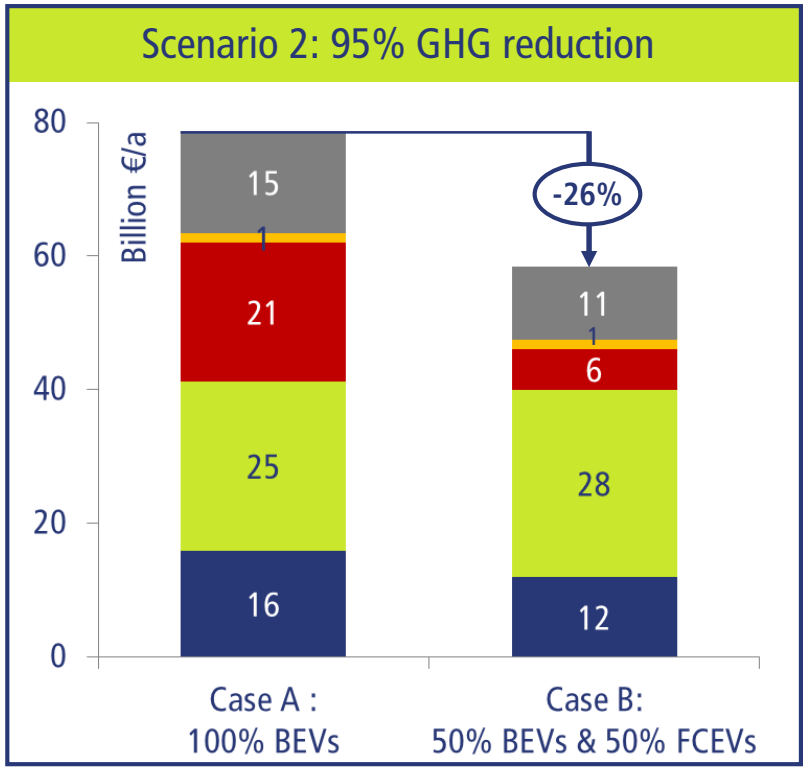


- Less than 8,000 HRS with an average size of ca. 800 kg_{H2}/d
- Long-term investments in charging/refueling infrastructure lower for FCEVs than for BEVs
- Major role of home charging (11 kW) assumed for 85% of BEVs at 1,500 €/unit but minor role of highways charging/refueling infrastructure for both alternatives

Combination of BEV and FCEV minimizes energy system costs due to synergy effects

ludwig bölkow systemtechnik





- Charging/refueling infrastructre
- Energy transport
- System flexibility (Storage, PtG, DSM)
- Intermittent power plants
- Flexible power plants (incl. re-dispatch)

- Lower energy system costs in Scenario 1 with a less strict GHG emission reduction target
- Significant structural differences between scenarios: large energy storage needs in Scenario 2
- Optimal solution through combination of the BEV and FCEV infrastructure due to synergetic use of electrolysis as a flexible load and seasonal energy storage but limited efficiency losses

Yes, we can combine the advantages of both technologies!

ludwig bölkow systemtechnik

- Parallel build-up of the charging and hydrogen refueling stations does not increase the total costs of the corresponding infrastructure.

- Combination of the BEV and FCEV infrastructure is an optimal solution from the system perspective due to synergetic use of electrolysis as a flexible load and seasonal energy storage but limited efficiency losses.

→ **BEVs and FCEVs should not compete against each other but contribute together to the German "Energiewende" (energy transition)!**

- Open research questions:
  - Analysis of the synergies in the context of sector integration with other energy sectors
  - Cost analysis for power distribution grid and hydrogen delivery to the end user
  - Energy imports for a full decarbonization of the energy system

Contact LBST

Dr. Jan Michalski
Project Manager

T: +49 (0)89 608110-18
E: Jan.Michalski@lbst.de

LBST · Ludwig-Bölkow-Systemtechnik GmbH
Daimlerstr. 15 · 85521 München/Ottobrunn · Germany

www.lbst.de