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electricity storage at an unrivalled cost level

Webinar 20 mei 2021
Storage meets Engineers (ESNL en KIVI)

Content of this webinar

Background – The Elestor Flow Battery

Integrating a H-Br flow battery with Hydrogen

Technical challenges

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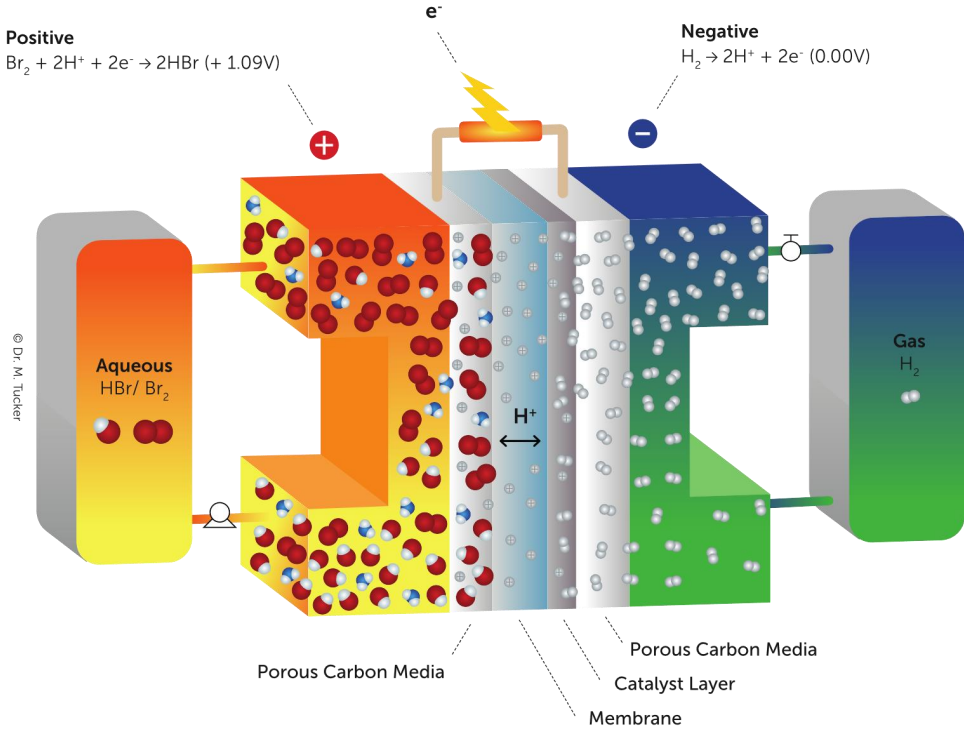
Background | Launching a technology

- For large scale, stationary electricity storage
- Applications:
  - Combined with large PV and Wind
  - Substitute for peaking power plants
- Fully modular, up to GW/GWh range
- Based on:
  - Flow battery technology
  - Active materials: Hydrogen & Bromine

discharge: fuel cell

$$H_2 + Br_2 \rightleftharpoons 2HBr + \text{Electrical energy}$$

charge: electrolyser



ELESTOR'S MISSION:

Targeting the lowest possible storage costs per MWh

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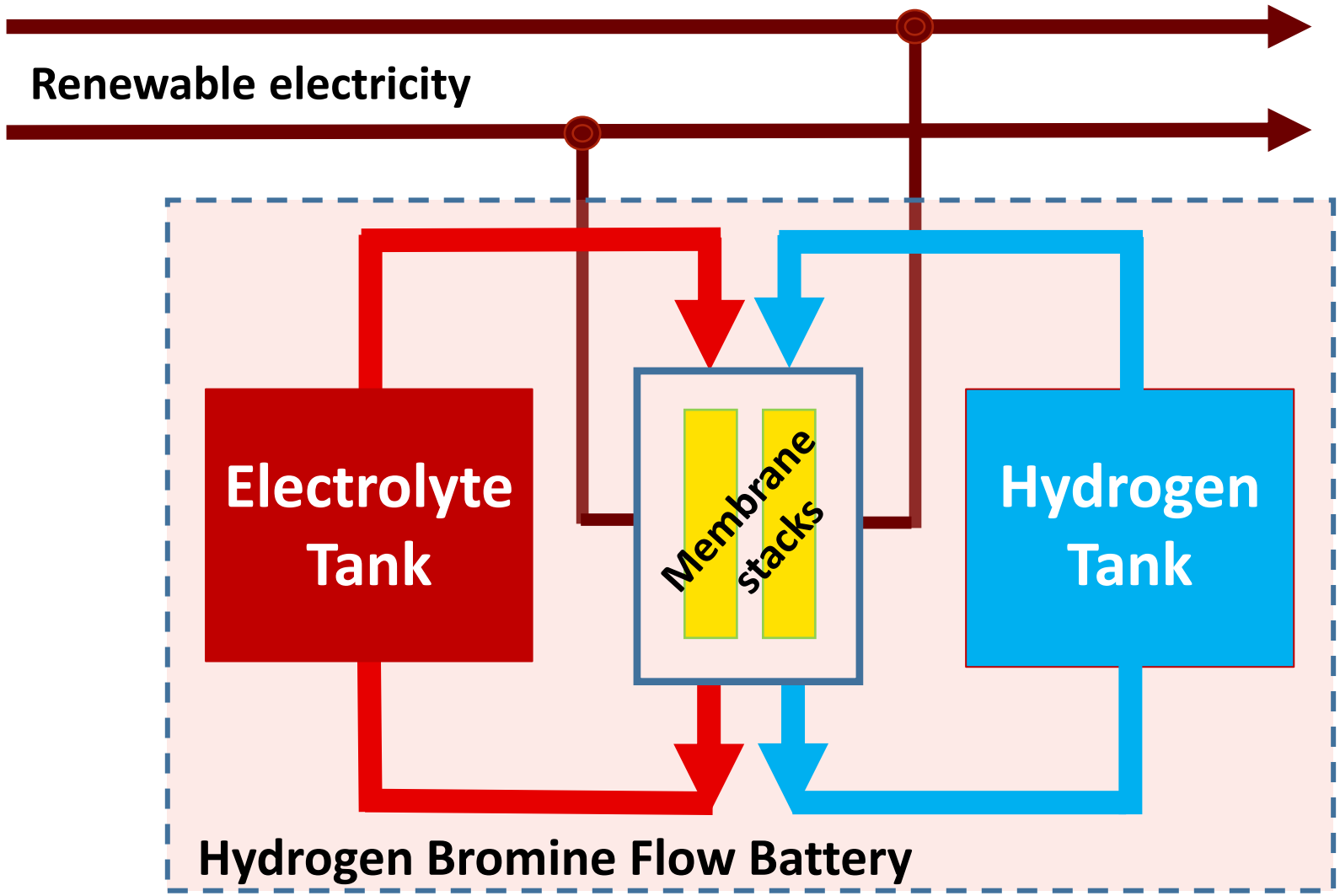
Hydrogen-Bromine Flow Battery



✓**Electricity storage** based on Hydrogen Bromine Flow Battery technology

✓**Consists of**

- Electrolyte tank
- Hydrogen tank
- Membrane stacks

✓**Enables** electricity storage at an unrivalled cost level (LCoS)

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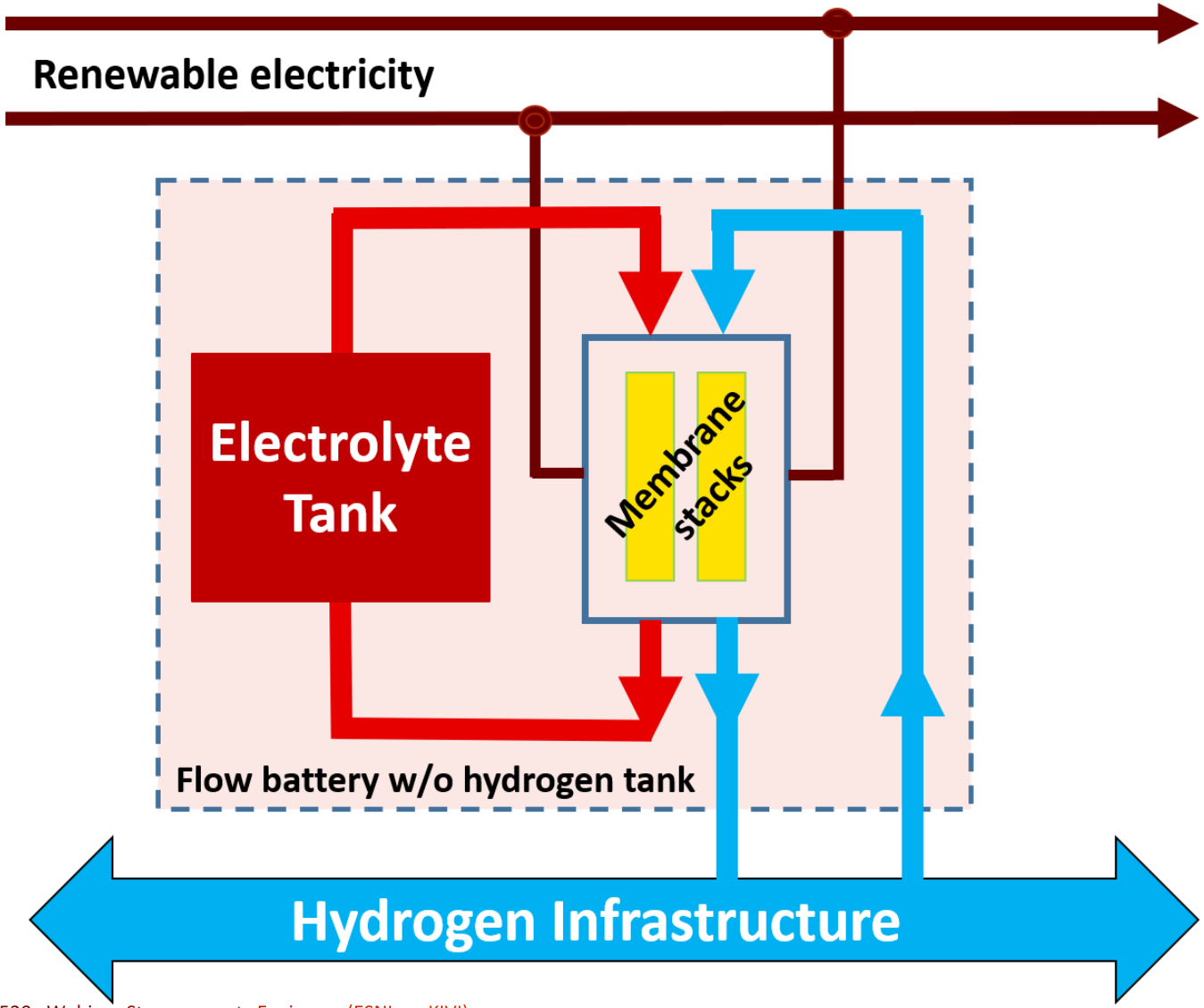
Unique link with hydrogen



- ✓ **Connects** electricity storage with hydrogen infrastructures
- ✓ **Hydrogen infrastructure** serves as 'hydrogen tank' (with zero effect on infrastructure)
- ✓ **Reduces**
  1) Battery capex
  2) Storage costs
  3) System size
- ✓ **Introduces** new optimization options

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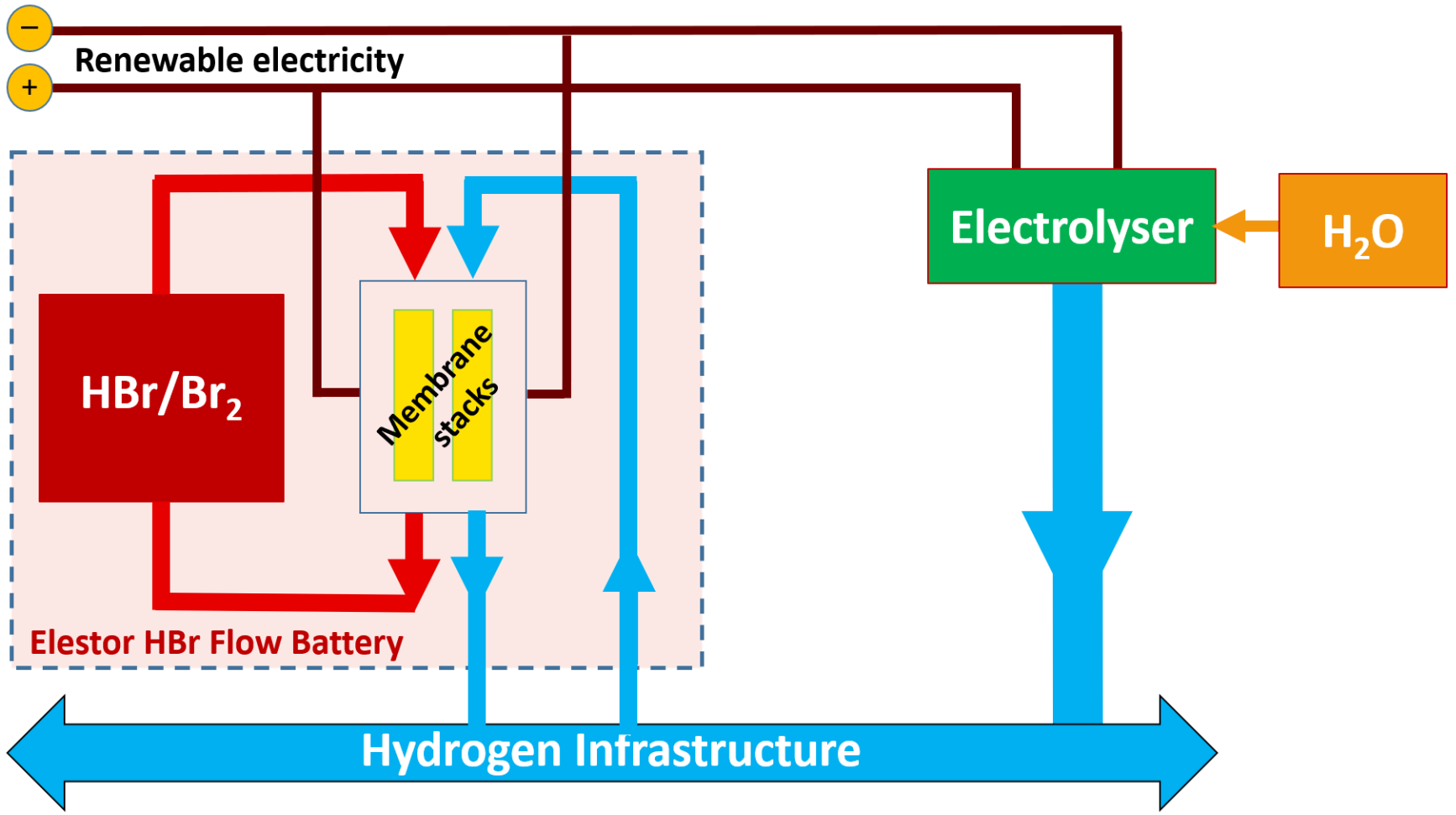
… even integrated with electrolysis



- ✓ **Integrates** electricity storage & hydrogen production
- ✓ **Maximizes** electrolyser utilization
- ✓ **Improves** electrolyser reliability
- ✓ **Reduces** capex of the HBr flow battery
- ✓ **Reduces** storage costs per kWh (LCoS) *further*

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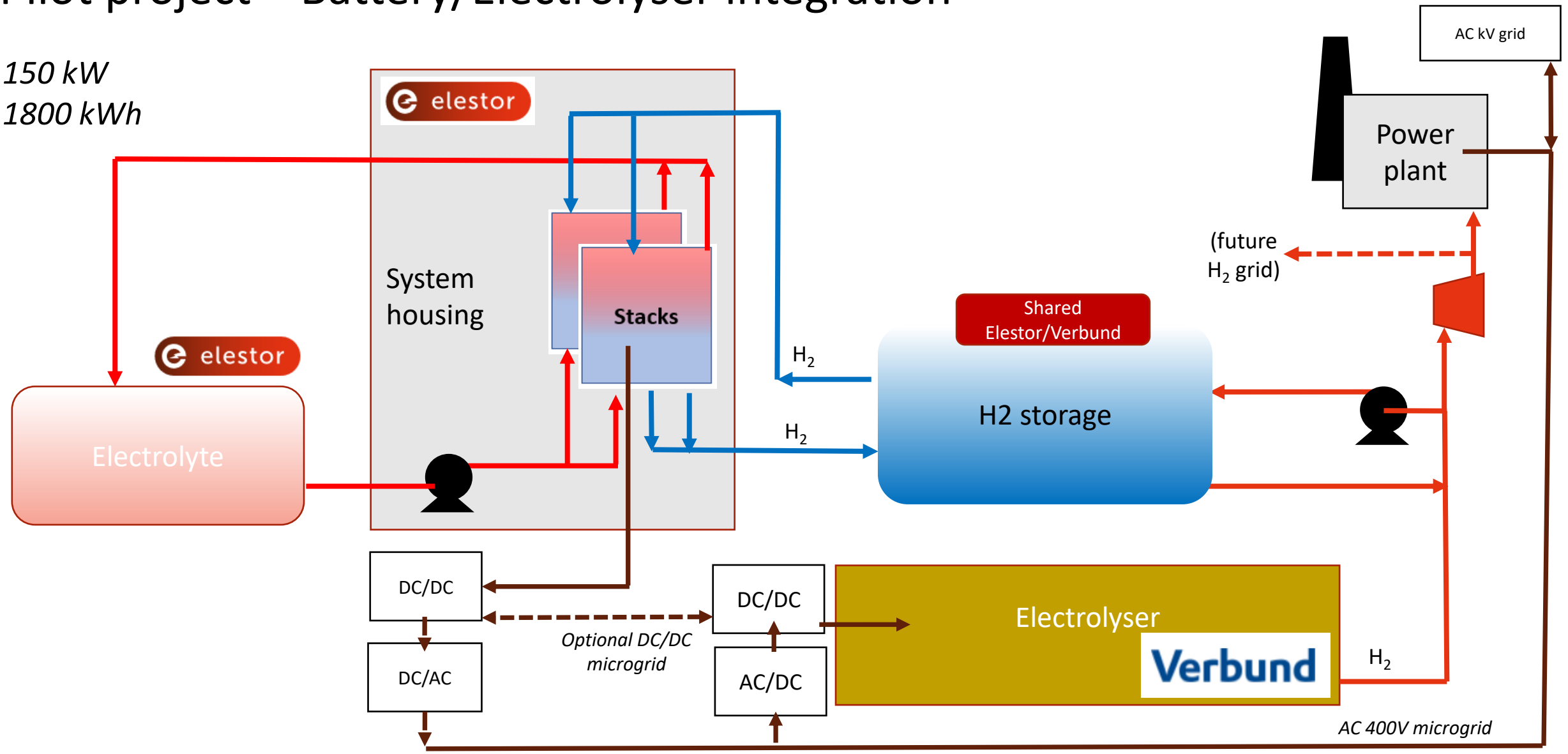
Pilot project – Battery/Electrolyser integration

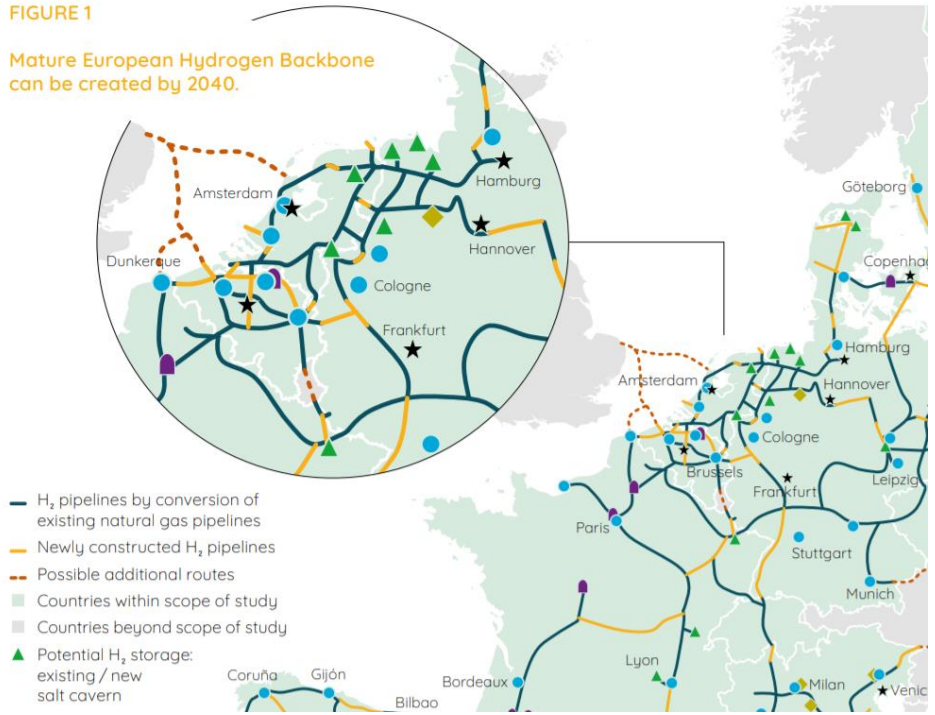
150 kW
1800 kWh



Technical Challenges - Integration with Hydrogen

- **Hydrogen infrastructure**: how will it look like?
  - Specifications (composition, pressure, materials of construction)
  - Locations – hype or hope?
  - Public vs. private H_2-networks
  - (inter)national codes under developments
- **Safeguarding & Materials Selection**
  - From battery to H_2-grid
  - From H_2-grid to battery
- **System control** – EMS vs. BMS
- **Electrical infrastructure**
  - Local HVDC vs. AC-grid

Example of plan for Hydrogen backbone



Source: gasforclimate2050.eu/ehb/

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Take-away

- Promising development: combination of
  grid scale Hydrogen-X flow battery with Hydrogen infrastructure
- Reduced Levelized Cost of Storage (Battery)
  &
  Reduced H_2 production costs (Electrolyser)
- Improved overall efficiency (battery & electrolyser)
- Technical complex, but no show-stoppers
- Key: develop specifications for
  Hydrogen infrastructure(s)

FACT:

The LCoS is decisive for the impact of storage on the energy transition


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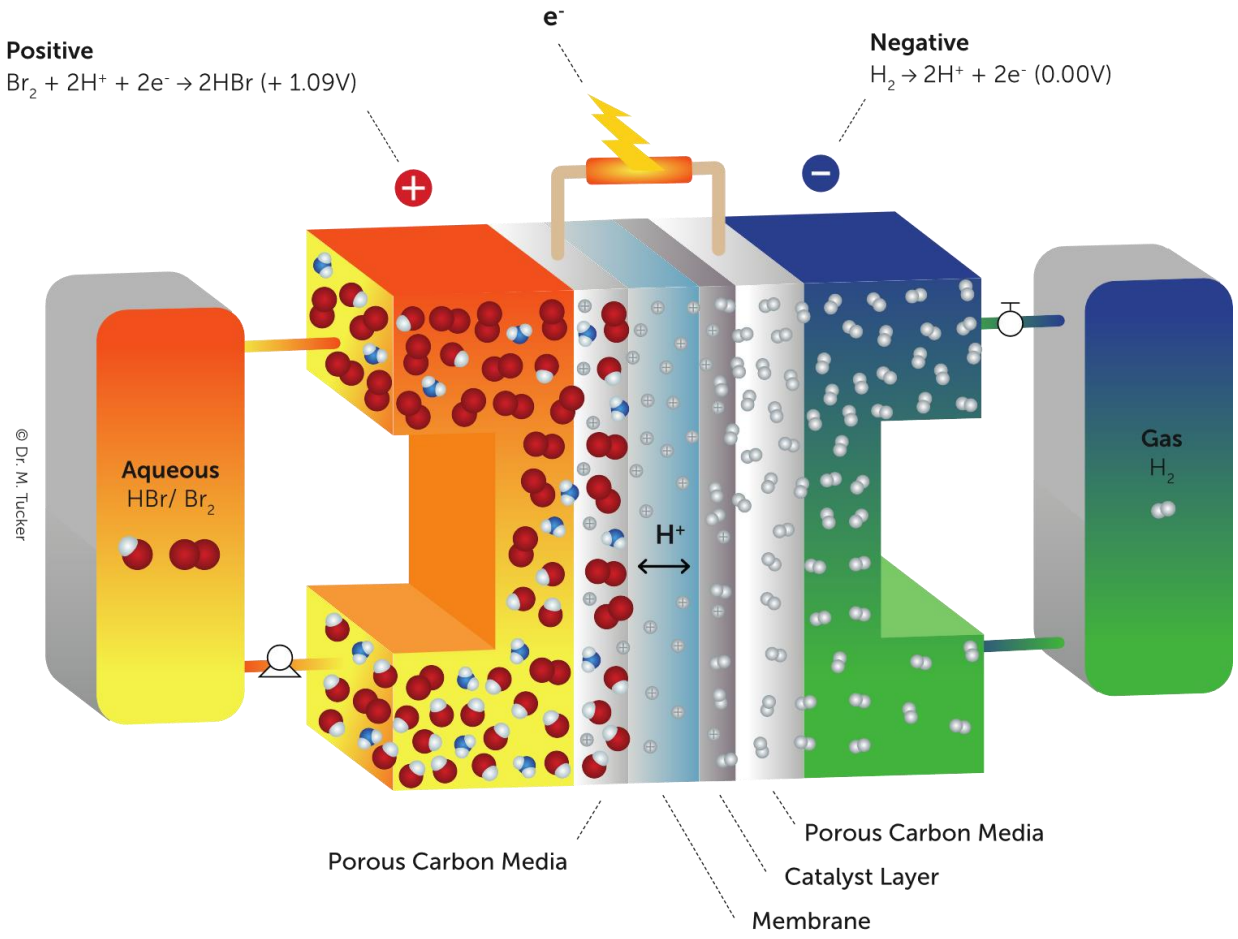
Questions?

Back-up slides

Technology: Combined Electrolyser and Fuel Cell



discharge: fuel cell

$$H_2 + Br_2 \rightleftharpoons 2HBr + \text{Electrical energy}$$

charge: electrolyser

Power and Capacity are not coupled

- Membrane surface area → Power [MW]
- Active material volumes → Capacity [MWh]

Virtually every thinkable combination is possible

100% reversible chemical reaction

- Chemicals are used, not consumed
- No refill during lifetime necessary
- Negligible loss of capacity during lifetime

FACT:

Reduces the LCoS to < € 50 / MWh

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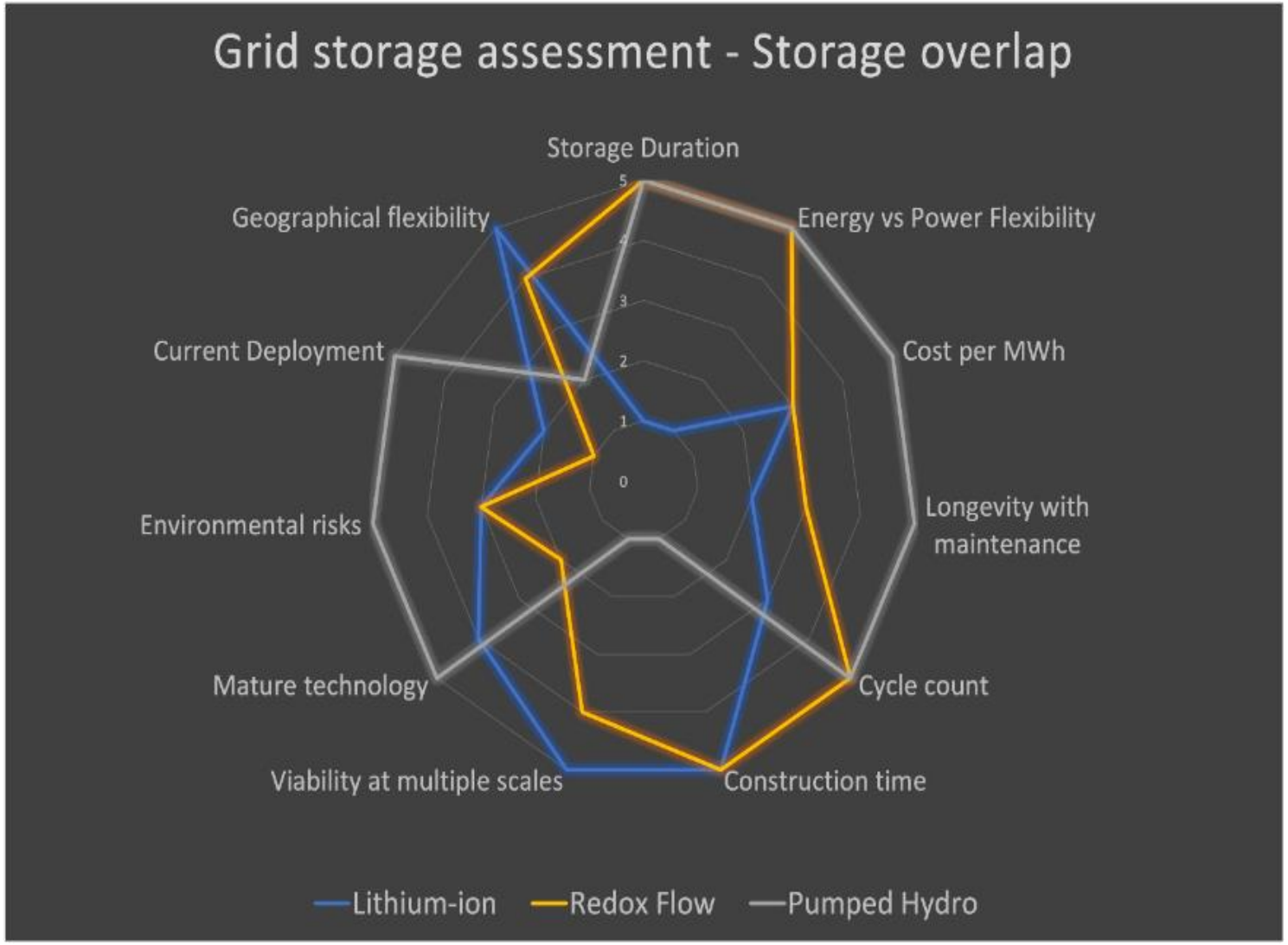
Competitive advantage grid storage



[1] Only when these 3 technologies are considered do we see the full spectrum of grid storage requirements being met

- Lithium-ion's limitations are balanced by pumped hydro storage
- Pumped hydro storage's challenges are balance by lithium-ion

But redox flow batteries fill up all of the gaps and more

[1] https://cleantechnica-com.cdn.ampproject.org/c/s/cleantechnica.com/2021/04/23/grid-storage winners-part-1-assessing-the-major-technologies/amp/

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Competitive advantage grid storage

Technology	Uncoupled MW/MWh	Capex €/MWh	LCoS €/MWh	Siting limits	Efficiency	Recycling	Intrinsic safety
Pumped Hydro	√√	√	√√	xx	√	√√	√
Li-ion	xx	√√	≈	√√	√	xx	≈
Vanadium RFB	√√	Xx	xx	√	≈	√	≈
Elestor HBr RFB	√√	√√	√√	√	≈	√	≈

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“We will make electricity so cheap
that only the rich will burn candles”

Thomas A. Edison