Hyrdogen via Electrolytic Processes

Chemical Storage for the Grid

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ESIG Hydrogen Tutorial
March 21, 2022

Decarbonization Pathways Enabled by Innovation

Decarbonization

Accelerate economy-wide, low-carbon solutions

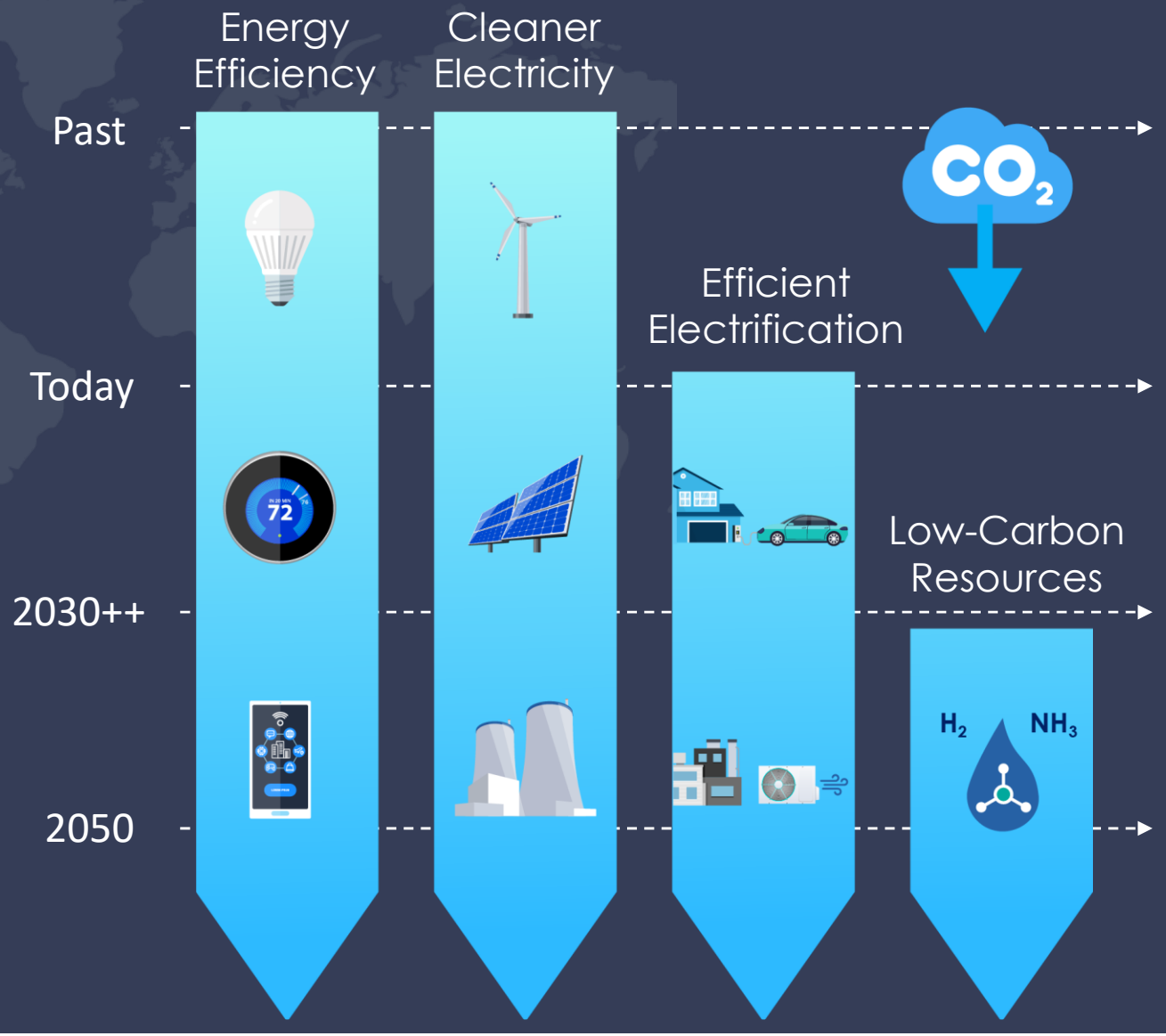
- Electric sector decarbonization
- Transmission and grid flexibility: storage, demand, EVs
- Efficient electrification

~10-15 years

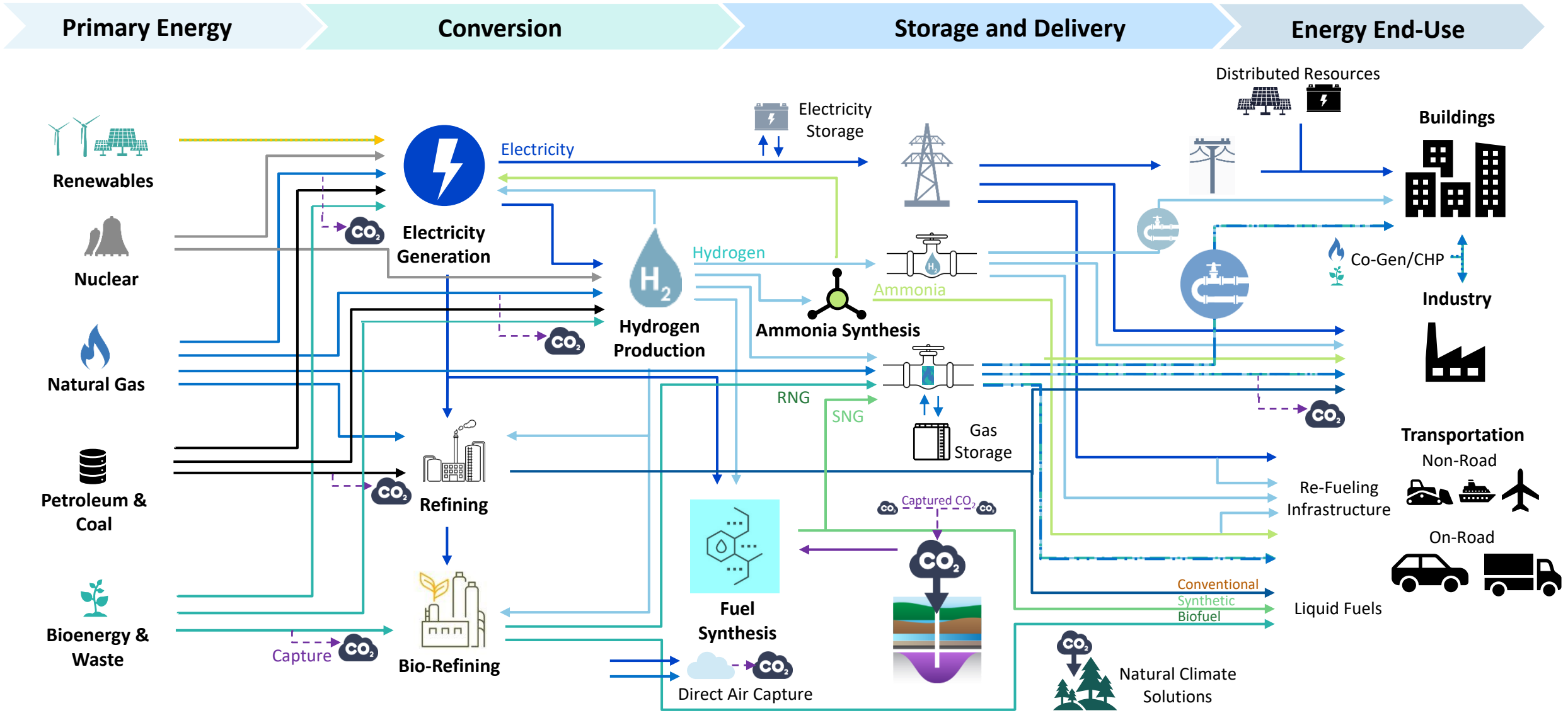
Achieve a net-zero clean energy system

- Ubiquitous clean electricity: renewables, advanced nuclear, CCUS
- Negative-emission technologies
- Low-carbon resources: hydrogen and related, low-carbon fuels, biofuels, and biogas

~15-30 years



Economy-Wide Low-Carbon Energy Pathways



New Targets for Hydrogen

ENERGY earthshots | Hydrogen
U.S. DEPARTMENT OF ENERGY

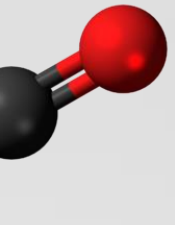
1 Dollar

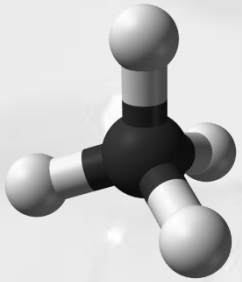
1 Kilogram

1 Decade

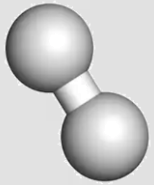
https://www.energy.gov/articles/secretary-granholm-launches-hydrogen-energy-earthshot-accelerate-breakthroughs-toward-net

Steam Methane Reformation

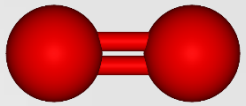


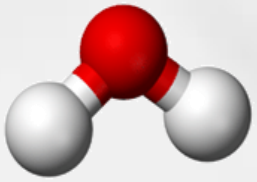


CH_4 + Steam → CO_2 + H_2

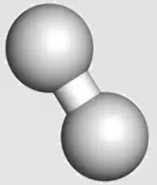


Water Electrolysis



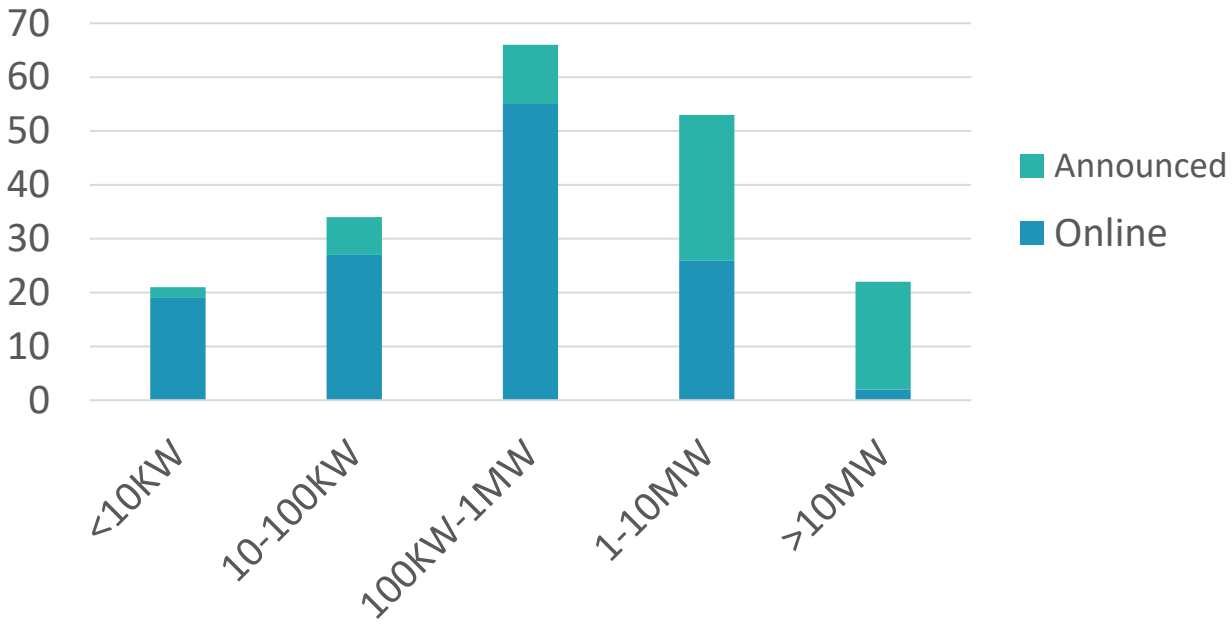


H_2O + Electricity → O_2 + H_2

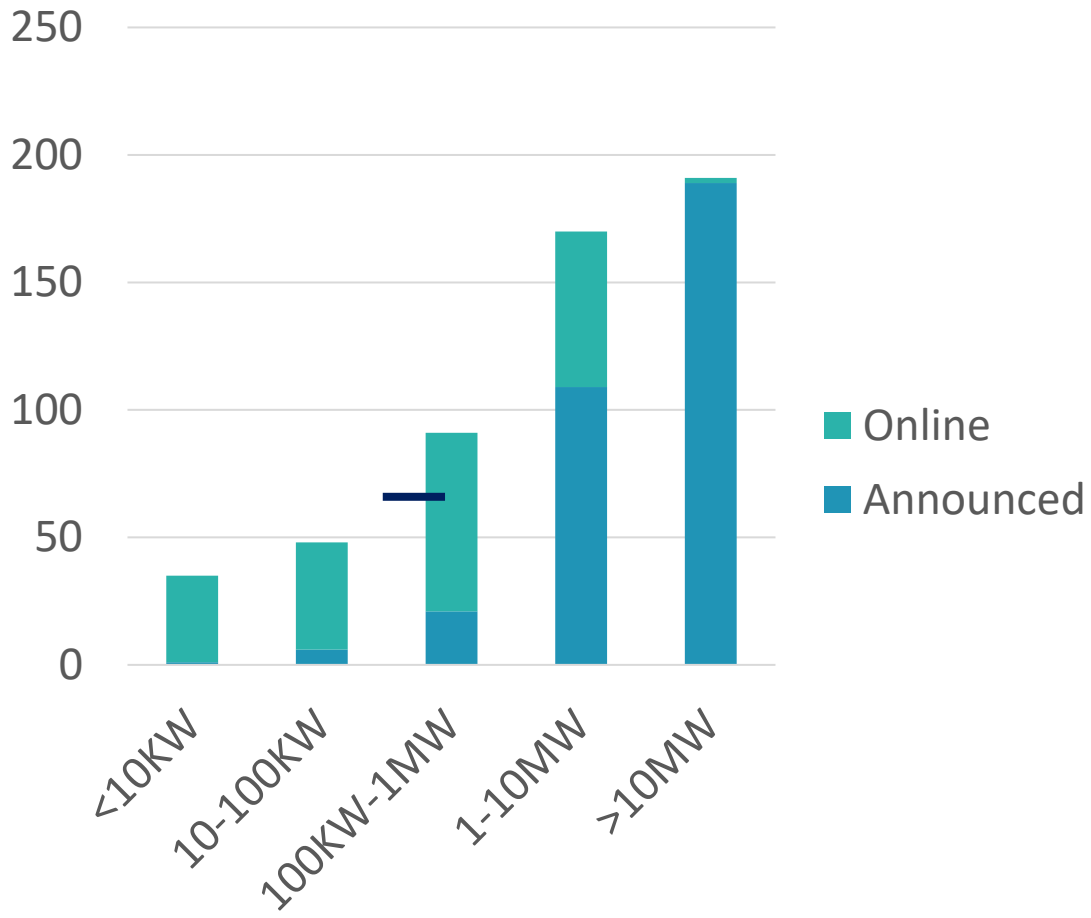


Electrolyzer Projects Took off Worldwide

IEA Projects Oct 2020



IEA Projects Oct 2021



Changing Generation

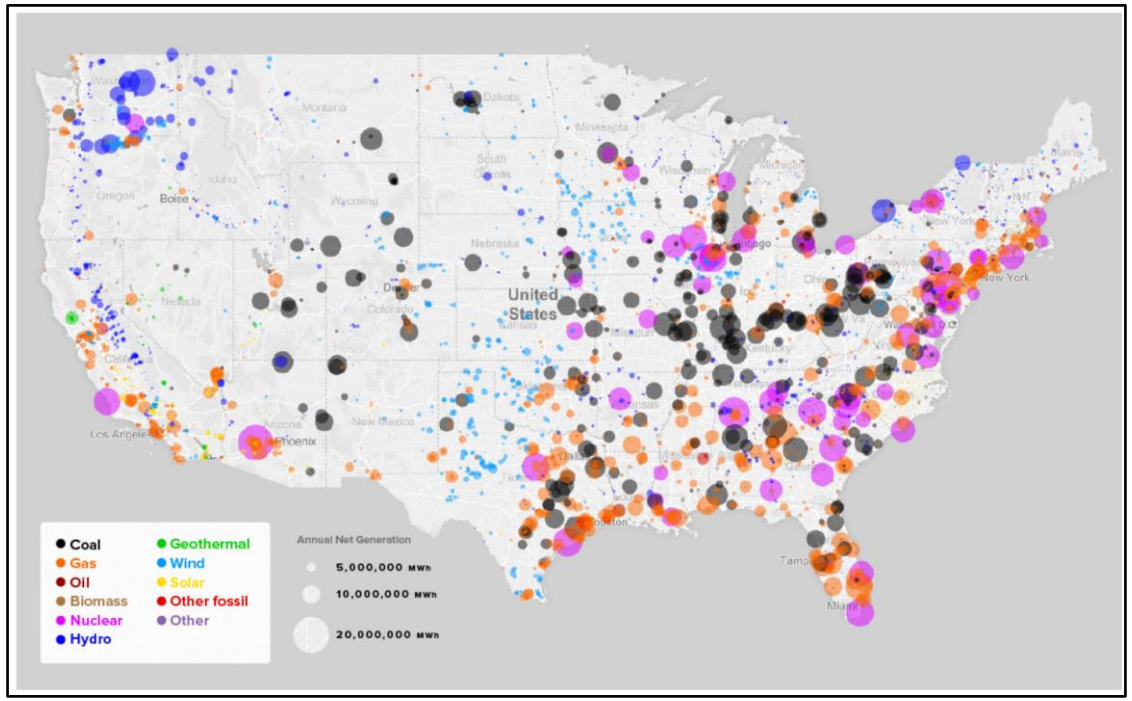
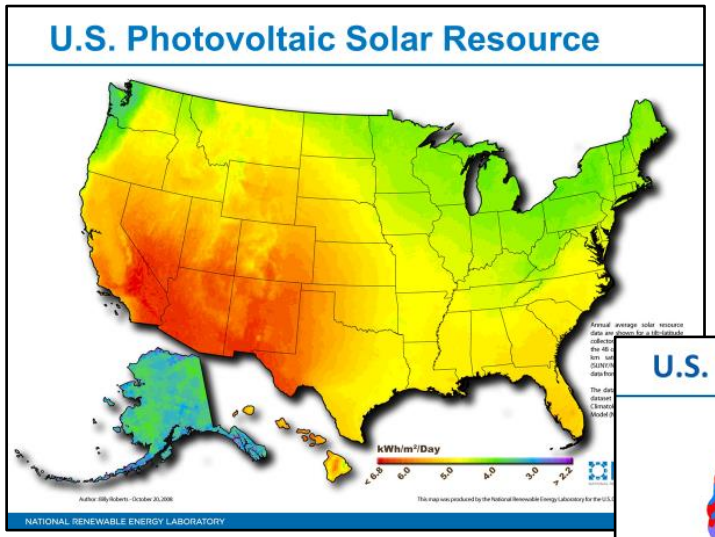
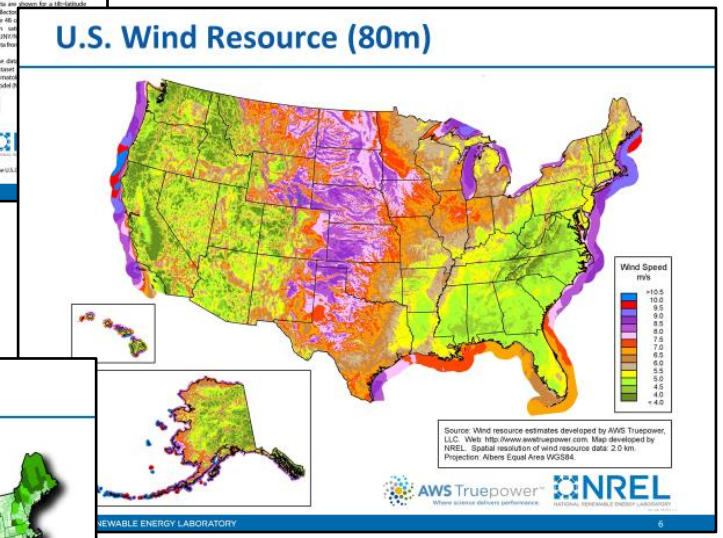


Image: Visual Capitalist, January 2019





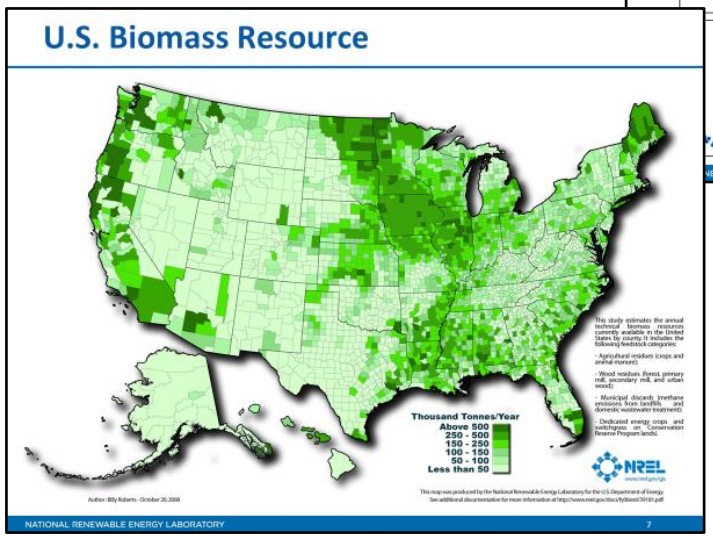


Image: NREL Renewable Technology Potential

CARBON-FREE ENERGY FOR MANUFACTURING AND INDUSTRY

Slide borrowed from Clifford Ho, SNL

Energy StorM Workshop Intro

Make → Move → Store → Use

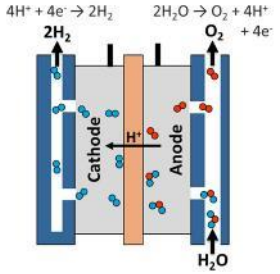
Electrical

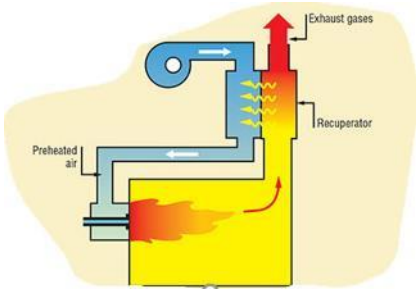



Thermal




Chemical

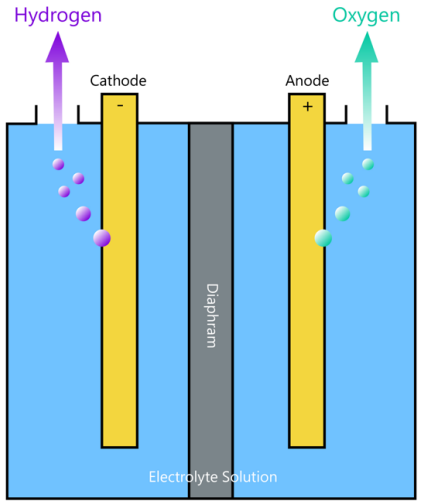


Commercial Electrolysis Technologies

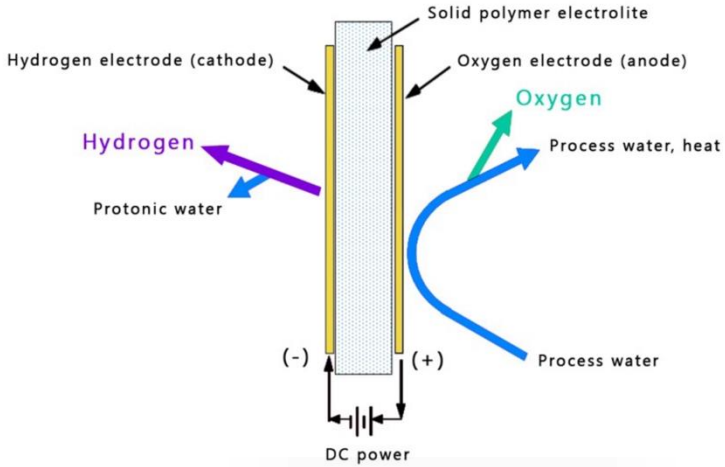
Alkaline

Liquid KOH electrolyte



2.25 MW alkaline stack

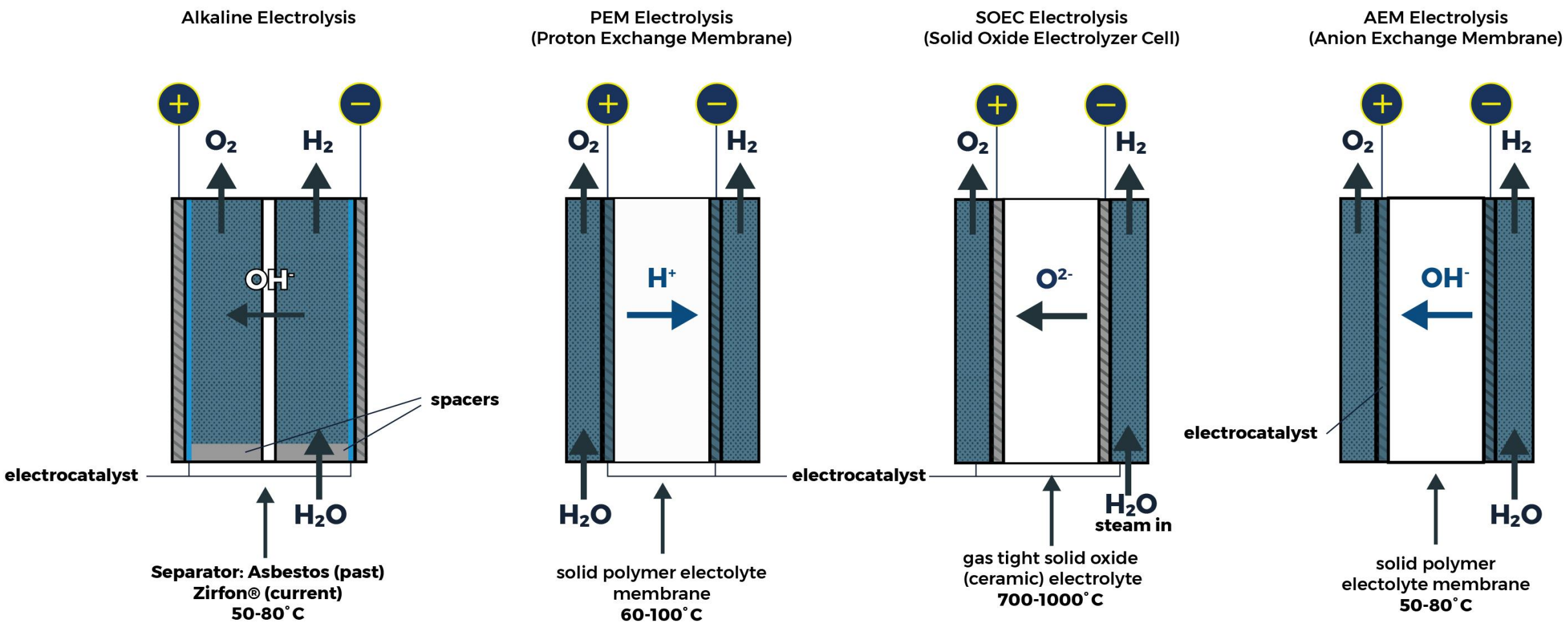
Proton Exchange Membrane (PEM)



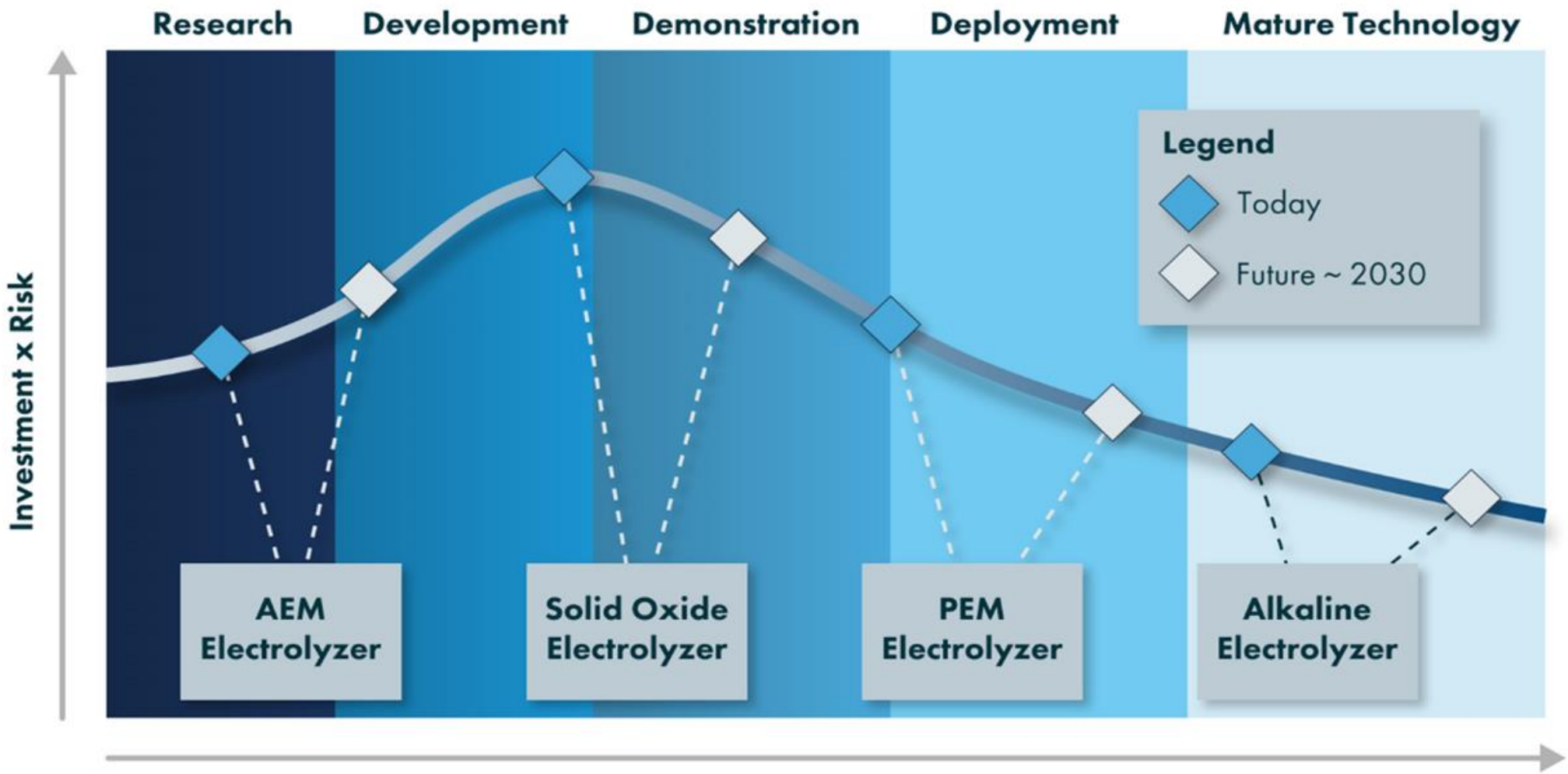
Solid polymer electrolyte

1.25 MW PEM Stack

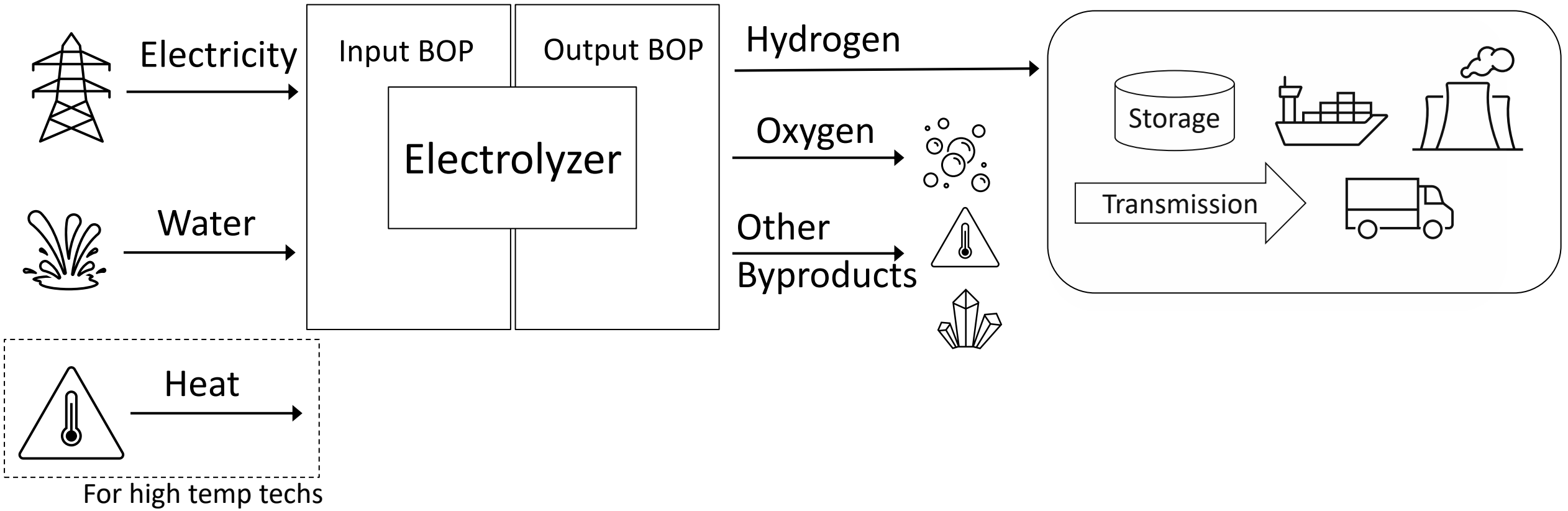
Major Electrolysis Technology Types



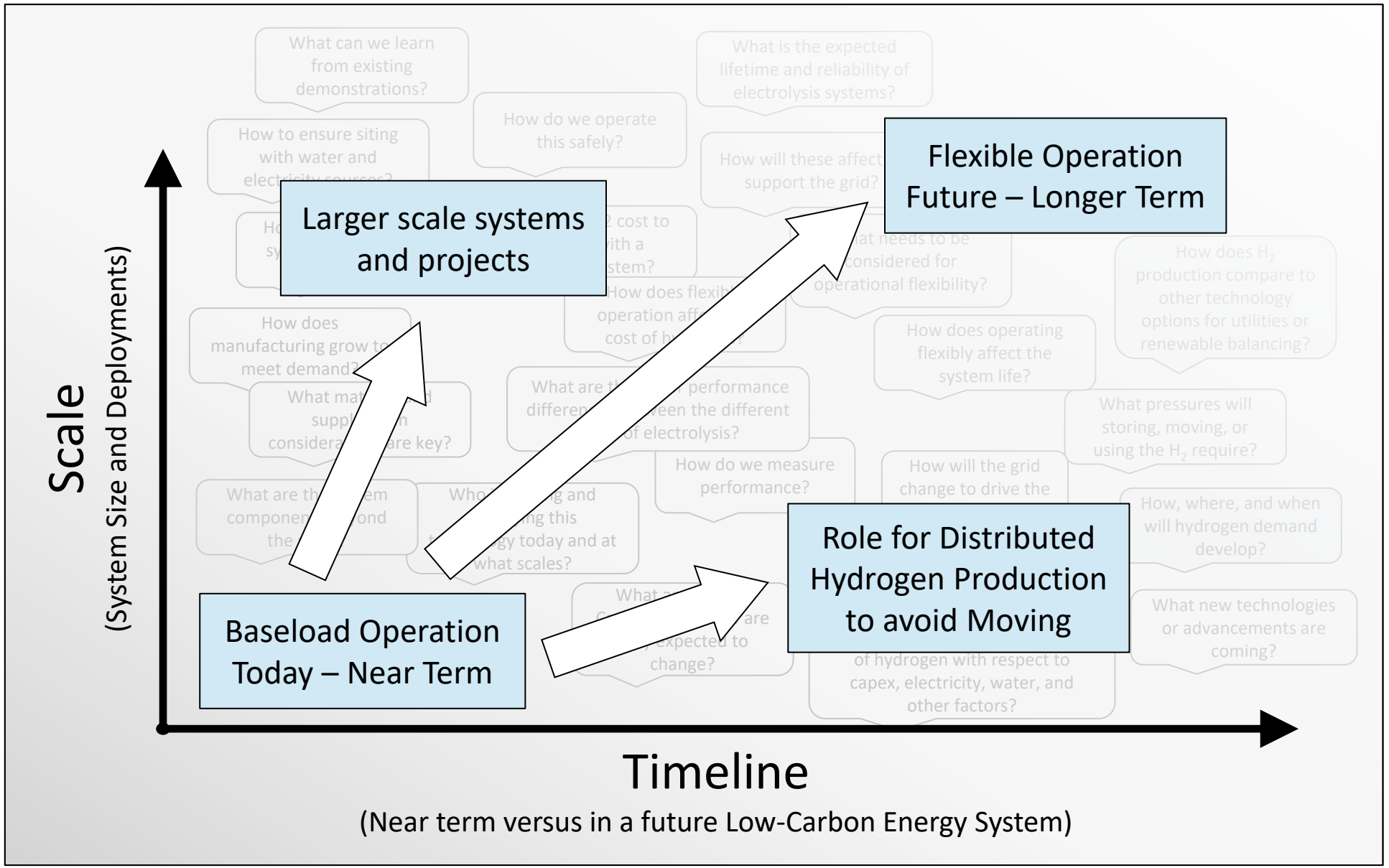
Status of Major Technology Types



Electrolytic Hydrogen Production



Research Questions, Drivers, and Project Plan to Investigate



2022 Electrolysis TSC Projects

1. Balance of Plant Components
2. Power Quality – Grid Integration
3. Vendor Presentations on Product Systems
4. Operations and Maintenance Overview
5. Water Siting and Use Considerations
6. Safety Considerations
7. Technoeconomic Analysis
8. Hydrogen Production Performance (Baseload and Flexible)
9. System Degradation
10. Flexible Operations
11. Technology Scouting

Working to Understand Electrolytic Hydrogen Production

PERFORMANCE COST LIFETIME

In the context of member decision making.

Portfolio Planning → Economic Fit → Project Design → Procurement → Operations → End-of-Life

To meet future Low-Carbon goals.

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