

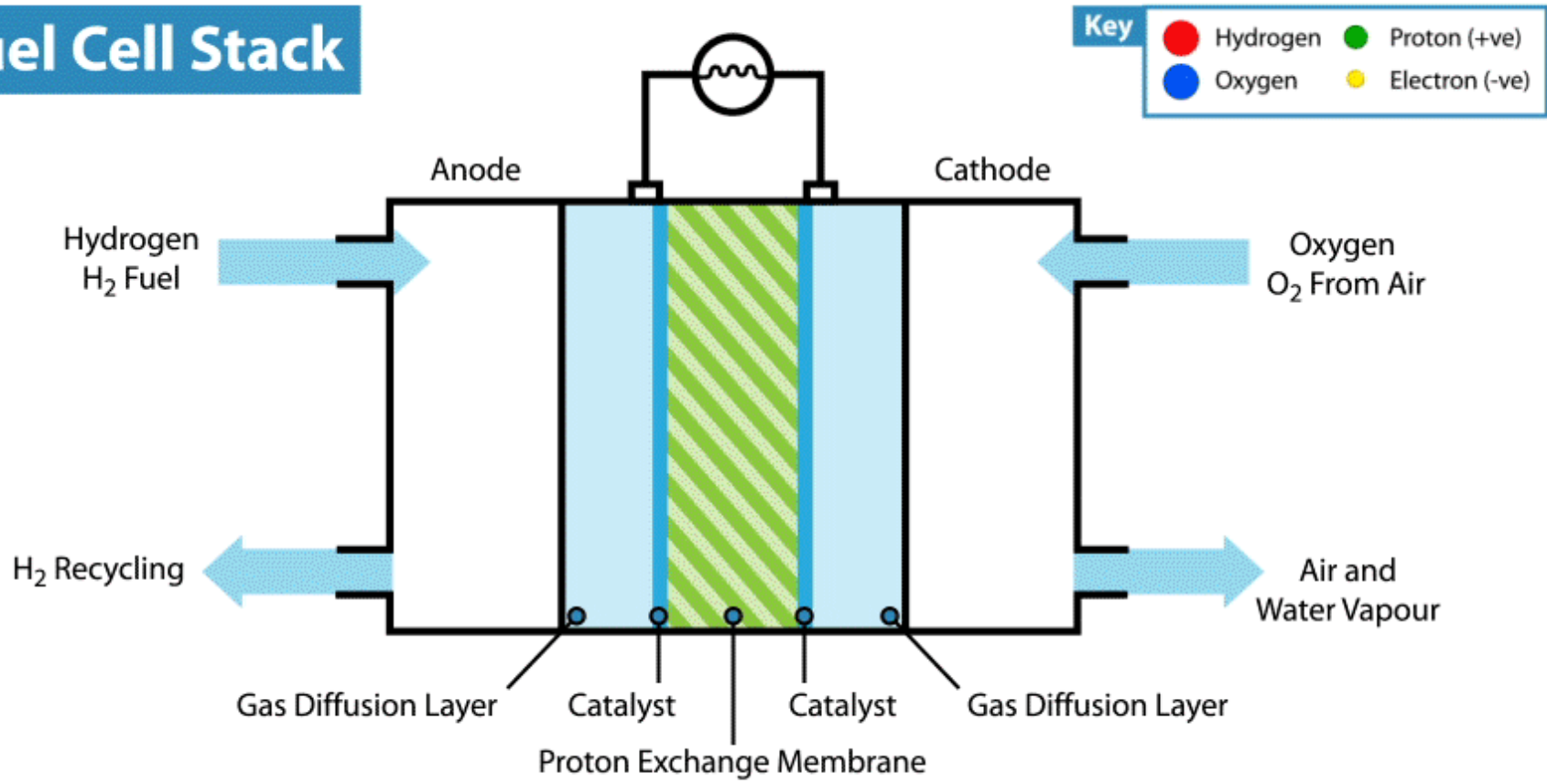


empowering business
to be in balance

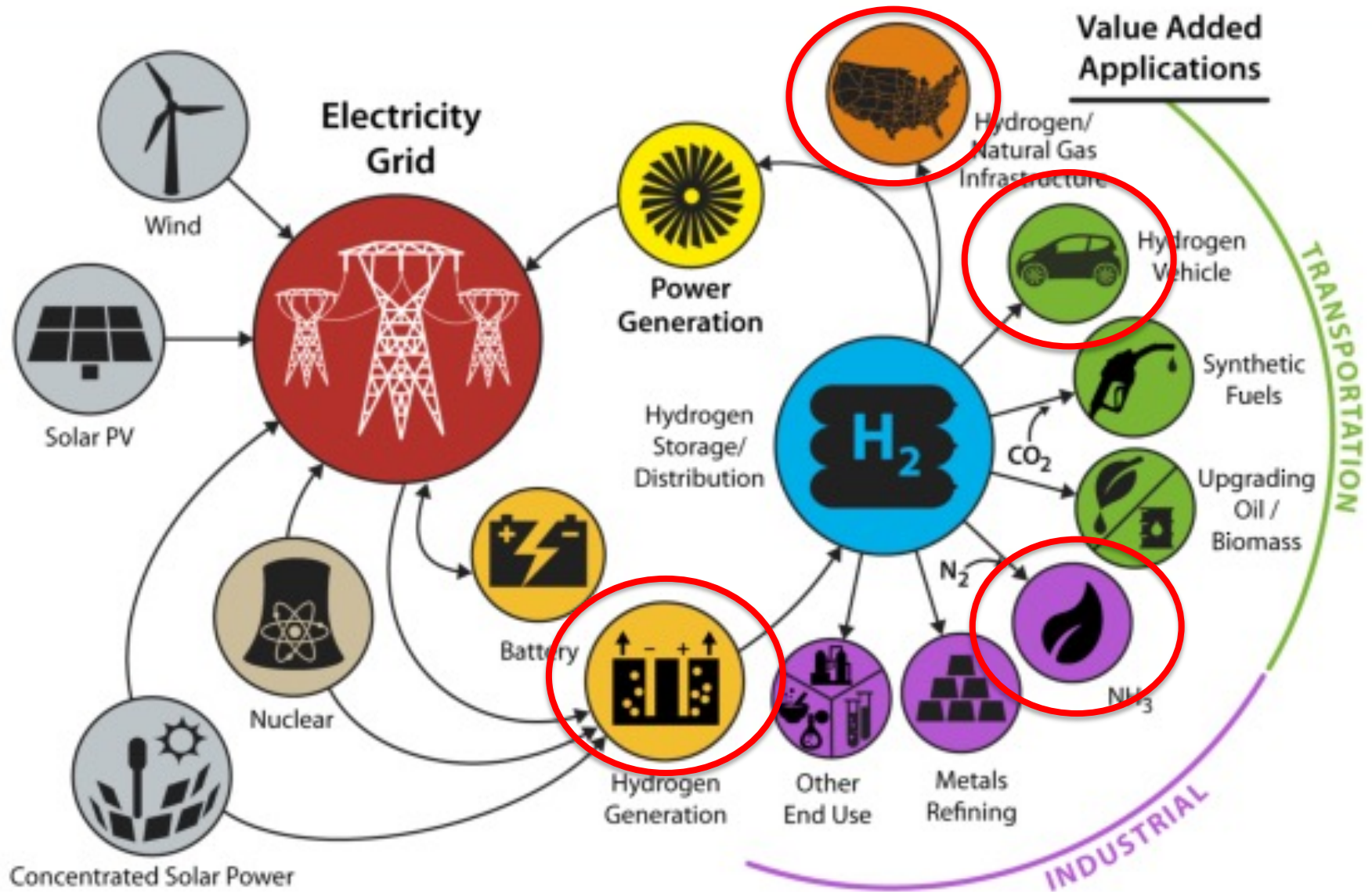
Renewable Hydrogen

July 2022

Fuel Cell Stack



Future H₂ at Scale Energy System



Source: US DOE, H2@Scale

BEF's Focus Areas

Bank of America:

“We believe that hydrogen is going to take **25%** of all oil demand by 2050”

<https://www.cnbc.com/2021/01/22/hydrogen-will-take-25percent-of-oil-demand-by-2050-bank-of-america-analyst.html>

Goldman Sachs:

The addressable market for green hydrogen is **\$10 trillion** by 2050

<https://www.goldmansachs.com/insights/pages/green-hydrogen.html>

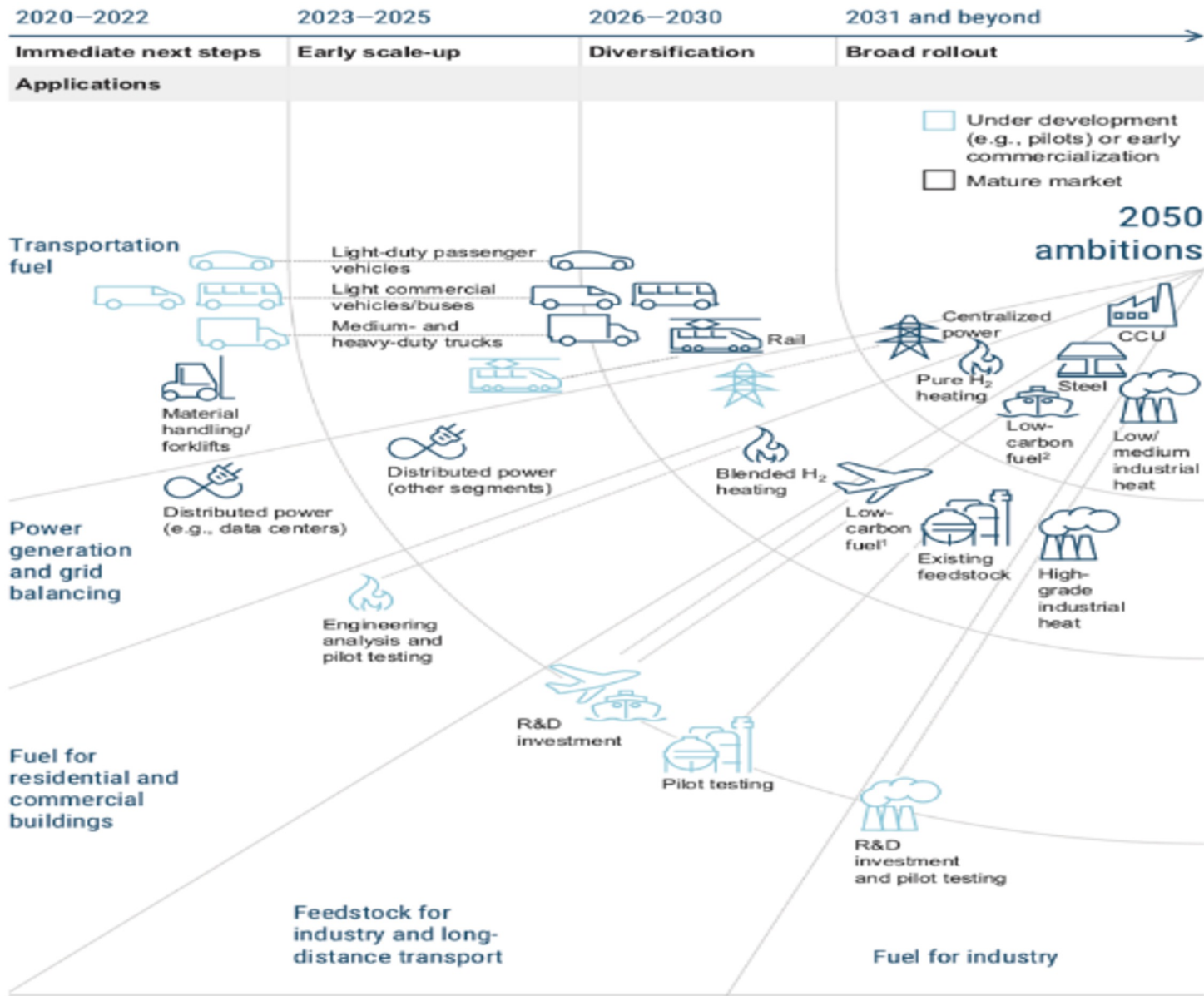
European Commission:

Promoting **\$470 billion** in renewable hydrogen investment by 2050

<https://www.forbes.com/sites/mariannelehnis/2021/12/31/the-eu-is-investing-550-billion-in-hydrogenbut-whats-the-future-of-the-hotly-contested-energy-source/?sh=4302b34613d7>



Hydrogen applications road map



¹ Carbon capture and utilization (for chemicals production)

² Biofuel, synfuel, ammonia

Hydrogen for Transport

- Grid upgrades
- Business productivity
- Mineral availability
- Vehicle weight
- Fast charging losses
- Weather related losses
- Multifamily residents
- Heavy duty transport
- Heavy/light duty synergies in scaling
- Resilience
- Land use



Electric Vehicles: Fuel Cell and Battery

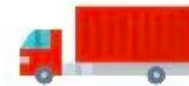


exoskeletons

endoskeletons



batteries



fuel cells

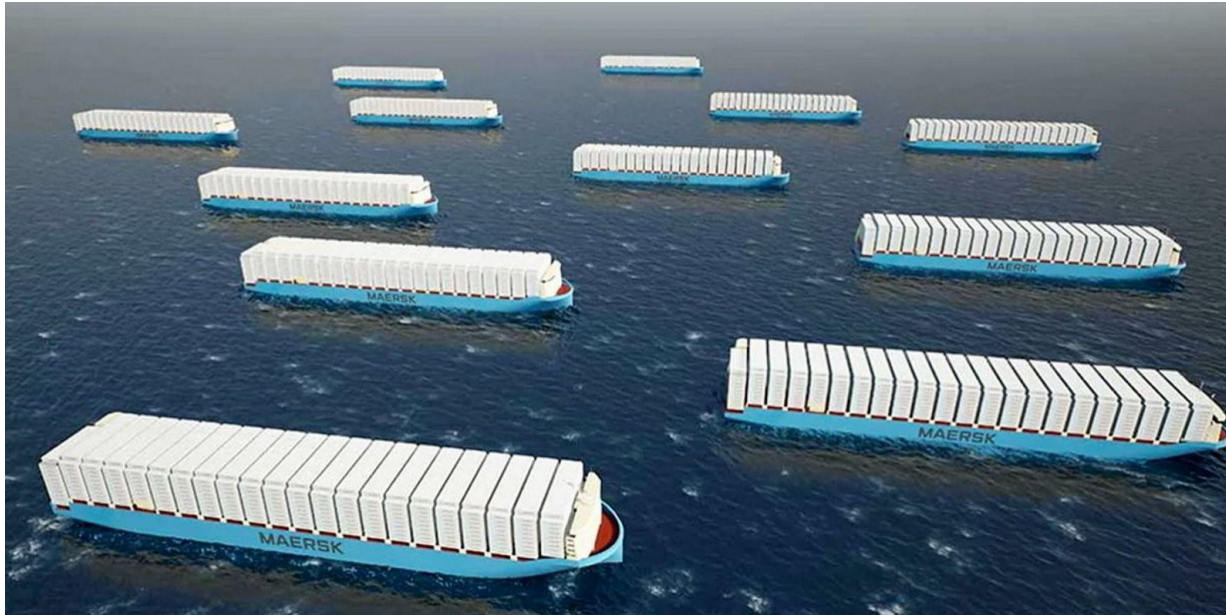
Global Momentum



Orsted



MAERSK



- 1.2GW of wind/solar to green fuels
- Will serve up to 12 methanol fueled ships out of a 700 vessel Maersk fleet

<https://www.rechargenews.com/energy-transition/orsted-and-maersk-eye-largest-ever-green-fuels-deal-with-giga-scale-us-wind-and-solar-plan/2-1-1182566>





“The Tre will come with 500 or 1,000 brake horsepower, and a range of 500 to 1,200 kilometers. [Nikola] plans to have more than 700 hydrogen stations across the U.S. and Canada by 2028.”



PNW Developments





Renewable Hydrogen Action Plan

- 30+ stakeholders from diverse sectors
- Identifying priorities for early renewable hydrogen policies and development
- Final plan [released](#)





TOYOTA

CENTRALIA COAL
Transition Grants



1st Renewable Hydrogen Fueling Station in the Pacific Northwest!

- Thanks to \$1.9m grant from the Centralia Coal Transition Grants Board
- Additional \$4m allocated from the State
- Toyota will donate 10 fuel cell electric Mirai to be loaned out for demonstration purposes
- Entirely fueled by renewable hydrogen produced by Douglas PUD





EWEB/NW Natural Hydrogen Pipeline Demonstration

- Early collaboration to gain experience in hydrogen pipeline injection
- Pipelines are efficient at moving large amounts of energy
- Dual fuel energy systems are more resilient
- Pipeline injection is a great application to grow renewable hydrogen demand
- <https://kval.com/news/local/public-private-partnership-working-toward-renewable-hydrogen-facility-in-eugene>





- Pacific Northwest Hydrogen Association – public/private partnership created by WA Department of Commerce to pursue DOE funding for a regional Hydrogen Hub
- WA legislature also created a new Office of Renewable Fuels and passed several hydrogen related incentives in SB 5910, nearly unanimous
- Accepting applications for the Advisory Committee
<https://pnwh2.com/>



Project Announcements

- Greentech Media, green hydrogen pipeline at 8.2GW or over 30x growth
 - <https://www.greentechmedia.com/articles/read/mega-projects-help-double-green-hydrogen-pipeline-in-just-five-months>
- Australia, 5GW of renewable hydrogen for export
 - <https://www.pv-magazine.com/2019/10/08/siemens-backs-5-gw-green-hydrogen-plan-for-australia/>
- Germany, 5GW of green hydrogen by 2030
 - <https://www.pv-magazine.com/2019/10/08/siemens-backs-5-gw-green-hydrogen-plan-for-australia/>
- Los Angeles Department of Water and Power, \$1B hydrogen energy storage facility
 - <https://www.bloomberg.com/news/articles/2020-03-10/l-a-aims-to-be-first-to-power-u-s-city-with-renewable-hydrogen>
- Shell, NorthH2, 10GW of offshore wind to hydrogen by 2040
 - <https://www.rechargenews.com/wind/shell-unveils-worlds-largest-offshore-wind-plan-to-power-green-hydrogen/2-1-763610>



Resources

- Renewable Hydrogen Alliance: <https://renewableh2.org/resources/>
- Fuel Cell Hydrogen Joint Undertaking: <https://www.fch.europa.eu/>
- British Columbia Hydrogen Study:
<https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/zen-bc-bn-hydrogen-study-final-v6.pdf>
- Bloomberg New Energy Finance:
<https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf>
- Fuel Cell Hydrogen Energy Association: <http://www.fchea.org/us-hydrogen-study>
- International Energy Agency: <https://www.iea.org/reports/the-future-of-hydrogen>
- International Renewable Energy Agency:
<https://irena.org/publications/2019/Sep/Hydrogen-A-renewable-energy-perspective>



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