



empowering business
to be in balance

Renewable Hydrogen

Bonneville Environmental Foundation
OR Senate Committee on Energy and Environment, January 2023

Outline

- H2 for Oregon's carbon reduction
- H2 for Oregon's energy strategy
- BEF's focus on H2



BEF Renewables

“Clean energy, strong communities”

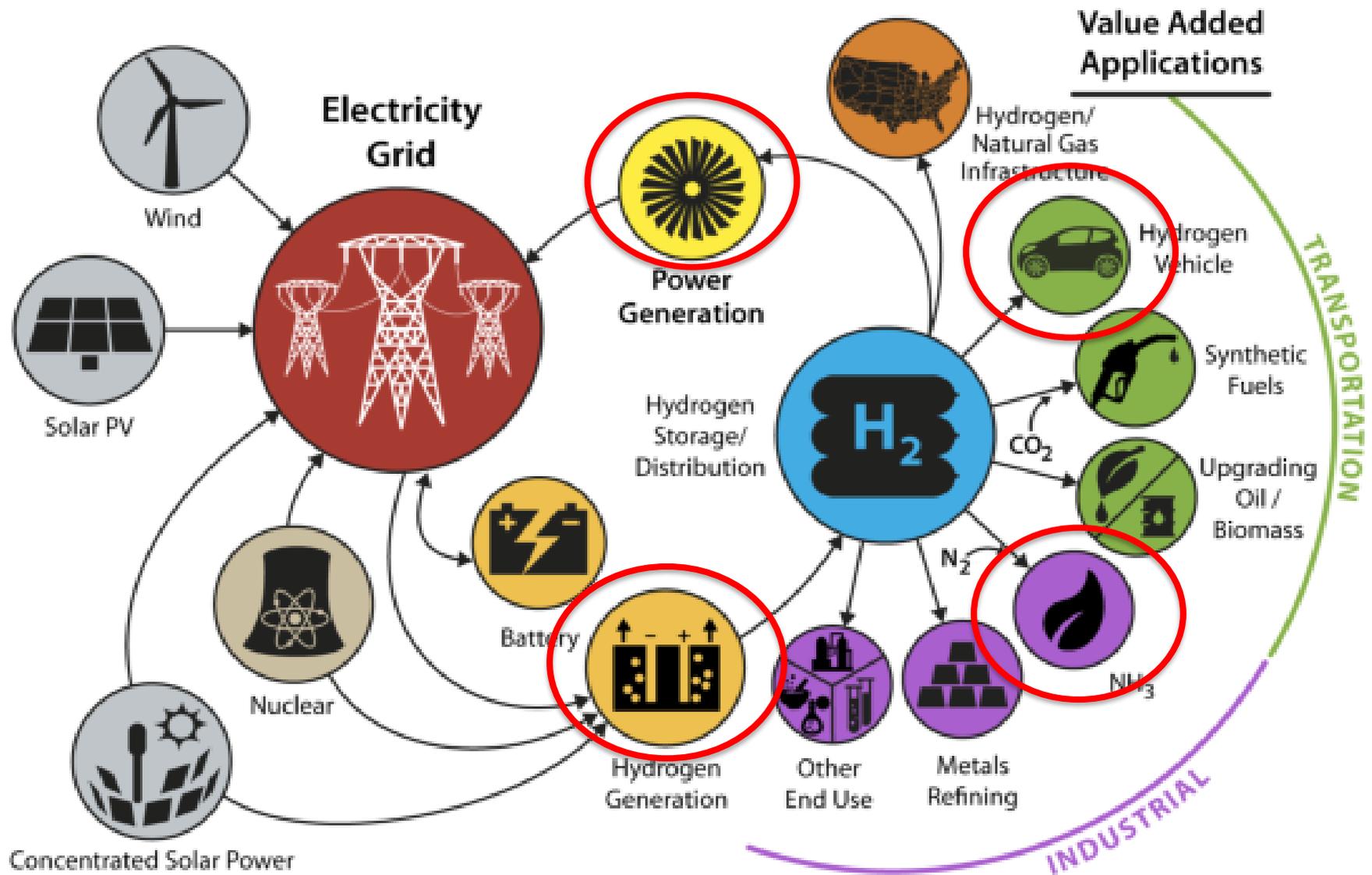
Breaking down barriers to renewable energy adoption. Focus areas include community solar, low-income solar, low-impact hydro, electric vehicles, renewable hydrogen, and electrification.



Renewable H2 is
essential for a zero-
carbon future



Future H₂ at Scale Energy System



Source: US DOE, H2@Scale

Oregon's H₂ Opportunities

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:

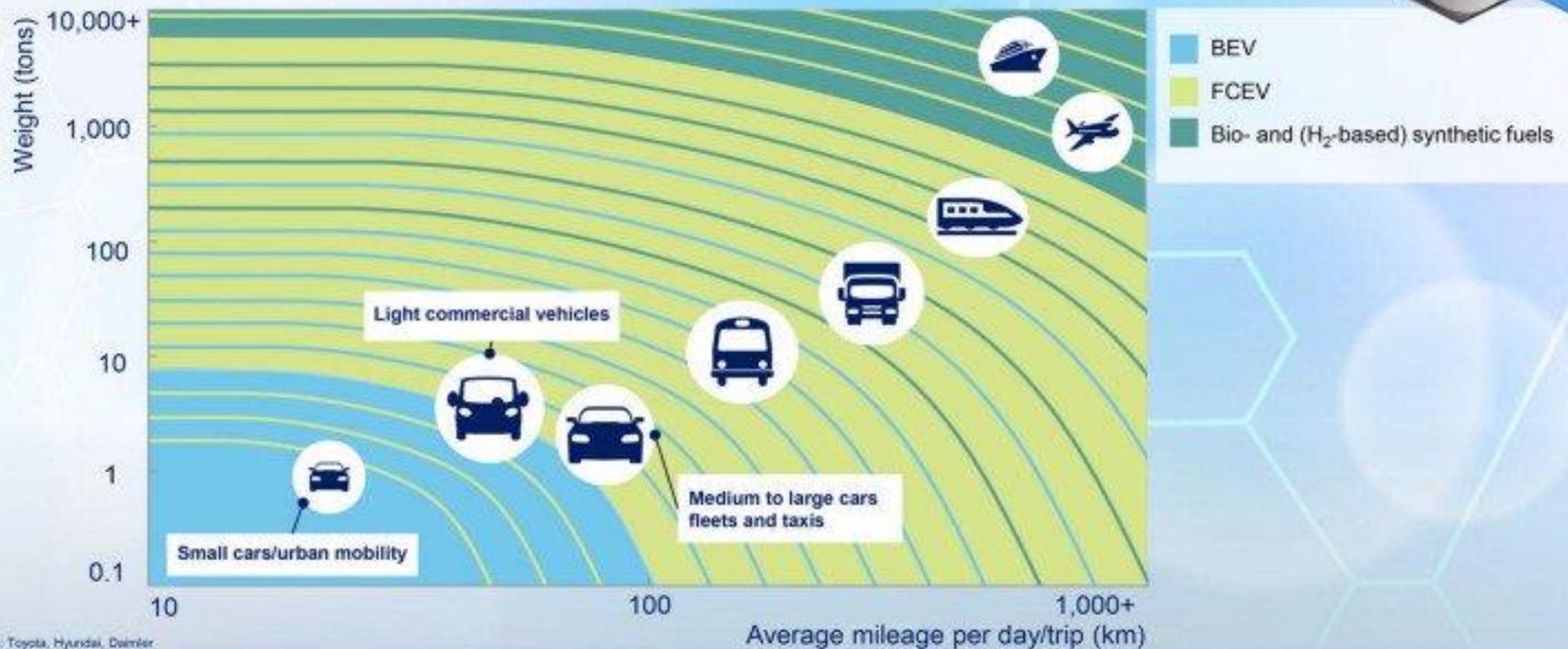
Promoting **\$470 billion** in renewable hydrogen investment by 2050

<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>



Fuel Cell Vehicles vs. Electric Vehicles

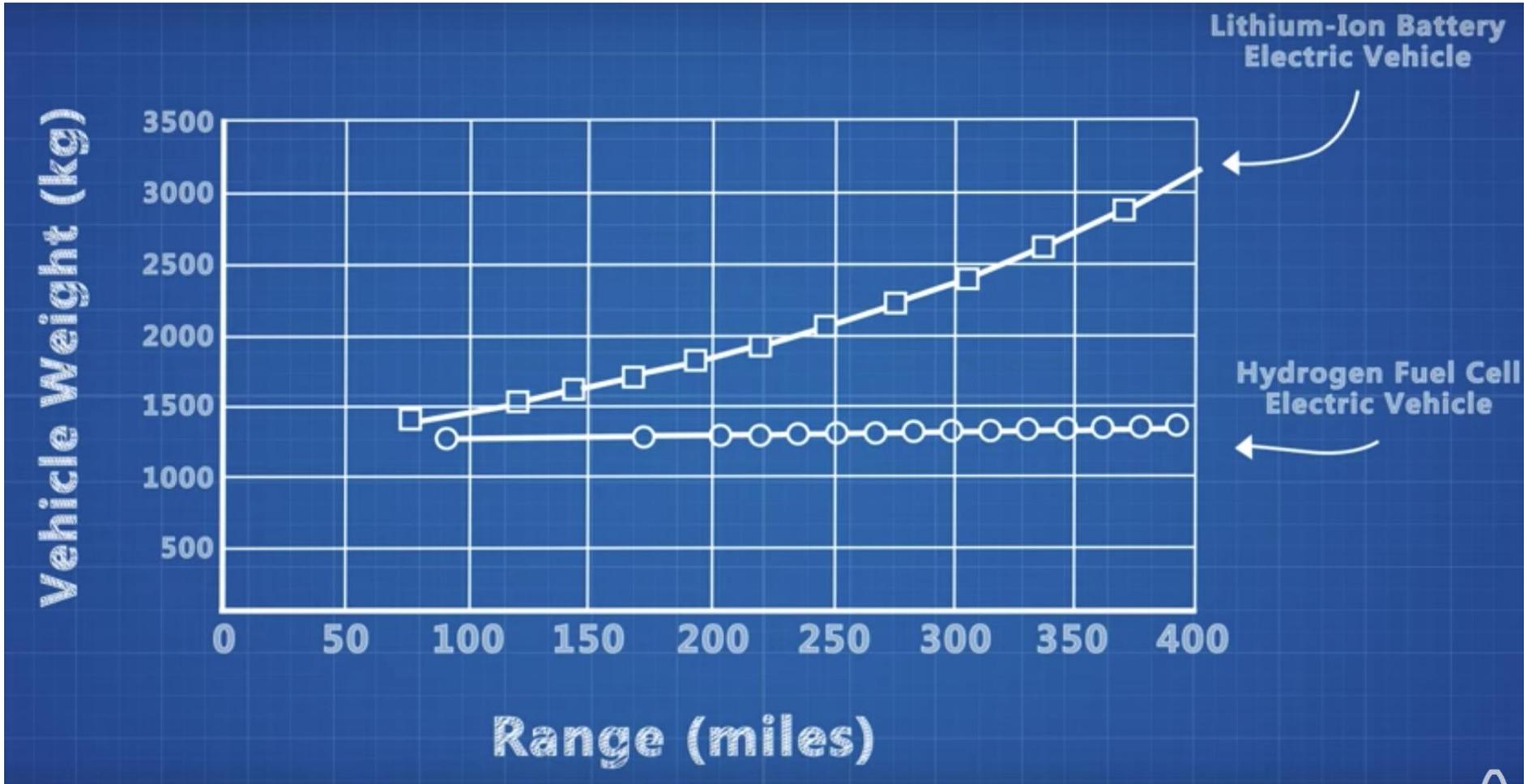
FCEVs are essential for decarbonising transport



TOYOTA



Fuel Cell Vehicles and Electric Vehicles



Zero emissions truck plan gets green light from Oregon regulators

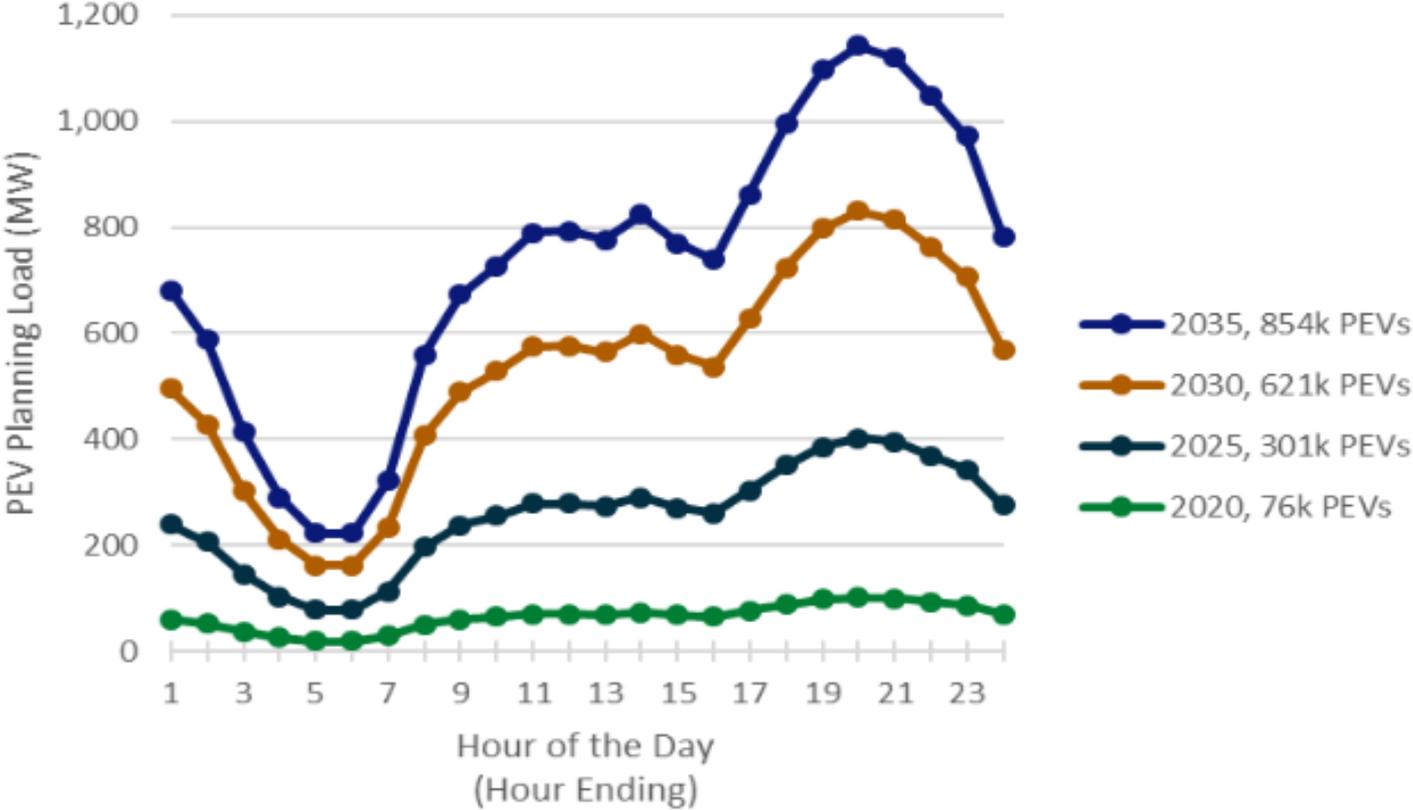


<https://www.opb.org/article/2021/11/17/zero-emissions-truck-plan-gets-green-light-from-oregon-regulators/>

H2 for Electricity



Planning Loads Across a Single Weekday Attributable to Personal Light-duty PEV Adoption, OR+WA Base Case, 2020 - 2035

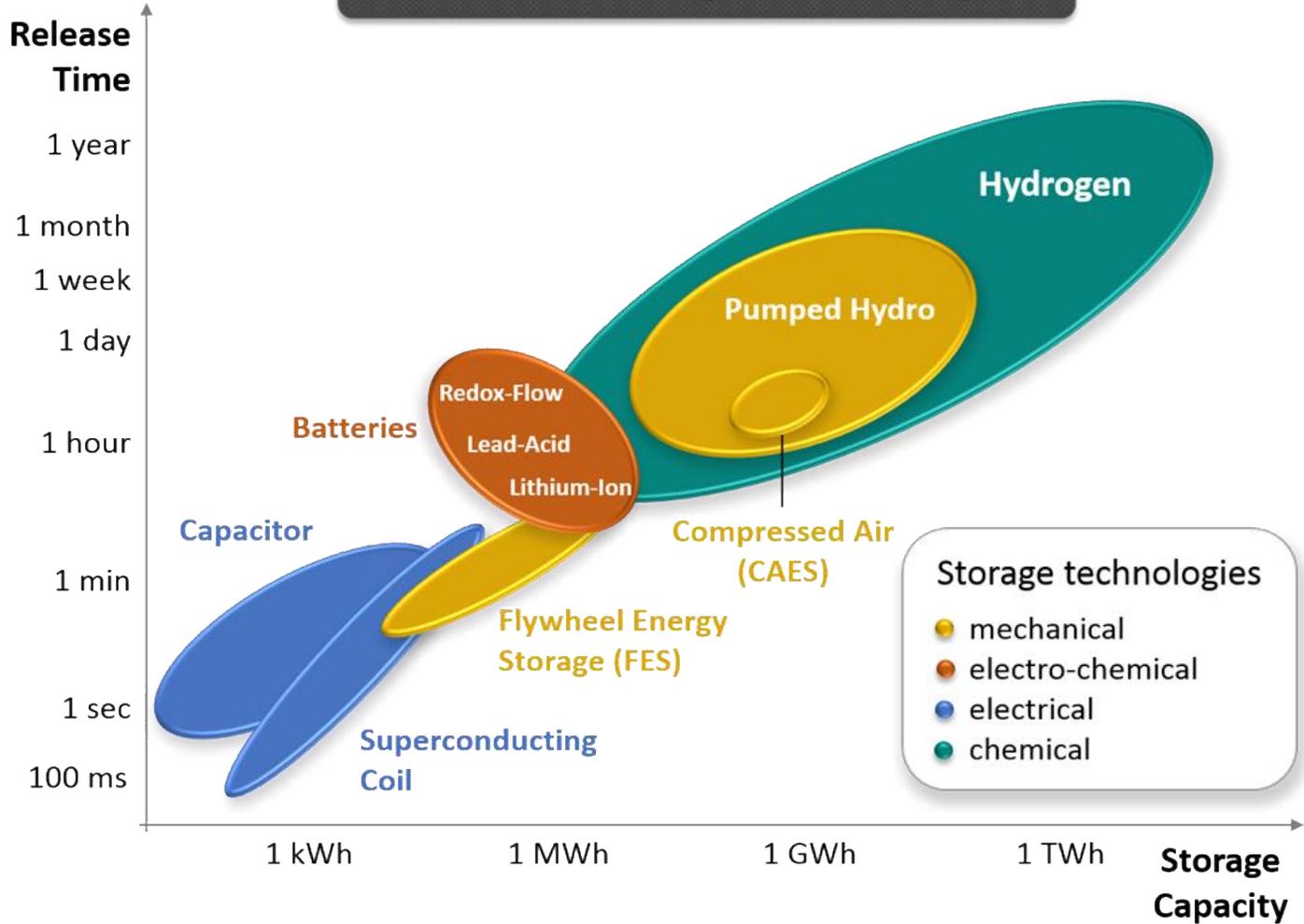


Source: E3 Study in PEV Adoption in OR/WA, 2018



Long Duration Energy Storage

Available Storage Technologies



Energy Storage

Ammonia has the potential to provide low cost energy storage at a scale significantly larger than alternatives. For reference:



World's largest **electric** battery store

Hornsdale Power Reserve

129 MWh



World's largest liquid **hydrogen** store

Cape Canaveral

9,000 MWh

(270 tonnes @ -253°C)



Typical large liquid **ammonia** store

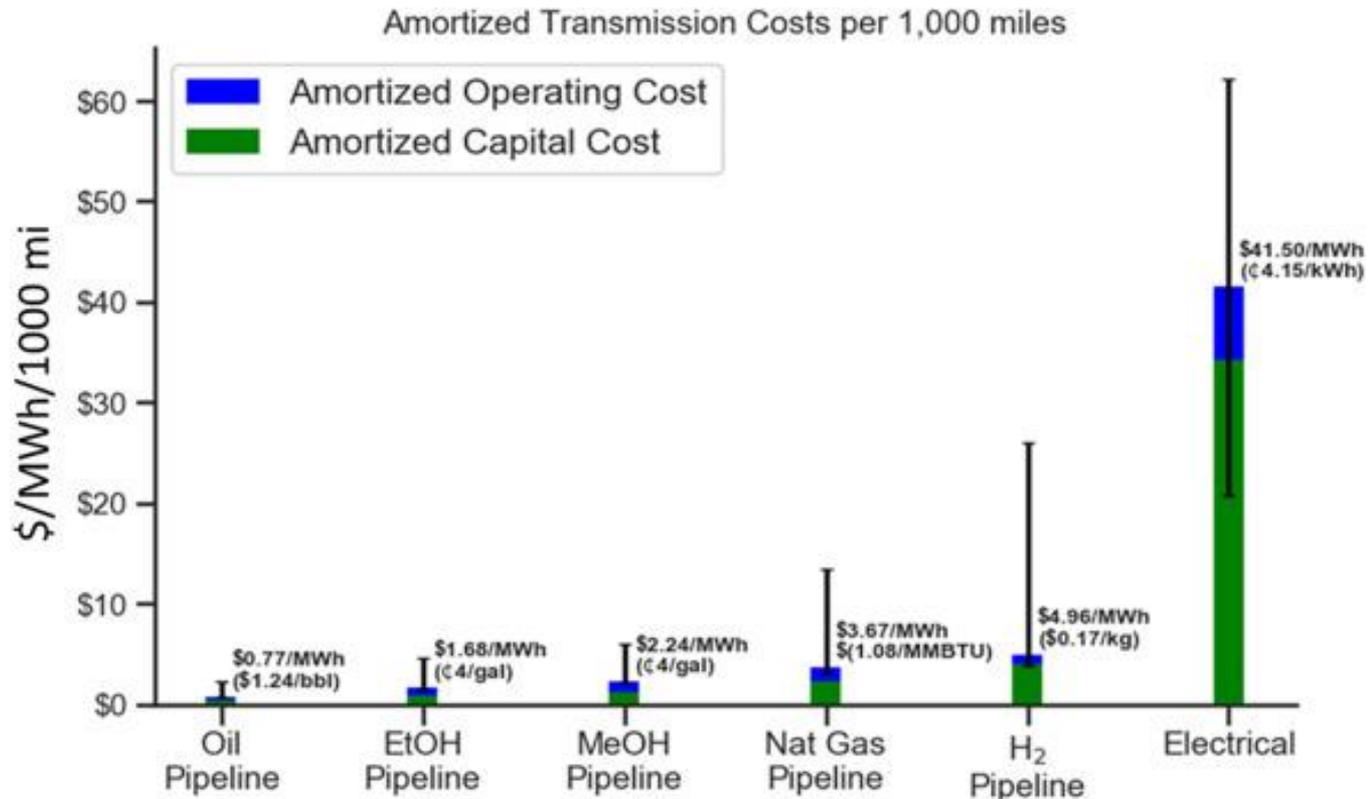
312,000 MWh

(60,000 tonnes @ -33°C)



Transmission

- Energy transmission over 1000s of miles will likely be needed in decarbonized economy
- Transmission by electricity is much more expensive than by gaseous and liquid carriers



H2 at BEF

- Renewable H2 [Action Plan](#)
- Hydrogen Hub support
- Education
- Project Development



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



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