

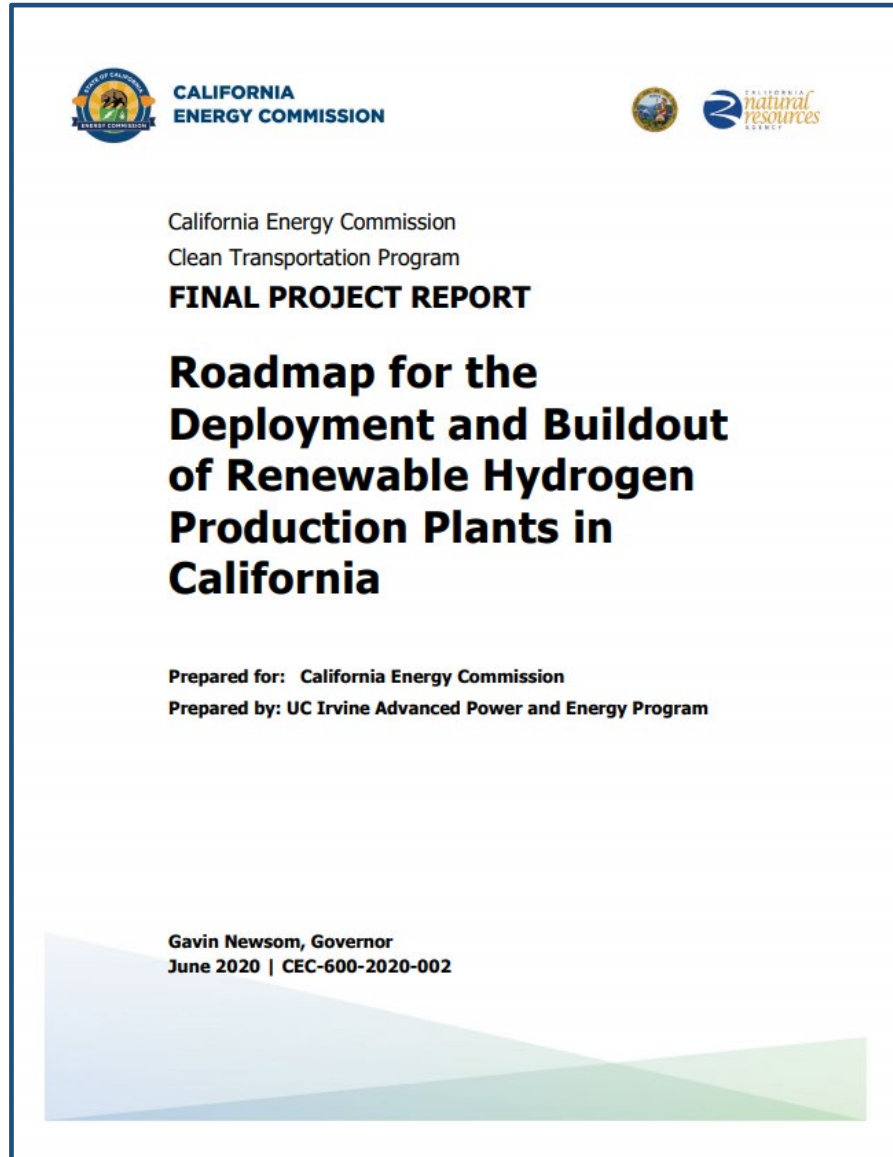


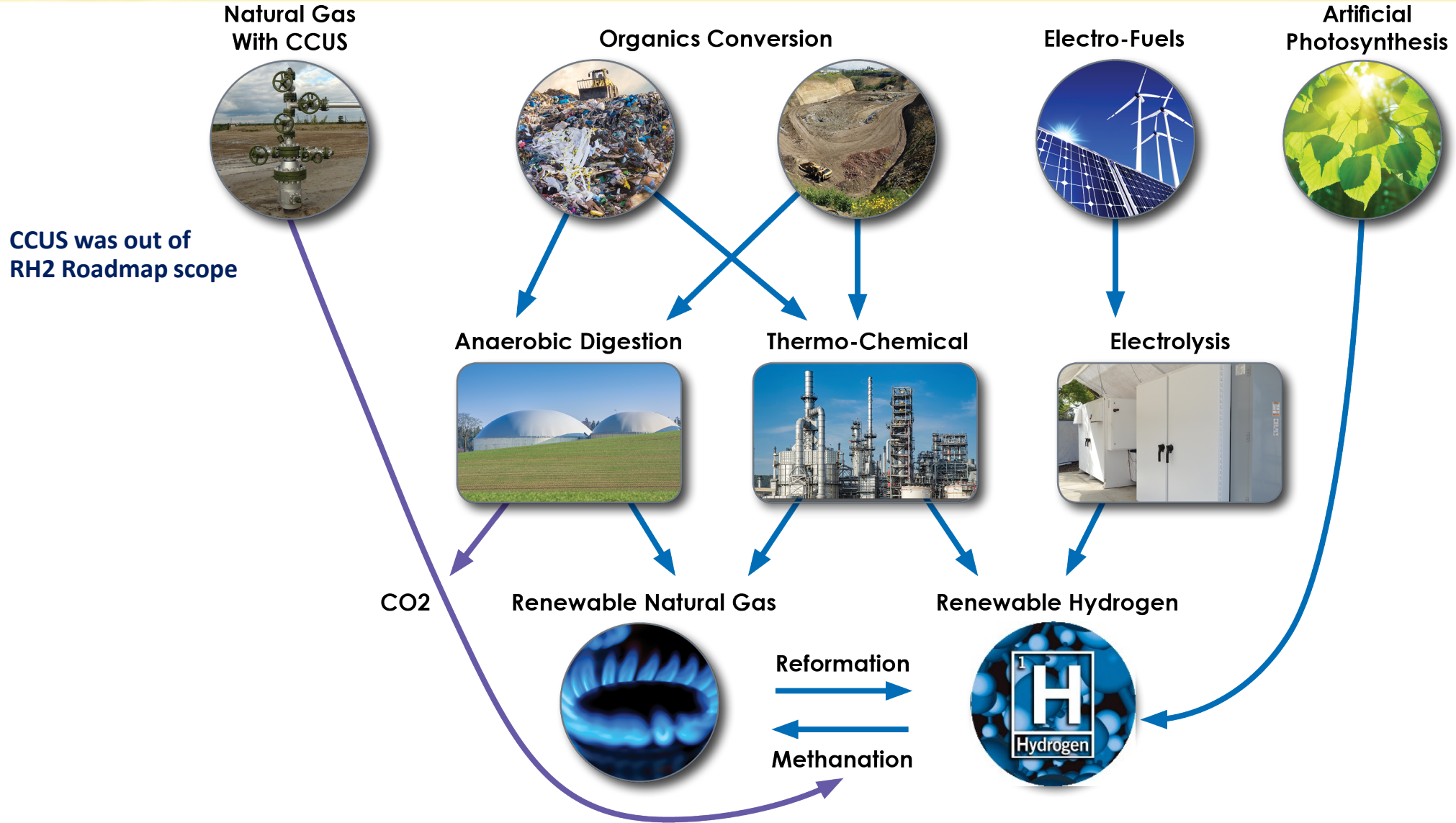
Scaling the Green Hydrogen Sector in California

CPUC Strategic Goals Workshop
September 20, 2023
Jeff Reed, UC Irvine



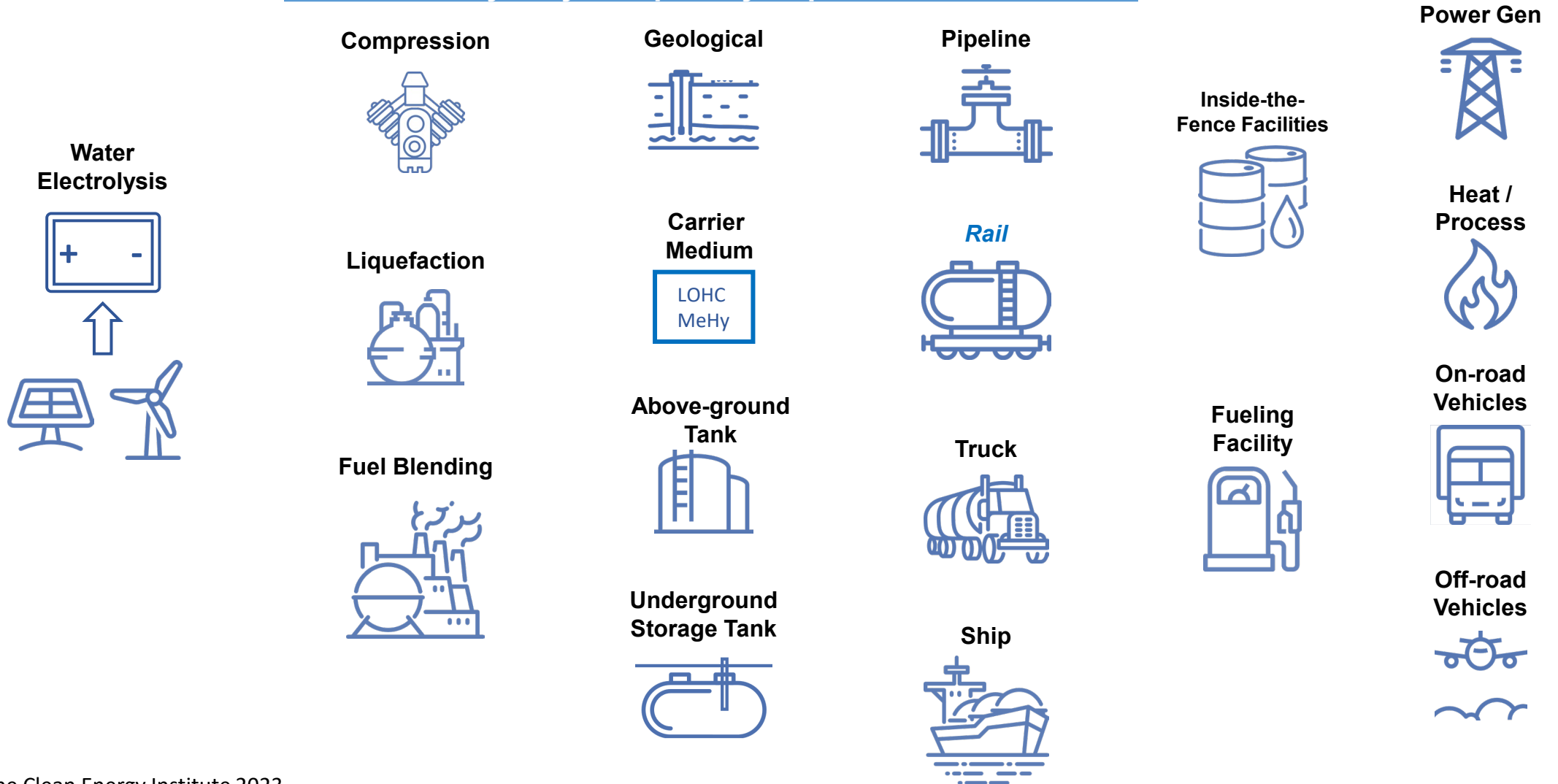
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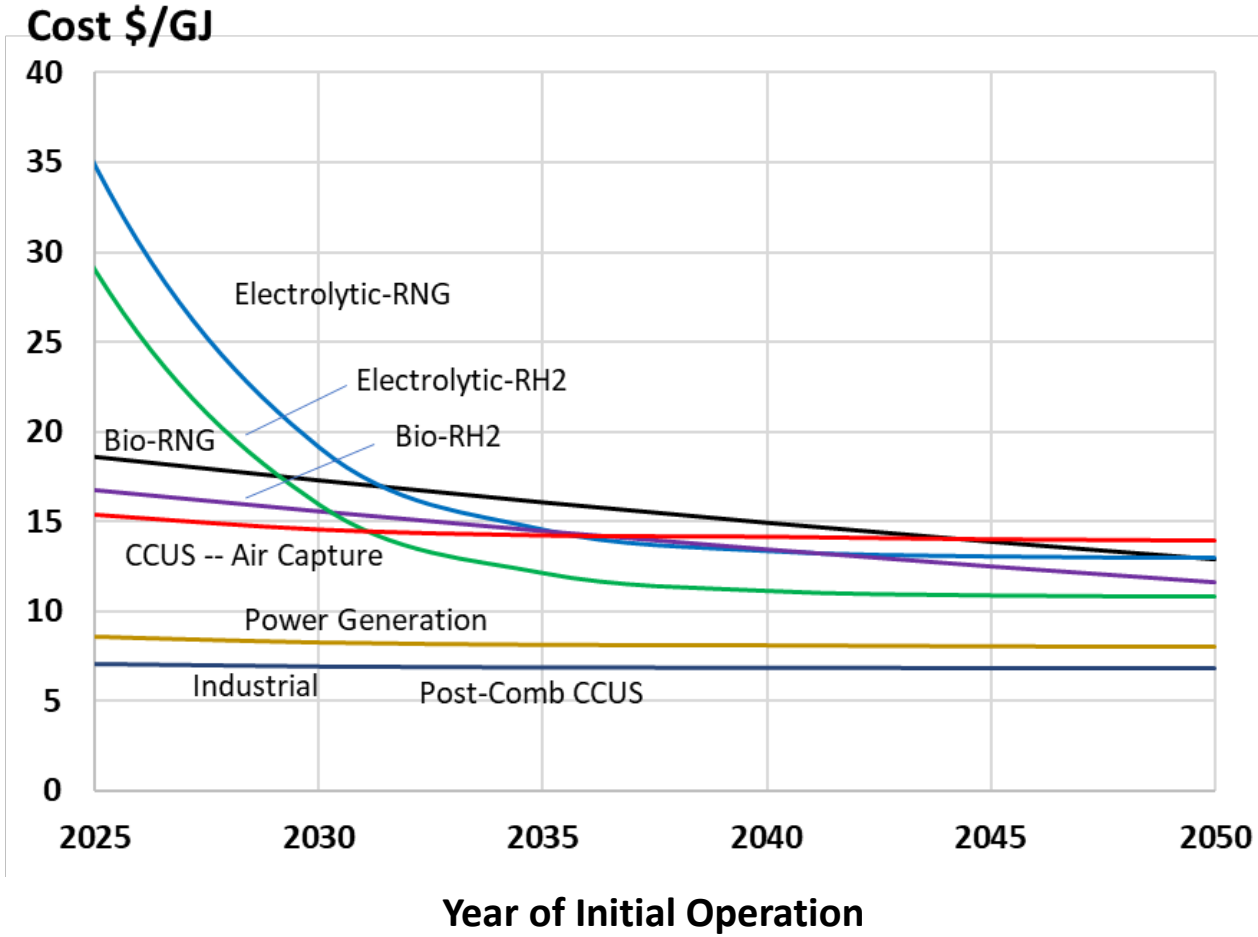


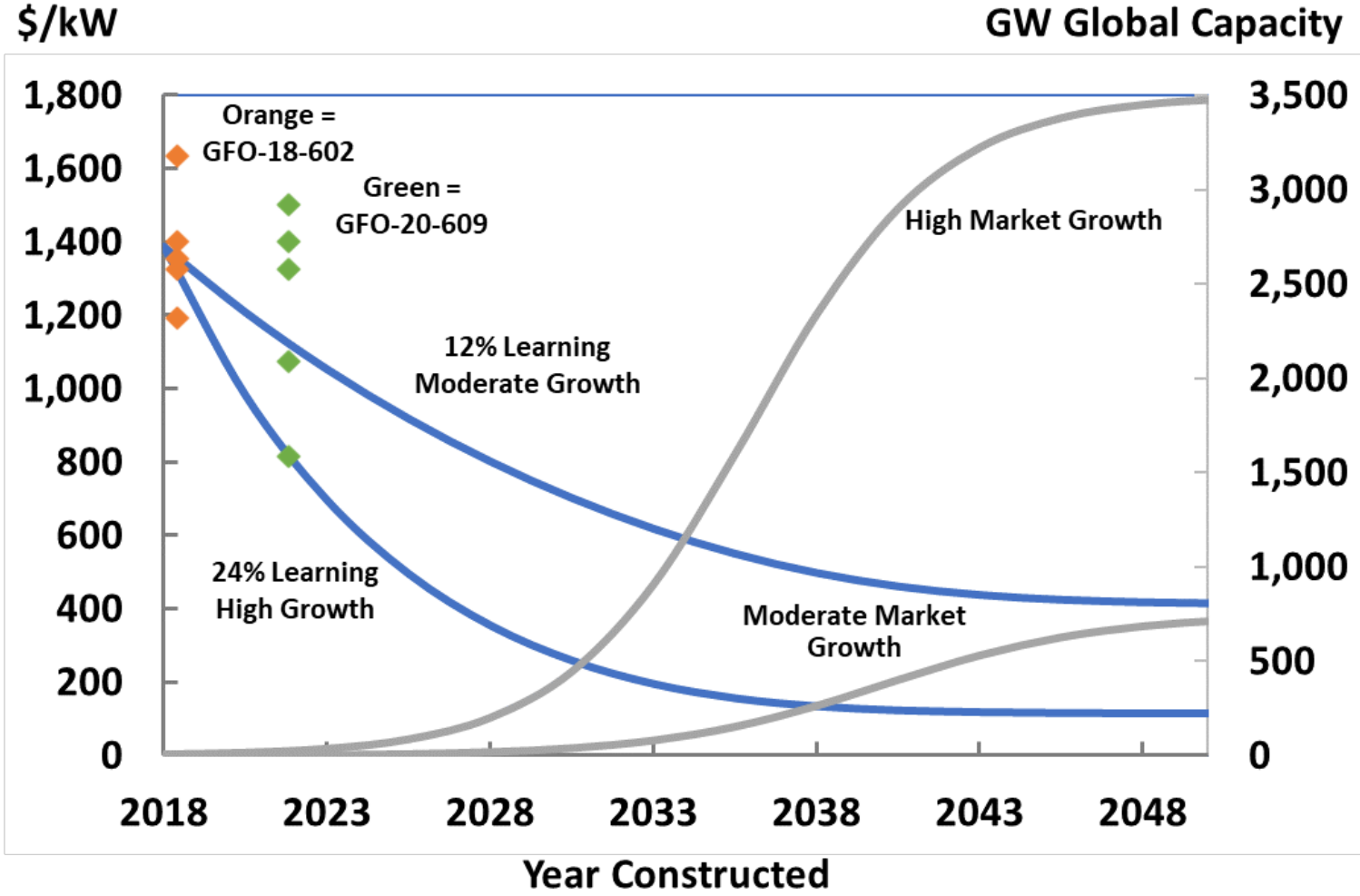


Order May Vary / Steps May Repeat or Be Absent



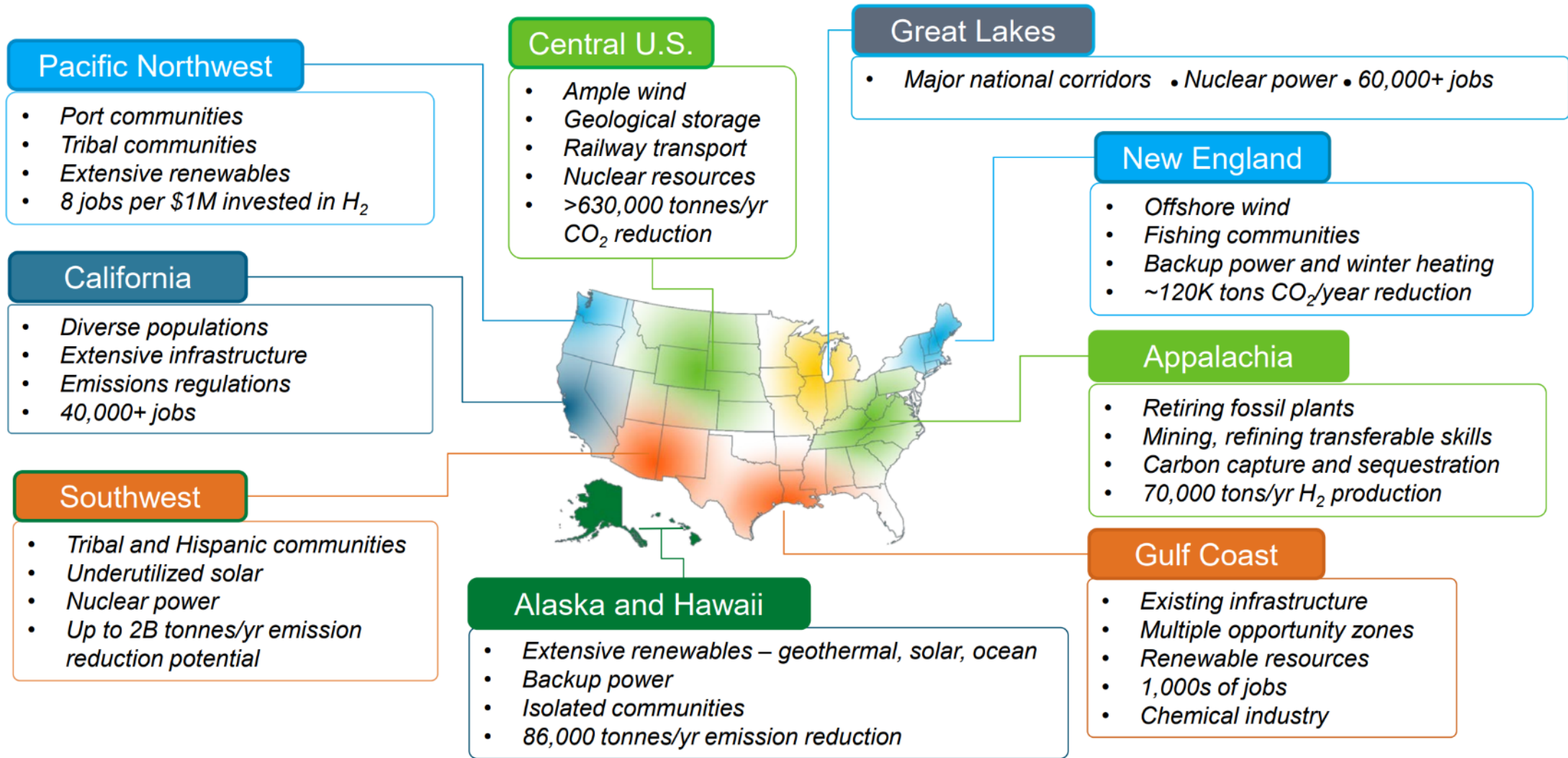
1. **Where are there gaps in technology, if any?**
 - **Electrolyzer cost – precious metal content**
 - **Understanding of the feasibility of underground hydrogen storage in depleted oil and gas reservoirs**
 - **Liquefaction technology performance -- efficiency and boil-off**
 - **Understanding of and mitigation of H₂ leakage from production through use (the small indirect global warming impact of hydrogen occurs only if emitted or leaked as hydrogen (versus combustion products))**
 - **Understanding of NO_x impacts and reduction approaches for use of hydrogen in combustion applications (industrial heat and power generation) – NO_x reductions for power and industrial heat likely achievable**
2. **What role should RD&D play in filling gaps in technology needs?**
 - **Basic research via DoE and NSF**
 - **Field demonstration and validation, field measurement, techno-economic and lifecycle analysis, and system planning via state agencies**
3. **At what point does the technology become economically competitive? (What is the goal cost and time horizon)**
 - **Currently competitive with \$3/kg federal credit**
 - **Late 2020's to early 2030's without subsidy**





4. What are the market facilitation needs to enable successful business models?
 - Consistent policy and adequate subsidies in the launch and scale phase of the market based on
 - For subsidies based on environmental goals, use pathway impacts rather than binary definitions – e.g., carbon intensity not colors and other quantified environmental attributes as appropriate such as NOx reduction
 - Establish time-matching, deliverability, and additionality provisions for GH2 GHG accounting that balance market advancement with acceleration of GHG reductions and apply even-handedly across technologies
 - Establish the regulatory framework and market rules for hydrogen pipelines and hydrogen blending on the natural gas system
 - Establish rates for grid delivered power to electrolyzer that reflect the cost-to-serve inclusive of grid benefits, and establish market rules allowing electrolyzer operators to procure electricity from wholesale generators
 - Streamline permitting, including CEQA – maybe a programmatic environmental impact report

5. Who should pay for infrastructure?
 - In the mature market, consumers of green hydrogen should pay the full cost of infrastructure
 - Subsidies from ratepayers and taxpayers support launch and scaling of infrastructure should be provided based on the long-term costs and benefits of the technology including the cost of externalities and commensurate with subsidies provided to “similarly situated” technologies and pathways



Thank You



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