Electrolyzers and Power-to-Gas at the Intersection of the Gas and Electric Grids

H2@Scale Workshop

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SoCalGas

A Sempra Energy utility

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Southern California Gas Company

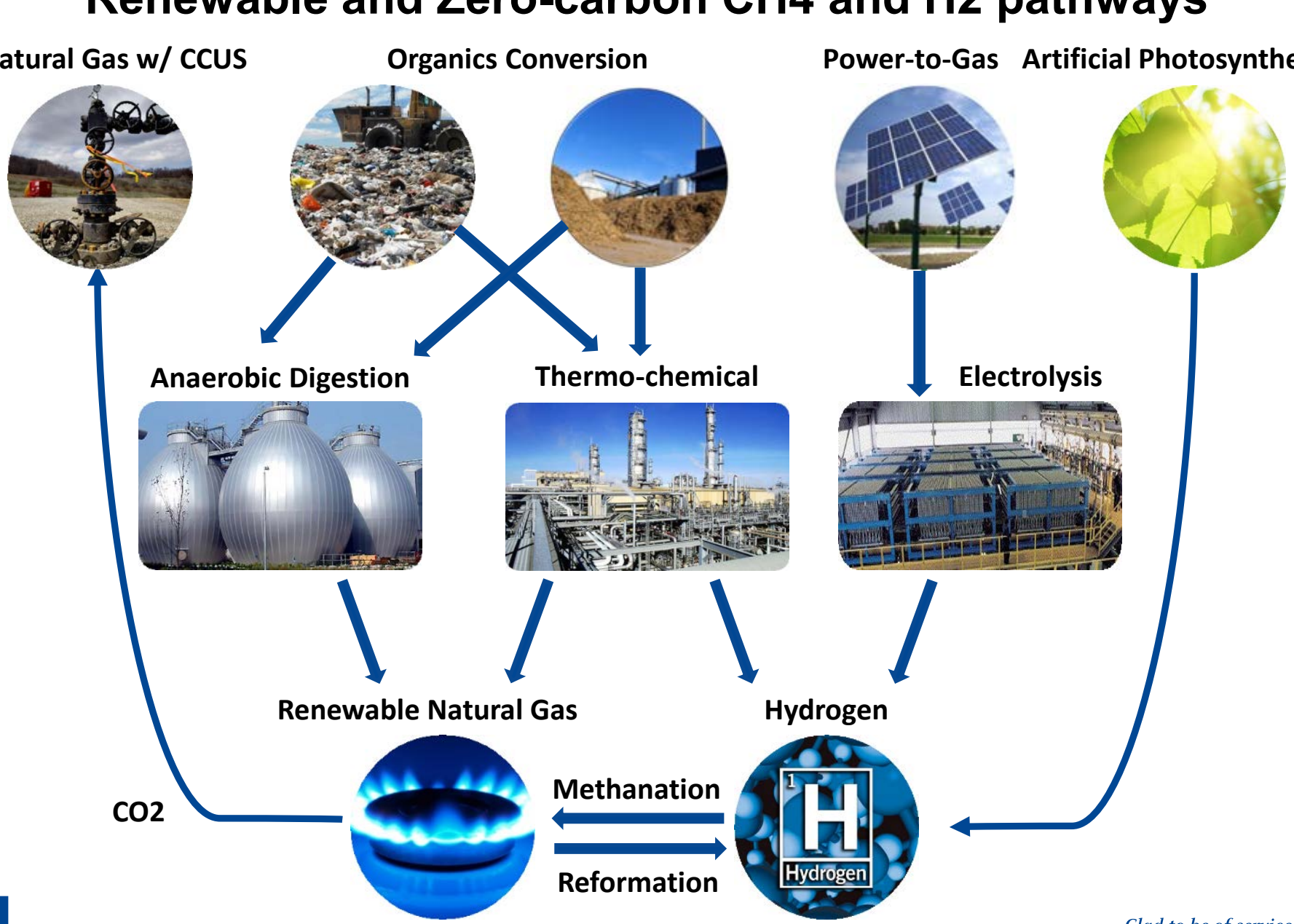
- The nation's largest natural gas distribution utility
  - 20.9 million consumers
  - 5.8 million meters
  - 500 communities
- Subsidiary of Sempra Energy (SRE)

California's Dual Emissions Challenge – 80% Reduction in NOx and GHG

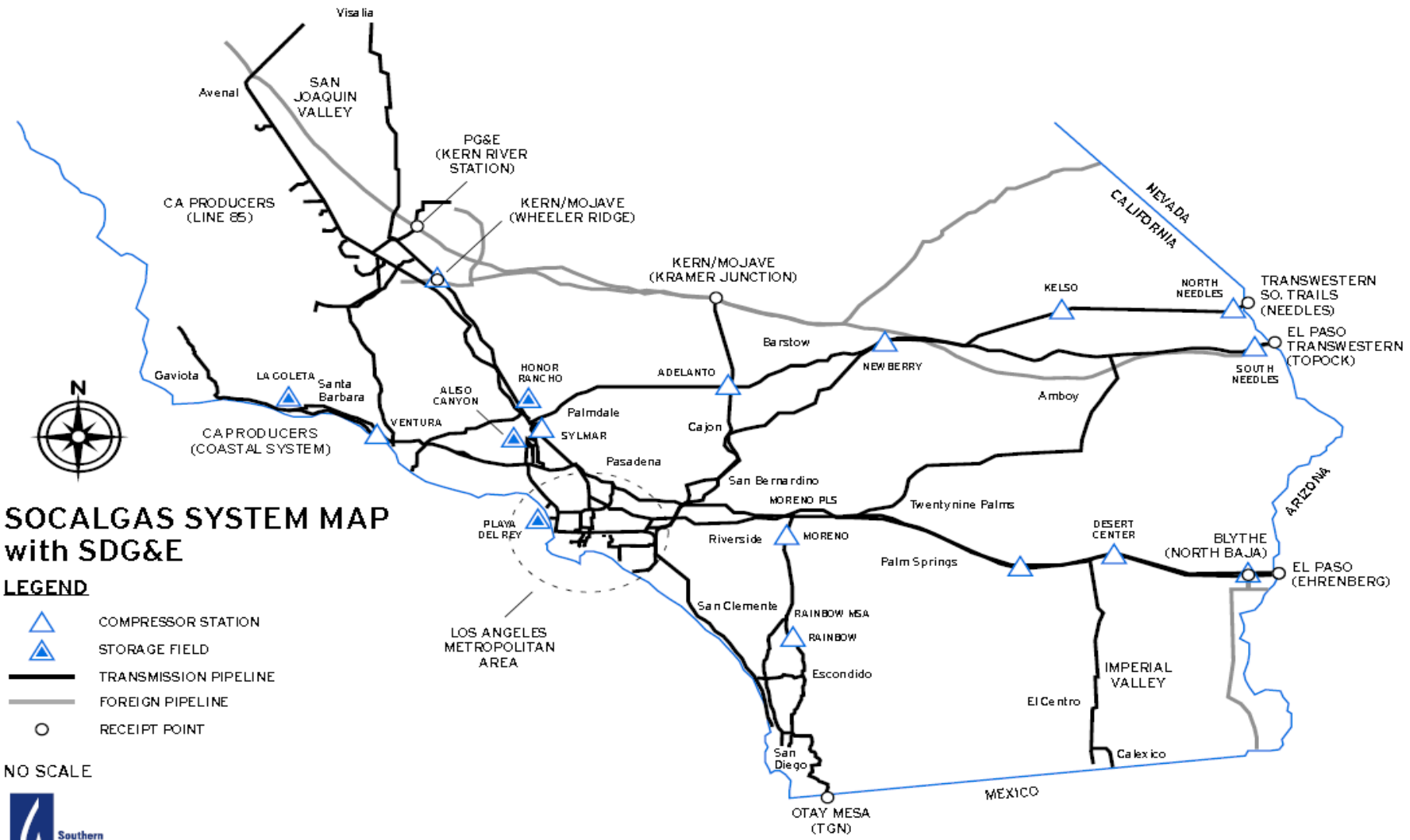
Federal Clean Air Act (CAA) - requirements to meet ozone standards in Central and Southern California air basins will require a 75% to 90% reduction in combustion emissions over the next 20 years.

California Climate Change Initiatives - Assembly Bill 32 "Global Warming Solutions Act" (AB32) and Governor's Executive Order 2050 – set goals of reducing greenhouse gas emission by over 80% by 2050.

Renewable and Zero-carbon CH4 and H2 pathways



Nearly universal deliverability and storage capability



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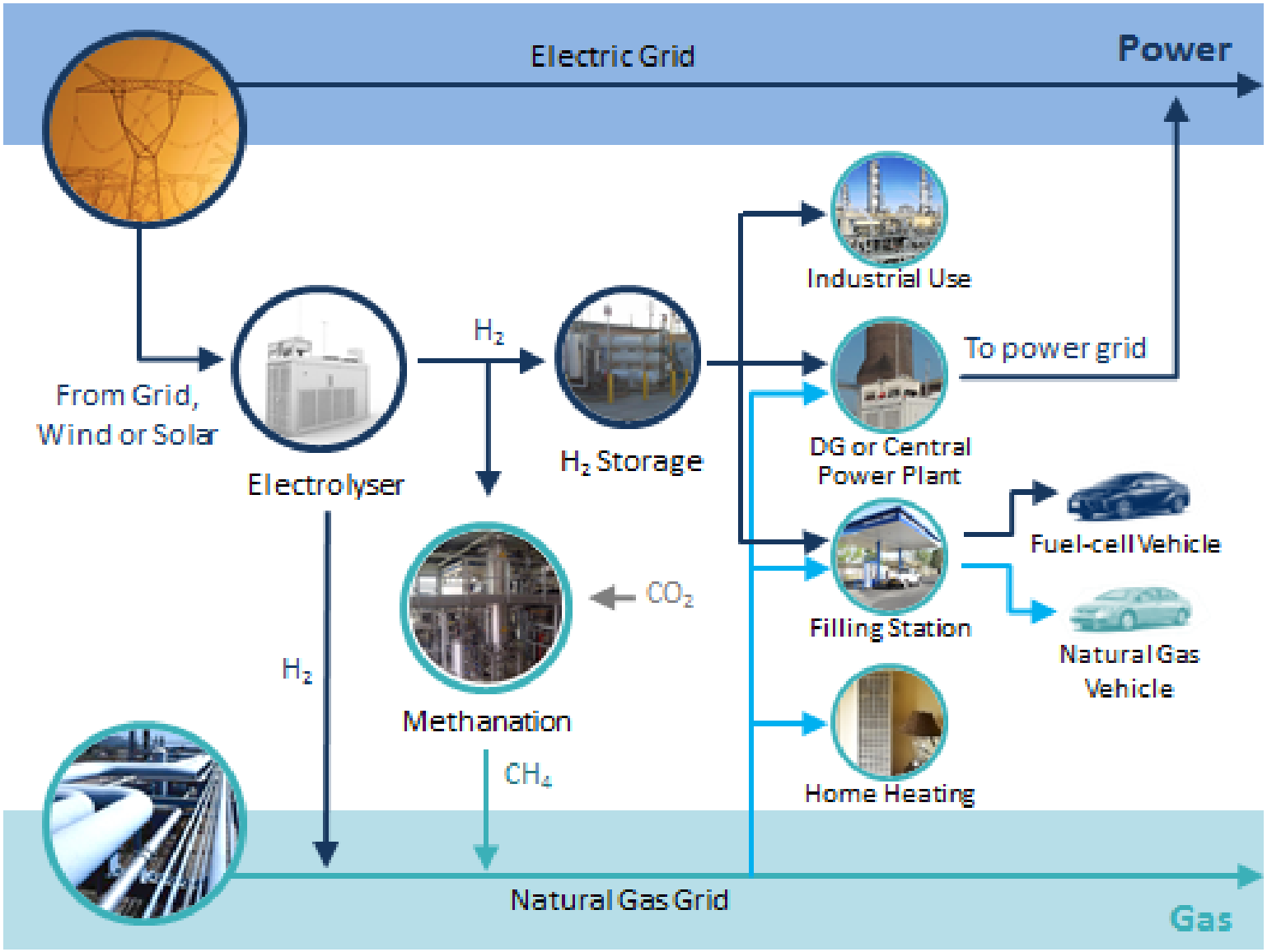
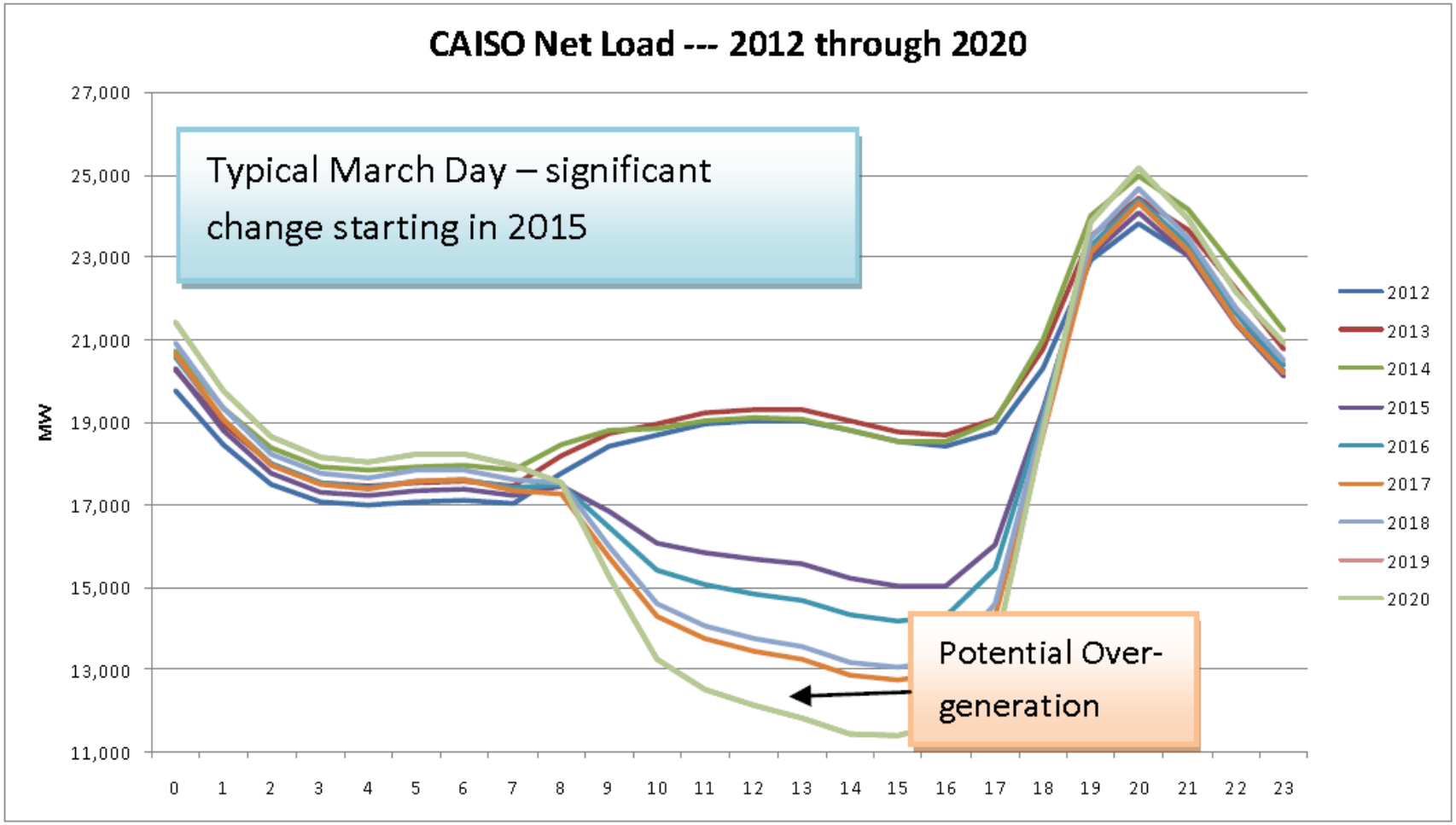
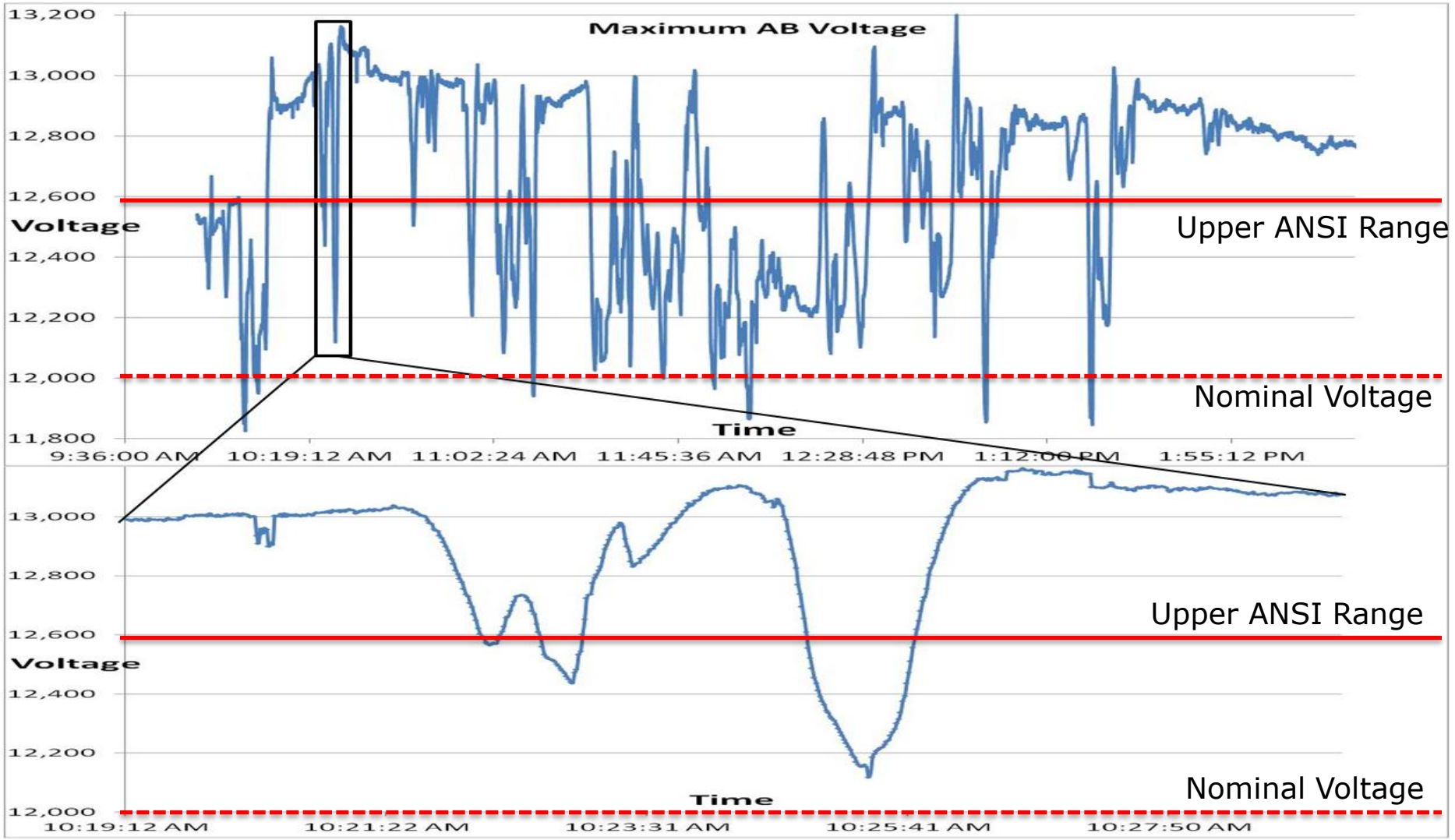
Power-to-Gas Concept



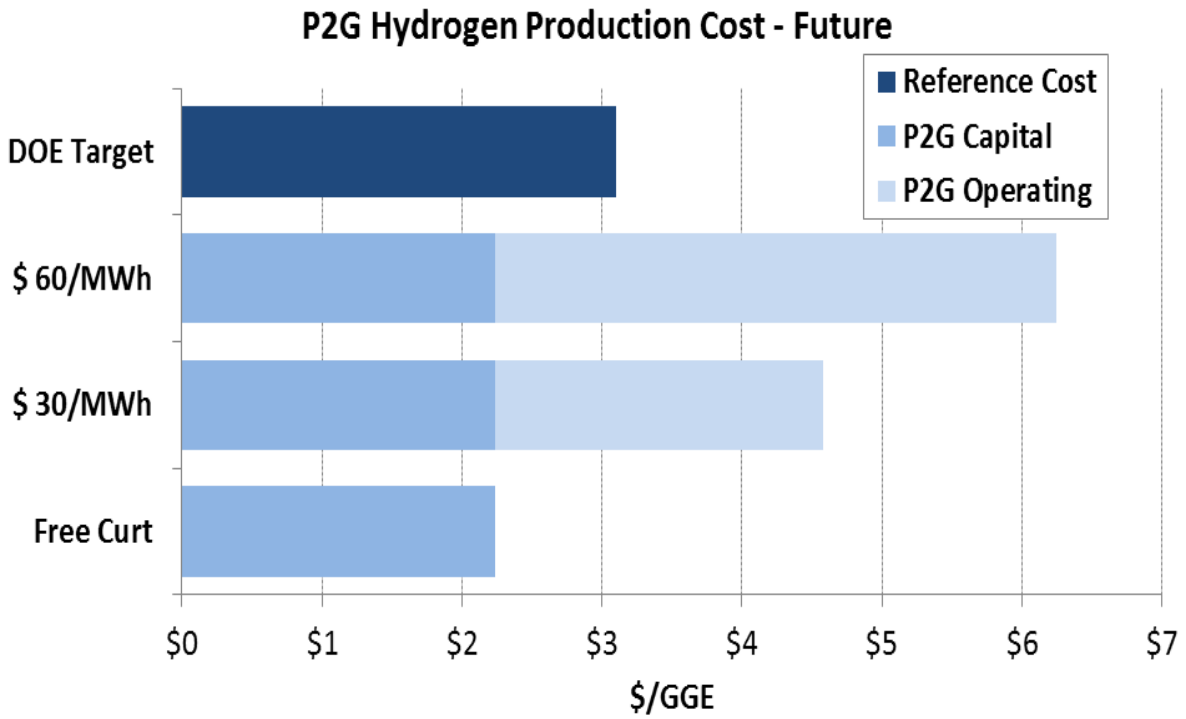
Long-predicted impacts of high renewables penetration on the California system load are now upon us



Localized grid impacts are also becoming significant

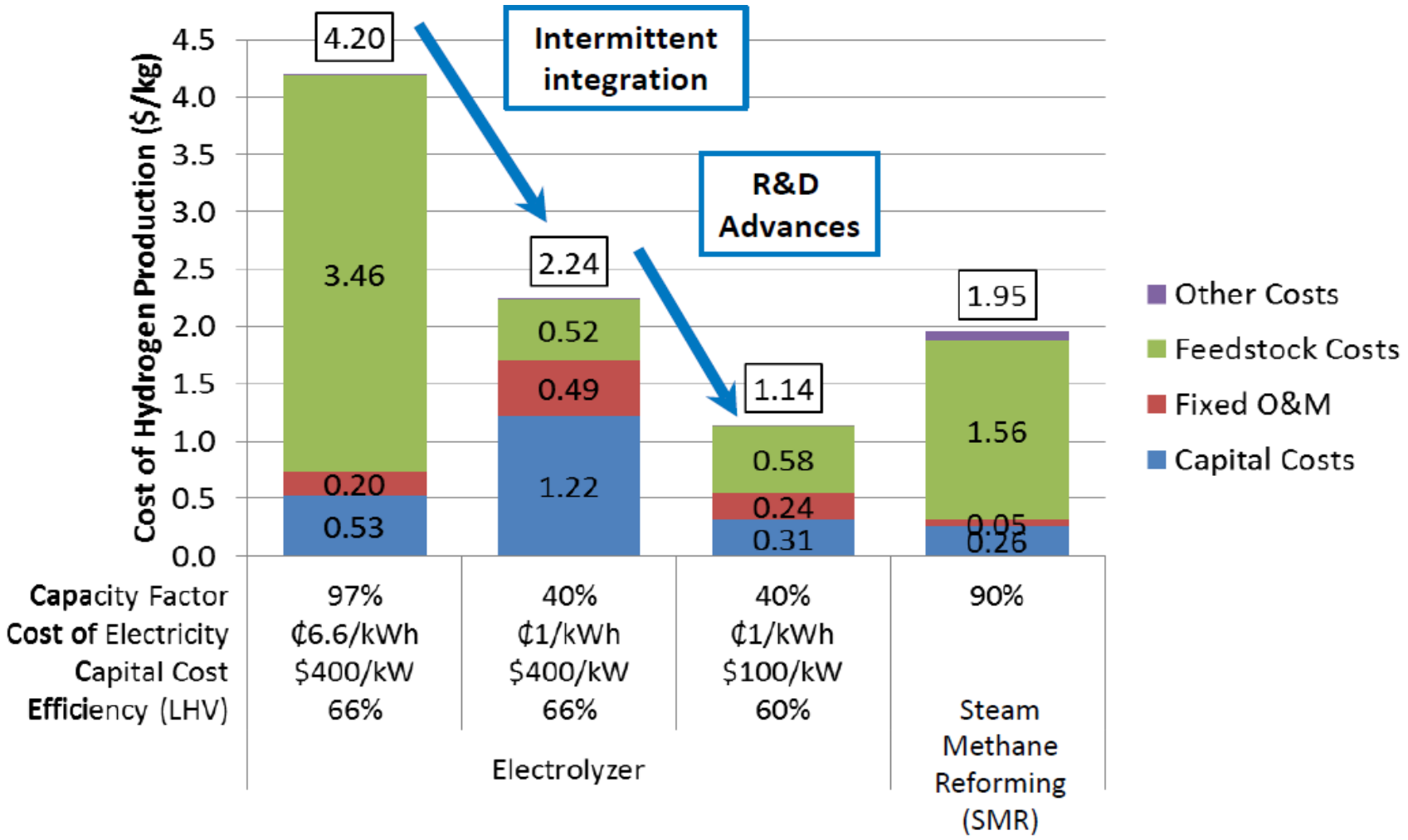


Indicative Fuel Production Cost



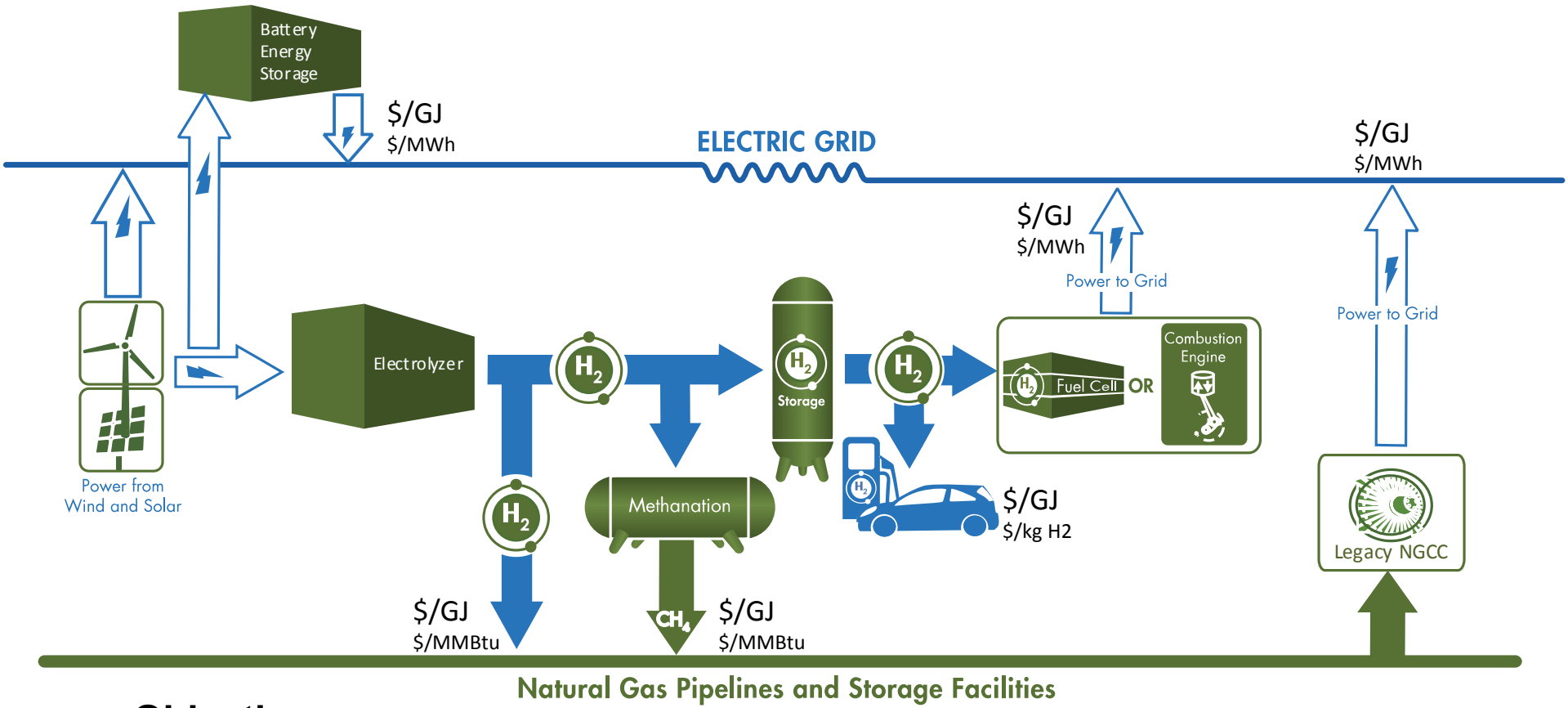
Source: UC Irvine and NREL analysis

Improving the economics of renewable H2:



DOE H2@Scale webinar, 7/28/16

UCI P2G Techno-Economic Analysis



Objective:

- Develop a Techno-Economic Analysis (TEA) model to accurately compare various P2G pathways to traditional storage technologies based on Levelized Cost or Returned Energy (LCORE).

Understanding and capturing the full range of the value stream is a challenge – P2G is a regulatory orphan

- View electrolyzer as a multi-function dispatchable resource
  - Produce fuel for transportation or other uses
  - Cycle/load follow… other grid services
- Produce in any hour that marginal revenue exceeds marginal cost
- Key dependencies
  - Electrolyzer capital cost and efficiency
  - Electricity cost
  - Value of renewable fuel
  - Value of grid services
- Current storage regime views P2G only as a load but no special rates are in place and market for grid services is not yet developed
- The P2G community needs to create a picture of the potential future for policy makers – value to the 2025 and 2035 grid not the 2016 grid

Future Outlook

Current State

- H2 predominantly used in refining – no renewable fraction
- Early build-out of H2 fueling stations serving a small number of vehicles
- No H2 blending on the natural gas system
- A few pre-commercial demonstrations and subsidized projects
- Electrolyzers not integrated into storage or dispachable load programs
- RH2 ~ $8/kg

Future State (2030)

- H2 (predominantly renewable) a significant element of the fuel mix
- Ubiquitous H2 fuel infrastructure and 100's of thousands of vehicles
- Significant dedicated H2 infrastructure
- Significant use of the natural gas grid for transport and storage (methane as feedstock + H2 blending)
- Full value of electrolyzers as a grid resource reflected in rates (real-time pricing) and fees for grid services
- RH2 < $2/kg