

Thermal Hydrogen: An Emissions Free Coal/Gas Economy

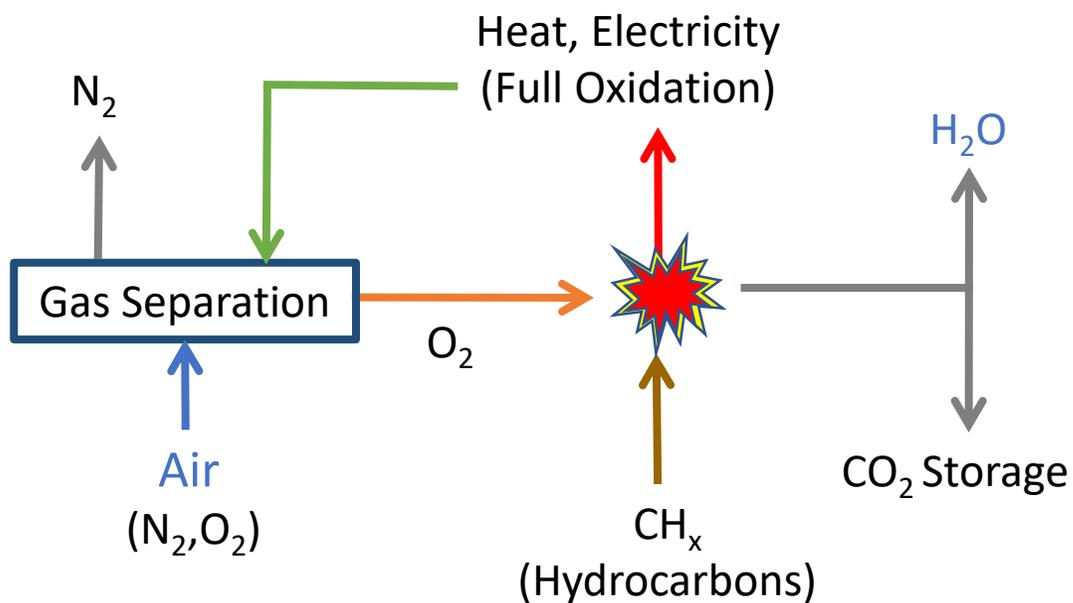
by: Jared Moore, Ph.D.

jared@meridianenergypolicy.com

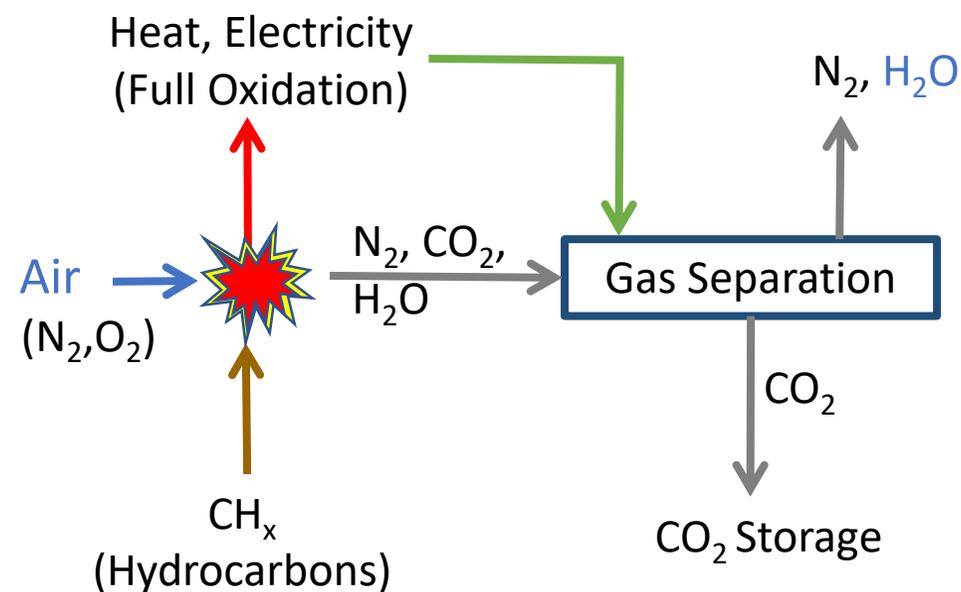
NCC Spring Meeting, April 19th, 2017

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Pre-Combustion CCS

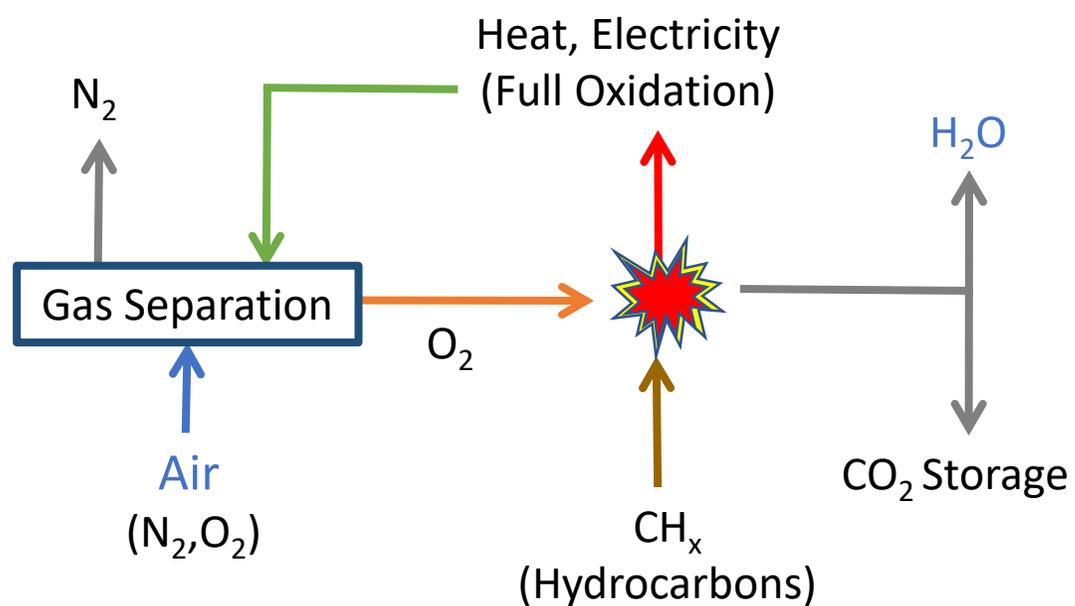


Post-Combustion Carbon Capture & Sequestration (CCS)

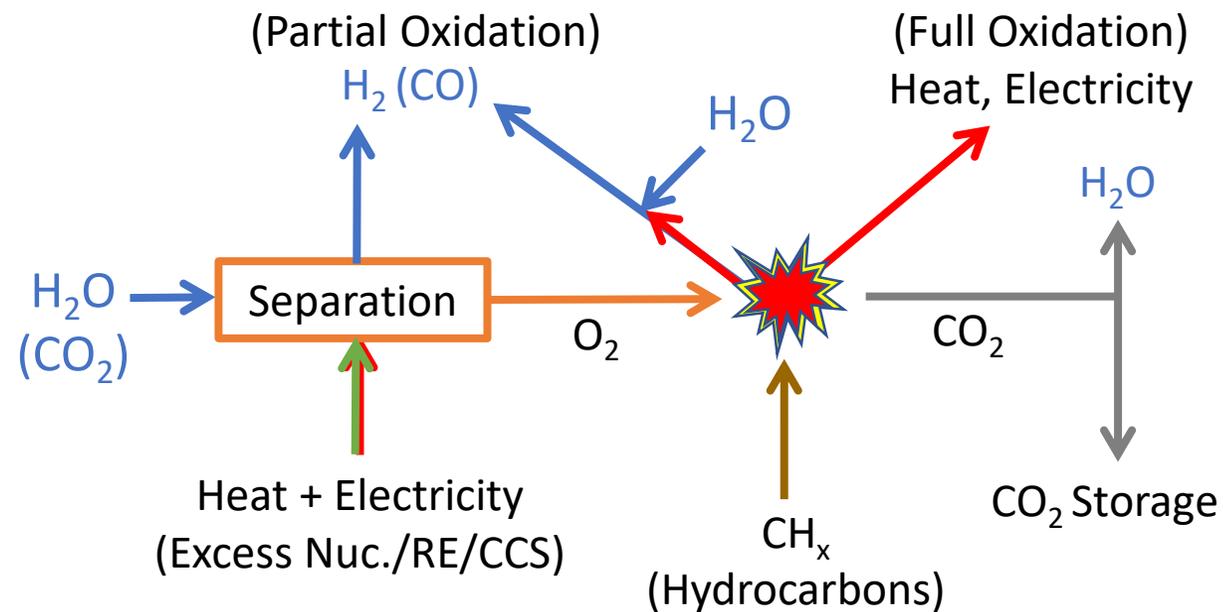


“CCS is all about gas separation, either before combustion, or after.”
Kyle Borgert, Ph.D. (CCS-Oxyfuel Expert)

Pre-Combustion CCS



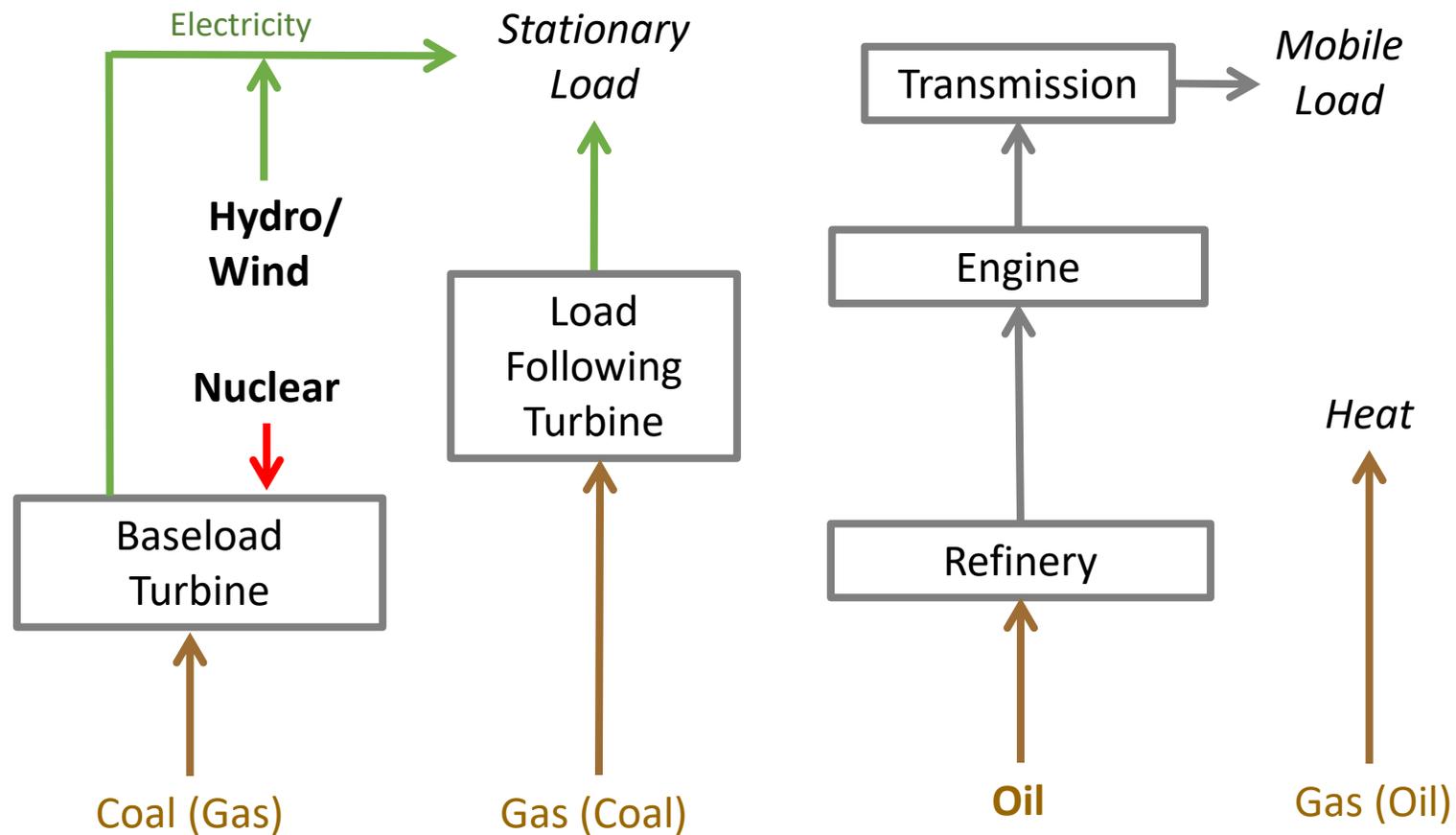
Thermal Hydrogen



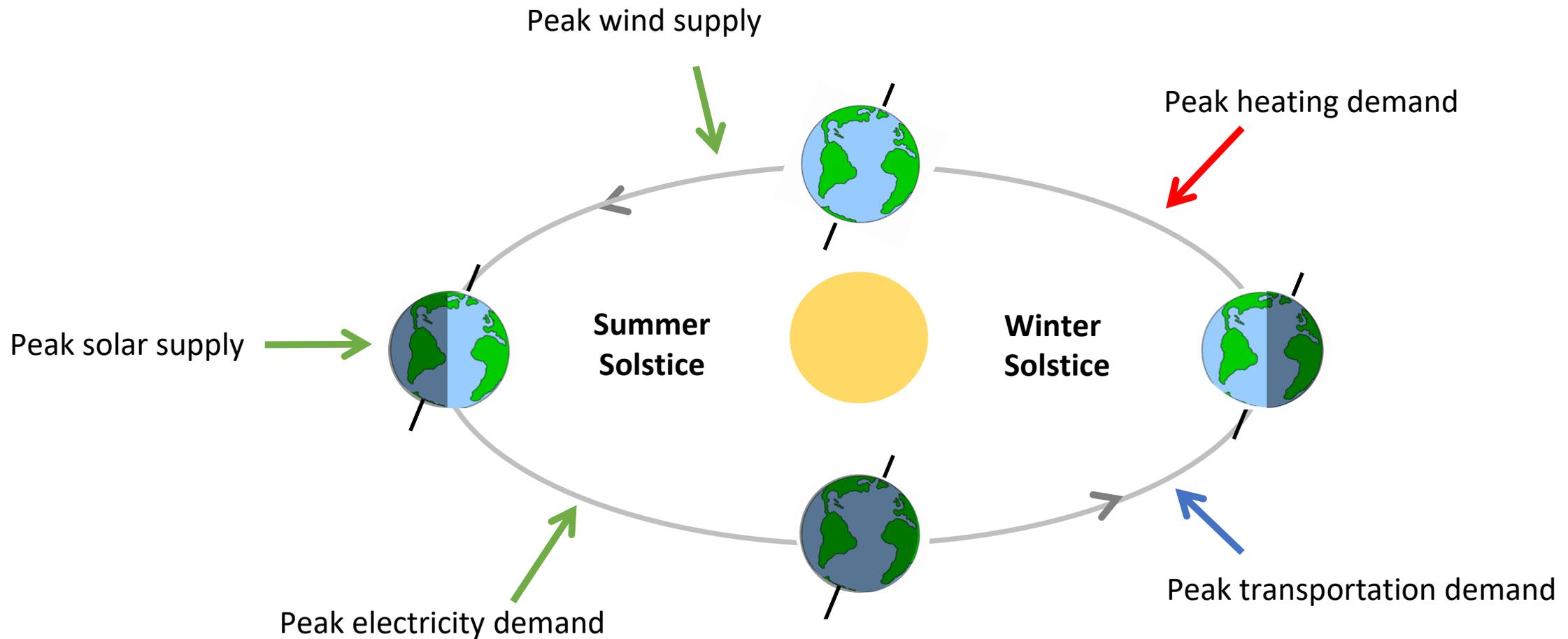
Thermal Hydrogen:

An integrated energy system where the storage of excess heat/energy as a chemical energy carrier also pre-empts gas separation for pre-combustion CCS.

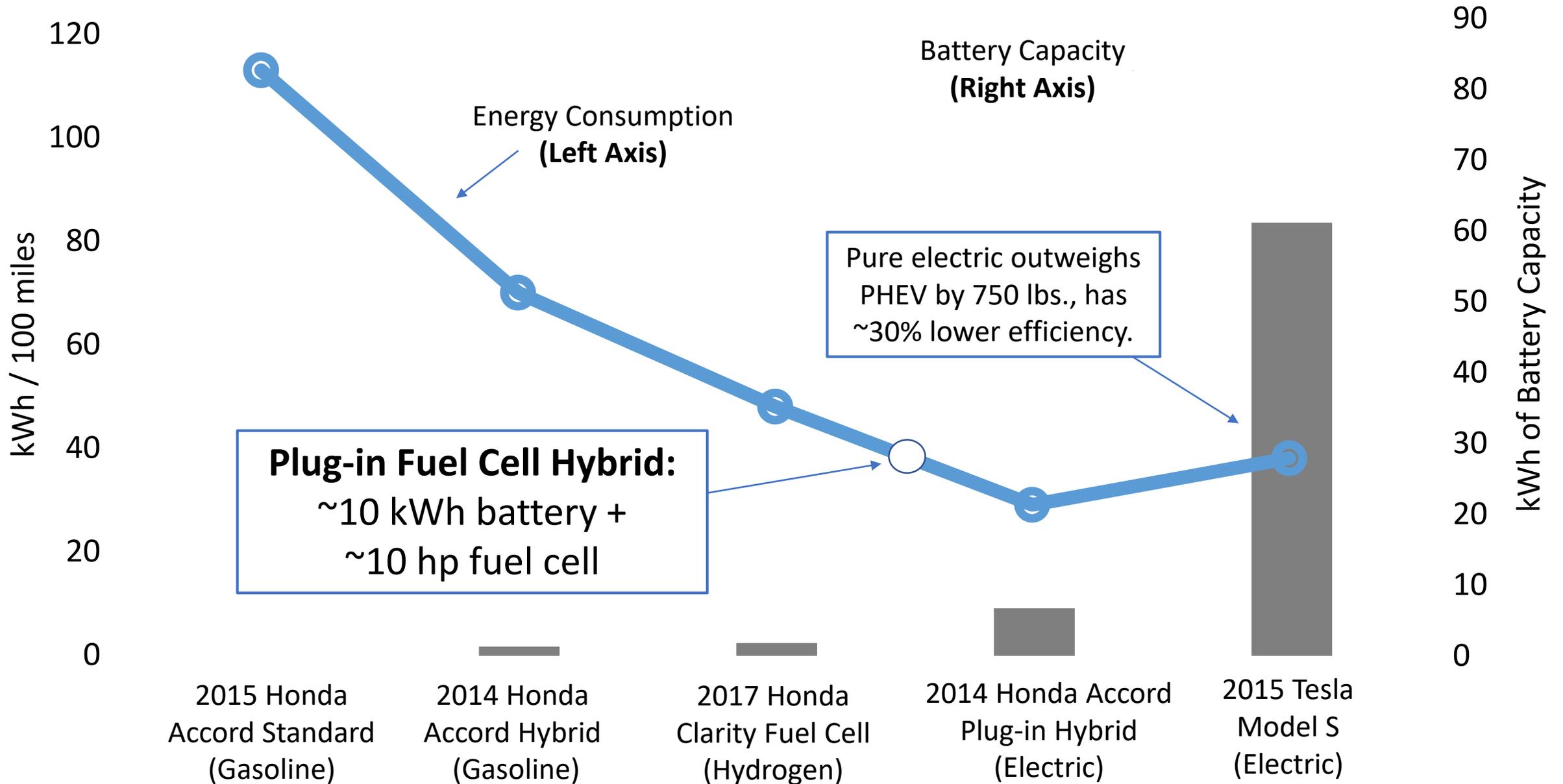
Modern Energy System: Load Following Economy



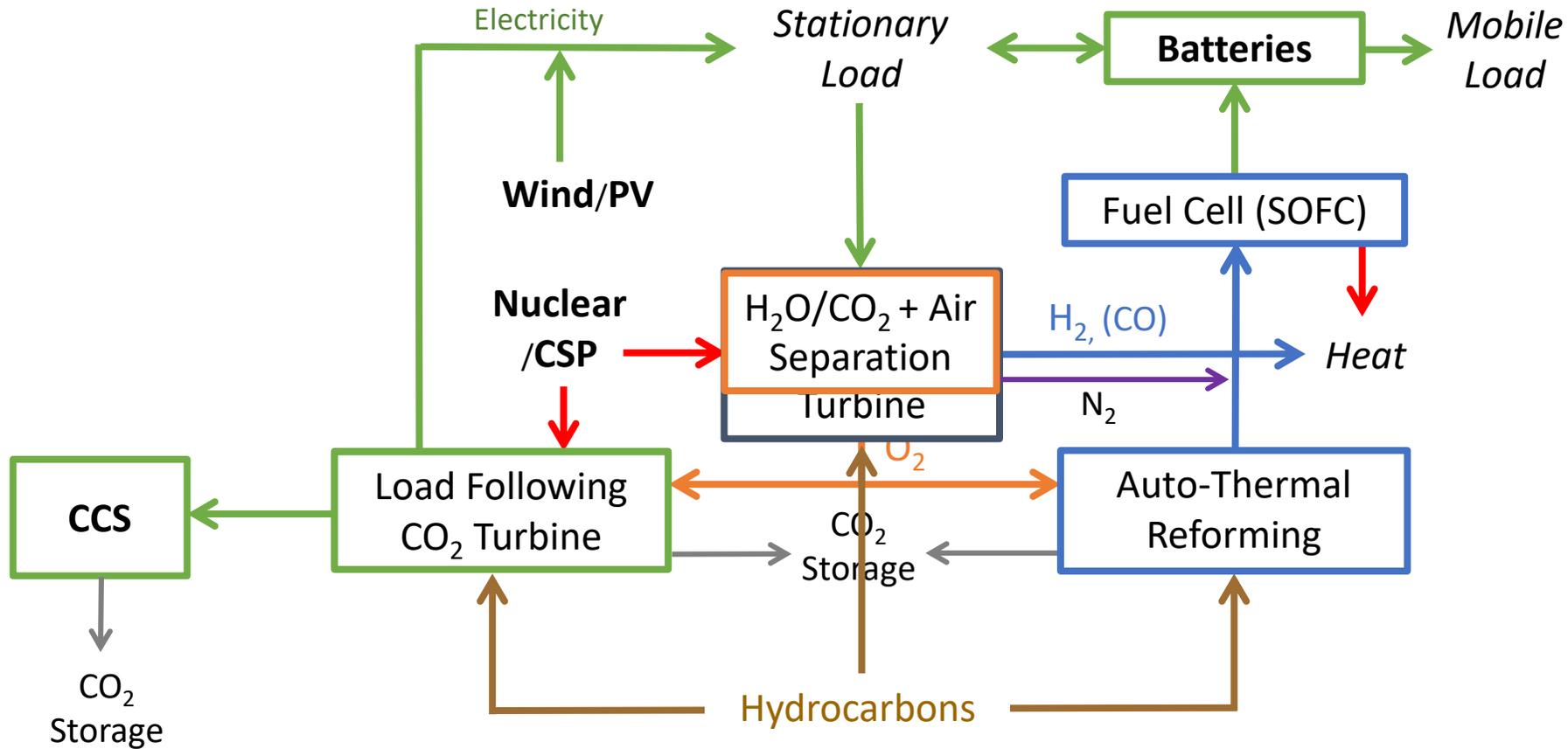
The Need for Storable, Liquid Fuels: Seasonal Mismatch Between Supply and Demand



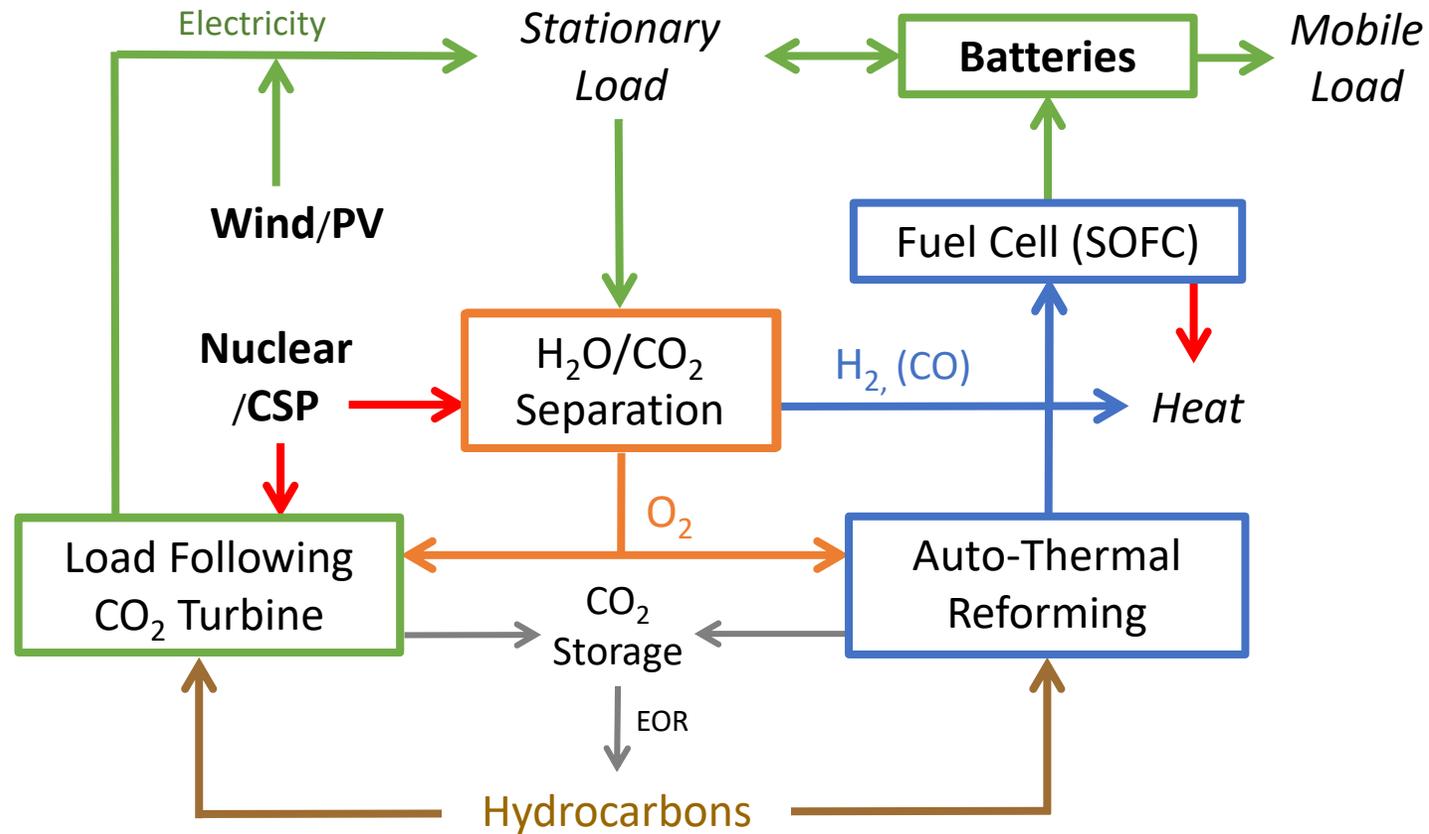
Energy Efficiency and Battery Size of Select Mid-Size Automobile Options



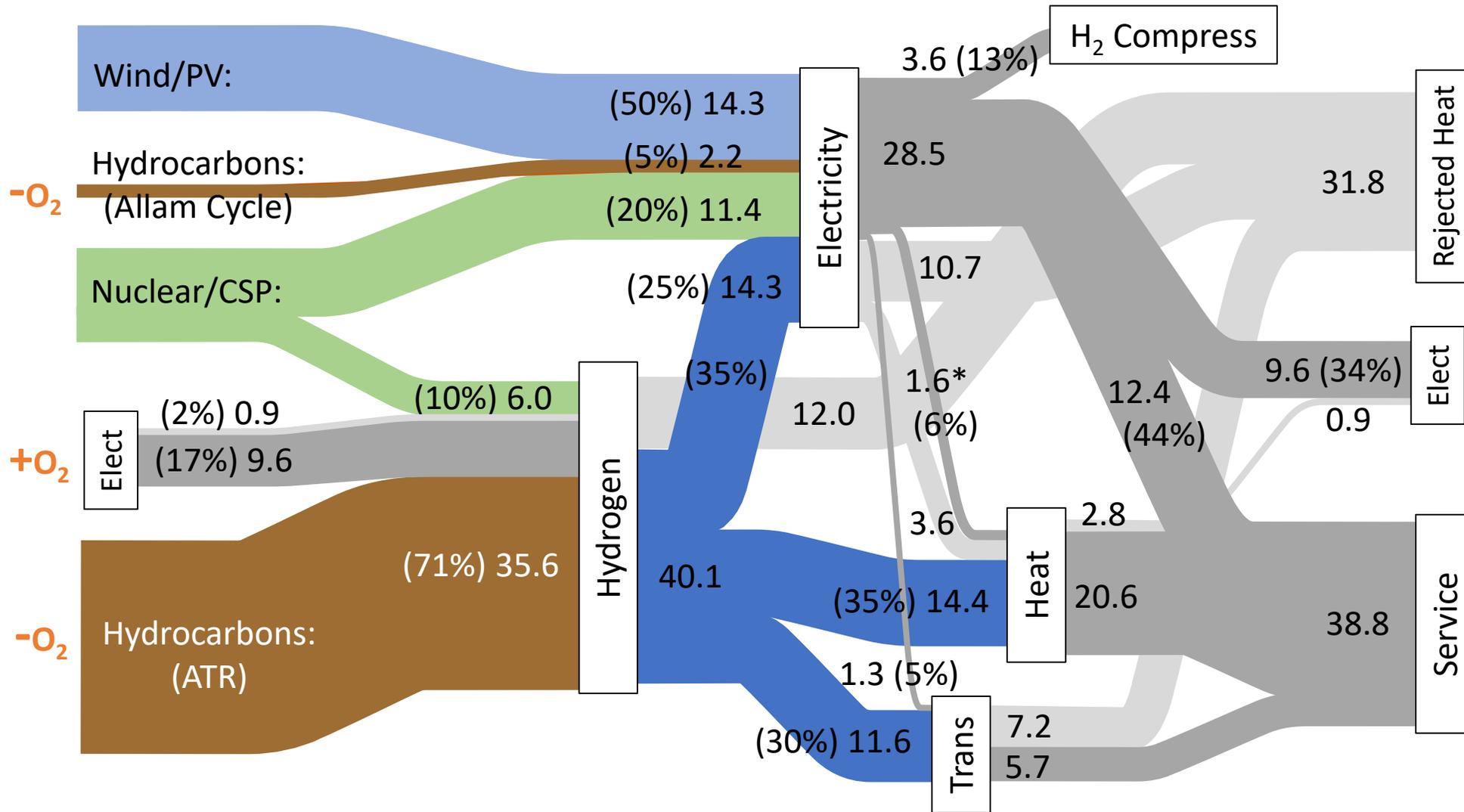
Thermal Hydrogen: A Demand Following Economy



Thermal Hydrogen: A Demand Following Economy

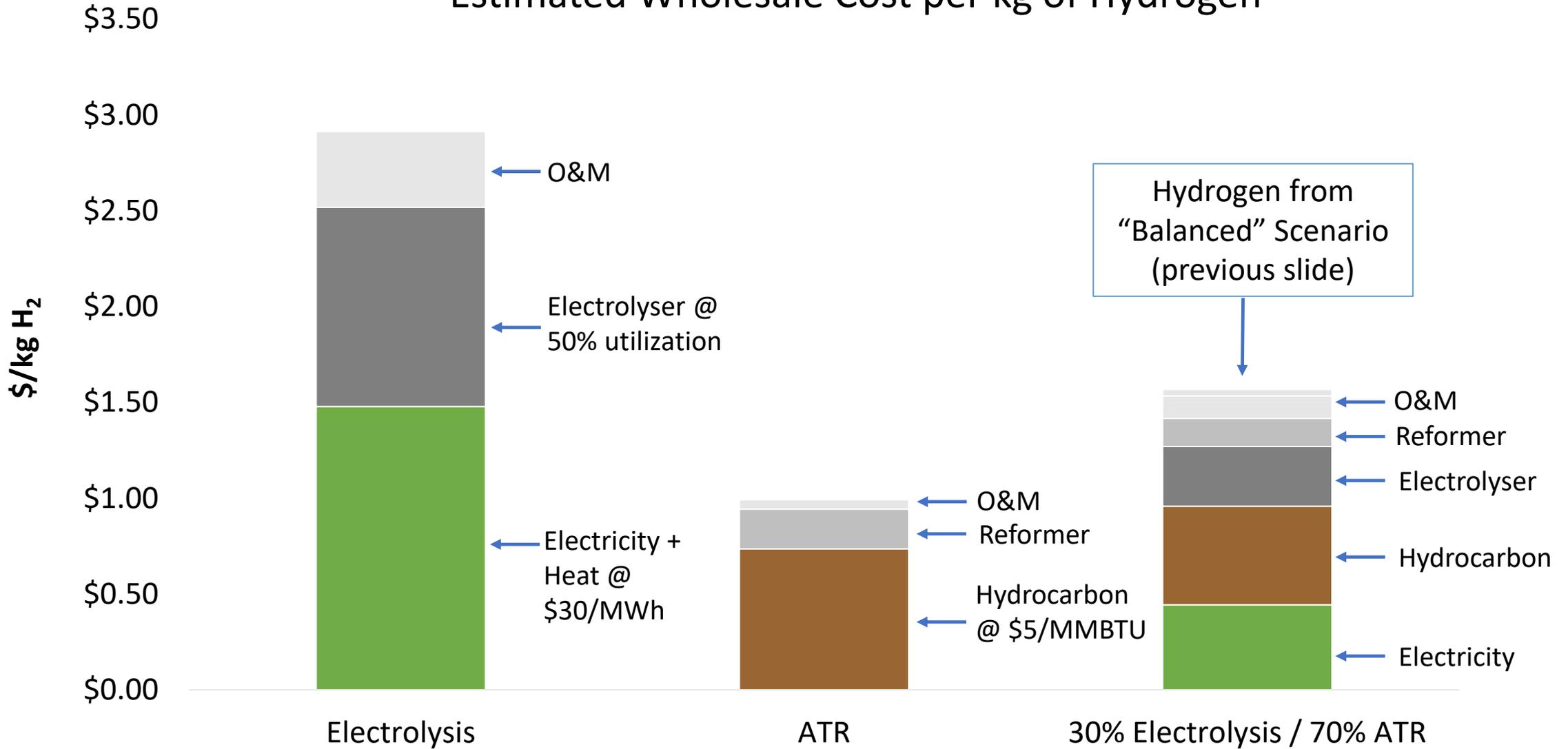


“Balanced” Thermal-Hydrogen Economy

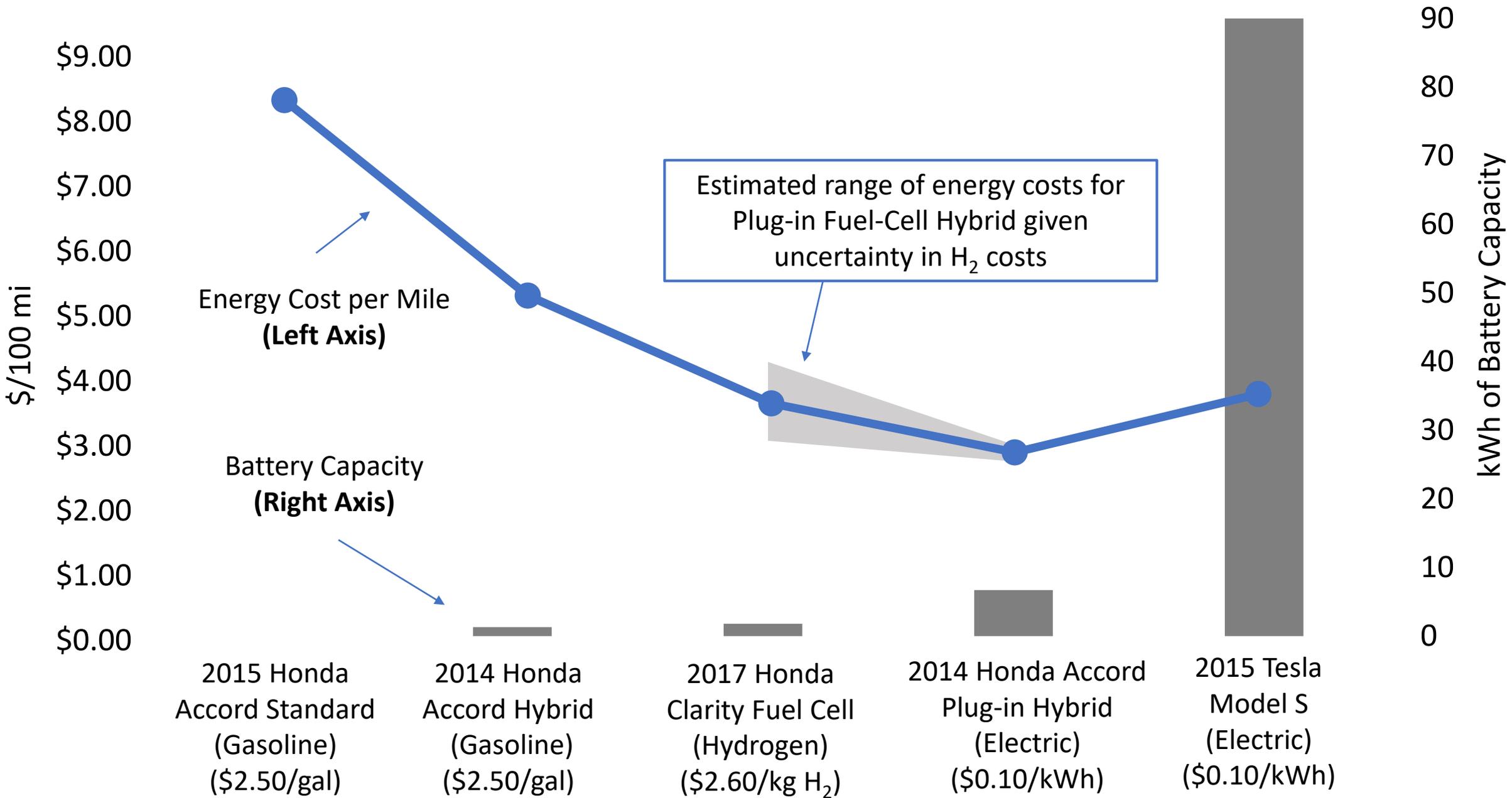


U.S. Energy System in Quads (Services Demanded 2014)

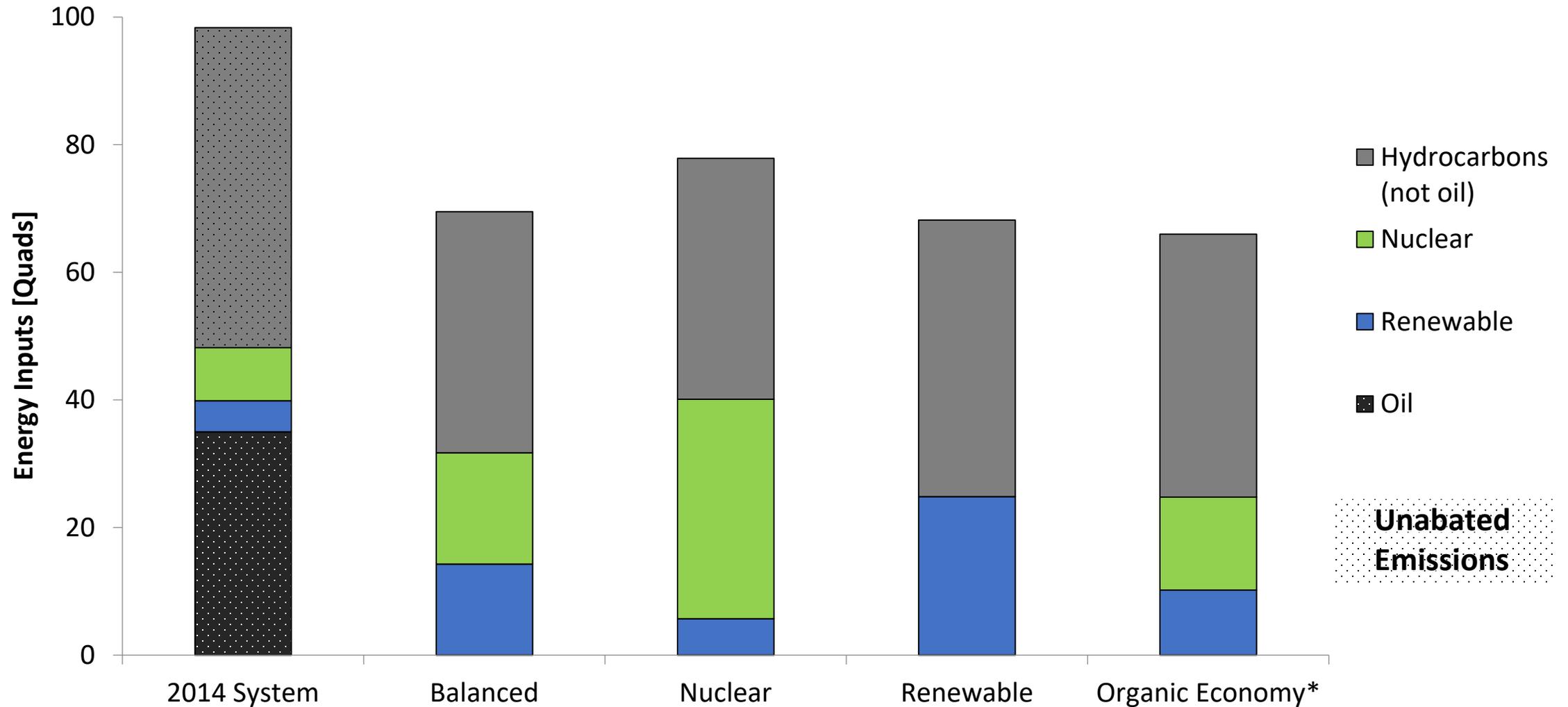
Estimated Wholesale Cost per kg of Hydrogen



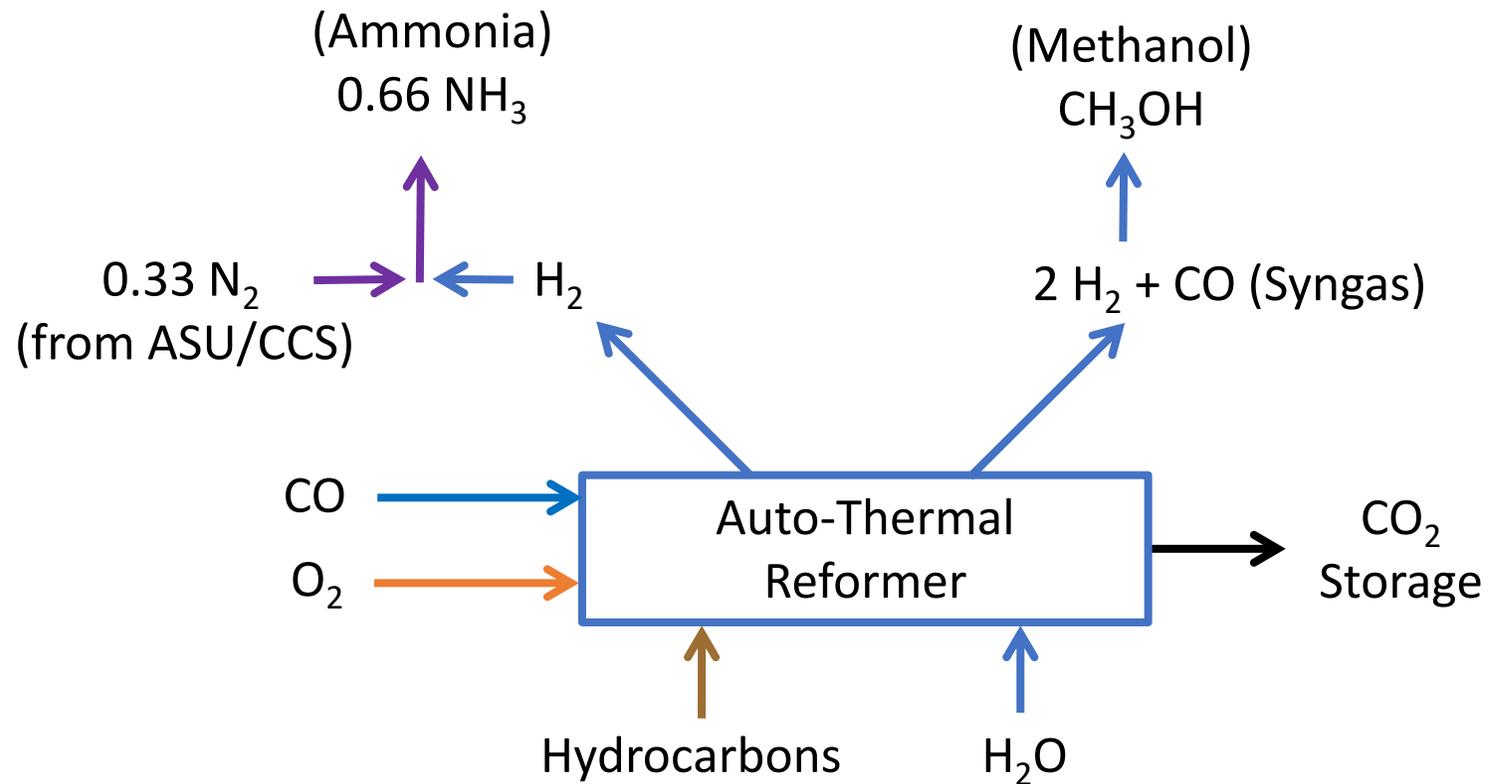
Energy Costs and Battery Size of Select Mid-Size Automobile Options



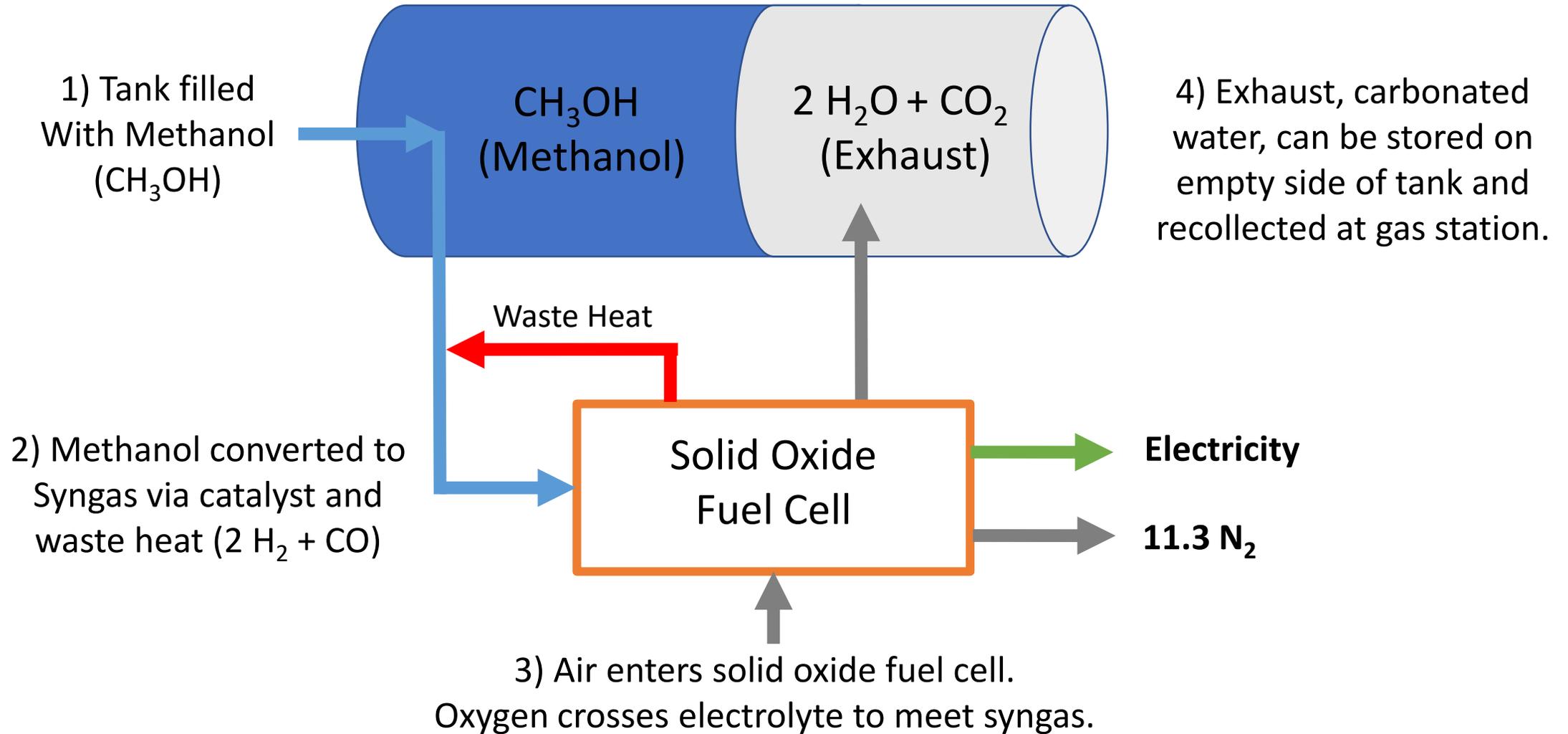
Competition and Choice: Innumerable energy supply, energy carrier options



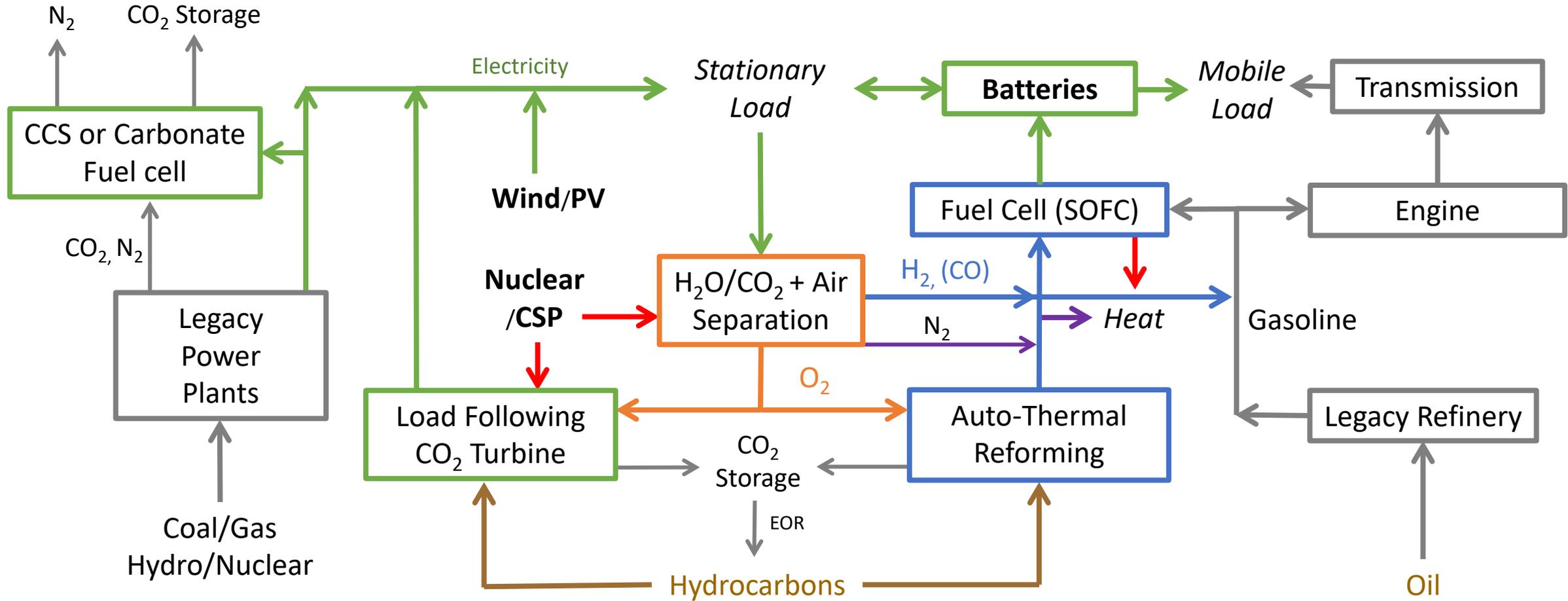
Distribution: The “organic” Thermal Hydrogen economy uses nitrogen (from CCS) and carbon as hydrogen energy carriers



How to Distribute Hydrogen as Methanol and “Recycle” H₂O and CO₂ from Solid Oxid Fuel Cells



Bridge from Modern Economy to Thermal Hydrogen Economy



Thermal Hydrogen:

An Emissions Free, Oil and Water Producing Energy Economy:

- Fueled mostly by hydrocarbons with minimal need for CCS (least steel)
- Most efficient hydrocarbon pathways possible
- Most efficient use of excess (nuclear) heat possible
- Highest utilization of electricity capacity
- Ceramic electrolyzers / fuel cells (no precious metals required)
- Lowest weight fully electric vehicles possible (lithium reduced by ~90%)
- “Demand following” options minimize need for gas storage
- Low distribution costs (minimum need for copper & no pure H₂ distribution)
- Most oil supply, energy supply options, and distribution options