Hydrogen Energy Storage for Renewable-Intensive Grids

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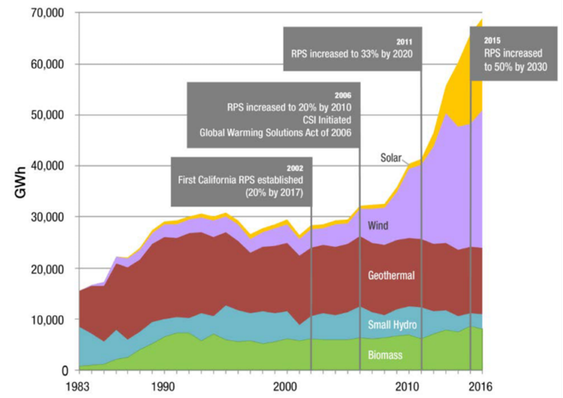
Research Question

- Given a highly renewable generation portfolio and active FCEV market, what is the optimal investment and operation of an HES system?
- What factors lead to economically competitive HES systems?
- How to optimize the flexibility, reliability, and profitability of a highly renewable energy portfolio by varying the allocation of energy via HES?
- Sensitivity of H2 carbon intensity and electricity carbon intensity to the number of operating FCEVs in an HES scenario.



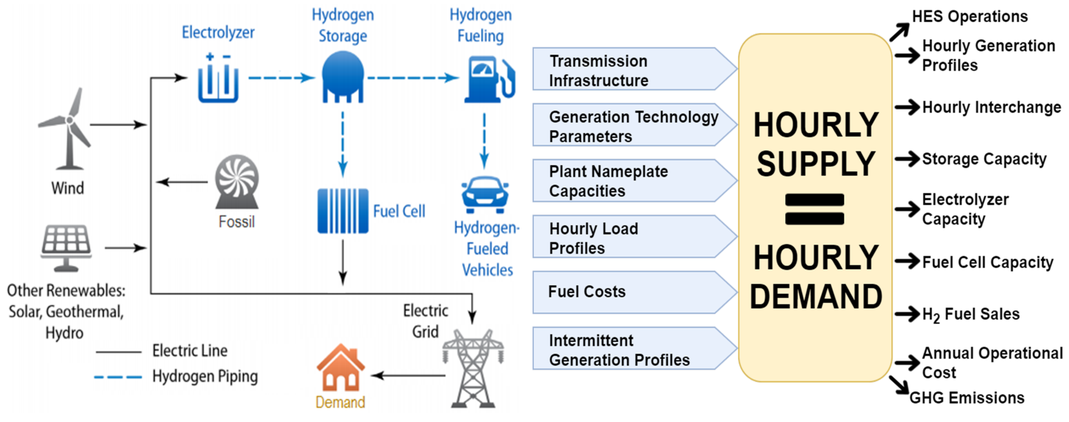
California Energy Generation by Resource Type

Notable California Policy

- SB32 – California Senate
- Zero Emission Vehicle (ZEV) Mandate
- Clean Vehicle Rebate Program (CVRP)
- Cap and Trade
- Renewable Portfolio Standards
- CA Energy Storage Mandate
- Net Energy Metering

Methods and Data

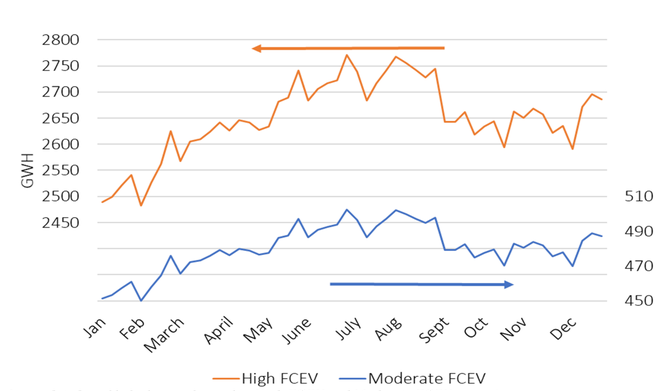
- Operate a linear optimization model to minimize cost to operator
- Determine what characteristics are formative in optimally operating a Hydrogen Energy Storage system
- Analyze these characteristics and their potential impact on a transition to alternative generation integration



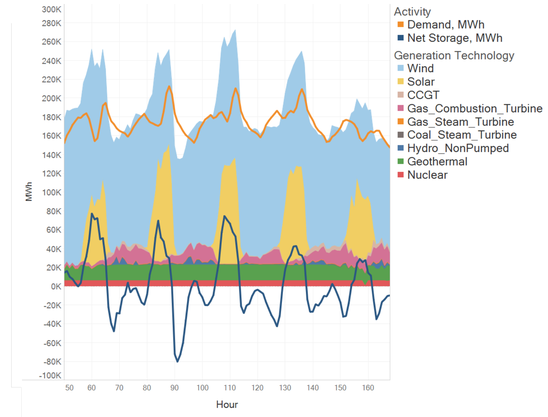
Results

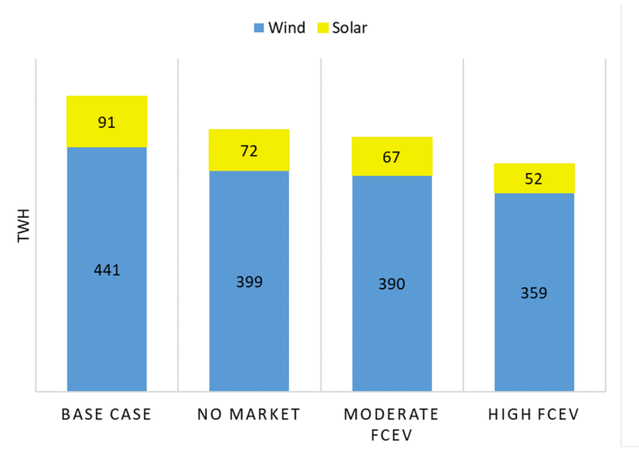
Scenario	HES System	Energy Efficiency	Electrification		Percentage of Nameplate			Price of H_2	VMT by FCEV
			Heating	Passenger VMT	Intermittent	Zero-Carbon	Fossil		
Base Case	No	Technical potential	100%	45%	66%	80%	20%	-	-
No Market	Yes								
Moderate FCEV								4.24 USD/kg	10%
High FCEV									55%

Comparison of modeling scenarios

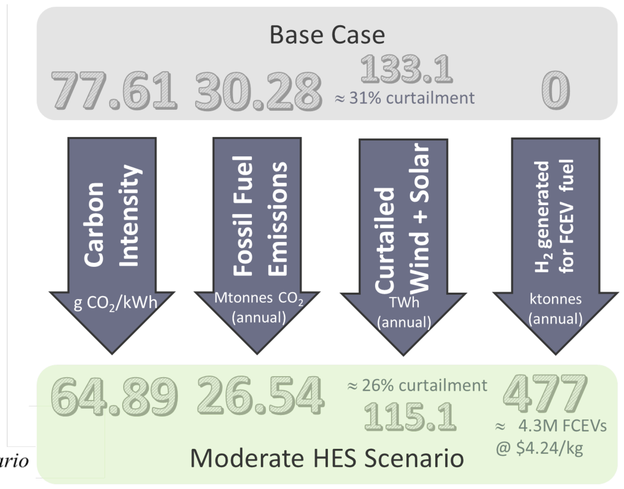


Interpolated weekly hydrogen demand in High FCEV and Moderate FCEV scenarios





Curtailment of intermittent renewable generation as a function of scenario



About this study

This study provides a greater understanding of the intrinsic benefits of leveraging the needs of a highly inflexible generation source (wind, solar PV) to provide a clean, cheap, and dependable transportation fuel. This technological platform can service as one of many tools used to provide stability to a highly renewable grid while capturing value for consumers and producers alike.

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