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.

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

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

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 serve as one of many tools used to provide stability to a highly renewable grid while capturing value for consumers and producers alike.

Results

Comparison of modeling scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>HES System</th>
<th>Energy Efficiency</th>
<th>Electrification</th>
<th>Passenger VMT</th>
<th>Percentage of Nameplate</th>
<th>Price of H₂</th>
<th>VMT by FCEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>No</td>
<td>Technical potential</td>
<td>100%</td>
<td>45%</td>
<td>66%</td>
<td>20%</td>
<td>-</td>
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<tr>
<td>No Market</td>
<td></td>
<td></td>
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<tr>
<td>Moderate FCEV</td>
<td>Yes</td>
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<tr>
<td>High FCEV</td>
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Sensitivity of H₂ carbon intensity and electricity carbon intensity to the number of operating FCEVs in an HES scenario.

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