**Fuel Cells and Renewable Energy in Data Centers**

Kyle Aukshunas, Lizette Chavez Farias, Brian Fritchman, Isaac Gu, Sam Heller, David Kim, Blake Lane, Yue Ma, Calvin Nguy, Ben Ordanza, Ethan Shin

Professor Jack Brouwer

### Background

Data centers are getting larger as cloud services become more popular, with 100 MW as the new standard (enough to power 16,400 average US homes).

Current power comes from the electric grid which is powered by unsustainable fossil fuels that produce pollutant emissions.

Photovoltaic solar panels and wind turbines can power data centers cleanly and renewably, but the power is not constant due to sun and wind variances.

Fuel cells convert chemical potential energy directly into electrical energy and lead to high efficiency, clean emissions, fuel flexibility, and reliability.

Electrolysis converts electrical energy into hydrogen to power fuel cells when renewable energy production is low.

### System Components

Renewable energy production varies much more than that of conventional energy, so we must use an energy storage system for times of low production.

### Sustainable Energy Solution

The design for this data center can be modified to power any variety of applications from a shopping mall to a family residence, all of which can be powered cleanly and sustainably. The design will be deployable around the world and can adapt to use many renewable energy sources.

### Size of Data Center

- **Wind:** Peak power: 33 MW
  - Capacity factor: 0.3

- **Solar:** Peak power: 290 MW
  - Capacity factor: 0.31

- **Size of Disneyland:** Both Parks, all Hotels and Parking Lots (0.75 mi²)

- **Size Required for 100 MW of Wind Power**
  - (5.1 mi²)

- **Size Required for 90 MW of Solar Power**
  - (3.65 mi²)

- **Size of 100 MW Data Center**
  - (0.02 mi²)

### Expenses and Funding

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Supply Part #</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Turbine - 90kW 48VDC</td>
<td>SUPERGA4811PC-3</td>
<td>$345</td>
</tr>
<tr>
<td>Solar Panel - 510W (Qty. 3)</td>
<td>1977310</td>
<td>$850</td>
</tr>
<tr>
<td>Electrolyzer - Hydrogen</td>
<td>52557H210</td>
<td>$565</td>
</tr>
<tr>
<td>H2 Storage Tank - 10K x 41L</td>
<td>525</td>
<td>$419</td>
</tr>
<tr>
<td>Battery - 4V 40AH (Qty. 3)</td>
<td>5-600</td>
<td>$3,350</td>
</tr>
<tr>
<td>Hardware Accessories</td>
<td>(various)</td>
<td>$1,431</td>
</tr>
</tbody>
</table>

**Total:** $7,144

**Funding:**

- **Source:**
  - Student Fees: $3,100
  - UROP Grant: up to $2,500

- **Amount:**
  - Total: $5,600

- **Budget Deficit:** $1,600