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Large-Scale Liquid Hydrogen Handling Equipment

*Hydrogen Delivery Analysis Meeting
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Some Delivery Pathways Will Necessitate the Use of Large-Scale Liquid Hydrogen Handling Equipment

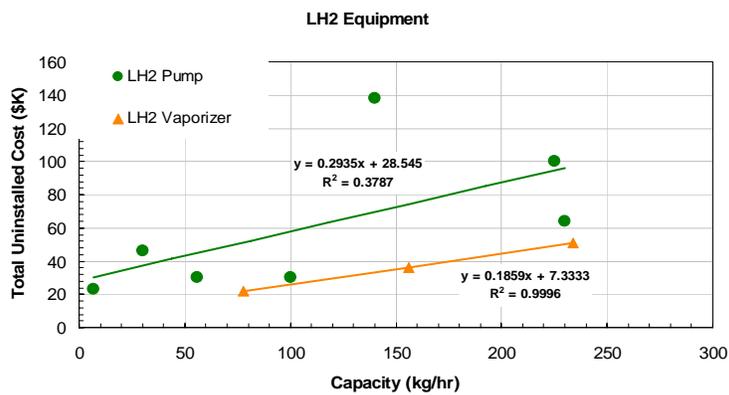
- **Potential Scenarios include:**
 - Production plant shutdowns
 - Summer-peak storage

- **Equipment Needs include:**
 - Storage tanks
 - Liquid Pumps
 - Vaporizers
 - Ancillaries

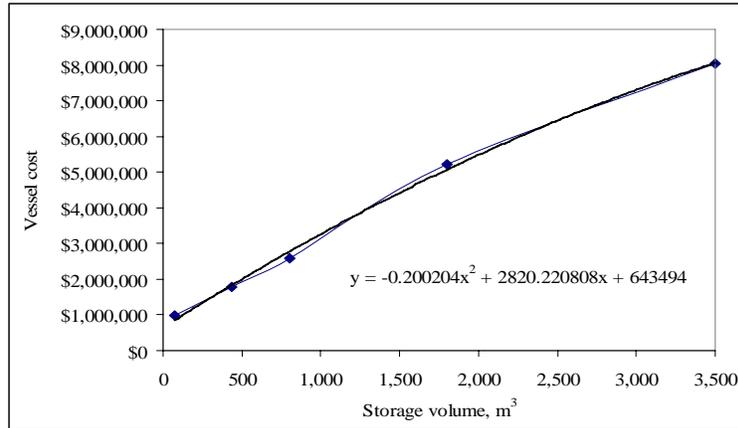
Concern is that Scaling up from Small Units Could Significantly Underestimate Costs of Larger Units

- Larger units may require field construction while smaller ones may be factory assembled
- Likely to be a maximum capacity for a given unit thereby requiring multiple units

Liquid Pump and Vaporizer Information Currently Based on Small-Scale Applications



Current Liquid Storage Costs Extend up to 3500 Cubic Meters for a Single Tank – Approximately 250 Tonnes of Liquid H2



Cost Information has been Revised but Remains Based Predominantly on Small-scale capacities, e.g., for Forecourts

- **Storage** (Current Estimate) \$ = $(-0.2 \times (\text{m}^3 \text{ of liquid H}_2)^2 + 2820 \times \text{m}^3 + 643498)$
 Maximum Capacity 3500 m³
 (Old Estimate) \$ = 1,100,000*(0.321*tonne H2 + 0.8174)
- Pump** (Current Estimate) \$ = 293.5*kg H2 per hour + 28545
 (Based on Capacities < 240 kg/hr)
 (Old Estimate) \$ = 150*(kg of H2/hour)
- **Vaporizer** (Current Estimate) \$ = 185.9*(kg H2 evaporated/hr) + 7333.3
 (Based on Capacities < 234 kg/hr)
 (Old Estimate) \$12,988 for 1500 kg/day
 \$7,920 for 100 kg/day

On-going Effort for Liquid Terminals Focused on Collecting and Analyzing Capacity and Cost Information on Liquid Pumps and Vaporizers

- **New information currently being sought from vendors and contractors**
- **Information to be examined for consistency**
- **New estimating algorithms developed and programmed in Components and Scenario Models as appropriate**