



## *Large-Scale Liquid Hydrogen Handling Equipment*

*Hydrogen Delivery Analysis Meeting  
May 8, 2007*

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managed by UChicago Argonne, LLC

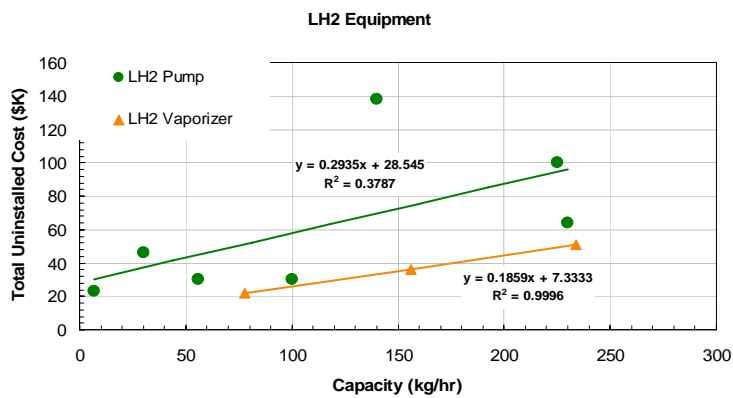
### *Some Delivery Pathways Will Necessitate the Use of Large-Scale Liquid Hydrogen Handling Equipment*

- Potential Scenarios include:
  - Production plant shutdowns
  - Summer-peak storage
- Equipment Needs include:
  - Storage tanks
  - Liquid Pumps
  - Vaporizers
  - Ancillaries

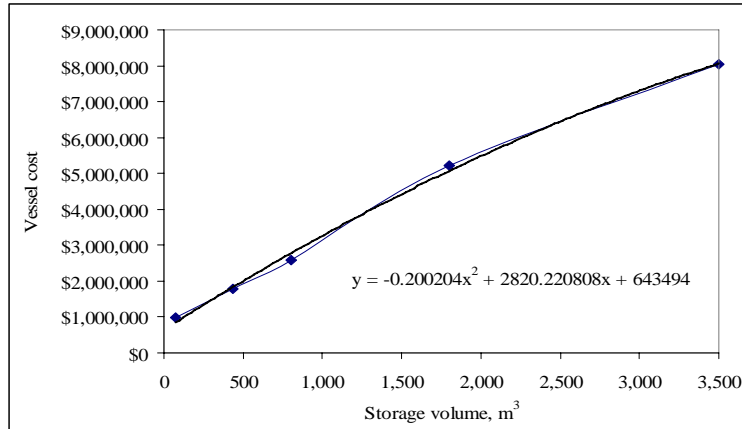
**Concern is that Scaling up from Small Units Could Significantly Underestimate Costs of Larger Units**

- 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 H<sub>2</sub>**



**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 m<sup>3</sup>  
(Old Estimate) \$ =  $1,1000,000 \times (0.321 \times \text{tonne H}_2 + 0.8174)$
- Pump** (Current Estimate) \$ =  $293.5 \times \text{kg H}_2 \text{ per hour} + 28545$   
(Based on Capacities < 240 kg/hr)  
(Old Estimate) \$ =  $150 \times (\text{kg of H}_2/\text{hour})$
- **Vaporizer** (Current Estimate) \$ =  $185.9 \times (\text{kg H}_2 \text{ evaporated/hr}) + 7333.3$   
(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