Overview of the Hydrogen Financial Analysis Scenario Tool (H2FAST)

H2USA Modeling Overview Webinar

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Presentation Outline

• Introduction: what is H2FAST and what questions can it answer?

• Review each version of H2FAST
  o H2FAST Web Tool
  o H2FAST Excel Tool
  o H2FAST Business Case Scenario tool (beta)

• Summary
The H2FAST framework has been implemented within multiple tools

Consistent financial calculations are deployed across the H2FAST web and spreadsheet tools and SERA scenarios

**H2FAST-Web** is a simple, easy to use online calculator

![H2FAST-Web interface](image)

**H2FAST-Excel** allows for more detailed inputs and elaborate outputs

![H2FAST-Excel interface](image)

**Business Case Scenario** tool explores the full range of SERA outputs

<table>
<thead>
<tr>
<th>Capital Cost [k$]</th>
<th>8.50</th>
<th>9.00</th>
<th>9.50</th>
<th>10.00</th>
<th>10.50</th>
<th>11.00</th>
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</thead>
<tbody>
<tr>
<td>Hydrogen Price [$/kg]</td>
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<td>800,000</td>
<td>4.9%</td>
<td>10.6%</td>
<td>14.9%</td>
<td>18.3%</td>
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<tr>
<td>900,000</td>
<td>4.7%</td>
<td>10.8%</td>
<td>14.9%</td>
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<td>5.2%</td>
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<td>1,100,000</td>
<td>5.7%</td>
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<td>1,200,000</td>
<td>6.2%</td>
<td>11.4%</td>
<td>15.0%</td>
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<td>20.3%</td>
<td>22.9%</td>
<td>24.5%</td>
<td>26.3%</td>
</tr>
</tbody>
</table>

**Tool interface designs have been tailored to distinct end-user groups**
What types of questions can H2FAST help to answer?

• **H2FAST: Web**
  – How will a $1 million capital incentive change the outlook for our station project?
  – What if we gain $10,000 per year (~$30/day) in additional convenience store sales due to hydrogen customers?

• **H2FAST: Excel**
  – What if our demand ramp-up rate is sluggish the first couple years, but then increases rapidly in the 4th year?
  – What if we put $5 million into a project with 7 stations?

• **H2FAST: BCS-Vis**
  – What kind of investments and incentives would be needed for a network of stations covering an entire metropolitan area or region?
  – How can we prioritize investments in one region or city compared to another?
H2FAST: A simple, user-friendly online tool

Visual results are provided instantly as inputs are changed by users

Introductory Language

Inputs

Download full financials for case

Reset Inputs

Single Value Results

Graphical Outputs (1)

Graphical Outputs (2)

Change Graphical Output metrics

Link to Download Spreadsheet Version

Embed widget

Download full financials for case
Example Case A: $1.2 M station, no subsidy, $14/kg price at the pump

- A nominal gaseous tank truck delivery station: 250 kg/day
- $1.2 million in capital and installation
- Hydrogen delivered for $5.50/kg and sold for $14/kg
- Top graph shows net investor cash flow; Bottom graph shows cumulative
- Result: $12.4/kg as breakeven price for a 10% IRR
Example Case B: Assume a $1.0 M Capital Incentive and $10/kg price

- Assume $1 M capital incentive in the first year
- Change pump price to $10 per kg
- Increase in IRR and investor payback period
- Result: $9.4/kg as breakeven price for a 10% IRR

H2FAST provides rapid assessments of the influence of incentives
Example Case C: $1.0 M Incentive, $10/kg price, $10k incidental revenue

- $1 M capital incentive
- $10 per kg price
- Add an incidental revenue stream of $10k per year (~$30/day)
- Increase in IRR and investor payback period
- Result: $9.2/kg as breakeven price for a 10% IRR

Many financing options can be explored quickly
H2FAST Excel Tool
H2FAST Spreadsheet: Summary of Capabilities

The spreadsheet version allows for greater control of inputs and more elaborate exploration of outputs

Inputs and User Interface

- Enter information for up to 10 stations and assess finances individually or as a cluster
- Side-by-side comparison of station projects
- There are two modes for users to provide inputs:
  - Basic mode: 20 parameters
  - Advanced mode: 51 parameters
- Inputs and outputs have hover-over descriptions to orient users

Outputs

- Detailed report tables are provided for each project year
  - Scenario parameters (e.g. volumes of sales)
  - Income statement
  - Cash flow statement
  - Balance sheet
  - Select ratio analyses
### Overall Financial Performance Matrix

- **Leverage type**: Advanced
- **Project length (years)**: 20
- **Station(s) Information**
  - Multi-Station Inputs
- **Feedstock Information**
  - **Total dispensing capacity (kg/day)**: 250
- **Demand Projection**
  - **Price of hydrogen at project onset ($/kg)**: 10.00
  - **Price escalation rate (% annually)**: 1.90%
  - **Demand ramp-up (years)**: 2.0
- **Financing Information**
  - **Total dispensing capacity (kg/day)**: 100
  - **Price of hydrogen at project onset ($/kg)**: 10.00
  - **Price escalation rate (% annually)**: 1.90%
  - **Demand ramp-up (years)**: 2.0

### Chart Selector & Description

- **Chart Selector**: Basic
- **Chart Description**: Multi-Station Inputs

### Data Table

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$0.00</td>
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<tr>
<td>Incidental revenue</td>
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</tr>
<tr>
<td>Price of hydrogen at project onset ($/kg)</td>
<td>10.00</td>
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</tr>
</tbody>
</table>

### Key Results

- **Real levelized values ($/kg H₂)**
  - **Sales revenue**: $0.00
  - **Capital incentive**: $0.00
  - **Incidental revenue**: $0.00
  - **Annual operating incentives**: $0.00
  - **Delivered hydrogen**: $10.00
  - **Maintenance expense**: $0.57
  - **Equipment cost**: $0.87
  - **Interest expense**: $0.25
  - **Sales tax**: $0.23
  - **Taxes payable**: $0.15
  - **Installation expenditure**: $0.10
  - **Property insurance**: $0.08
  - **Rent**: $0.05
  - **License & permitting**: $0.05
  - **Labor expense**: $0.00
  - **Cost of natural gas**: $0.00

### User Interface Overview

- **Color coding facilitates navigation**
- **Basic user inputs**
- **Advanced user inputs**
- **Calculated values**
- **Key results**
### Multi-Station Inputs

<table>
<thead>
<tr>
<th>Select station(s) to analyze</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station being analyzed (yellow background)</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Station type</th>
<th>Delivered gas</th>
<th>Delivered gas</th>
<th>Delivered gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dispensing capacity (kg/day)</td>
<td>100</td>
<td>250</td>
<td>500</td>
</tr>
<tr>
<td>Equipment capital cost</td>
<td>$930,156</td>
<td>$1,031,846</td>
<td>$1,659,916</td>
</tr>
<tr>
<td>Installation cost</td>
<td>$213,936</td>
<td>$237,325</td>
<td>$381,781</td>
</tr>
<tr>
<td>Planned &amp; unplanned maintenance ($/year)</td>
<td>$82,852</td>
<td>$95,316</td>
<td>$141,412</td>
</tr>
</tbody>
</table>

One time capital incentives (grant or ITC) | $ - | $ - | $ - |
Annual operating incentives (grant or PTC) | $ - | $ - | $ - |
Annual incidental revenue | $ - | $ - | $ - |

Cost specifications can be entered for multiple stations
- Users can select individual or all stations
- Users can specify different station types
- Costs should be changed by the user
- Pre-populated values are derived from HRSAM
User Interface Overview

Users can switch between model modes and stations to be analyzed
- Up to 10 stations can be modeled
- All stations can be modeled as a cluster
### Demand Projection

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of hydrogen at project onset ($/kg)</td>
<td>10.00</td>
</tr>
<tr>
<td>Project start year</td>
<td>2015</td>
</tr>
<tr>
<td>Price escalation rate (% annually)</td>
<td>1.90%</td>
</tr>
<tr>
<td>Installation time (months)</td>
<td>18</td>
</tr>
<tr>
<td>Demand ramp-up (years)</td>
<td>2.0</td>
</tr>
<tr>
<td>Long-term nominal utilization (%)</td>
<td>70%</td>
</tr>
</tbody>
</table>

### Feedstock Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of delivered hydrogen ($/kg)</td>
<td>$5.50</td>
</tr>
<tr>
<td>Escalation rate of hydrogen cost (% annually)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Price of electricity ($/kWh)</td>
<td>$0.120</td>
</tr>
<tr>
<td>Escalation rate of electricity cost (% annually)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Price of natural gas ($/mmBTU)</td>
<td>$8.00</td>
</tr>
<tr>
<td>Escalation rate of natural gas cost (% annually)</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

### Other operating expenses

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit card fees (% of sales)</td>
<td>2.50%</td>
</tr>
<tr>
<td>Sales tax (% of sales)</td>
<td>2.25%</td>
</tr>
<tr>
<td>Road tax ($/kg)</td>
<td>$0.36</td>
</tr>
<tr>
<td>Road tax escalation rate (%/year)</td>
<td>1.90%</td>
</tr>
<tr>
<td>Staffing labor hours (h/year-station)</td>
<td>-</td>
</tr>
<tr>
<td>Labor rate ($/h)</td>
<td>$40</td>
</tr>
<tr>
<td>Labor escalation rate (% annually)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Licensing &amp; permitting ($/year-station)</td>
<td>$1,000</td>
</tr>
<tr>
<td>Licensing &amp; permitting escalation rate (%/year)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Rent of land ($/station-year)</td>
<td>$3,000</td>
</tr>
<tr>
<td>Rent escalation (% annually)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Property insurance (% of dep capital)</td>
<td>1.5%</td>
</tr>
<tr>
<td>Selling &amp; administrative expense (% of sales)</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

### Financing Information

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project operational life (years)</td>
<td>20</td>
</tr>
<tr>
<td>Total tax rate (state, federal, local)</td>
<td>38.50%</td>
</tr>
<tr>
<td>Is installation cost depreciable?</td>
<td>No</td>
</tr>
<tr>
<td>Are operating incentives taxable?</td>
<td>No</td>
</tr>
<tr>
<td>Is capital incentive depreciable?</td>
<td>Yes</td>
</tr>
<tr>
<td>Are tax losses monetized (tax equity application)</td>
<td>Yes</td>
</tr>
<tr>
<td>Allowable tax loss carry-forward</td>
<td>7 year</td>
</tr>
<tr>
<td>General inflation rate</td>
<td>1.90%</td>
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<tr>
<td>Depreciation (MACRS)</td>
<td>7 year</td>
</tr>
<tr>
<td>Leveraged after-tax nominal discount rate</td>
<td>10.0%</td>
</tr>
<tr>
<td>Debt/equity financing</td>
<td>0.5</td>
</tr>
<tr>
<td>Debt type</td>
<td>Revolving debt</td>
</tr>
<tr>
<td>If loan, period of loan (years)</td>
<td>20</td>
</tr>
<tr>
<td>Debt interest rate (compounded monthly)</td>
<td>6.00%</td>
</tr>
<tr>
<td>Cash on hand (% of monthly expenses)</td>
<td>100%</td>
</tr>
</tbody>
</table>

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**User Interface Overview**

Users can specify all financial parameters:

- Projected demand
- Feedstock & utility costs
- Other operating expenses
- Capital structure
- Taxes
User Interface Overview

Key outputs are highly visible
- IRR
- Payback
- Year of positive earnings
- NPV
- Break-even price of hydrogen

Note: values are leveraged, based on equity investors cash flow.
User Interface Overview

Station 2: Cumulative investor cash flow, (Thousands)

Visualization of time series results
Users can select from 65 different metrics
- Green window provides parameter descriptions
Users are provided with a detailed breakdown of revenues and expenses

- Values are reported on per-kilogram of hydrogen sold
### General parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
<th>Value 5</th>
<th>Value 6</th>
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<th>Value 11</th>
<th>Value 12</th>
<th>Value 13</th>
<th>Value 14</th>
<th>Value 15</th>
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</table>

### Income statements

<table>
<thead>
<tr>
<th>Statement</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
<th>Value 5</th>
<th>Value 6</th>
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</thead>
</table>

### Cash flow statements

<table>
<thead>
<tr>
<th>Statement</th>
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<th>Value 3</th>
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</table>

### Balance sheets

<table>
<thead>
<tr>
<th>Statement</th>
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<th>Value 3</th>
<th>Value 4</th>
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<th>Value 12</th>
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<th>Value 14</th>
<th>Value 15</th>
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</thead>
</table>

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Report Tables: All typical US GAAP report values are displayed for each analysis year.
Time Series Examples

Station 3:

Cumulative investor cash flow, (Millions)

- User can select from 65 common reportable time series
- Detailed description is available for each time series
- Labels can be turned on and off to show numeric values

Range of tables satisfied most end user inquiries
Multivariate visualization provides access to large scenario data results

- The SERA model can generate a large volume of scenario results
- The H2FAST framework can be applied across the entire hydrogen supply chain system and a broad range of scenario parameters
- Some engaged audiences, such as H2USA WG members, are interested in exploring ranges of inputs assumptions and multiple sets of scenario outputs

Demand and Delivery by City

Regional/State-level Subsets of Results

Vehicle Adoption Rates

State Name
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- New Jersey
- New York
- Rhode Island
- Vermont

Stand-alone reports cannot capture the full range of possible outputs

Station Placement

Cash Flows

The Business Case Scenario Visualization tool (BCS-Vis) is being developed to allow end-users to explore a wide range of inputs and outputs
Business Case Scenario tool explores the full range of SERA outputs

BSC-Vis allows end users to explore a wide range of time series scenario metrics across various geographic scales

4-min video demonstrates the multivariate visualization tool: http://youtu.be/J7y51c-dldo
Selection of years

Select the scenario and the modeled data of interest

Launching the SERA Visualization

Slider changes the modeled year and updates the map and chart
Selection of urban areas

Clicking an urban area provides a chart of all yearly values for the currently selected data parameter.
Selection of metrics and output variables

Changing the data parameter updates the legend, chart, map and hover information.
Summary

• The H2FAST Web and Spreadsheet tools are an effective means of informing investment decisions on hydrogen station projects
  o Developed for end-users requiring a simple, first-cut analysis (web version) as well as more detailed and elaborate analyses (spreadsheet version)

• The H2FAST framework can also be applied to the entire hydrogen fuel supply chain to evaluate the financial implications of infrastructure development at the city, region, or national levels
  o This framework is currently being used internally to inform H2USA IFWG members in scenario exploration
  o A beta version of a visualization tool has been developed to allow access to these multivariate results to a broader audience
Questions?

Contact email: Marc.Melaina@nrel.gov