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Hydrogen Financial Analysis Scenario Tool (H2FAST): Spreadsheet Tool User's Manual

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List of Acronyms

DSCR	debt service coverage ratio
EBITD	earnings before interest, taxes, and depreciation
H2	hydrogen
H2FAST	Hydrogen Financial Analysis Scenario Tool
IRR	internal rate of return
IRS	Internal Revenue Service
ITC	investment tax credit
MACRS	Modified Accelerated Cost Recovery System
NPV	net present value
NREL	National Renewable Energy Laboratory
PP&E	plant, property, and equipment
PTC	production tax credit
SERA	Scenario Evaluation, Regionalization, and Analysis
SMR	steam methane reforming

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1 Introduction

The Hydrogen Financial Analysis Scenario Tool (H2FAST) provides a quick and convenient in-depth financial analysis for hydrogen fueling stations. This manual describes how to use the spreadsheet version of H2FAST, which is one of three H2FAST formats developed by the National Renewable Energy Laboratory (NREL). Although all of the formats are based on the same financial computations and conform to generally accepted accounting principles (FASAB 2014, Investopedia 2014), each format provides a different level of complexity and user interactivity.

The web tool is the simplest to use and allows users to quickly vary approximately 20 input values. The results are basic financial performance parameters such as investor cash flow, internal rate of return, and the break-even sale price of hydrogen. The web tool is available at http://www.nrel.gov/hydrogen/h2fast/.

The next most complex format is the interactive Microsoft Excel spreadsheet, which can be downloaded at http://www.nrel.gov/hydrogen/h2fast/. As this manual illustrates, the H2FAST spreadsheet offers basic and advanced user interface modes for modeling individual stations or groups of up to 10 stations. It provides users with detailed annual finance projections in the form of income statements, cash flow statements, and balance sheets; graphical presentation of financial performance parameters for 65 common metrics; life-cycle cost breakdown for each analysis scenario; and common ratio analysis results such as debt/equity position, return on equity, and debt service coverage ratio.

Finally, the most complex and customizable format is available as part of SERA—NREL's Scenario Evaluation, Regionalization, and Analysis Model—and will be available at http://developer.nrel.gov/. This format is designed for expert users. It accepts user-defined input files and is ideal for examining large numbers of scenarios quickly, for example, to perform sensitivity analyses.

2 Getting Started

To access the spreadsheet version of H2FAST, go to http://www.nrel.gov/hydrogen/h2fast/ and click the "Spreadsheet Version" button. Download the Excel file to your computer and then open it, making sure to enable macros. This tool is designed for use with Microsoft Excel 2010 and newer Excel versions; full functionality with older versions is not guaranteed.

The spreadsheet opens on the *Interface* worksheet (Figure 1). This is the primary worksheet you will use to input values and view results. Three other worksheets are accessible by clicking the tabs at the bottom of the screen. The *Description* worksheet provides basic information about the tool. The *Report Tables* worksheet shows detailed technical and financial outputs in tabular form. The *Station Characteristics* worksheet contains a table with additional inputs and calculations; most users will not need to modify values in this worksheet.

Active cells in each worksheet are color coded: yellow for basic user inputs, orange for advanced user inputs, blue for calculated values, and green for key results. For many of the cells, descriptive information pops up when you click in the cell. In addition, you can click the information cells (denoted with an "i") for more information.

2.1 Inputs

You input information within the *Interface* worksheet. To begin your inputs, click the "Basic" or "Advanced" button in the *Station(s) Information* table to select the interface type. Basic is the default and enables a relatively small number of input fields. Advanced enables additional input fields. Next, enter the number of stations you want to model, from 1 to 10. Then proceed to the *Multi-Station Inputs* table, which is immediately to the right of the *Station(s) Information* table. Here you define each of your stations. First select station type: delivered gas, delivered liquid, electrolysis, or onsite SMR (steam methane reforming). Then enter values for dispensing capacity, equipment capital cost, installation cost, maintenance cost, incentives, and incidental revenue. It is important that you replace the default information with your own stations' values. The default values are placeholders only and do not represent actual or predicted values for hydrogen stations. If you need to modify values for electricity use, natural gas use, or delivered hydrogen, go to the *Station Characteristics* worksheet and fill in the relevant yellow cells for each station type.

H2FAST does not assume a particular station configuration, refueling pressure, or state of technological maturity. The tool is intended to be flexible so that users can input station cost assumptions for whatever system is of interest. H2FAST is not a cost estimation tool. Guidance on appropriate values for station costs (e.g., capital equipment costs) is available in Melaina and Penev (2013) as well as in Argonne National Laboratory's Hydrogen Refueling Station Analysis Model (HRSAM) (ANL 2015) and the U.S. Department of Energy's Hydrogen Analysis (H2A) forecourt production case studies (DOE 2015). The U.S. Energy Information Administration's *Annual Energy Outlook* is a useful source for forecasts of electricity and natural gas prices (EIA 2015).[1]

[1] Additional information on hydrogen station network planning can be found within web resources provided by the California Fuel Cell Partnership (www.fuelcellpartnership.org/), the H2USA public-private partnership (http://h2usa.org/), and the California Energy Commission's Alternative and Renewable Fuel and Vehicle

After you have defined your stations in this manner, return to the *Interface* worksheet's left column and accept or overwrite all cells in orange (using the advanced interface) and yellow (using the basic or advanced interface) as you scroll down (see Appendix A for descriptions of all inputs and default values). That's all you need to do. Results are calculated automatically as described in the following section. To restore the default values, click the "Restore Defaults" button at the upper left of the worksheet.

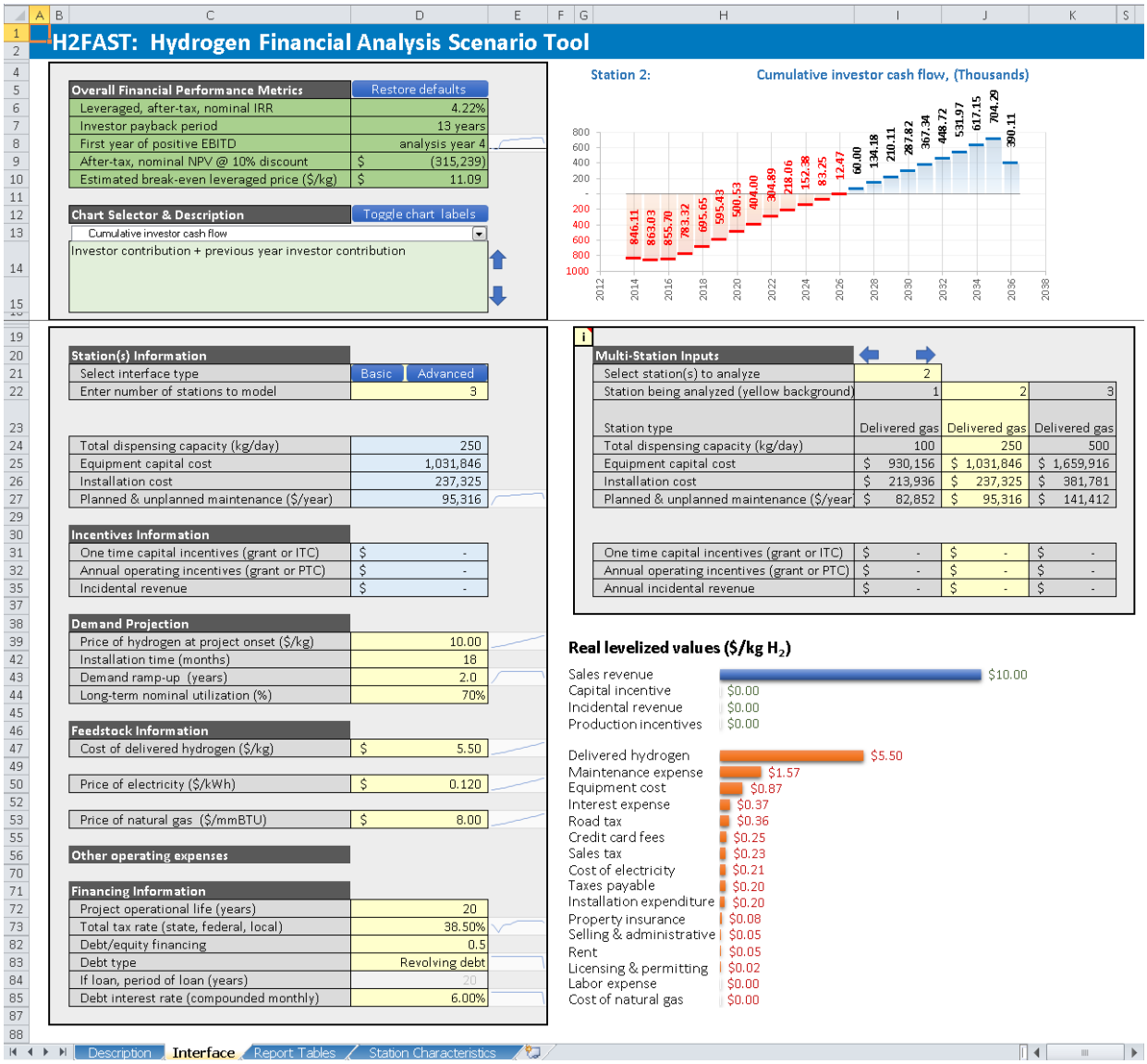

Figure 1. Spreadsheet version of H2FAST, *Interface* worksheet

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Technology Program (www.energy.ca.gov/drive/projects). Relevant near-term hydrogen station finance and incentive analyses have been conducted by Energy Independence Now (www.einow.org/reports.html). The Alternative Fuels Data Center's Station Locator (www.afdc.energy.gov/locator/stations/) shows current hydrogen station locations in the United States, and Ludwig Bolkow Systemtechnik GmbH (www.netinform.net/h2/H2Stations/) maintains a map of worldwide hydrogen stations.

2.2 Results

You can view results for each of your stations individually or for all of your stations combined. Click the blue arrows at the top of the *Multi-Station Inputs* table to switch between stations. The selected station is highlighted in yellow. Figure 2 shows an example with station 2 selected. To select all stations, click the left blue arrow until you have selected the station 1 column, and then click the left arrow one more time. This selects and highlights all of the stations (Figure 3).

Multi-Station Inputs						
Select station(s) to analyze	2					
Station being analyzed (yellow background)	1	2	3	4	5	6
Station type	Delivered gas	Delivered gas	Delivered gas	Delivered liquid	Delivered liquid	Delivered liquid
Total dispensing capacity (kg/day)	100	250	500	250	500	1,000
Equipment capital cost	$ 930,156	$ 1,031,846	$ 1,659,916	$ 1,135,428	$ 1,619,632	$ 2,813,099
Installation cost	$ 213,936	$ 237,325	$ 381,781	$ 261,148	$ 372,515	$ 647,013
Planned & unplanned maintenance ($/year)	$ 82,852	$ 95,316	$ 141,412	$ 145,254	$ 184,703	$ 282,057
One time capital incentives (grant or ITC)	$ -	$ -	$ -	$ -	$ -	$ -
Annual operating incentives (grant or PTC)	$ -	$ -	$ -	$ -	$ -	$ -
Annual incidental revenue	$ -	$ -	$ -	$ -	$ -	$ -

Figure 2. *Interface* worksheet, *Multi-Station Inputs* table, showing station 2 selected

Multi-Station Inputs						
Select station(s) to analyze	All Stations					
Station being analyzed (yellow background)	1	2	3	4	5	6
Station type	Delivered gas	Delivered gas	Delivered gas	Delivered liquid	Delivered liquid	Delivered liquid
Total dispensing capacity (kg/day)	100	250	500	250	500	1,000
Equipment capital cost	$ 930,156	$ 1,031,846	$ 1,659,916	$ 1,135,428	$ 1,619,632	$ 2,813,099
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One time capital incentives (grant or ITC)	$ -	$ -	$ -	$ -	$ -	$ -
Annual operating incentives (grant or PTC)	$ -	$ -	$ -	$ -	$ -	$ -
Annual incidental revenue	$ -	$ -	$ -	$ -	$ -	$ -

Figure 3. *Interface* worksheet, *Multi-Station Inputs* table, showing all stations selected

For whichever stations are selected, results are presented in three areas in the *Interface* worksheet. The *Overall Financial Performance Metrics* table at the top left shows values for leveraged, after-tax, nominal IRR (internal rate of return); investor payback period; first year of positive EBITD (earnings before interest, taxes, and depreciation); after-tax, nominal NPV (net present value) at your selected discount rate; and estimated break-even leveraged price of hydrogen (Figure 4). Click on each value for a definition of the metric (see Appendix B for descriptions of all outputs).

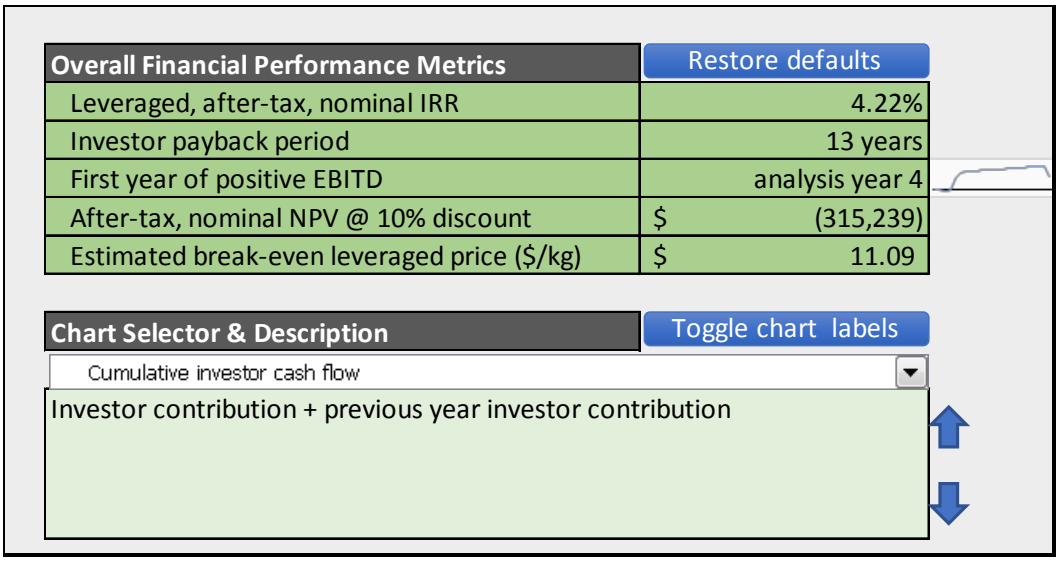


Figure 4. *Interface* worksheet, *Overall Financial Performance Metrics* table

The IRR is the discount rate at which a project's NPV is equal to zero. The IRR calculations can exhibit complex behavior. In simple cases where investor cash flow is negative in the first year and positive in each subsequent year, the IRR can have only one value. However, if investor cash flow has more than one sign change during the project period, multiple solutions for the IRR will exist. H2FAST uses Excel's native IRR calculation. In cases with multiple IRR solutions, it typically displays the smallest positive solution.

NPV and hydrogen break-even price are linked to the value you entered for "Leveraged after-tax nominal discount rate" in the *Financing Information* table. The NPV is calculated using that discount rate. The break-even price is the price at which your station(s) would need to sell hydrogen to receive an IRR equal to the discount rate you specified. If you set your actual hydrogen price ("Price of hydrogen at project onset" in the *Demand Projection* table) exactly equal to the break-even price, the IRR you receive will equal the discount rate you entered, and the NPV will be zero.

The break-even leveraged price of hydrogen per kilogram often will be substantially higher than a typical gasoline price per gallon, even though the amount of energy in a kilogram of hydrogen is approximately equal to the energy in a gallon of gasoline. However, because a fuel cell electric vehicle is about twice as efficient as a similar conventional gasoline vehicle, an owner can drive twice as far on a kilogram of hydrogen than on a gallon of gasoline. Therefore, if the hydrogen price is $10 per kilogram, the cost to the owner would be equivalent to a gasoline price of about $5 per gallon on a cost-per-mile-driven basis.

Various results also can be displayed within the *Interface* worksheet's chart field. Selecting a chart from the drop-down menu under *Chart Selector & Description* displays the selected chart (Figure 5). The text field below the menu describes the active chart. You can scroll through the various charts by clicking the blue up and down arrows to the right of the text field. The "Toggle chart labels" button turns the chart labels on and off.

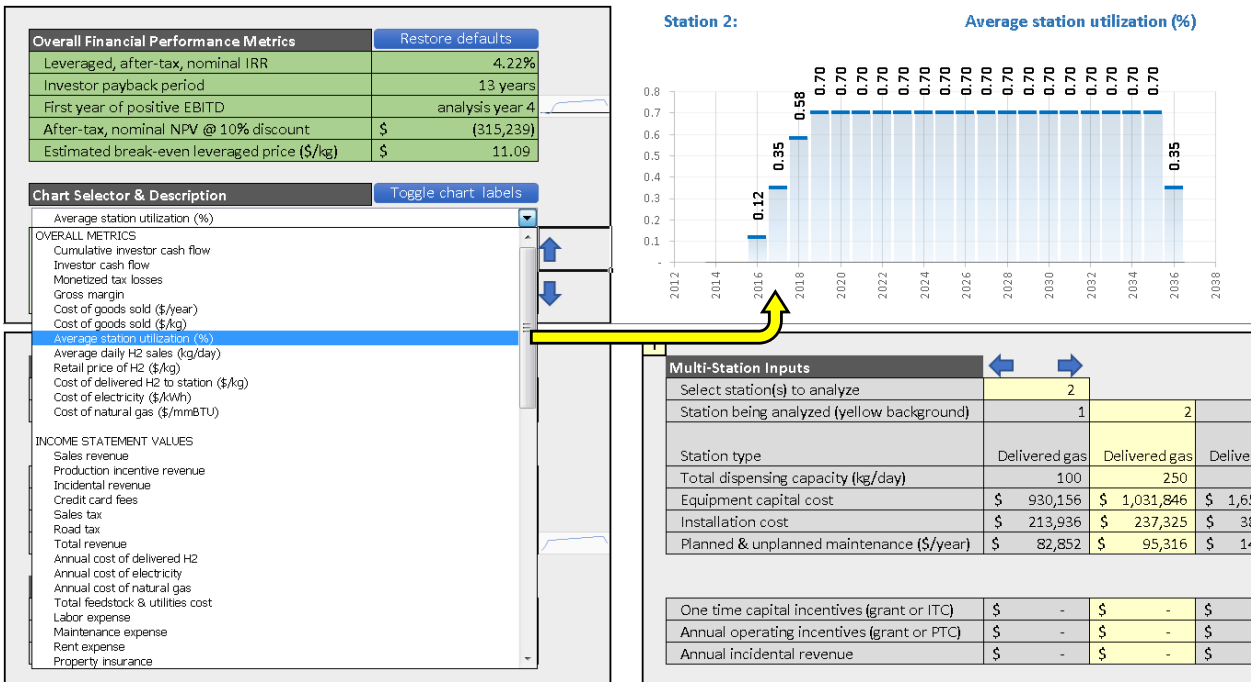


Figure 5. *Interface* worksheet, *Chart Selector & Description*, showing chart options

The final location for results within the *Interface* worksheet is below the *Multi-Station Inputs* table at the bottom right. These bars and values represent levelized (dollars per kilogram of hydrogen produced) revenues and expenses (Figure 6).

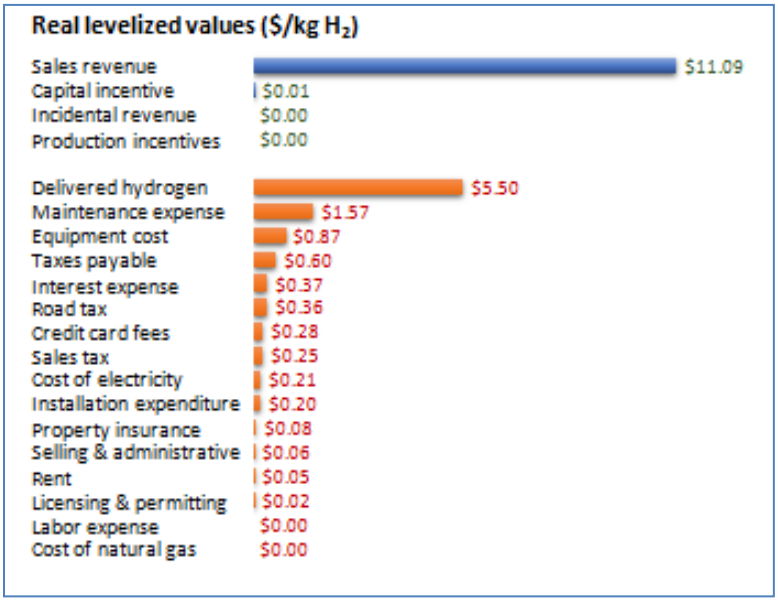
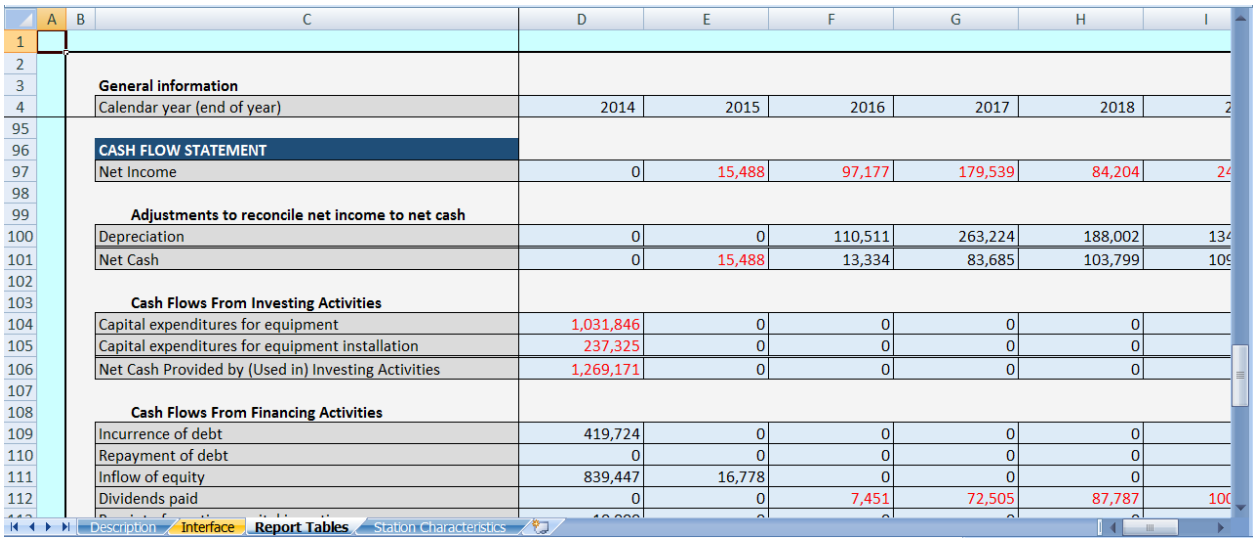


Figure 6. *Interface* worksheet, levelized revenue and expense results

Tabular results for each year of the project's life are available within the *Report Tables* worksheet (Figure 7). In addition to general information and price escalations on an annual basis, these results include income statement, cash flow statement, and balance sheet projections for each year in the analysis period.



	C	D	E	F	G	H	I
3	**General information**						
4	Calendar year (end of year)	2014	2015	2016	2017	2018	2
95							
96	**CASH FLOW STATEMENT**						
97	Net Income	0	15,488	97,177	179,539	84,204	24
98							
99	**Adjustments to reconcile net income to net cash**						
100	Depreciation	0	0	110,511	263,224	188,002	134
101	Net Cash	0	15,488	13,334	83,685	103,799	109
102							
103	**Cash Flows From Investing Activities**						
104	Capital expenditures for equipment	1,031,846	0	0	0	0	
105	Capital expenditures for equipment installation	237,325	0	0	0	0	
106	Net Cash Provided by (Used in) Investing Activities	1,269,171	0	0	0	0	
107							
108	**Cash Flows From Financing Activities**						
109	Incurrence of debt	419,724	0	0	0	0	
110	Repayment of debt	0	0	0	0	0	
111	Inflow of equity	839,447	16,778	0	0	0	
112	Dividends paid	0	0	7,451	72,505	87,787	100

Figure 7. *Report Tables* worksheet showing tabular results

3 Technical Support

If you have questions or comments about the spreadsheet version of H2FAST, please contact:

Michael Penev
Phone: 303-275-3880
Email: Michael.Penev@nrel.gov

References

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Appendix A: Model Inputs and Default Values

Station Information[a]		
Input	**Default Value**	**Description**
Select interface type	Basic	Advanced mode allows access to detailed model assumptions.
Enter number of stations to model	6	Input information for up to 10 stations. Model can then report financial information on one station at a time or all stations combined.
Total dispensing capacity (kg/day)	250	This value defines average daily dispensing capacity. The station is still capable of adequately refueling cars during peak demand days.
Equipment capital cost	$1,031,846	Cost of equipment only (not including engineering cost, permitting, and installation). Note: model assumes that salvage value equals decommissioning costs.
Installation cost	$237,325	This cost should include costs associated with installation, such as engineering, permitting, lot, and utility upgrades.
Planned & unplanned maintenance ($/year)	$95,316	Levelized annual maintenance expenses for planned and unplanned equipment servicing and overhauls. Expenses are assumed to be non-depreciable.
Maintenance escalation (% annually)	1.9%	Each year expenses may escalate due to higher cost of technician labor or material expenses.

[a] These values are entered in the *Station(s) Information* and *Multi-Station Inputs* tables.

Incentives Information[a]		
Input	**Default Value**	**Description**
One time capital incentives (grant or ITC)	—	Incentive is provided at the beginning of the project (accounted on Dec. 31, the year before construction begins). The credit can be a grant or an investment tax credit (ITC).
Annual operating incentives (grant or PTC)	—	Production-based incentives commence the month of station commissioning. This can be a grant or a production tax credit (PTC). If PTC, specify as non-taxable (row 75).
Operating incentives decay rate (%/year)	10%	Annual operating incentives may be reduced each year. This input allows this revenue stream to be ramped down to zero by a fixed annual percentage.
Operating incentives sunset (years)	10	Number of years in which operating incentives are available. This input can simulate early termination of incentives before an annual ramp-down is complete.
Incidental revenue	—	Station revenue enhancements derived from hydrogen. Value should be expressed as (marginal revenue − marginal expenses).
Incidental revenue escalation rate (%/year)	1.9%	Each year expenses may escalate due to higher cost of technician labor or material expenses.

[a] These values are entered in the *Incentives Information* and *Multi-Station Inputs* tables.

Demand Projection		
Input	**Default Value**	**Description**
Price of hydrogen at project onset ($/kg)	$10.00	This is the total cost to the end customer and includes all transaction costs such as credit card fees and sales taxes. Specified price is for the beginning of the project. Note: advanced input allows users to set an annual escalation rate.
Project start year	2015	Year in which the project starts (Jan. 1). Note: financial reporting occurs Dec. 31, and investments into the project will be reported as Dec. 31 of the prior year.
Price escalation rate (% annually)	1.90%	This sets the rate of annual escalation.
Installation time (months)	18	Months between investment in a station and its first sale.
Demand ramp-up (years)	2.0	Specify number of years to achieve long-term average utilization. This value imposes a straight-line ramp-up in station utilization.
Long-term nominal utilization (%)	70%	Infrastructure requires reserve capacity for network robustness to nearby station outage and abnormal traffic events. 70% is advised.

Feedstock Information		
Input	**Default Value**	**Description**
Cost of delivered hydrogen ($/kg)	$5.50	Stations using delivered hydrogen are charged for delivered gas. Price is defined at the start of the project (not at start of operation).
Escalation rate of hydrogen cost (% annually)	1.9%	This sets the rate of annual escalation.
Price of electricity ($/kWh)	$0.120	Input a blended electricity price. Note: advanced input allows users to set an annual escalation rate.
Escalation rate of electricity cost (% annually)	1.9%	This sets the rate of annual escalation.
Price of natural gas ($/mmBtu)	$8.00	Use this value to set natural gas blended price for stations using natural gas. Note: advanced input allows users to set an annual escalation rate.
Escalation rate of natural gas cost (% annually)	1.9%	This sets the rate of annual escalation.

Other Operating Expenses		
Input	**Default Value**	**Description**
Credit card fees (% of sales)	2.50%	This is a flow-through expense for credit card fees.
Sales tax (% of sales)	2.25%	This is a flow-through expense for sales taxes.
Road tax ($/kg)	$0.36	This is a flow-through expense for road taxes.
Road tax escalation rate (%/year)	1.90%	This sets the rate of annual escalation.
Staffing labor hours (h/year-station)	—	This value allows allocation for any on-site labor attributed to dispensing. As stations are typically fully automatic, this value is usually zero. Note: labor associated with hydrogen deliveries and station maintenance should not be factored in here.
Labor rate ($/h)	$40	Fully burdened rate of labor. Note that this is for on-site labor, if any, and should not factor in labor rates for maintenance and station hydrogen restocking.
Labor escalation rate (% annually)	1.9%	This sets the rate of annual escalation.
Licensing & permitting ($/year-station)	$1,000	Sum of all licensing and permitting expenses. Do not include licensing and permitting during station installation (those are accounted for in the installation expense).
Licensing & permitting escalation rate (%/year)	1.9%	This sets the rate of annual escalation.
Rent of land ($/station-year)	$3,000	Rent is paid annually for the footprint of any hydrogen equipment. Rent expenses prior to operation should be rolled into installation cost.
Rent escalation (% annually)	1.9%	This sets the rate of annual escalation.
Property insurance (% of dep capital)	1.5%	Annual expense as percentage of the depreciated equipment value. Insurance covering installation should be rolled into installation costs.
Selling & administrative expense (% of sales)	0.5%	Use this value to assign any overhead expenses, such as administrative and management costs, as a percentage of the sales revenue stream.

Financing Information		
Input	**Default Value**	**Description**
Project operational life (years)	20	Specify the operating life of the project. Enter a value between 5 and 40. Note: Installation time plus equipment life must be less than 40.
Total tax rate (state, federal, local)	38.50%	Specify the total tax rate, which may include federal, state, county, and city taxes.
Is installation cost depreciable?	No	Specify whether costs associated with construction and permitting are depreciable.
Are operating incentives taxable?	No	Specify whether operating incentives are treated as income (taxable) or whether they are tax exempt.
Is capital incentive depreciable?	Yes	Specify whether incentives received for capital are taxable or tax exempt.
Are tax losses monetized (tax equity application)	Yes	Can tax losses be monetized by offsetting coupled business tax liabilities?
Allowable tax loss carry-forward	7 years	IRS allows carry-forward of tax losses usually for 7 years. Note: this is not used if tax losses are monetized (tax equity application).
General inflation rate	1.90%	This value specifies a general inflation rate and is used in calculation of levelized costs.
Depreciation (MACRS)	7 years	Specify allowable Modified Accelerated Cost Recovery System (MACRS) depreciation schedule. Note that depreciation is calculated using quarterly IRS allowance tables based on commissioning quarter.
Leveraged after-tax nominal discount rate	10.0%	Specify a discount rate for reporting of net present value. Note that this rate should include consideration of inflation.
Debt/equity financing	0.5	This factor guides the initial financing capital structure (ratio of debt financing to equity financing).
Debt type	Revolving debt	Specify the type of debt financing (loan or revolving debt). In case of revolving debt, a fixed amount of debt is issued.
If loan, period of loan (years)	20	Enter repayment period for loan (if loan debt is used). This value should not exceed the equipment life.
Debt interest rate (compounded monthly)	6.00%	Enter interest rate on debt—used for both loan and revolving debt calculations.
Cash on hand (% of monthly expenses)	100%	This is cash retained by the business for purposes of liquidity and includes operating expenses, taxes, and interest.

Station Characteristics					
Input	Default Value				Description
	Delivered gas	Delivered liquid	Electrolysis	Onsite SMR	
Electricity use (kWh/kg)	1.72	0.60	70.0	10.0	Specify electricity used for each kilogram of hydrogen dispensed. This should include electricity for production, compression, cooling, and auxiliaries (e.g., lighting, controls).
Natural gas use (mmBtu/kg)				0.170	Specify how much natural gas is used for each kilogram of dispensed hydrogen. This is used for steam methane reformers (SMR).
Delivered hydrogen (kg/kg)	1.00	1.00			Specify how much hydrogen must be delivered to the station per kilogram of hydrogen dispensed (in case of liquid hydrogen some loss may occur).

Appendix B: Model Outputs

Global Scenario Outputs

Overall Financial Performance Metrics	
Output	**Description**
Leveraged, after-tax, nominal IRR	Rate of return based on investor cash flow (investment − withdrawals).
Investor payback period	Based on first year in which cumulative cash flow for investors is greater than zero.
First year of positive EBITD	First year in which earnings before interest, tax, and depreciation are greater than zero.
After-tax, nominal NPV	Net present value of investor net cash flow (investment − withdrawals).
Estimated break-even leveraged price ($/kg)	Price of hydrogen that would yield specified leveraged, after-tax, nominal IRR.

User-Selectable Graphs

Overall Metrics	
Output	**Description**
Cumulative investor cash flow	Investor contribution + previous year investor contribution.
Investor cash flow	Investor withdrawals − investor contributions.
Monetized tax losses	Tax loss credits could be applied when majority equity holder has tax liabilities in excess of any credits.
Gross margin	(Total revenue − cost of goods sold) / total revenue.
Cost of goods sold ($/year)	Total operating expenses + depreciation + interest − selling and administrative.
Cost of goods sold ($/kg)	Cost of goods sold / annual hydrogen sales (kg).
Average station utilization (%)	Annual dispensed hydrogen / design annual capability. Note: design capacity hinges on no excessive customer wait times during peak demand during the year.
Average daily H2 sales (kg/day)	Total annual sales / 365.
Retail price of H2 ($/kg)	Price of hydrogen to the end customers (nominal $).
Cost of delivered H2 to station ($/kg)	Amount paid to a gas supplier for delivering hydrogen to a fueling station, on a per-unit basis (nominal $/kg).
Cost of electricity ($/kWh)	Total annual expense for electricity / total electric energy used (kWh). Note: this “blended” price should include all utility expenses such as time-of-day use charges and utility administrative fees.
Cost of natural gas ($/mmBtu)	Total annual expense for natural gas / total natural gas used (mmBtu). Note: this “blended” price should include all expenses such as administrative fees.

Income Statement Values	
Output	**Description**
Sales revenue	Annual revenue derived from sales of hydrogen. It does not include revenue from incentives.
Production incentive revenue	Annual revenue derived from production incentives (nominal $).
Incidental revenue	Other station revenue enhancements from presence of hydrogen. This value should be expressed as (marginal revenue − marginal expenses).
Credit card fees	Reduction in total revenue based on credit card fees (flow-through expense).
Sales tax	Reduction in total revenue based on sales tax expense (flow-through expense).
Road tax	Reduction in total revenue based on road tax expense (flow-through expense).
Total revenue	Sales revenue + incentive revenue − credit card fees − sales tax − road tax (annual basis).
Annual cost of delivered H2	Annual expense for hydrogen delivered to the station (in case of delivered hydrogen stations—gas or liquid).
Annual cost of electricity	Annual expense for electricity use.
Annual cost of natural gas	Annual expense for natural gas use.
Total feedstock & utilities cost	Expense for delivered hydrogen + expense for electricity use + expense for natural gas use.
Labor expense	Annual labor expense.
Maintenance expense	Annual expenses for maintenance.
Rent expense	Annual expense attribution for equipment footprint on the retail location.
Property insurance	Annual insurance expense associated with value of equipment. Note: insurance is proportional to the depreciated equipment value.
Licensing & permitting	Annual expenses associated with licensing and permitting.
Selling & administrative	Annual expenses associated with selling and administrative activities (management overhead).
Total operating expenses	Annual total operating expenses. Does not include depreciation, taxes, and interest.
EBITD	Total annual revenue − total operating expenses. Earnings before interest, taxes, and depreciation (EBITD).
Interest on outstanding debt	Annual interest on outstanding debt. Note: in case of loan debt, interest is accrued monthly.
Equipment depreciation	Depreciation expense for equipment, calculated based on quarter of equipment commissioning. Note: this is a tax-accounting metric and not a cash expenditure.
Taxable income	Income subject to taxation, before consideration of tax loss carry-forward.
Available deferred tax losses	Tax loss carry-forward remaining after annual taxes payable calculations.
Taxes payable	Taxes payable for the year.
Net income	Revenues − operating expenses − interest expense − taxes payable − depreciation expense.

Cash Flow Statement Values	
Output	**Description**
Net annual operating cash flow	Net income + dividends.
Capital expenditures for equipment	Cash flow for initial equipment purchases.
Equipment installation cost	Cash flow for initial installation, permitting, and commissioning expenses.
Total capital expenditure	Total cash flow for initial equipment and installation expenses.
Incurrence of debt	Cash flow associated with acquisition of debt financing.
Repayment of debt	Cash flow associated with repayment of debt. Note: in the case of revolving debt, repayment is done in full at the end of the analysis period.
Inflow of equity	Cash flow associated with equity investment.
Dividends paid	Cash flow to equity investors (dividends or owner withdrawals).
One-time capital incentive	Cash flow from receipt of capital incentive / grants.
Net cash for financing activities	Incurrence of debt − repayment of debt + inflow of equity − dividends paid + receipt of capital incentives.
Net change of cash	Annual change in cash position.

Balance Sheet Values	
Output	**Description**
Cumulative cash	Previous year cash position + current year net cash.
Cumulative PP&E	Total undepreciated plant, property, and equipment (PP&E).
Cumulative depreciation	Accumulated depreciation: previous year depreciation expense + current year depreciation expense.
Net PP&E	Depreciated value of plant, property, and equipment (PP&E): cumulative PP&E − cumulative depreciation.
Cumulative deferred tax losses	Tax loss carry-forward usable to offset future year tax liabilities.
Total assets	Accumulated cash + accumulated PP&E − accumulated depreciation + accumulated tax loss carry-forward.
Cumulative debt	Outstanding debt.
Total liabilities	Outstanding debt. Note: accounting is performed on annual bases (assumes accounts payable = accounts receivable, and maintains cash on hand for liquidity).
Cumulative capital incentives equity	Accumulated equity from one-time receipt of capital incentives.
Cumulative investor equity	Accumulated equity from investor contributions.
Retained earnings	Previous year retained earnings + current year net income − current year paid dividends.
Total equity	Accumulated equity from capital incentives + accumulated equity from investor contributions + retained earnings + accumulated tax loss carry-forward. Note: value can be negative in highly leveraged scenarios.
Investor equity less capital incentive	Total equity − capital incentive.

Ratio Analysis	
Output	**Description**
Returns on investor equity	Net income / investor equity. Note: investor equity = total equity − capital incentive.
Debt/equity ratio	Total debt / total equity.
Returns on total equity	Net income / total equity. Note: total equity = investor equity + capital incentive.
Debt service coverage ratio (DSCR)	EBITD / interest. EBITD: earnings before interest, taxes, and depreciation.

Appendix C: Quick Facts about Hydrogen Fueling

Photo by Chris Ainscough, NREL 19512

Hydrogen	
Sources of hydrogen	Conversion of natural gas via steam methane reforming is the primary means of producing hydrogen today. Onsite production by electrolysis is also used for smaller demands. Future systems may include gasification of biomass, large-scale electrolysis using wind, or direct conversion using solar, coal, or nuclear resources.
Energy equivalence	The energy in 1 kilogram of hydrogen is approximately equivalent to the energy in 1 gallon of gasoline.
Cost per kilogram of hydrogen	Because a fuel cell electric vehicle is about twice as efficient as a similar conventional gasoline vehicle, an owner can drive twice as far on a kilogram of hydrogen than on a gallon of gasoline. Therefore, if the hydrogen price is $10/kg, the cost to the owner would be equivalent to about $5/gal gasoline on a cost-per-mile-driven basis.
Fuel Cell Vehicles	
Onboard hydrogen storage methods	Compressed hydrogen at 5,000–10,000 psi (near term); other options include liquid hydrogen and hydrogen stored on or in other materials
Projected range per full fuel tank	300+ miles
Hydrogen required for 300-mile range	~ 5–6 kilograms
Hydrogen Stations	
Public stations open	12
Private stations open	33
States with most stations	California (18), New York (5), Michigan (4)

Data sources: Alternative Fuels Data Center (www.afdc.energy.gov/fuels/hydrogen.html), FuelEconomy.gov (www.fueleconomy.gov). Station statistics are as of May 8, 2015.