Fuel Cell Technologies Office Webinar

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Hydrogen Financial Analysis Scenario Tool (H2FAST) Model Summary and Demonstration

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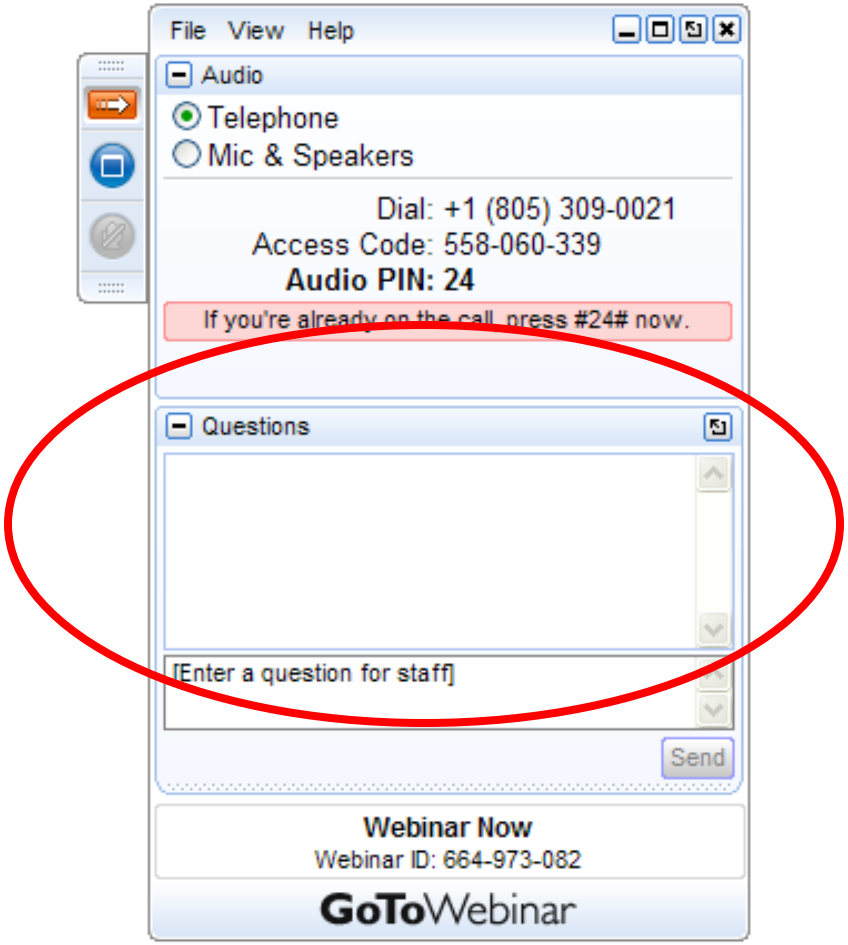
Question and Answer

- Please type your questions into the question box



Acknowledgements

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Model development contributors

- California Fuel Cell Partnership
- H2USA Investment and Finance Working Group (IFWG) Provided requirements & review
  - (California Energy Commission, California Governor's Office, California Air Resources Board)
- Additional external reviewers
  - (Welford Energy, Curry & Co., Aaqius, Energy Independence Now)

Federal Laboratory & University

- Ricardo Bracho, MBA and Michael Elchinger, MBA (NREL) Compliance with accounting & finance standards
- Jeff Grover, DBA (CEO, Grover Group Inc.) Line-by-line model review & validation

Webinar Overview

What is H2FAST (Power Point)

- User inputs
- Framework
- Outputs
- Analysis steps outline

Example analysis (Excel version of H2FAST)*

- Retail station financial analysis (Basic interface)
- Advanced inputs (incentives, price escalations, demand ramp-up)
- Risk analysis (uncertainty handling of inputs, ranges of outcomes)

* Model can be downloaded by clicking “Spreadsheet Version” on http://www.nrel.gov/hydrogen/h2fast/

H2FAST Overview

What is H2FAST

- Financial model for hydrogen systems*
- Simple interface, rigorous analysis
- Fully reviewed by financial industry experts

What analysis does it do

- Retail station finances
- Delivery & distribution
  - pipelines
  - truck delivery
- Production pathways, for example:
  - steam methane reformers
  - electrolysis
  - fuel cell combined heat, hydrogen, power

Who uses the model

- Retail station operators
- Government & policy makers
- Equity and debt investors
- Strategic investors (gas suppliers, car makers)
- Equipment manufacturers
- Academic institutions & national laboratories

* H2FAST is not a capital cost estimator.

Model Framework

User inputs

- Capital costs
- Incentives (grants, operating incentives, take or pay contracts)
- Maintenance cost
- Demand profile (e.g. construction time, demand ramp-up)
- Feedstock use (consumption, prices, escalation)
- Retail price of hydrogen
- Financial parameters (e.g. depreciation schedule, interest rates, etc.)

Model computation framework: Generally Accepted Accounting Principles (GAAP)*

- **Income statement** projections (revenues, expenses, taxes)
- **Cash flow statement** projections (cash on hand, capital expenditures, financing transactions)
- **Balance sheet** projections (assets, liabilities, equity)

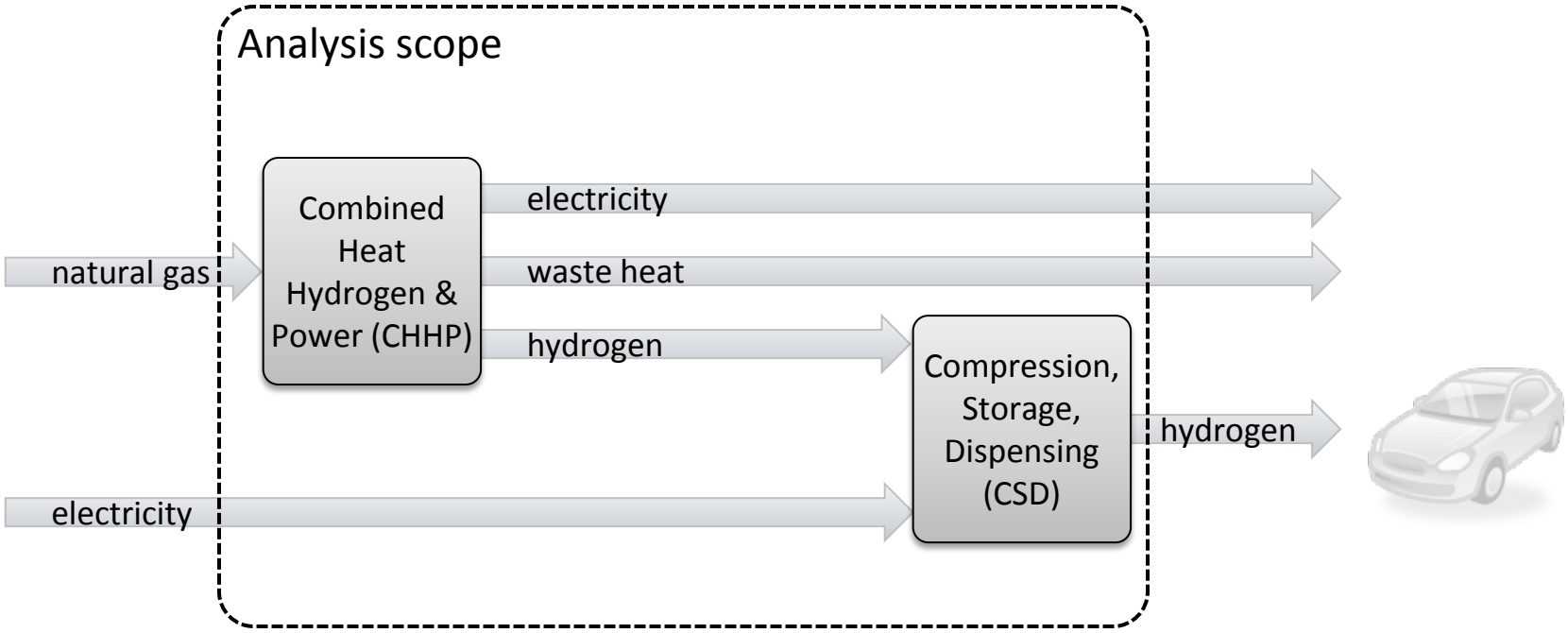
Model outputs

- **Financial performance parameters** (e.g. Internal rate of return, pay-back period, break-even price of hydrogen)
- **Time series charts** for all line item parameters
- Per-kilogram **cash flows break-down** (revenues, expenses, financing cash flows)
- Uncertainty distributions (for risk analysis studies)

* Model can perform analysis compatible with International Financial Reporting Standards (IFRS)

Example Analysis – CHHP, Hypothetical 200 kg/day

Hypothetical system scenario



Note: Breakdown of system is not necessary but is instructive to model flexibility and ease of use.

Example Analysis – CHHP, Hypothetical 200 kg/day

Step 1: Specify installation & maintenance costs

Station being analyzed (yellow background)	1	2	3
Station name	200 kg/day CHHP (production only)	200 kg/day CSD	200 kg/day CHP & CSD (sum of 1 & 2)
Capacity (kg/day)	250	250	250
Equipment capital cost	$ 3,000,000	$ 1,500,000	$ 4,500,000
Non-depreciable fixed assets (e.g. land)	$ -	$ -	$ -
Installation cost	$ 500,000	$ 500,000	$ 1,000,000
End of project sale of non-depreciable assets	$ -	$ -	$ -
Planned & unplanned maintenance ($/year)	$ 200,000	$ 150,000	$ 350,000

Step 2: Specify feedstock & co-product volumes

Coproduct specifications			
Usable waste heat (mmBTU/kg)	0.040	-	0.040
Electricity co-production (kWh/kg)	44.41	-	44.41
User defined co-product (units/kg)	-	-	-

Feedstock use			
Delivered hydrogen gas trailer (kg/kg)	-	-	-
Delivered hydrogen liquid trailer (kg/kg)	-	-	-
Delivered hydrogen pipeline (kg/kg)	-	1.00	-
Electricity use (kWh/kg)	-	1.72	1.72
Natural gas use (mmBTU/kg)	0.384	-	0.384
User defined feedstock (units/kg)	-	-	-

Note: Costs are fictitious and intended to show analysis methodology—not showcase the application.

Column 1

- Reflects CHHP production only
- Co-product generation normalized per kilogram of hydrogen produced

Column 2

- Reflects dispensing only
- Hydrogen purchased from CHHP system
- Electricity purchased for compression and cooling

Column 3

- Reflects the entire system

Note: Breakdown of system is not mandatory but helps with clarity. Only highlighted entry (yellow) is analyzed.

Example Analysis – CHHP, Hypothetical 200 kg/day

Step 3: Specify feedstock & co-product pricing

Products Value	
Price of hydrogen at project onset ($/kg)	10.00
Price escalation rate (% annually)	1.9%
Usable waste heat ($/mmBTU)	$ 5.00
Escalation rate of cost (% annually)	1.9%
Electricity co-production ($/kWh)	$ 0.10
Escalation rate of cost (% annually)	1.9%
User defined coproduct ($/unit)	$ -
Escalation rate of cost (% annually)	1.9%

Feedstock Cost	
Cost of delivered hydrogen via gas truck ($/kg)	$ -
Escalation rate of cost (% annually)	1.9%
Cost of delivered hydrogen via liquid truck ($/kg)	$ -
Escalation rate of cost (% annually)	1.9%
Cost of delivered hydrogen via pipeline ($/kg)	$ 2.00
Escalation rate of cost (% annually)	1.9%
Cost of electricity ($/kWh)	$ 0.100
Escalation rate of cost (% annually)	1.9%
Cost of natural gas ($/mmBTU)	$ 5.00
Escalation rate of cost (% annually)	1.9%
Cost of user defined feedstock 1 ($/unit)	$ -
Escalation rate of cost (% annually)	1.9%

Note: Price of hydrogen can be specified as for price-taker modeling or set equal to "Estimated break-even leveraged price ($/kg)" for price-setter modeling.

Only relevant costs need to be updated. Feedstock or co-products that are not used do not impact analysis.

Example Analysis – CHHP, Hypothetical 200 kg/day

Step 4: Specify project financial details

Other operating expenses	
Credit card fees (% of sales)	2.50%
Sales tax (% of sales)	2.25%
Road tax ($/kg)	$ 0.36
Road tax escalation rate (%/year)	1.90%
Staffing labor hours (h/year-station)	-
Labor rate ($/h)	$ 40
Labor escalation rate (% annually)	1.9%
Licensing & permitting ($/year-station)	$ 1,000
Licensing & permitting escalation rate (%/year)	1.9%
Rent of land ($/station-year)	$ 3,000
Rent escalation (% annually)	1.9%
Property insurance (% of dep capital)	1.5%
Selling & administrative expense (% of sales)	0.5%

Financing Information	
Total tax rate (state, federal, local)	38.50%
Capital gains tax	15.00%
Is installation cost depreciable?	No
Are operating incentives taxable?	No
Is capital incentive depreciable?	Yes
Are tax losses monetized (tax equity application)	Yes
Allowable tax loss carry-forward	7 year
General inflation rate	1.90%
Depreciation method	MACRS
Depreciation period	7 year
Leveraged after-tax nominal discount rate	10.0%
Debt/equity financing	0.5
Debt type	Revolving debt
If loan, period of loan (years)	20
Debt interest rate (compounded monthly)	6.00%
Cash on hand (% of monthly expenses)	100%

Sales Specification	
Project start year	2015
Project operational life (years)	20
Installation time (months)	18
Demand ramp-up (years)	0.0
Long-term nominal utilization (%)	80%

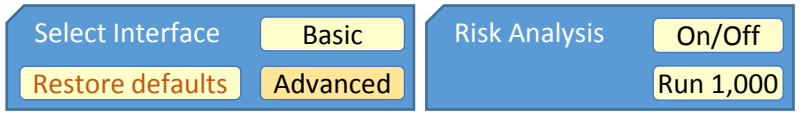
Take or Pay Contract Specification	
Price of unsold hydrogen	-
Price linear decay (% of initial/year)	0%
Contract sunset (years)	15.00
Utilization supported up to (% of capacity)	50%

Note: Take-or-pay contract specifications allow for utilization risk mitigation strategy analysis.

Example Analysis – CHHP, Hypothetical 200 kg/day

Step 5: Specify uncertainties & run risk analysis

- Click "Advanced"
- Click "Risk Analysis On/Off"
- Specify uncertainty of parameters (triangular distribution)



	Most likely value	Minimum value	Maximum value
Capacity (kg/day)	250	250	250
Equipment capital cost	4,500,000	3,150,000	6,750,000
Non-depreciable fixed assets (e.g. land)	-	-	-
Installation cost	1,000,000	1,000,000	1,000,000
End of project sale of non-depreciable assets	-	-	-
Planned & unplanned maintenance ($/year)	350,000	350,000	350,000
Maintenance escalation (% annually)	1.9%	1.9%	1.9%
Coproduct Specifications			
Usable waste heat (mmBTU/kg)	0.040	0.020	0.040
Electricity co-production (kWh/kg)	44.41	44.41	44.41
User defined co-product (units/kg)	-	-	-

For example, equipment capital cost and heat utilization varied.

Model uses triangular distribution.

- Click "Run 1,000" – to perform Monte Carlo analysis with 1,000 iterations.

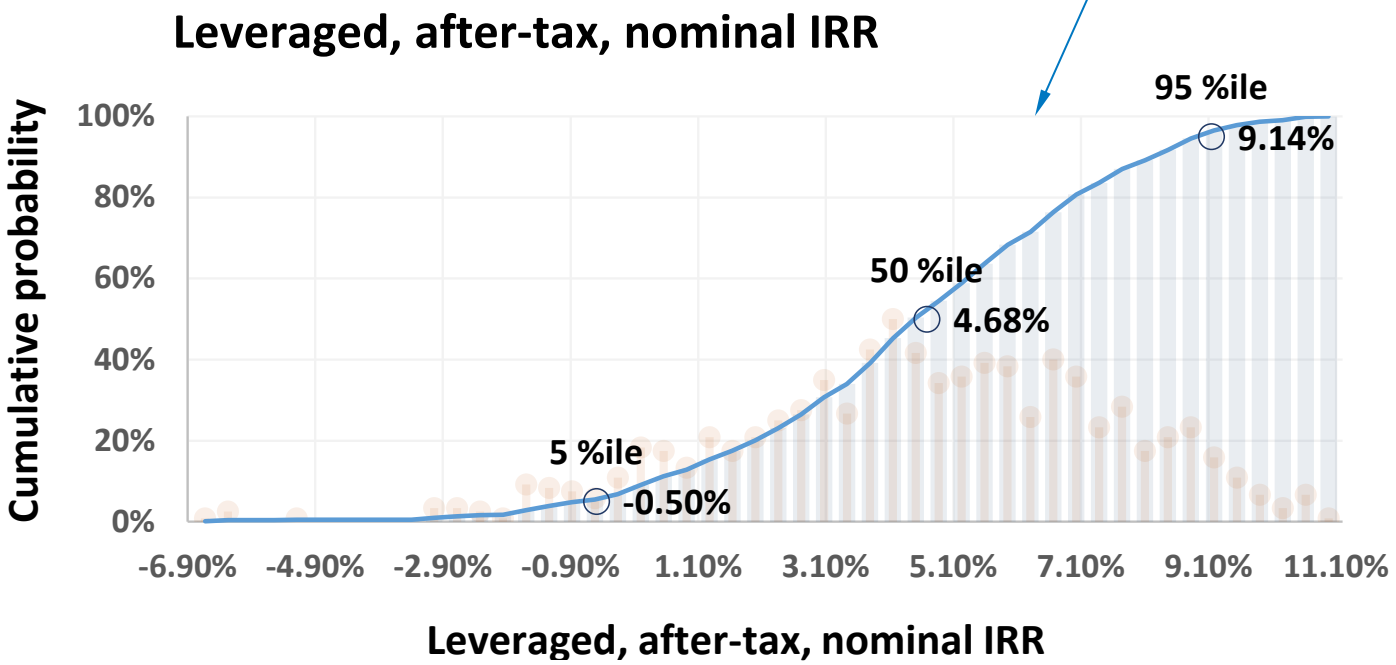
Example Analysis – CHHP, Hypothetical 200 kg/day

Examine results

Overall Financial Performance Metrics	Most likely value	5%'ile	95%'ile	Plot
Leveraged, after-tax, nominal IRR	5.88%	-0.54%	9.50%	●
Profitability index	1.35	0.83	1.78	○
Investor payback period	10 years	8	16	○
First year of positive EBITD	analysis year 2	2	2	○
After-tax, nominal NPV @ 10% discount	$ (894,655)	$ (2,345,175)	$ (102,307)	○
Estimated break-even leveraged price ($/kg)	$ 12.45	$ 10.28	$ 16.42	○

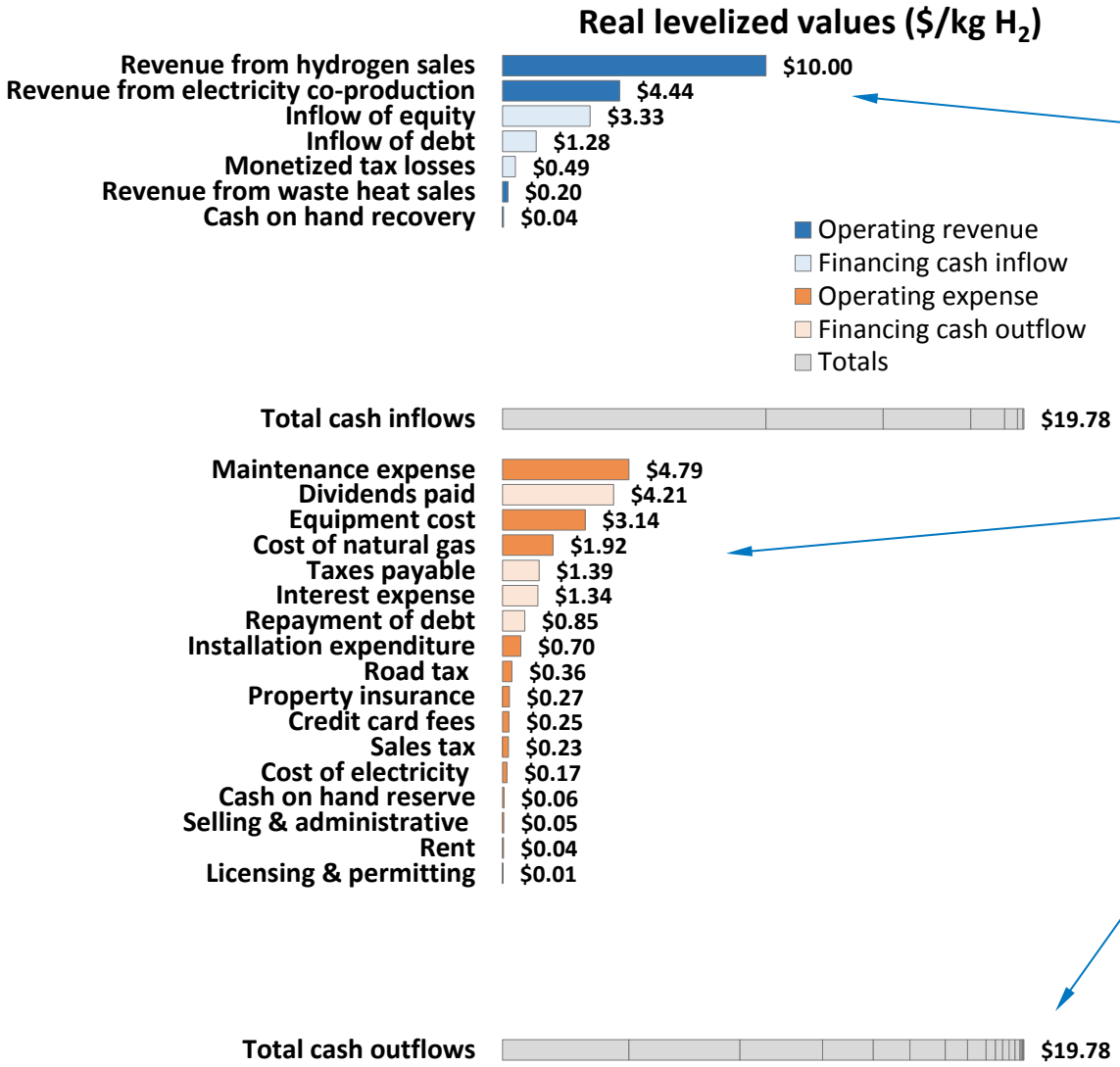
Click to select distribution to plot

Breakeven leveraged price can be used to yield IRR target.



Example Analysis – CHHP, Hypothetical 200 kg/day

Examine results - continued



Operating revenues and financing cash inflows are normalized for ease of comparison.

Operating expenses and financing cash outflows are normalized for ease of comparison.

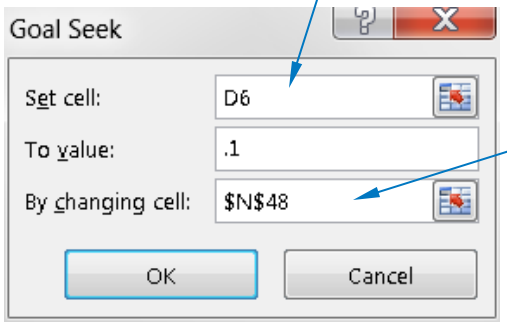
Total cash inflows and outflows are reported to demonstrate consistency.

Example Analysis – CHHP, Hypothetical 200 kg/day

Example: Estimate capital incentives for $10/kg hydrogen

Overall Financial Performance Metrics	Most likely value
Leveraged, after-tax, nominal IRR	5.88%
Profitability index	1.35
Investor payback period	10 years
First year of positive EBITD	analysis year 2
After-tax, nominal NPV @ 10% discount	$ (894,655)
Estimated break-even leveraged price ($/kg)	$ 12.45

Station being analyzed (yellow background)	1	2	3
Station name	200 kg/day CHHP (production only)	200 kg/day CSD	200 kg/day CHP & CSD (sum of 1 & 2)
Incentives Information			
One time capital incentives (grant or ITC)	$ -	$ -	$ -
Annual operating incentives (grant or PTC)	$ -	$ -	$ -
Per kilogram incentive	$ -	$ -	$ -
Incidental revenue ($/year)	$ -	$ -	$ -



Goal Seek can be used to solve for inputs.

In this example, it takes $1.097 million of capital incentive to yield $10/kg hydrogen @ 10% IRR.

Overall Financial Performance Metrics	Most likely value
Leveraged, after-tax, nominal IRR	10.00%
Profitability index	1.84
Investor payback period	8 years
First year of positive EBITD	analysis year 2
After-tax, nominal NPV @ 10% discount	$ (1)
Estimated break-even leveraged price ($/kg)	$ 10.00

Station being analyzed (yellow background)	1	2	3
Station name	200 kg/day CHHP (production only)	200 kg/day CSD	200 kg/day CHP & CSD (sum of 1 & 2)
Incentives Information			
One time capital incentives (grant or ITC)	$ -	$ -	$ 1,096,987
Annual operating incentives (grant or PTC)	$ -	$ -	$ -
Per kilogram incentive	$ -	$ -	$ -
Incidental revenue ($/year)	$ -	$ -	$ -

Excel Example

Example analysis (Excel version of H2FAST)*

- Retail station financial analysis (Basic interface)
- Advanced inputs (incentives, price escalations, demand ramp-up)
- Risk analysis (uncertainty handling of inputs, ranges of outcomes)

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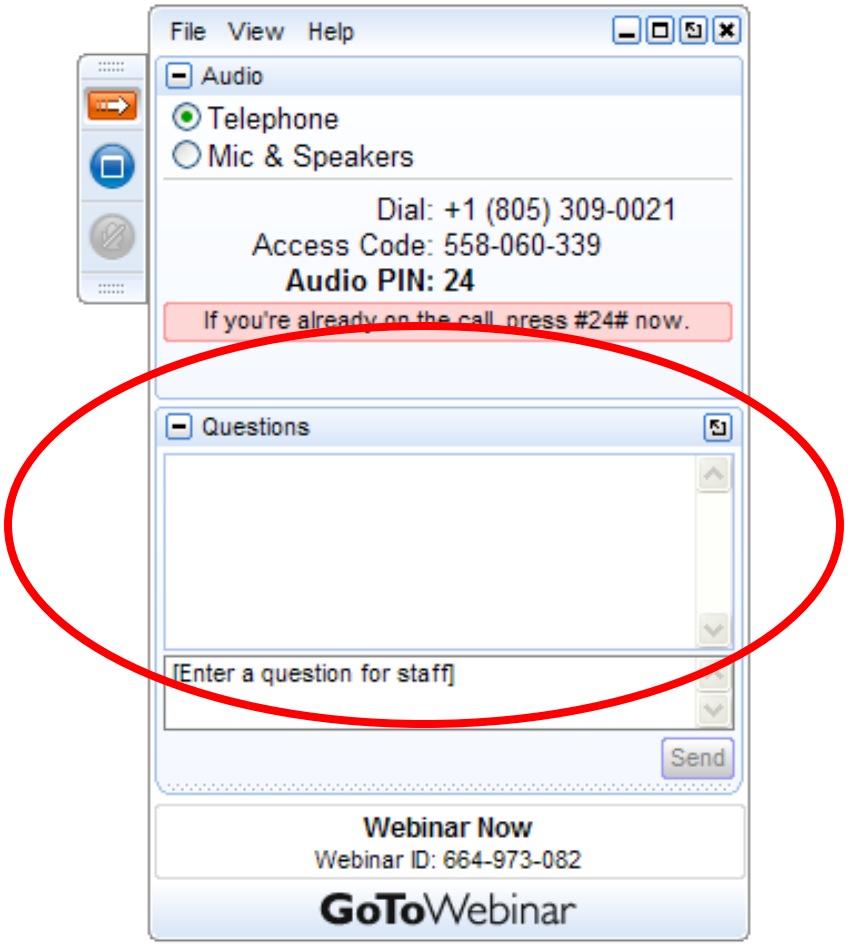

Thank you

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