

Production and Delivery Analysis in the HFC&IT Program

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Outline

- Market price of hydrogen today
- Purpose of analysis
- Types of analysis
- Analysis tools
- H2A
 - Objectives
 - Sub-groups
 - Activities
- Organizations



Market Value of Hydrogen Today

Source: Chemical Market Reporter, 2/24/03; Merchant H₂

•Between 1997-2002:

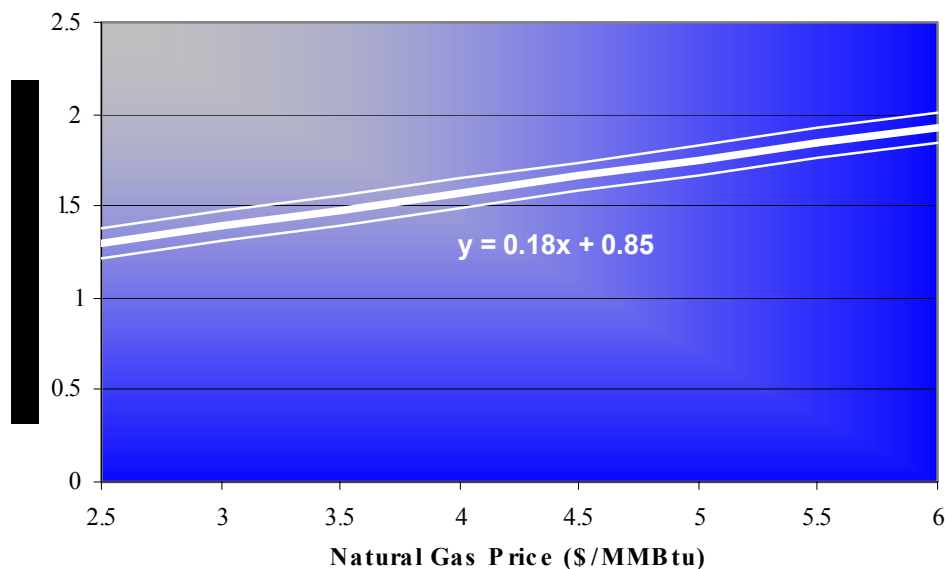
- Compressed gas, tube trailer, plant-gate
- Low: \$5.3/kg (1997)
- High: \$11.0/kg (2002)
- Steady upward trend

•Current:

- Compressed gas, tube trailer, plant-gate: \$7.2 - 11.0/kg
- Cryogenic liquid, tanker truck, plant-gate: \$4.9 - 7.6/kg
- Compressed gas, pipeline, delivered: \$0.8 - 3.4/kg

Source: SRI Chemical Economics Handbook, 2002, Captive H₂

- At \$3.50/MMBtu natural gas, H₂ = \$1.40 - 1.56/kg
- \$0.63/kg H₂ is due to the natural gas; fixed cost = \$0.77 - 0.93/kg
- At \$5.00/MMBtu natural gas, H₂ = \$1.67 - 1.93/kg
- No compression or storage





Analysis in the HFC&IT Program

- To support Program decision-making
- To help develop a balanced R&D portfolio
 - Part of project selection
 - Guide research toward key cost areas
 - Identify time-frames for near-, mid-, and long-term success
- To provide analytic basis for federal investment decisions
- To help quantify implications of policy
- To measure progress toward goals

Analysis Spectrum

Resource Analysis

- Where are the resources to make hydrogen and how much do they cost?

Technology Feasibility Analysis

- Which technologies have the greatest potential for economic success?
- Where should research efforts be focused?
- What are the impacts of production volume?

Environmental Analysis

- What are the environmental impacts of hydrogen technologies?
- What steps can be taken to reduce impacts?

Delivery Analysis

- What are the most economic options for delivering hydrogen?

Infrastructure Development Analysis

- What are the optimal scenarios for developing the hydrogen infrastructure?
- What will a hydrogen infrastructure cost?

Energy Market Analysis

- What is the hydrogen future?
- Which technologies are most likely to be a part of the hydrogen future, and what are the interactions between hydrogen and other energy carriers?
- What are the scenarios for hydrogen use in transportation and stationary markets

Analysis Tools

- Geographic Information Systems (GIS)
- Process modeling (e.g., ASPEN Plus)
- Fuel cell modeling (e.g., ADVISOR, PSAT)
- Cash flow analysis
- Life cycle assessment
- Delivery modeling
- Energy market modeling



Hydrogen Analysis - H2A

- Lack of transparency and consistency make comparison of the numerous studies difficult
- Collective group of analysts doing hydrogen-related work in production and delivery
- Purpose: *Improve the transparency and consistency of approach to analysis, improve the understanding of the differences among analyses, and seek better validation from industry.*
- *Two meetings: February in D.C., April in Golden*
- *Next meeting: July in D.C.*
- Lead: Mark Paster, DOE

H2A Objectives

1. Establish a **standard format for reporting** analysis results for improved transparency and ease of communicating analysis results in a short yet detailed fashion.
2. Seek better validation of public analyses: **dialog with industry**.
3. Better **demand analyses** and factoring demand into supply/infrastructure analysis interactively.
4. Better **understanding of the differences** among current and publicly available analyses and make these differences more transparent.
5. Establish a **mechanism for facile dissemination** of all public analysis results.
6. **Improved understanding of the purpose** of hydrogen production and delivery analyses and identify analysis gaps.
7. Try to reach consensus on **specific analysis parameters** (or at least ranges, or a reference case).

H2A Sub-groups

Central production:

- Coal
- natural gas
- biomass

Forecourt production

- Dispensing
- small-scale natural gas reforming
- on-site electrolysis
- liquid carrier reforming

Other production

- central thermochemical nuclear
- central electrolysis
- wind/solar
- photobiological

Delivery

- pipelines (existing and new)
- gas truck
- liquid truck

H2A Current Activities

- Deliverables:
 - July: Reporting spreadsheets finalized
 - July – November: Subgroups develop case summaries
 - November: Industry comment on case summaries
 - January: Analysis conference
 - February: Publish case summaries
- Reference case parameters
 - Discount rate (internal rate of return, hurdle rate)
 - Debt / Equity and cost of debt
 - Tax
 - Plant life
 - Depreciation schedule
 - Plant decommissioning

Organizations

- Department of Energy
- Argonne National Laboratory
- Directed Technologies, Inc.
- Energetics
- Gas Technology Institute
- Industry Hydrogen Infrastructure Group (IHIG)
- Mitretek
- National Renewable Energy Laboratory, NREL
- Oak Ridge National Laboratory
- Princeton University, Joan Ogden
- Tellus Institute
- TIAX
- TMS

Seeking the involvement of industry to achieve objectives

Analysis Output Examples

