

Wrap-Up / Ammonia Fuel Industry Business Model

6th Annual Ammonia Fuel Conference

Kansas City – October 13, 2009

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Overview

- Re-cap of meeting
- News
- “Listing” of NH₃ fuel – An Update
- Ammonia Fuel Industry Business Model

Conference Re-Cap (Day 1)

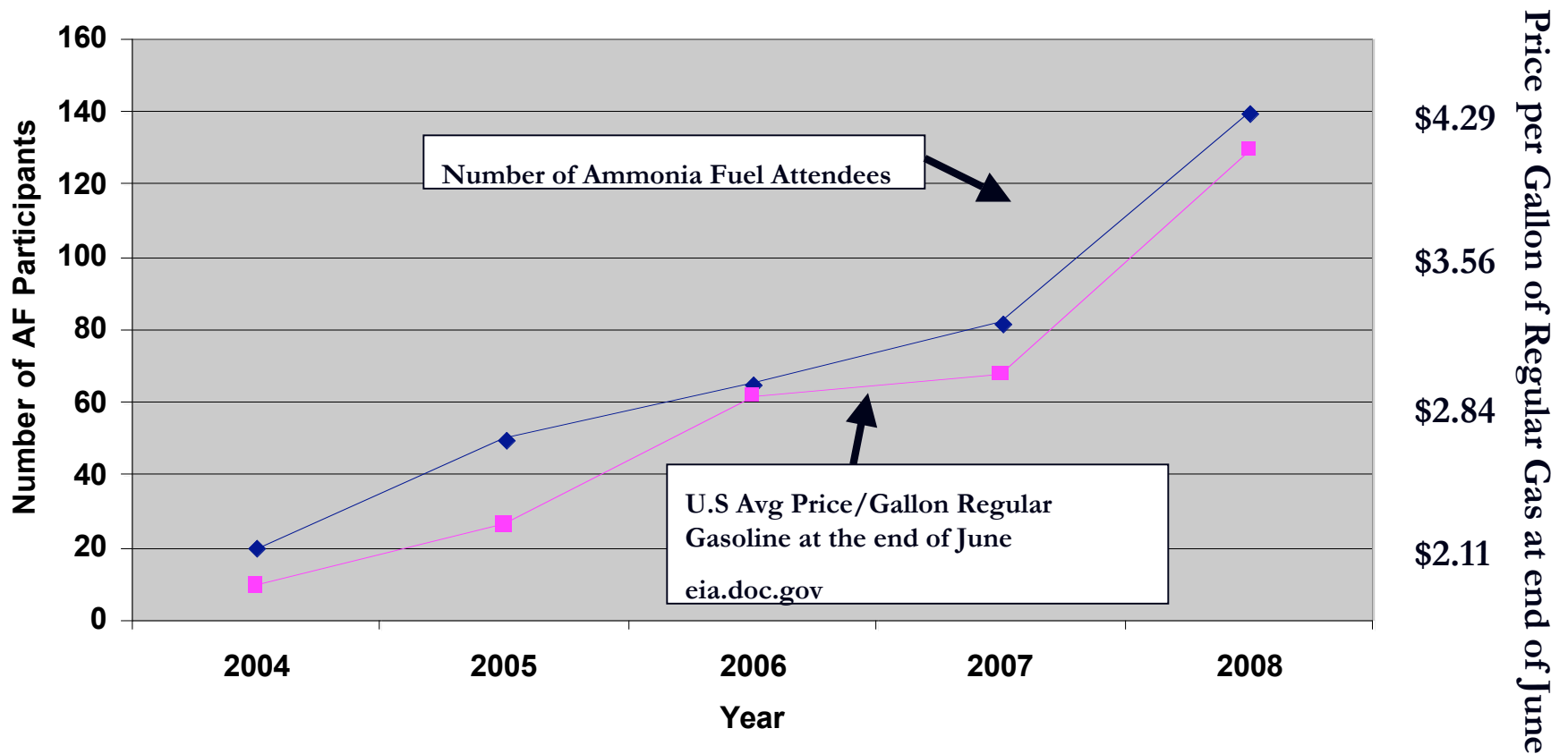
- Excellent attendance and participation (as usual, $\sim 1/2$ or so of participants signed up in the last 10 days)
- Federal government participation still low
- Matt Simmons pointed to NH_3 fuel as a (the only?) viable alternative to petroleum
- Chair of NFA board points to future and organizational growth
- Beautiful NH_3 Hot Rod
- Continued improvement with performance and emissions with SI and diesel ICEs
- Wind to NH_3 (for fuel and fertilizer) continues to look technically feasible; economics still being studied
- Martin and Robertson presentations point to high value of NH_3 for energy storage applications
- Syngest Biomass to NH_3 moving forward smoothly, expected to produce NH_3 fuel cost competitive with gasoline
- NH_3 from air blown coal gasification – economics look good, C-seq may be techno-economically possible

Conference Re-Cap (Day 2)

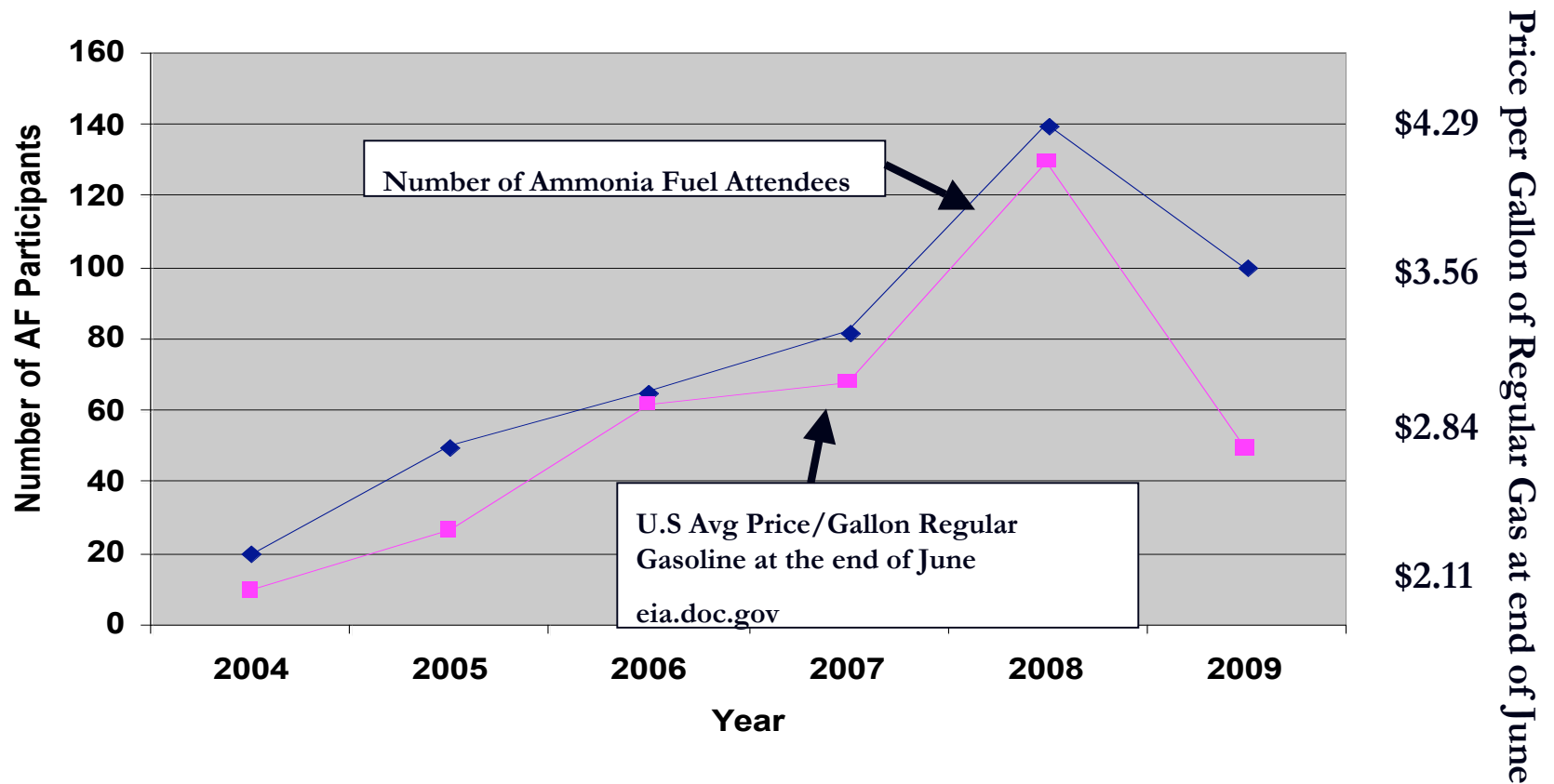
- Fed funding opportunities through USDA
- NH₃ is a remarkable working fluid and fuel
- Safety story and documentation getting stronger
- Regulatory framework just beginning development
- Innovative regenerative fuel cell concept
- Progress on IEC grants on NH₃ synthesis and combustion
- Advancements in energy harvesting from NH₃ containing wastewater
- Strategy for “listing” NH₃ fuel being developed



Ammonia Conference Attendance Driver



Ammonia Conference Attendance Driver



NH3 News

- “NH3 from Hydropower” paper in Oct 09 *Hydro Review*
- Hydrogen Hubs feasibility study web-site www.hydrogenhub.org
- NH3 (100%) 9.3L Hot Rod almost complete
- Patents issued, investment developing
- NH3 proposal finalist in DOE ARPA-E competition (out of 3500 entries)
- USDA recognizes NH3 as an official alternative fuel

H3N1 (NH3) Virus Warning

- No known cure
- No vaccine
- No carbon
- Highly communicable
- Strikes primarily in areas of open-mindedness and/or high IQ

“Listing” of NH₃ Fuel

- Administrative or legislative approach?
- VanNess Feldman (Seattle) working to assess situation
- Contacted several Congressional offices (WA, MN, IA, Maine...)
- Strong interest in NH₃ designation as alt fuel
- Exploring
 - “Input” to DOE
 - Amendment to federal energy legislation
- Legislative route will require a coalition effort

**An Ammonia NH₃ Fuel
Industry Business
Model**

Past NH₃ Fuel Conference Summation Talks (JHH)

- 2005 – Opportunities and Challenges for an Ammonia Fuel Economy
- 2006 – An International Ammonia Fuel R&D Agenda
- 2007 – Ammonia and the Clean Energy Portfolio
- 2008 – An Ammonia Fuel Business Plan

Problem is...

- Clearly and simply conveying the Big Picture for NH₃ fuel (e.g. to investors or legislators)
- Getting the NH₃ fuel Big Picture story down to easy to swallow bites
- Clarifying the “values” of each bite, e.g. wind-to-NH₃

Why Bother?

- Oil independence
- Sustainability
- Lower cost
- Smaller carbon footprint
- Less drain on finite fossil resources
- Energy per capita decreasing or projected to decrease
- Achieve higher standard of living
- Etc.

Matt Simmons quote, 10/12/09

NH₃ (Liquid Ammonia) is the only realistic solution that makes sense.

Oil Economy / Business Model

Resource Recovery

- Drilling
- Tar Sands



Refining

- Central Refining



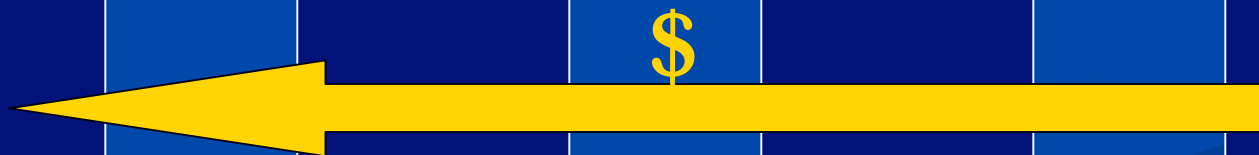
Distribution

- Transport to fuel outlets
- Tank storage



End Use

- Vehicle
- Heat
- Other



Electric Power Business Model

Resource Recovery

- Hydro
- Wind
- Solar
- Nuclear
- Fossil



Refining

- Grid Mgt.



Distribution

- Local Power Cos.
- Storage technologies



End Use

- Residential
- Commercial/Industrial
- Other

\$

NH3 Fuel Business Model

Resource Recovery

- Nat gas
- Coal
- Biomass
- Mammal waste
- Water (RE and nuclear)
- Air
- Electric Power

Product →

Refining

- H-B
- Plasma
- SSAS
- Other

Product →

Distribution

- Truck
- Rail
- Pipe line
- Pressure and Atmos Storage.

Product →

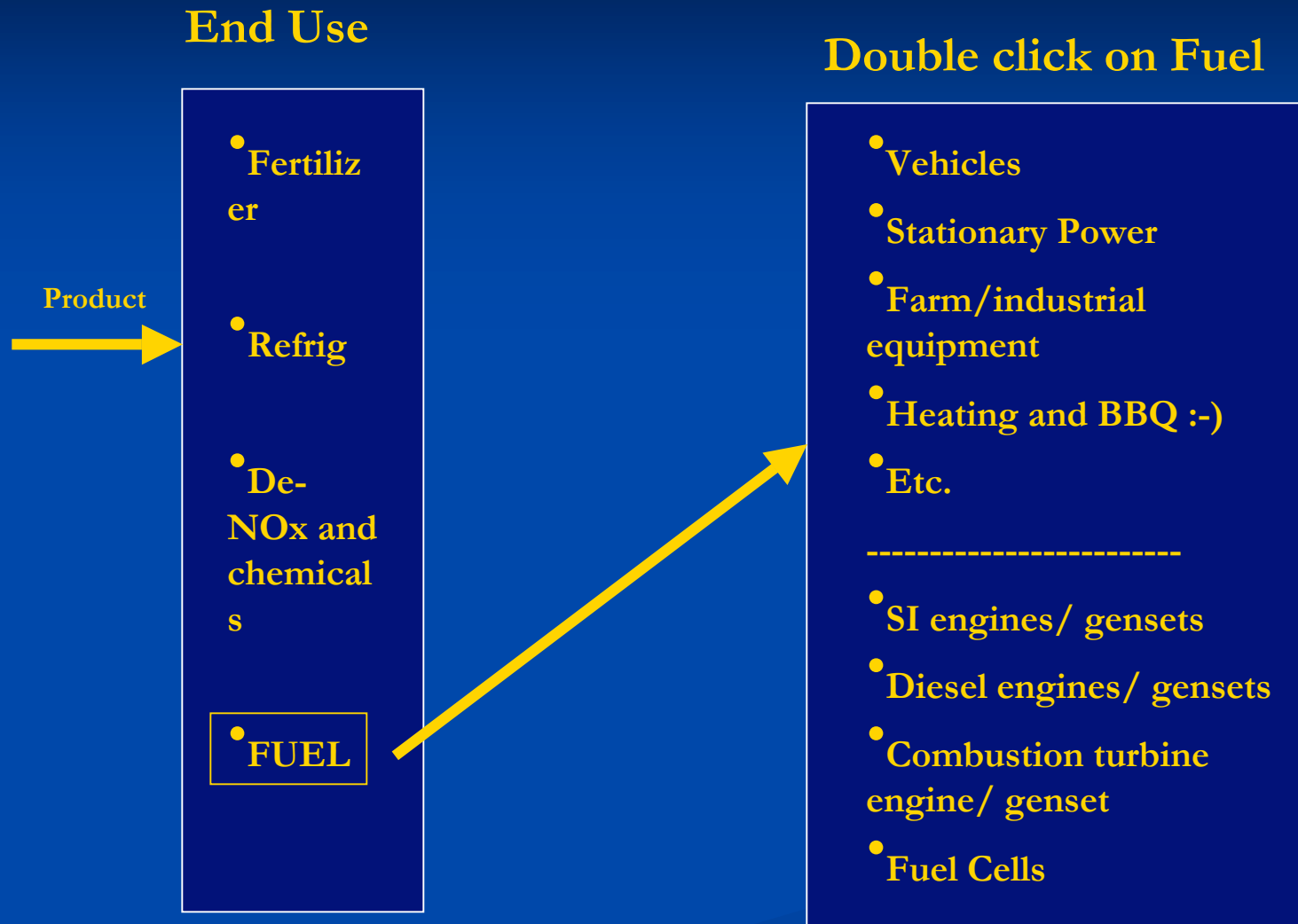
End Use

- Fertilizer
- Refrig
- De-NOx and chemicals
- FUEL

\$



NH3 Fuel Business Model



What's Needed?

- Potential for profit
- Investment
- Customers (private and government)
- Regulatory and Safety Framework
- Alignment of sister technologies and companies
- Etc.

What did he say?

- Most of the pieces for an NH₃ economy are in place, although may need optimization/improvement
- Growth elements for NH₃ economy are not unlike oil, electricity
- When will we reach the tipping point?

Thank You

U.S. Ammonia Pipeline

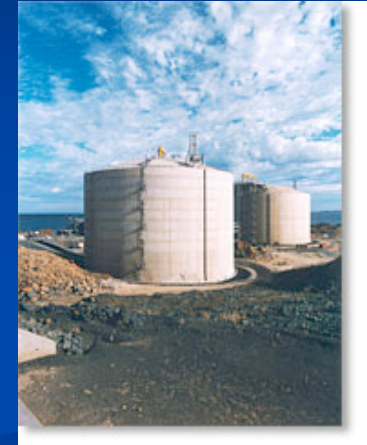
3000 Miles
Total



Ammonia Is Easy To Store



Ammonia Delivery Infrastructure



Ammonia Fueled Vehicles

Rjukan 1933



Ann Arbor 2007



Relevant quote 1 –

There are three kinds of ball players –
those who make something happen,
those who watch it happen, and those
who wonder what happened.

- Tommy Lasorda, LA Dodgers

Relevant quote 2 –

Mr. Holtz, there are lots of people who don't know what is going on. But, you don't even suspect something is going on.

- High school guidance counselor
To Lou Holtz, future football coach