BMU
Biomass Unit Ops

Bio-hydrogen for Power Plants

Start-up – 2 models: CHP and H_2

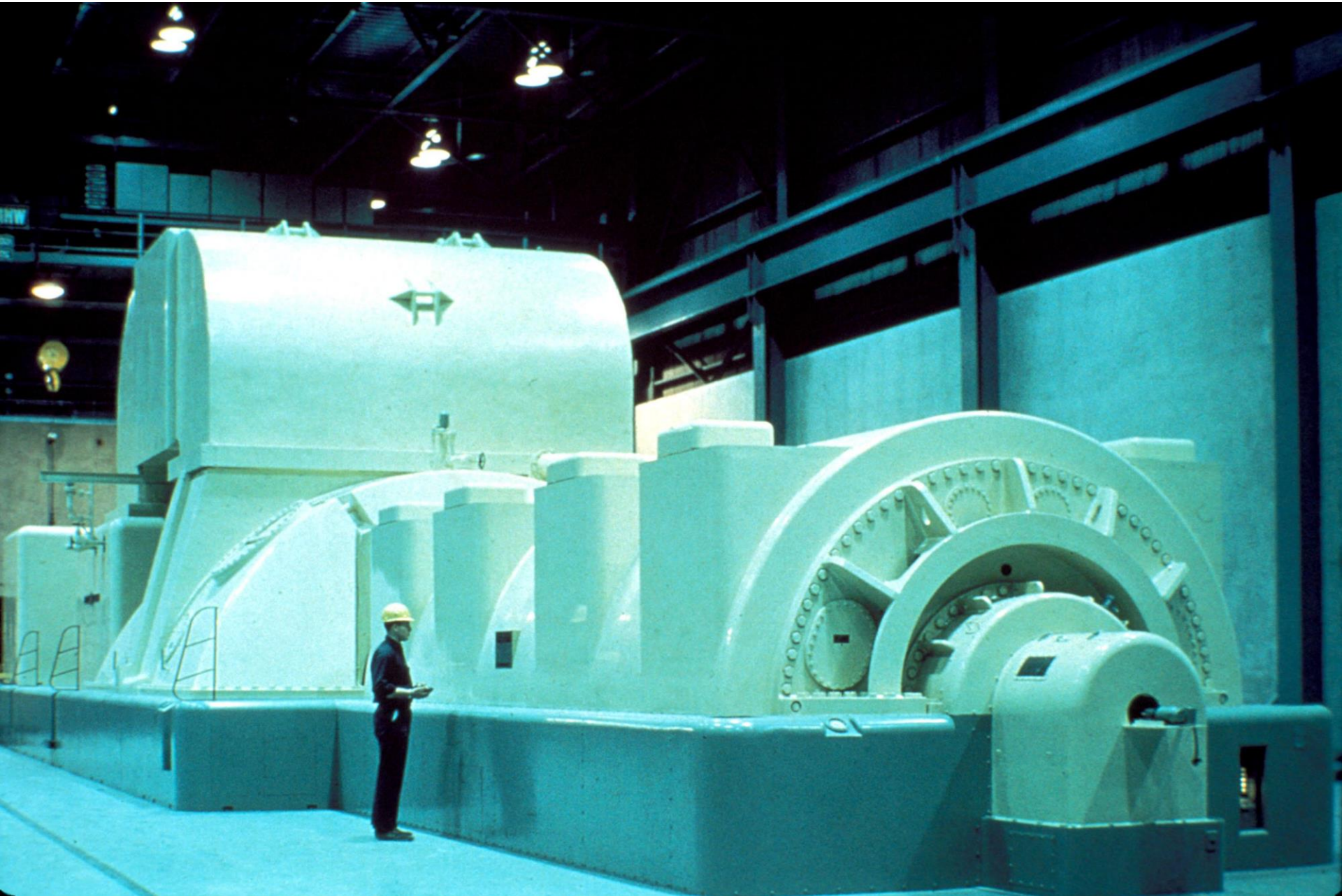
Zero cash – Investor pitches & SBIRs

Seed level – seeking $1,370,000

Peter J. Schubert, Ph.D., P.E., Inventor, Founder, Managing Director of BMU

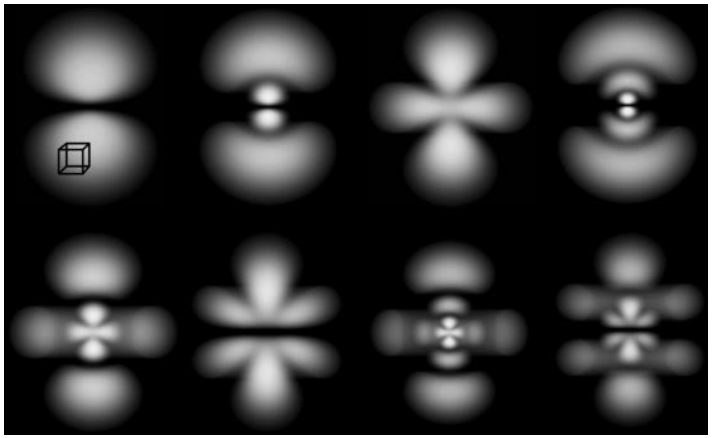
TransTech Energy Conference, WVU, 6-7 November 2013

Generators have internal friction

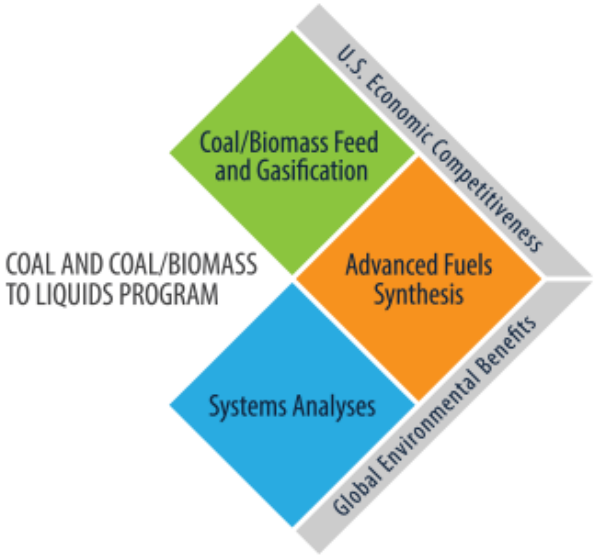


Hydrogen-cooled Turbo Generators

- H_2 has 40% viscosity of air
- 14x more heat capacity
- Reduced insulation damage
- High purity is best
- Make-up needed



Hydrogen Focus

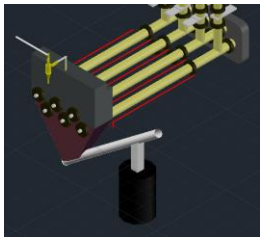


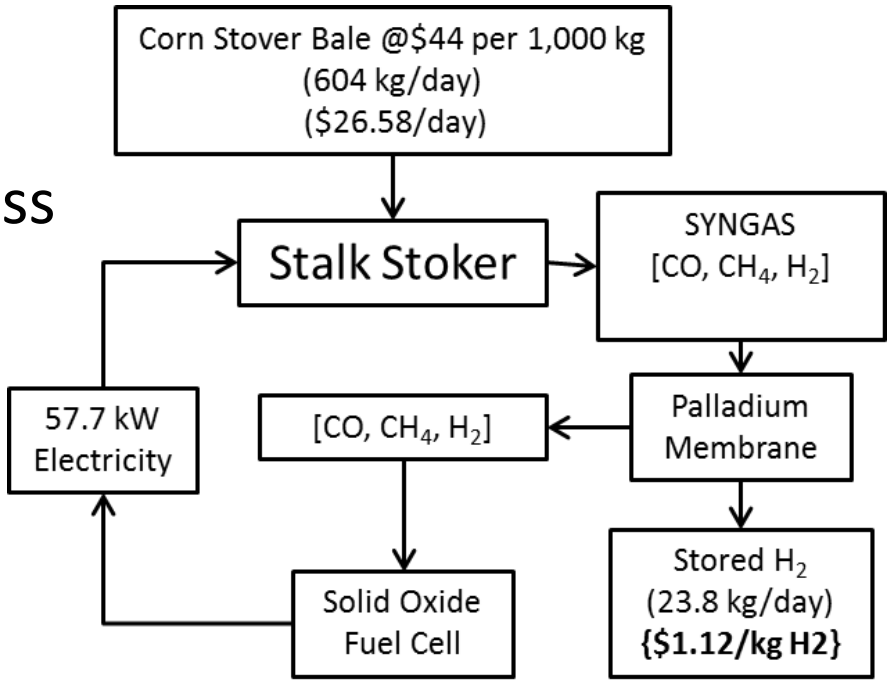
- Market price is ~ **$4** per kilogram
  - NREL goal is $3.70/kg distributed[1]
- NETL Energy Lab:
  - Goal and Milestones – Alternate Hydrogen Production Pathway
    Goal: By the end of 2013, optimize, integrate and make available an alternative economic and environmentally responsive hydrogen production pathway and reforming system to produce decentralized hydrogen. [2]

1 http://www.nrel.gov/hydrogen/production_cost_analysis.html
2 http://www.netl.doe.gov/technologies/hydrogen_clean_fuels/alternate.html

Bio-Hydrogen

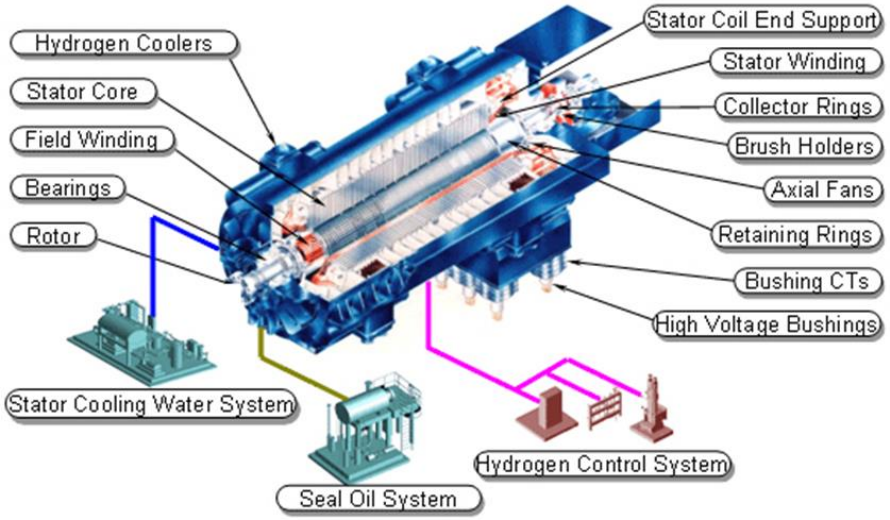
- Indirectly-Heated Pyrolytic Gasification (I-HPG)
  - Novel, unconventional gasification method
  - US Patent 8,465,562 awarded 18 June 2013
  - Converts biomass to H_2/CO syngas
- Hydrogen at **$1.12/kg**
  - High-purity (7-9's)
  - Energy self-sufficient process
- Ready to scale-up
  - Funds sought to prove 6x:
    - $1,370,000
    - 2 years





Market Opportunity

- **Current Practices for Hydrogen**
  - On-site electrolysis of water, compressors, moderate-pressure storage
  - Tank cylinder storage
  - SMR
- **Opportunity**
  - Reduce costs
  - Reduce emissions of fossil carbon
  - Promote local economy
    - farmers provide non-food ag residues
    - Wood-working factories provide sawdust
- **Scope for thermal power plants**
  - 600 coal-fired US[1], 104 nuclear
  - 2400 coal-fired globally[2], 437 nukes
  - 1200 new plants planned[3]
- **Size of hydrogen market**
  - US at $70,000,000/year (estimated)
  - Global demand growing 4.1%/year[4]



1 http://www.sourcewatch.org/index.php?title=Existing_U.S._Coal_Plants
2 http://www.worldcoal.org/resources/frequently-asked-questions/
3 http://www.huffingtonpost.com/2012/11/20/world-coal-fired-power-plants_n_2166699.html
4 http://www.freedoniagroup.com/World-Hydrogen.html

Competitive Advantages

- Patented and proven biomass gasifier
- Ability to scale - from farms to power plants
- **Low-cost** hydrogen on-demand
  - Moderate-pressures only
  - Wide turn-down ratio
- **Less fossil carbon**
- Local sources

Stalk Stoker #1 of 3

Business Strategy

- *Combined heat and power (CHP) at farm/factory s*
  - *Business plan rev. 3 in-progress, 3 investor pitches so*
  - *Seeking $2.4M, then $1.0M in Year 2 to commercializ*
  - *Biochar as leading money-maker*
- **High-purity hydrogen for turbo generators**
  - **Seeking $1.37M to build 6x prototype**
  - **Obtain economic performance data**

Today's Focus

- Modular scale-up to match customer needs
  - May choose dual-source to reduce risk
  - Future: co-fire syngas

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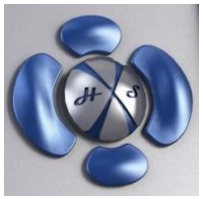
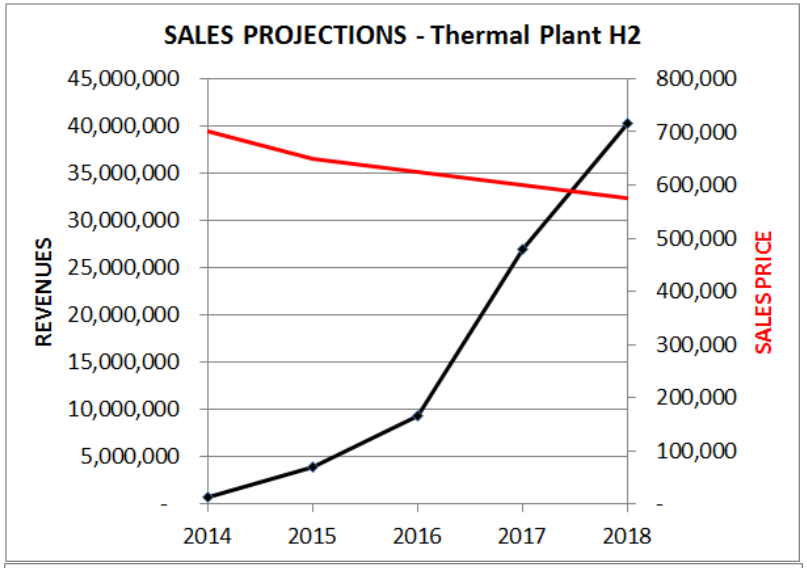
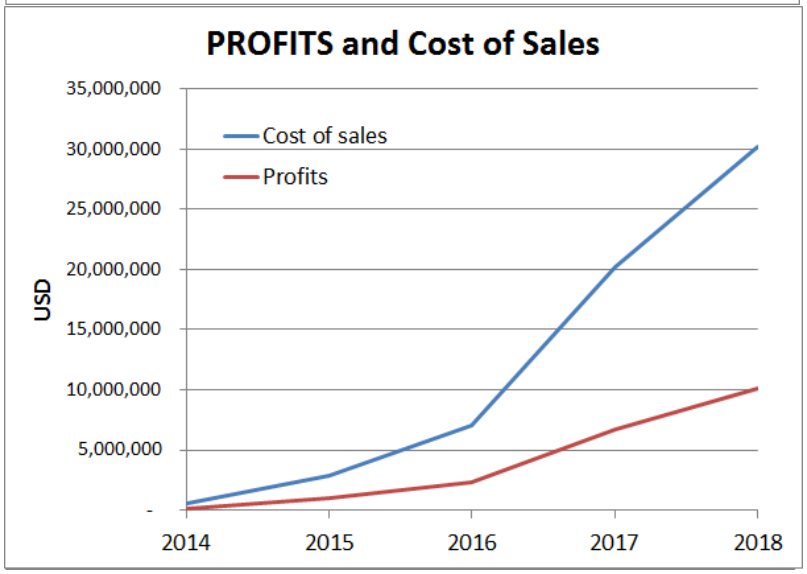
Sales and Marketing

- Place S/N 1 in 2014 @ HE
- All HE plants in 2015
- Across Indiana 2016
- Midwest & beyond ‘17-8
- “Specialty” product alongside CHP/Biochar
- Expand – co-fire syngas
- Augment – H_2 storage







Company

- Biomass Unit Ops, LLC
  - Start-up created by the tech transfer arm of the Indiana University System (IURTC).
  - BMU is based on issued and pending patents invented by Prof. Peter J. Schubert

- Leadership Team:
  - Dr. Joe Trebley, IURTC, Managing Director of BMU
  - Mr. John Craun, CEO in-waiting
    - One of 13 Entrepreneurs-in-residence

END