



Commercialization of IH²[®] Biomass Direct-to-Hydrocarbon Fuel Technology

Alan Del Paggio, Vice President

CRI Catalyst Company
910 Louisiana, Houston, TX 77002



Disclaimer

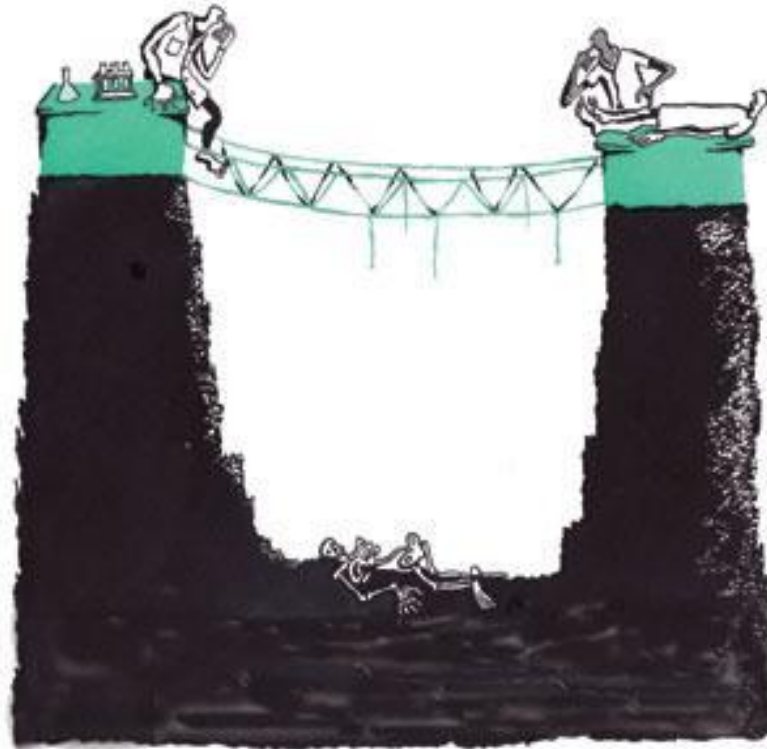
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The “Valley of Death”

Technical
Success

when you
demonstrate a
brilliant idea



Commercial
Success

when you get
someone to build a
second plant

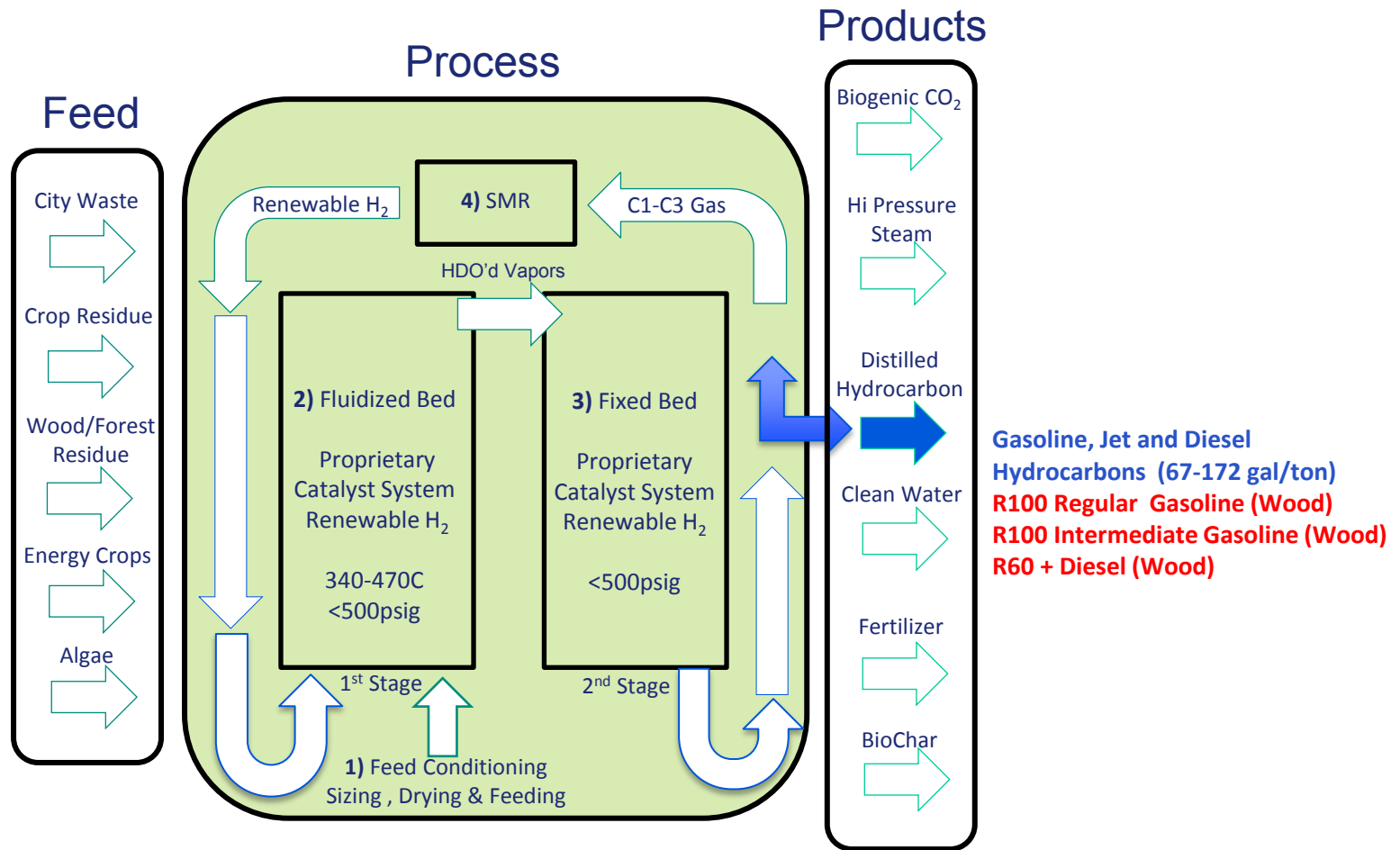


Building the Bridge to Commercial Success

- Use existing reactor / process technologies where possible
- Deliver a fungible or infrastructure compatible product
- Utilize broad range of feeds
- Be self-sufficient / stand alone if needed / integrate for savings
- Demonstrate over multiple scales
- Circumnavigate troubled waters (e.g. 'food vs. fuel')
- Be economic vs. fossil fuel
- Know and engage key stakeholders
- Formulate entity-specific CVPs
- Partner early
- Mitigate risks



The IH²® Process Developed by GTI



Demonstrate over Multiple Scales ($>10^7$)

>220000L/day
Commercial
FEL-2



2200L/day
Showcase



22L/day
Chicago



1L/day
Chicago,
Bangalore

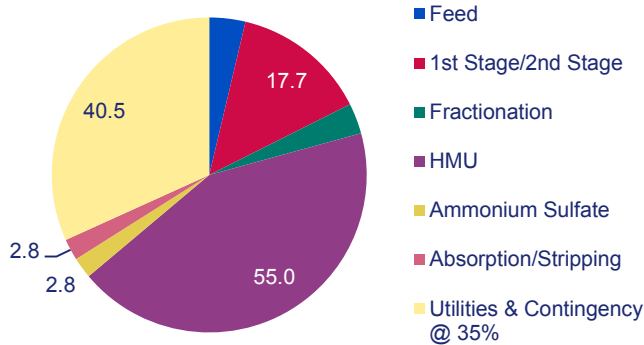


0.02L/day
Bangalore

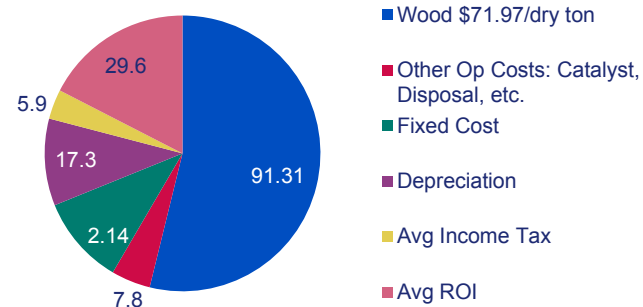


Be Economic vs. Fossil Fuels (NREL Study)

Installed Equipment Costs \$127.5mIn

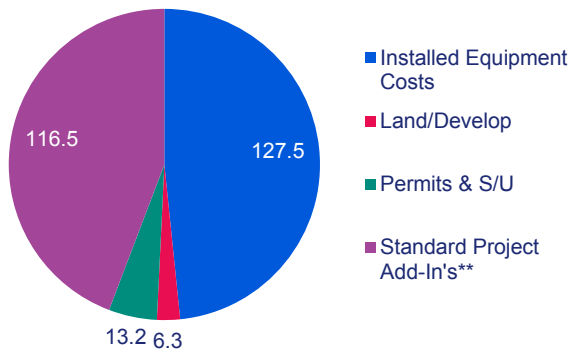


Operating Costs Total \$1.64/gal*



*Includes \$0.1884/gal coproduct credit

Total Capital Investment \$263mIn



** Prorated Expense (10%), H O & Construction (20%), Field Expense (10%), Working Capital (10%), Project Contingency (30%)

<http://www.osti.gov/bridge/servlets/purl/1059031/1059031.pdf>

- Stand Alone/Green Field (US Gulf Coast basis)
- 2000mt/d wood (50% moisture fed, dried to 10% moisture at 1st stage)
- Conservative: 60.9 vs 66.4mIn gal/year; 4500bbl/day
- Equipment cost - HMU is largest @ \$55mIn ~45% TIC
- Feed Stock ~55% of Operating Cost
- No subsidies, tax, RIN or carbon credits included! \$3.96capex/annual gal
- **Minimum Fuel Selling Price – \$0.433/L (2007) \$0.476/L (2012)**
- **\$1.64/gal \$1.80/gal**
- Refinery Synergy w/Refinery H₂ Supply
 - **Estimated MFSP \$0.359/L (2007) \$0.394/L (2012)**
 - **\$1.36/gal \$1.49/gal**
- KBR FEED underway (FEL-2 complete)
- Opex validated by prospective clients



Know and Engage Key Stakeholders

- Potential customers include biomass and energy companies
- Local, State and National governments (Thank you US DOE!)
- Fuel qualification/certification/registration
- EPC companies
- Technology suppliers
- Off take agreements
- Funding entities
- Sustainability groups
- Consumers...



Partner Early

- Develop individual CVPs, the larger the prize the better
- Understand client specific drivers same
- Understand client risk appetite
 - commercial risks largely mitigated with fungible fuels
 - some technical uncertainty remains
 - mitigate operational risk
- Share risks where possible
- Phased project approach
- Long term mutual commitment to success



Thank You

*Learn more at
www.cricatalyst.com/catalysts/renewables.html*