SynGas Technology, LLC

Elk River, Minnesota USA
www.syngastechnology.com
Contact: Chris Goralski, CEO
cgoralski@syngastechnology.com
-or-
Duane Goetsch, CTO
dgoetsch@syngastechnology.com

Commercialization of Reliable Syngas Production for Fuel & Chemical Synthesis

Enabling the Economical Production of High Value Chemical and Fuels from Biomass

Who is SynGas Technology?

- Minnesota based developer of technology for renewable fuels and chemicals
- 2010 spin-out from Gradient Technology, an Elk River, MN based specialty chemical engineering firm
  - Syngas cleanup contracting for State of MN for BTL and consulting for DOE CCS project
  - Reactor design for demo plants for DOE BTL projects and public GTL developer
- Over 100 years experience in technology development including gasification, alternative fuels synthesis and utilization, and chemical processing
  - Chris Goralski, PhD, Chief Executive Officer
  - Duane Goetsch, Chief Technology Officer
  - Kym Arcuri, PhD, Vice-President – Fuel Synthesis
  - Leroy Clavenna, PhD, Vice-President – Gasification
- Key Advisors with extensive Industry, Market and Technology Knowledge
- Strong ties to the University of Minnesota as alumni and through advisor relationships with faculty

Forces Driving the Development of Alternative Fuels

Energy Security

US Imports >60% of Oil used, much of which comes from politically unstable geographies*

Falling Petroleum Reserves

Proven reserves growing slower than demand and at rising production costs

Rising Energy Prices

Oil prices have increased from ~$20/bbl in 2002 to ~ $90/bbl today and are projected to further increase

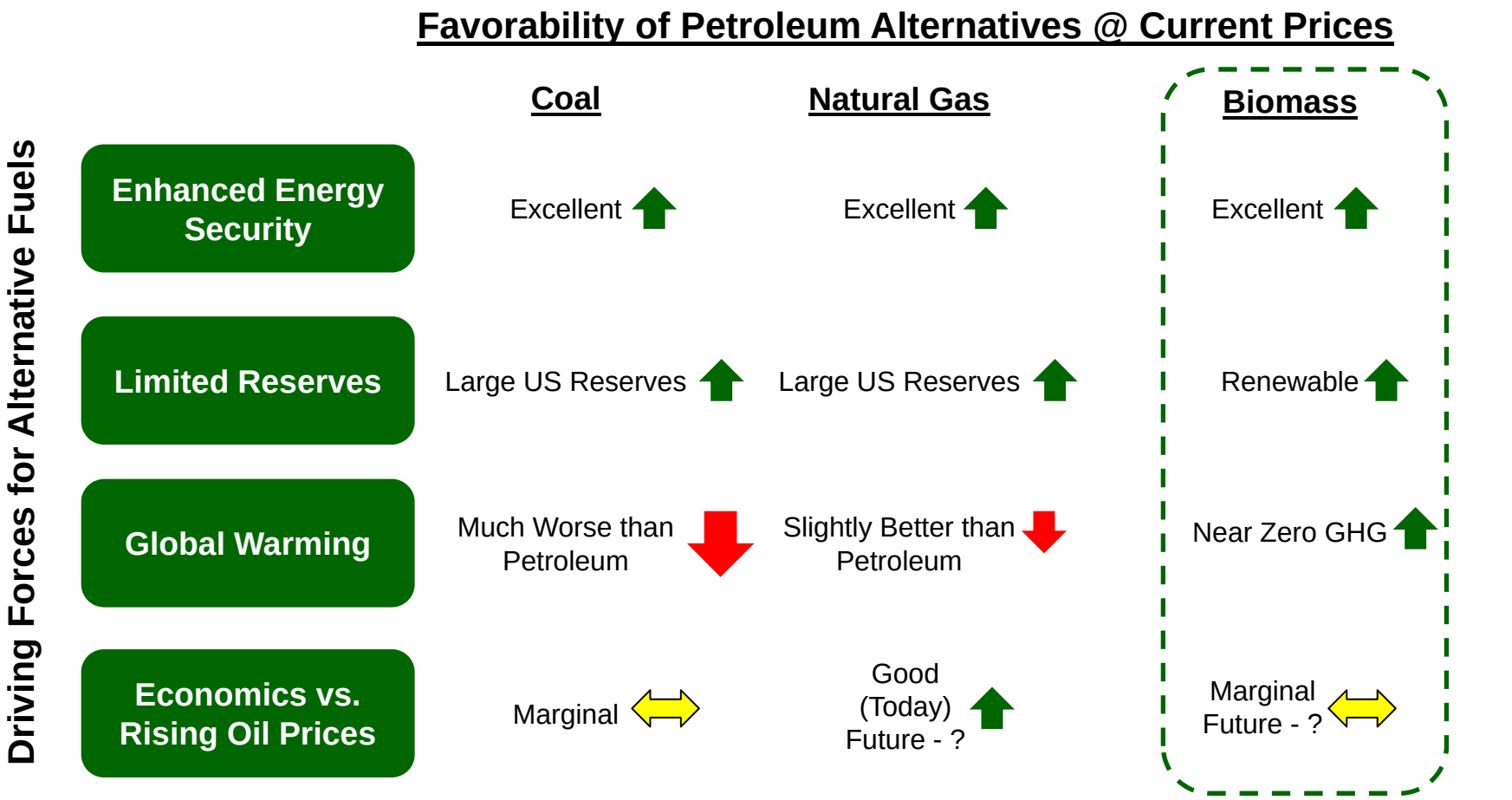
Global Warming

IPCC Fourth Assessment Report Warns of global temperature rise in the range of 1.8-4.0 °C by end of 21st century

Petroleum and Petroleum Derived Products Represent Over a $2 Trillion Market

*Source: EIA, 2010

Biomass is an Attractive Feedstock to Provide Alternatives to Petroleum Derived Fuels…



Biomass also provides a strong source of rural economic development and additional sources of farm income in Minnesota

The Biofuels Challenge

*

State:	Solid	Liquid
Composition:	Carbon, Hydrogen and Oxygen	Carbon and Hydrogen
Structure:	Very Large Molecules	Small/Medium Molecules

All biofuels processes must:

Convert solid to liquid
Eliminate oxygen (either as water or CO2)
Rearrange the structure of the biomass backbone

* Photo Courtesy of NREL

Potential Processing Routes to Gen2 Biofuels

		Feedstock	Product	Pros (+) / Cons (-)
Biochemical	**Fermentation**	Sugars	Final Product Requires Separation	(+) High Selectivity (-) Low Specific Productivity (-) Not Spec Fuel
Biochemical	**Algae**	CO2 / Sugars	Renewable Oil Requires Separation Requires H2	(+) High Selectivity (-) Difficult separation (-) Requires H2 (not renewable)
Thermochemical	**Direct (Pyrolysis)**	Residuals	Crude-like replacement Requires +++ H2	(+) Low Capital Cost (-) Low Thermal Efficiency (-) Not Spec Fuel
Thermochemical	**Gasification + Synthesis**	Residuals	ASTM Spec Fuels and Chemicals	(+) Produce Spec Fuel (+) Good Thermal Efficiency (-) Capital Intensive

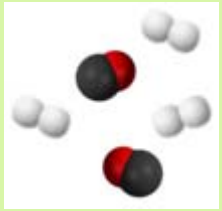
Further development is required to address fundamental challenges of *economical*, *direct replacement*, renewable fuels

The SGT Approach to Biofuels

Step 1: Pretreatment

Homogenize material
Stabilize for storage & transport
Prepare for gasification

Step 2: High Pressure Gasification



Deconstruct biomass backbone
Eliminate impurities
Recover NPK

Step 3: Product Synthesis

- **ASTM Gasoline**
- **ASTM Diesel**
- **Chemicals (e.g. Ammonia)**

Utilize commercial technology to produce direct replacement final products

Note: All Processes High Pressure

Key Advantages of SGT Approach to Biofuels

High Throughput Design	Base technology proven on natural gas for almost 10 years reduces capital cost and minimizes by-product production
Simplified Feed System	Provides high reliability required in refinery/chemical plant operations
High Pressure Operation	Significantly reduces capital and operating costs and matches downstream process requirements of proven product synthesis technology
High Thermal Efficiency	Maximizes yield to product and minimizes GHG emissions

SGT Gasification Process Offers Potential for >$100M Capital Cost Reduction and 15% Improved Yield

SGT Path to Commercialization

	Current Stage of Development	Next Stage of Development
Pretreatment Technology	Operating pilot plant in Elk River, MN capable of processing a variety of feeds	Commercial facility to produce pelleted coal replacement in Madelia, MN
Gasifier Technology	Proven for natural gas for almost 10 years at 200 bbl/day scale Engineering and full scale subsystem prototypes in Elk River, MN to adapt to biomass	10-150 ton/day process demonstration unit (potential phase II for Madelia)
Integrated Fuel Production	Technology for syngas to gasoline and syngas to diesel demonstrate at > 2,000 bbl/day scale worldwide Demo scale (up to 10 bpd) demonstrated on biomass derived syngas	Integrate product synthesis with SGT gasifier (potential phase III for Madelia)

Next Steps With Prairie Skies Phase I

Independent engineering feasibility study

- Led by independent engineer out of Oklahoma with Oil, Gas, and Biomass experience
- Assessing the adequateness of existing engineering and financial package to support production cost estimates and assess facility viability

Market feasibility study

- Led by Minneapolis Biomass Exchange
- Assessing market demand and price points for treated biomass pellets as a coal replacement

Next Gen Grant

Production and testing of sample materials

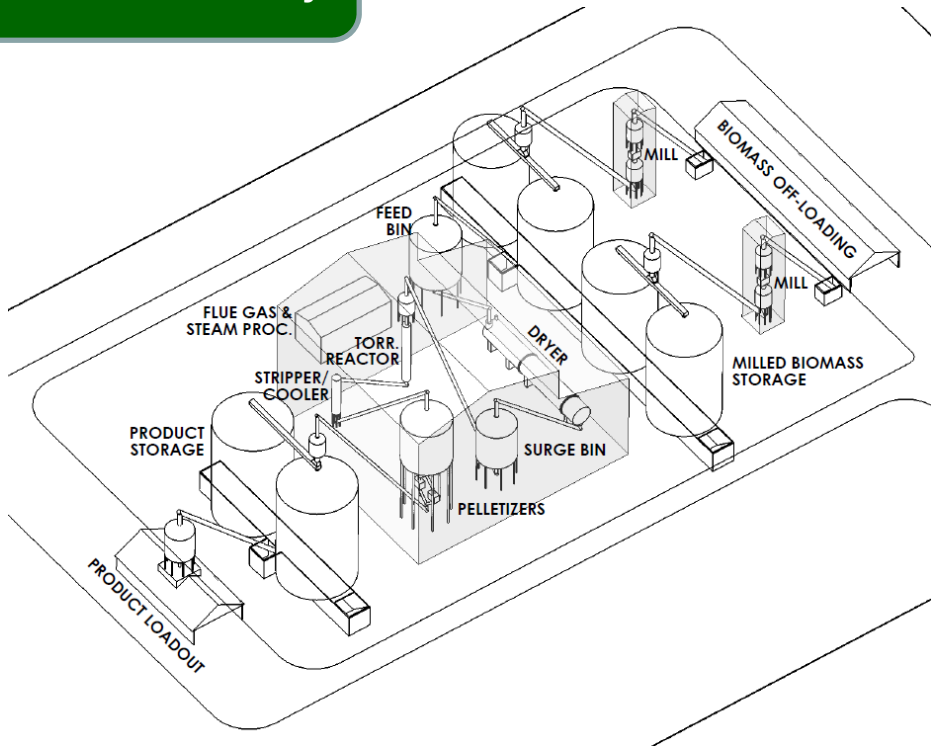
- Good results with wood and corn stover that are being extended to other residues and grasses

Some Additional Perspectives to Offer

1. **Biomass has less than half of the volumetric energy density of oil which means that *all things equal*, the capital costs for a given nameplate capacity will be at least twice that of a conventional facility**
2. **In capital intensive industries, *costs tend to be engineered in* and only core technology improvements can lead to lower costs in future plants**
3. ***Economies of scale are real* and cost barriers for distributed processing are significant**
4. **Rushing immature technology to commercial production is a recipe for economic failure (see 2.)**
5. **Minnesota is falling behind other states in supporting biofuels whereas we were a leader in ethanol**
   - **State of Louisiana committed $14M in building and finance grants, $4.5M in relocation incentives, and up to $330M in private activity bonds to attract Sundrop Fuels to build a wood-to-gasoline plant in Louisiana**

Questions?

Layout of Madelia Torrefaction Facility



200 BBL/Day Gasifier Island & FT Diesel PDU at Exxon Baton Rouge Refinery