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EXTENSION

Syngas to Anhydrous Ammonia: The Case of Haber-Bosch

Michael Sparby & Randy Hilliard, Agricultural Utilization Research Institute

Fueling the Future:

The Role of Woody and Agriculture Biomass for Energy Workshop

February 18, 2009

Roosevelt

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University of Minnesota Extension, Roseau and Lake of the Wood Counties;
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Biomass Gasification



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What is Biomass Gasification?

- Gasification is a process that converts carbon materials, such as biomass, into carbon monoxide and hydrogen by reacting the raw material at high temperatures with a controlled amount of oxygen.
- The resulting gas mixture is called synthesis gas or syngas and is itself a fuel.

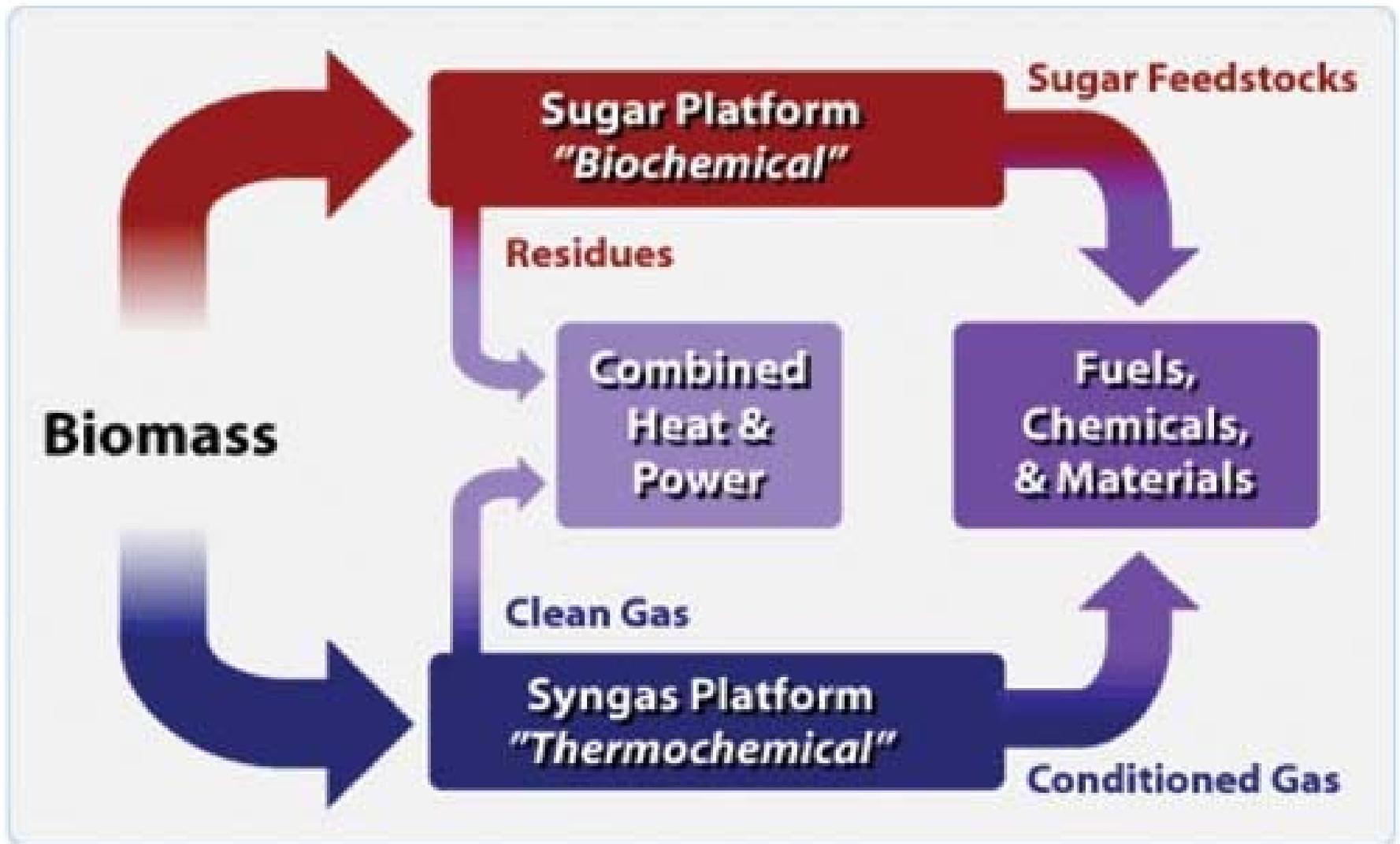


History of Gasification

- The gasification process was developed in the 1800's as town gas powering lights and cooking applications
- Natural gas eventually replaced town gas
- Fischer-Tropsch into synthetic fuel
 - Passing syngas over a catalyst
 - During WWII Germany was producing up to 124,000 barrels per day



Biorefinery Concept



Examples of Gasification Projects in the Region

- Gasification
 - Chippewa Valley Ethanol Coop
 - University of Minnesota Morris Campus
 - Central Minnesota Ethanol Coop
 - Williams
 - Bois Forte
 - Isanti County
 - Stevens County
 - White Earth



Williams Gasification Project

- AURI worked with Northern Excellence
 - Assess BTU analysis of 9 different grasses and co-products
 - Identified two main co-products
 - Kentucky Blue grass screenings
 - Perennial Rye grass screenings



<u>Wood Pellet</u>		<u>Rye Grass Straw</u>		<u>Alfalfa Stem</u>	
Moisture	4.31	Moisture	6.73	Moisture	7.84
Ash	1.86	Ash	4.7	Ash	4.97
Btu	7940.49	Btu	7165.44	Btu	7202
<u>Peat</u>		<u>Redtop Straw</u>		<u>Kentucky Blue Straw</u>	
Moisture	59.81	Moisture	6.33	Moisture	7
Ash	7.16	Ash	5.08	Ash	5.64
Btu	2816	Btu	6982.02	Btu	7032.48
<u>Timothy Grass Straw</u>		<u>Reed Canary Straw</u>		<u>Bluegrass Screenings</u>	
Moisture	6.76	Moisture	6.94	Moisture	6.27
Ash	5.22	Ash	4.97	Ash	10.16
Btu	7210.15	Btu	7042.62	Btu	6827.84

Roseau Gasification Project



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Project Background

- Roseau Gasification Project
 - • Phase I – Install and demonstrate a small scale biomass to synthesized gas to hydrogen to ammonia
 - • Phase II – After the demonstration is completed the unit will be used to produce synthesized gas to run an engine to produce electricity for the Roseau school district



Project Partners

- Minnesota Wheat Growers Association
- Minnesota Turf Seed Council
- City of Roseau
- DEED
- Farmers Union Foundation
- Roseau Electric Coop
- Farmers Union Oil Company, Roseau
- US Department of Energy
- EERC
- AURI



Phase I

- Install and demonstrate a small scale biomass to synthesized gas to hydrogen to ammonia
 - Small scale proof of concept
 - Use PSA (Power Swing Absorption) to clean up the hydrogen
 - Run the hydrogen through a Haber Bosch system to generate ammonia



Phase I

- Haber Bosch Process
 - is the nitrogen fixation reaction of nitrogen and hydrogen, over an iron catalyst, to produce ammonia
 - 100 million tons of nitrogen fertilizer per year
 - 3-5 % of the world natural gas production



Potential Outcome for Phase I

- An economic analysis of a larger 1 megawatt unit would consume 18,250 tons per year
- ammonia production of 8,278 tons per year.
- The capital cost of this system would be \$12 million.



Phase II

- Grass screening gasification
 - After the demonstration is completed the unit will be used to produce synthesized gas to run an engine to produce electricity for the Roseau school district

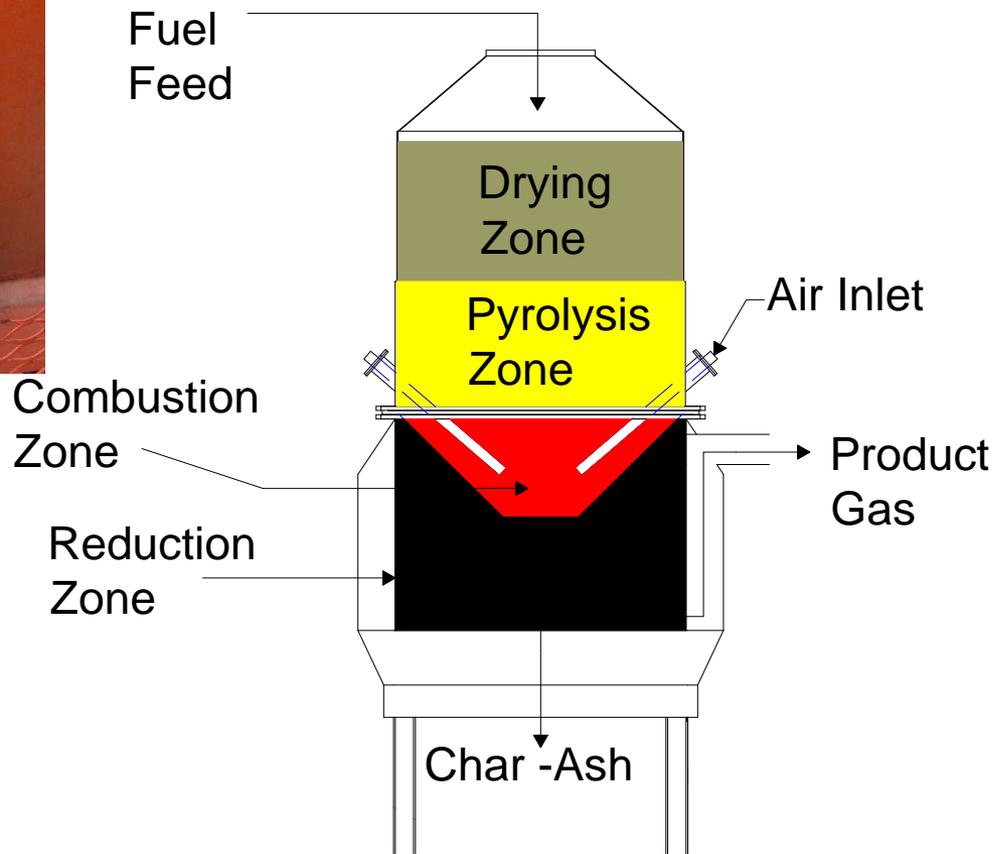


Outcomes for Phase II

- Be able to prove distributed energy gasification technology
- Development of a workbook for other interested communities



Downdraft Gasification



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Questions?

Thank You!

**The Resource for Value-Added
Agriculture in Minnesota**



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