



FLORIDA SOLAR ENERGY CENTER®

Creating Energy Independence

Biomass to Fuels and Chemicals

November 10, 2011

Ali T-Raissi



What is the economic cost of importing petroleum?

- ❖ The price tag for the imported oil in 2010 was about \$400B
- ❖ It cost U.S. about \$500B (in 2011 \$) to complete building of the entire Federal Interstate Highway System

What else \$400B gets you?

❖ This is more than the U.S. expenditure on



Manhattan Project

\$24.4B

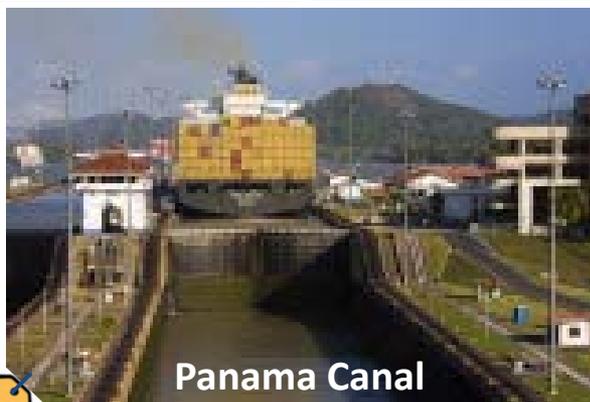


Apollo Program



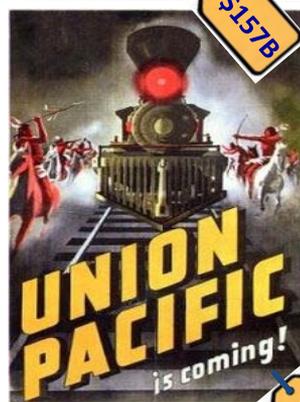
Alaska Pipeline

\$11B



Panama Canal

\$14B



Transcontinental Railroad

\$157B



Marshall Plan

\$120B



What else \$400B can get you?

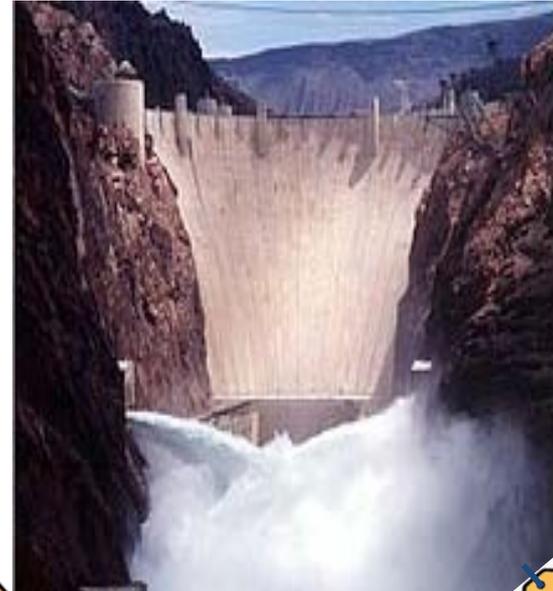


\$22B

The Big Dig Project



World Trade Center



\$2.2B

Hoover Dam

\$0.8B



Golden Gate Bridge

\$1.5B

Combined --- and still have about **\$48B** left over!



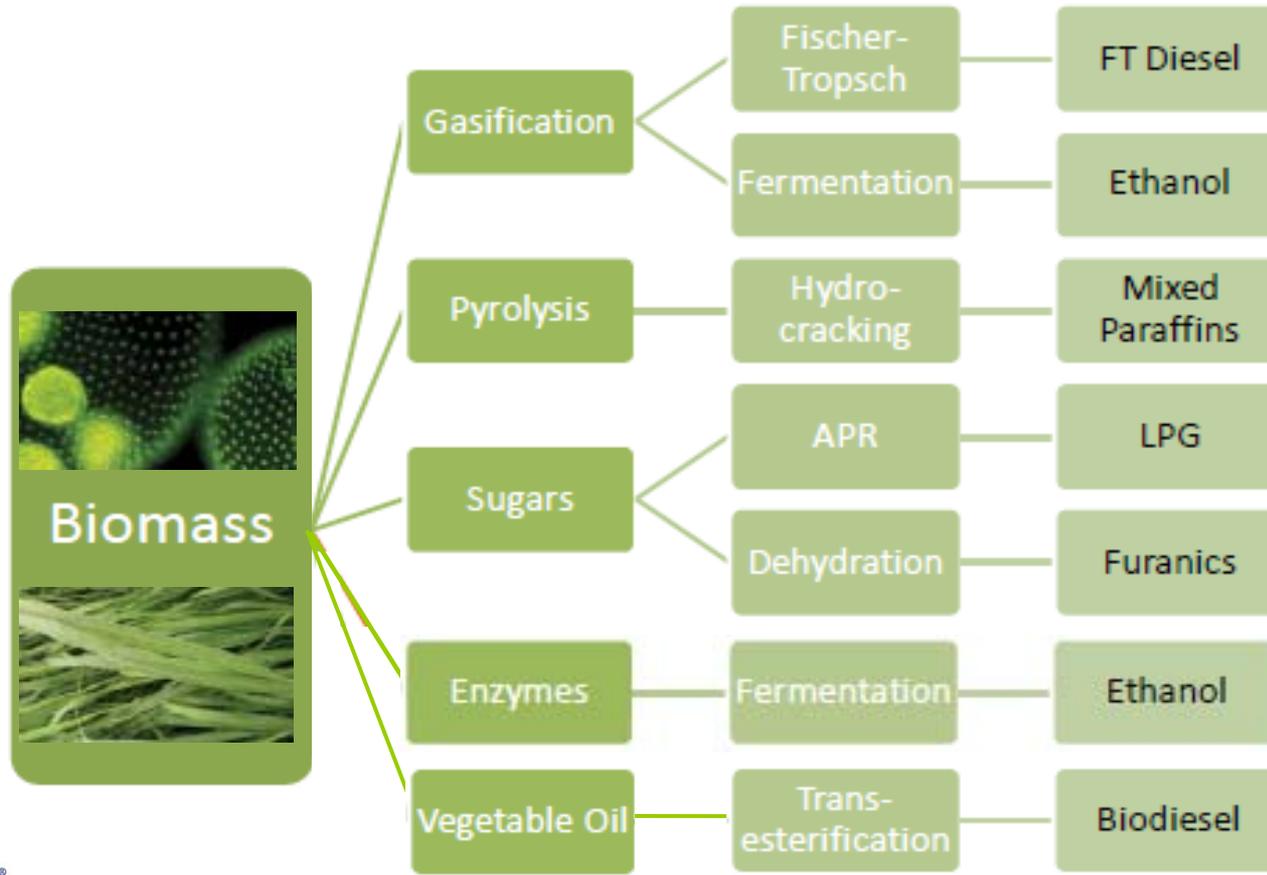
How much of a financial burden is the fuel cost for an average family?

- ❖ For most families, fuel cost is the 2nd largest expense
- ❖ For those making less than \$50,000 per year, it constitutes the highest expense – even more than the housing costs!

Can transportation fuels be made from non-petroleum resources?

- ❖ Yes – almost any carbonaceous material can be converted to liquid fuels. Things like biomass, landfill gas, animal waste, municipal solid waste, sewage sludge, etc.
- ❖ And, there are many processes to accomplish that

What are some of the processes for making liquid fuels from biomass?



How much has US DOE invested in biofuels development?

- ❖ To date, DOE has invested more than \$1B on integrated biorefinery demonstration projects (matched with \$1.7B from industry) to field advanced biofuels, bioproducts, and power

What are the biomass-to-fuels program goals at US DOE?

- ❖ Reducing oil imports by 1/3 by 2025
- ❖ Diversifying fuel mix
- ❖ Establishing Renewable Fuel Standard
- ❖ Increasing production to 36B gallons in 2022 (less than 13B gallons/year produced today)

What are the biomass-to-fuels program goals at US DOE?

- ❖ **Conducting resource assessment to establish geographic and economic criteria under which 130 and 250 million dry tons per year of biomass would be available by 2012 and 2017, respectively**

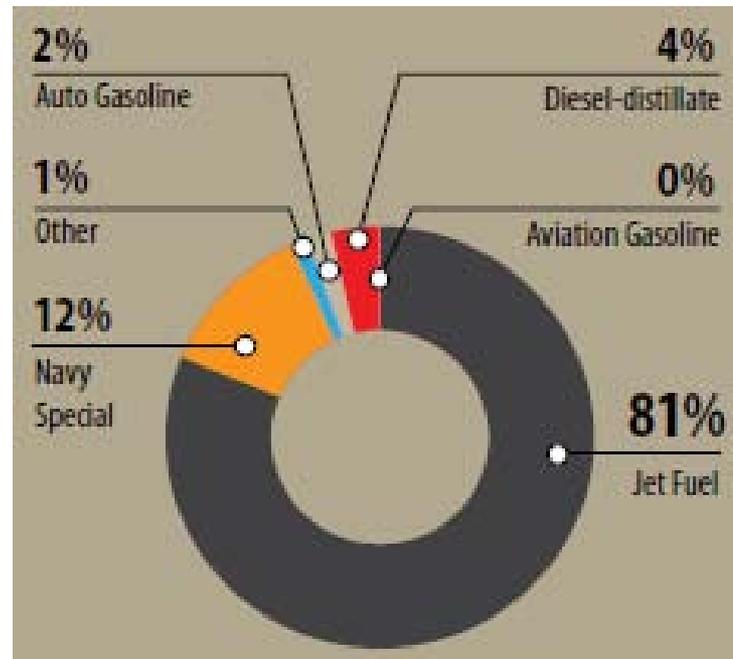
What are the biomass-to-fuels program goals at US DOE?

- ❖ Developing feedstock logistics to reduce costs from harvest to chemical plant gate to \$35 per dry ton (in 2007\$) by 2012
- ❖ Achieving those same cost goals for a wider range of biomass feedstocks by 2017

How about the US DOD?

- ❖ The primary need is for the jet fuel

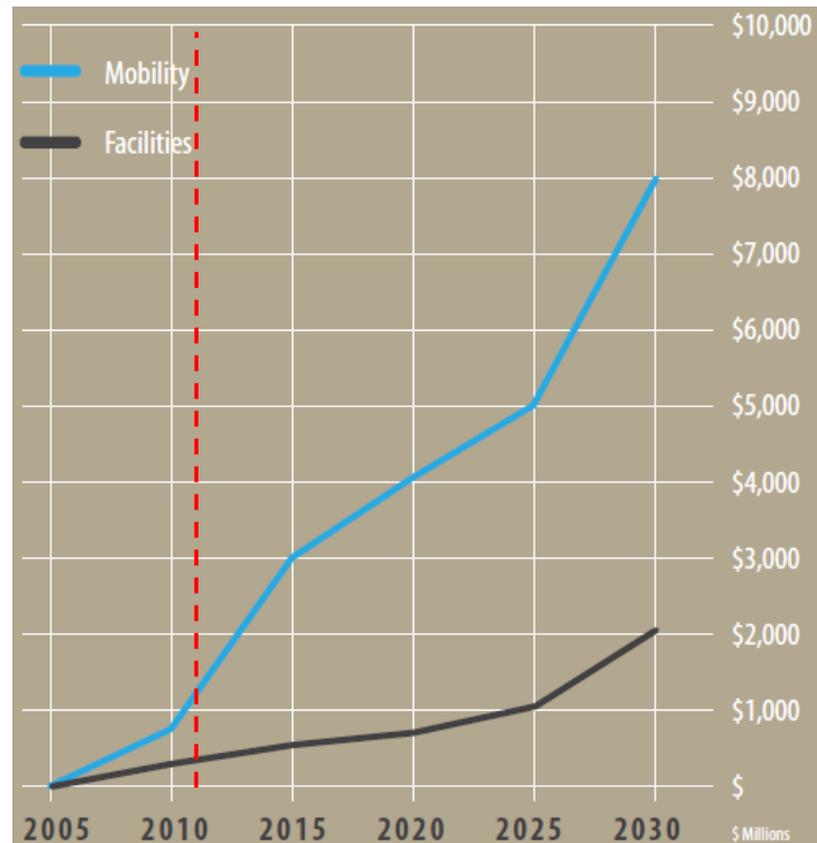
DOD Operational Fuel Costs, FY2010 – \$11.5B



Source: FY2010 Federal Energy Management Report

Is DOD committed to clean energy?

DOD's Past and Future Investment in Clean Energy



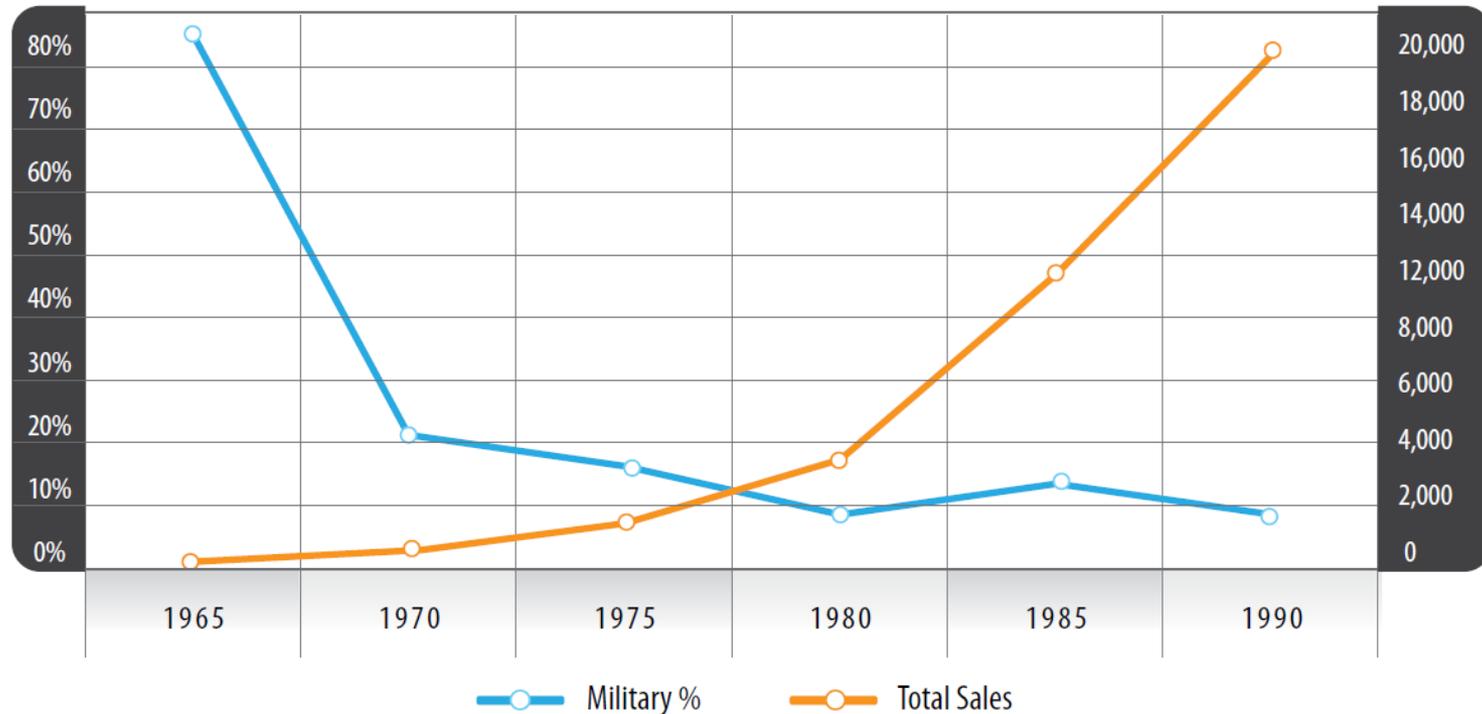
Source: "From Barracks to the Battlefield," The Pew Charitable Trusts, 2011



Will it make any difference?

- ❖ A lot, since DOD has buying power
- ❖ And, from past experience with the development of markets for integrated circuits, it is likely that DOD can influence broader adaptation of biofuels and other clean energy technologies

Total sales and DOD share of US integrated circuit sales



Source: David Mowery, Haas School of Business, University of California Berkeley
referenced in: "From Barracks to the Battlefield," The Pew Charitable Trusts, 2011

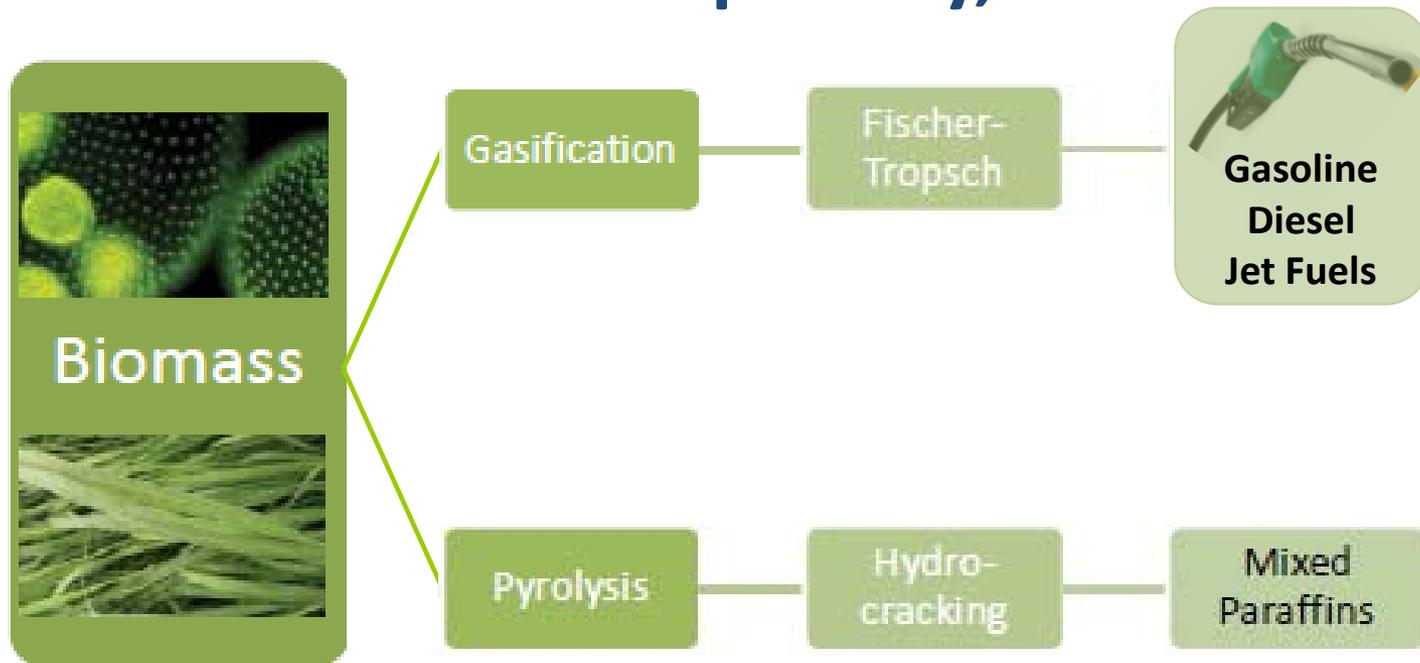
What's UCF doing in biofuels arena?

- ❖ Research at FSEC has centered on biomass gasification (a very forgiving process for generating syngas) from various feedstocks (likes of crop residues, forest waste, yard clippings, and energy crops; as well as aquatic biomass) and
- ❖ Fischer-Tropsch synthesis to generate liquid hydrocarbon fuels



Why gasification/FT synthesis?

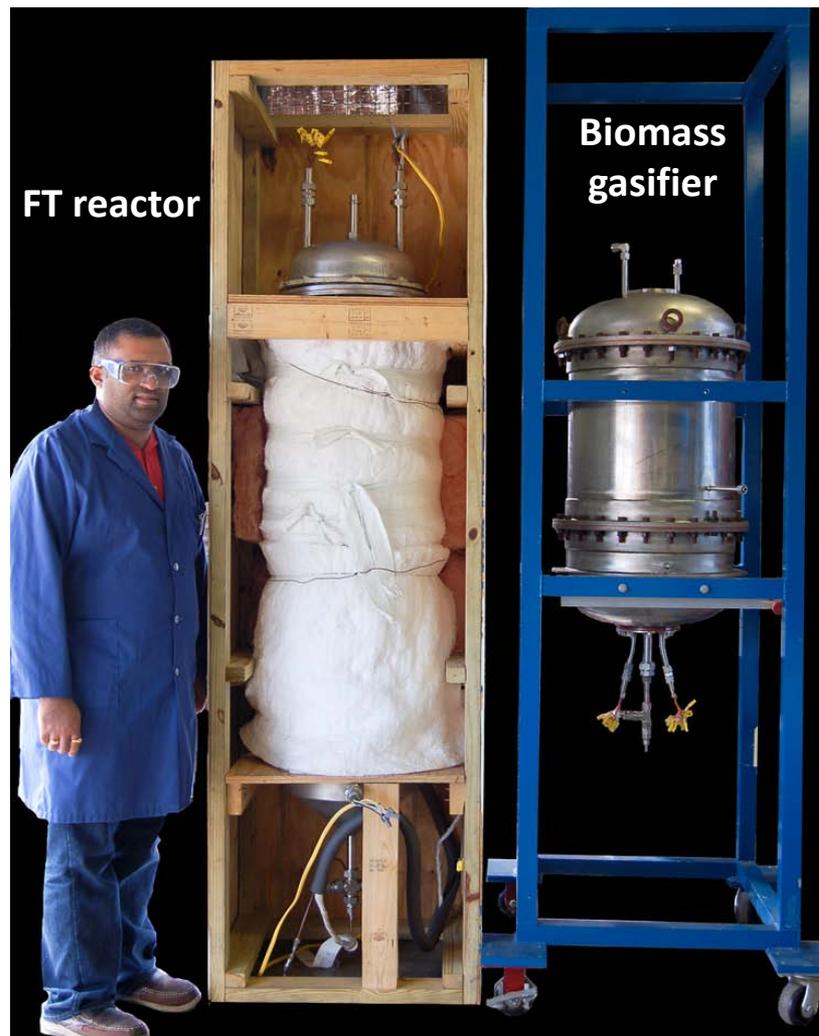
- ❖ Process offers many advantages – among them are feedstock flexibility, tech transition capability, etc.



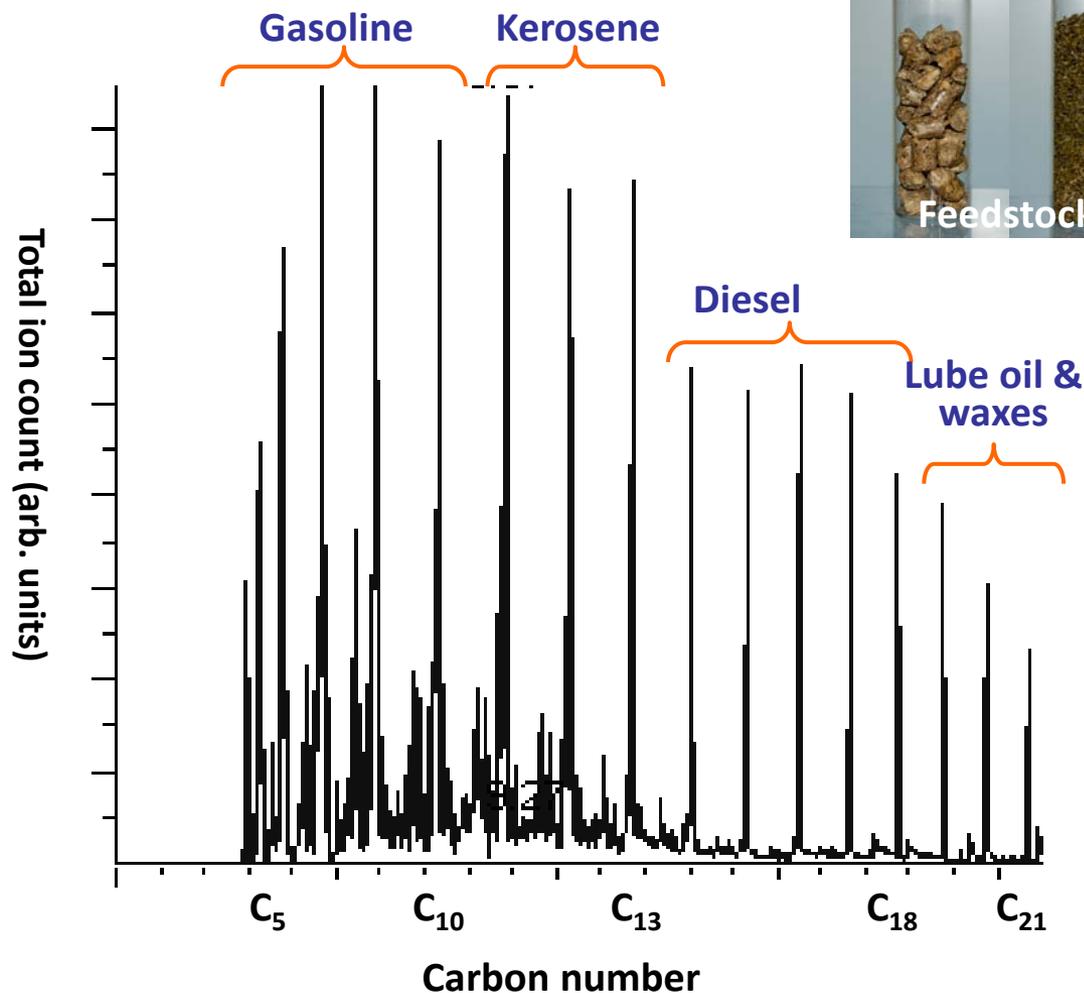
What is the status of work at FSEC?

- ❖ We have designed, built and tested a special oxygen-blown gasification and Fischer-Tropsch synthesis system
- ❖ FT reactor has our own proprietary design and catalyst formulation
- ❖ We can convert any pre-treated biomass to clean, wax-free, sulfur-free drop-in fuels.

FSEC's gasification/FT synthesis pilot plant



What is the composition of the FSEC syncrude?



What are the estimated costs?

- ❖ Based on the experimental data and using the AspenPlus™ CPS, we have developed the product cost

Cost component	Cost (\$/kg of FT fuel produced)	% of total cost
Capital costs	0.81	39.3
Fixed O & M	0.18	8.6
Feedstock	1.12	54.4
Other raw materials	0.06	3.0
Byproduct credits - electricity generation	-0.13	-6.5
Other variable costs	0.02	1.2
Synfuel cost (at the gate)	\$0.80-2.10	Per kg
	\$3.00-7.00	Per gallon

What are the future plans?

- ❖ **If additional funding is made available, FSEC will build a larger-scale BTL demonstration plant. Data collected from this activity will give a more realistic capital and operational cost data that will be useful to commercialization of the technology**

Acknowledgements



Human Energy



Credit: Malcolm Denmark, FLORIDA TODAY

