

Biomass Energy



D. Yogi Goswami, Ph.D, PE
Distinguished University Professor
Director, Clean Energy Research Center
University of South Florida, Tampa, FL

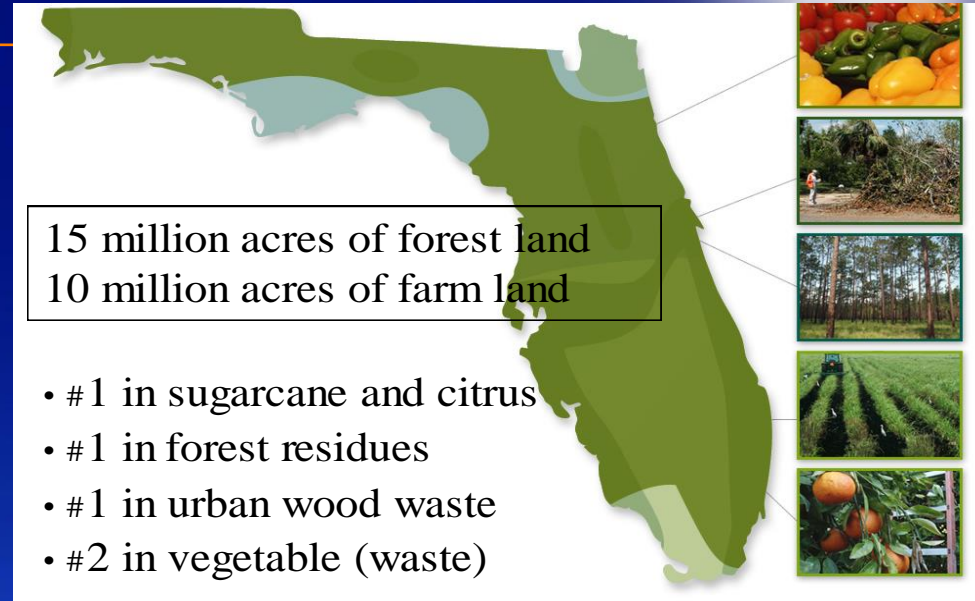
Stakeholders Meeting
August 20, 2014

Hosted by FPL



Developing Florida Biomass Resources

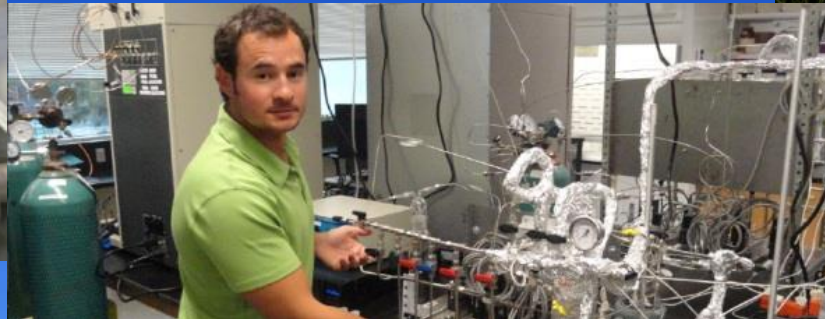
- Florida has ~10% of US biomass resources
- 51% statewide tree coverage
- 80% of it is commercial
- Climate allows year around energy crop growth, high crop yield and conversion efficiency



- 100MW Biomass Power Plant - Gainesville Renewable Energy Center
- Biomass to ethanol plant - INEOS
- Algae to ethanol pilot plant – Algenol
- University of Florida cellulosic ethanol biorefinery

Biomass to Energy

- Energy Intensive Crop Development – molecular genetics
- Energy From Algae: Fresh water, marine algae; Genetic transformation; Solar photo-bioreactors; Lipids to fuels
- Electricity Cogeneration from Biomass and Solid Waste
- Thermo-Chemical and Biochemical Conversion of Biomass to Liquid Fuels



Scalable Algae Cultivation

Dr. Philippidis

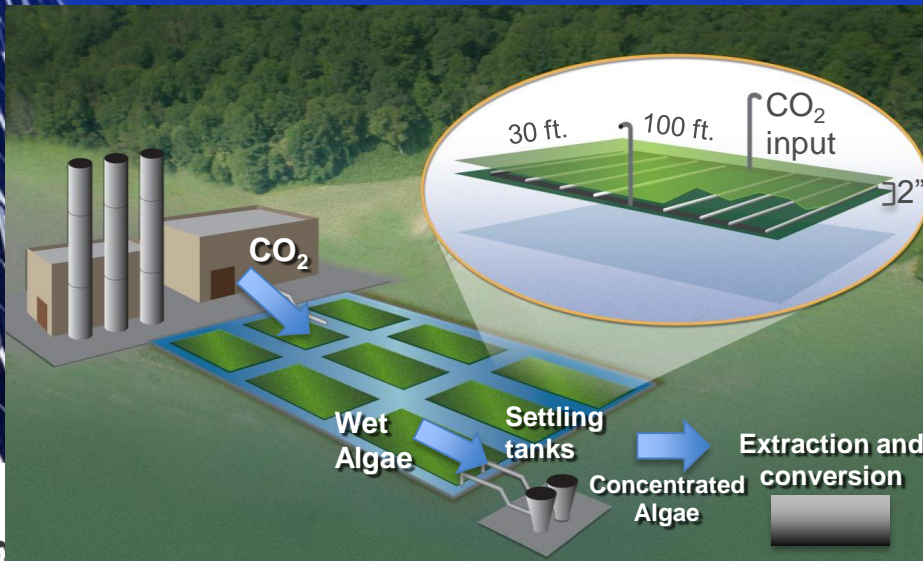
Open pond

- **Low investment**
- Low biomass density (huge water volume to process)
- Low yield

Closed photobioreactor (PBR)

- High investment
- High biomass density
- **High yield**

Innovative Approach: Horizontal Bioreactor (HBR)



- **Low capital cost**
- **High cell density & productivity**
- A fraction of water use (< 1/4th)
- Lower cost of downstream processing
- Thermal control
- Contamination barrier
- Floating (or on the ground)
- Readily scalable (modular)

High-Temp Steam Gasification of Biomass and MSW

(Dr. Jacob N. Chung)

Agricultural Wastes

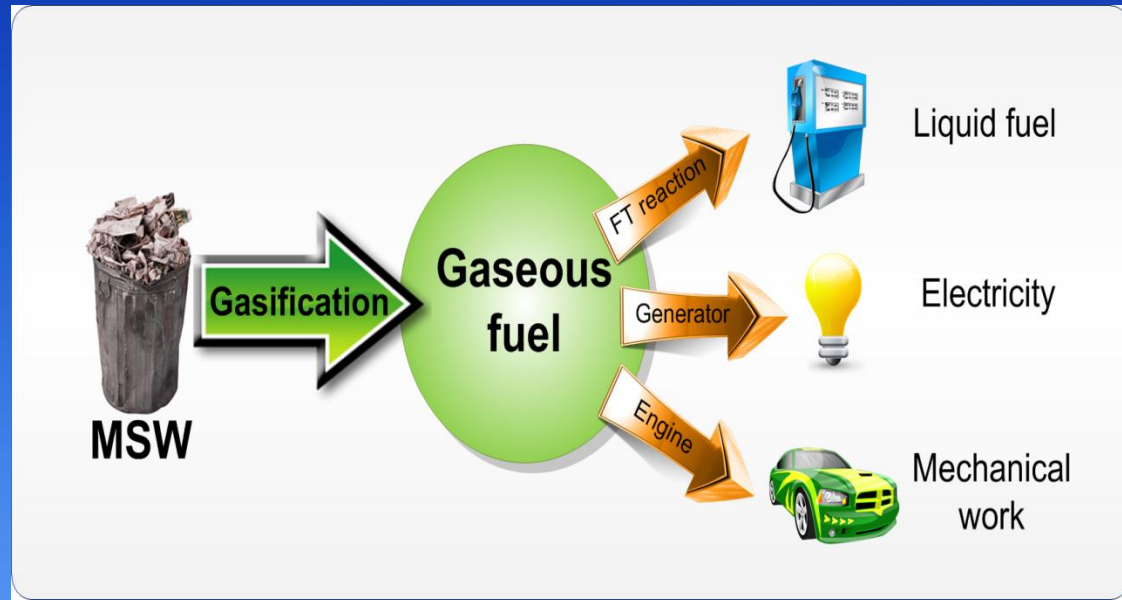


MSW

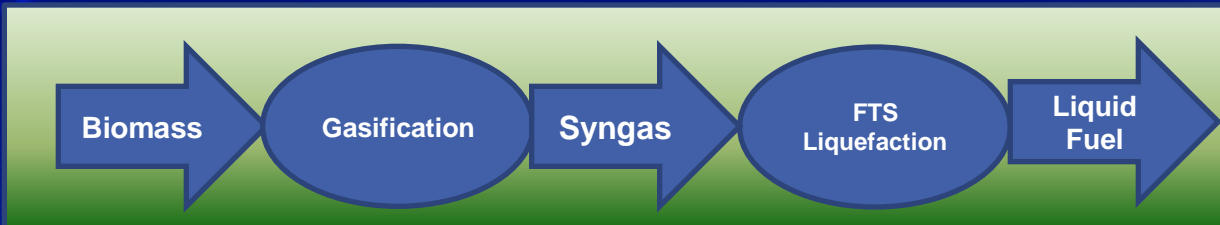


High Temperature
Steam Gasification

Syngas



Thermochemical Biomass Conversion

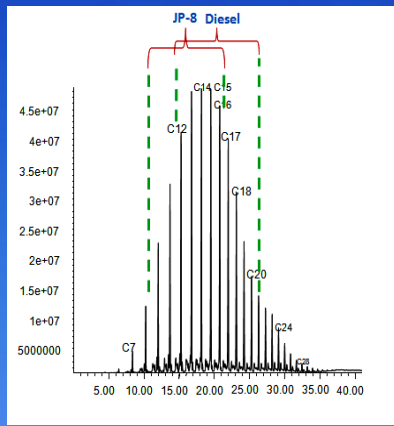
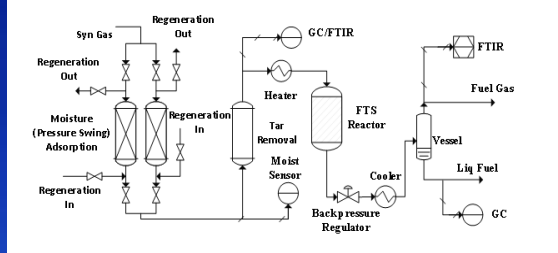
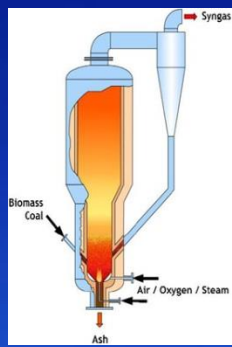


Gasifier

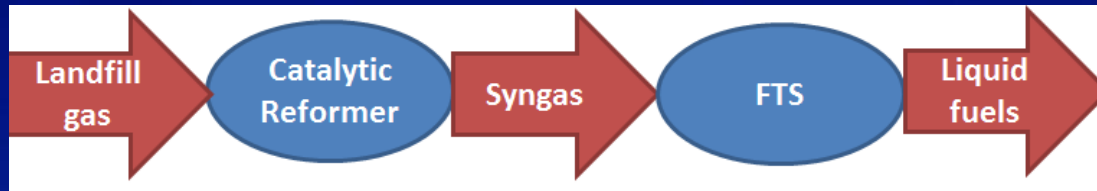
Fischer-Tropsch Synthesis

Diesel, Jet Fuel

Biomass



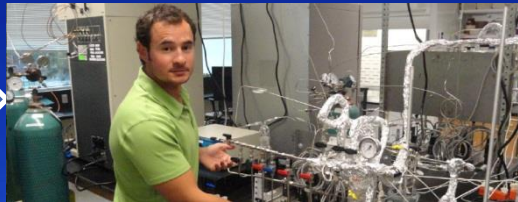
Landfill Gas to Diesel



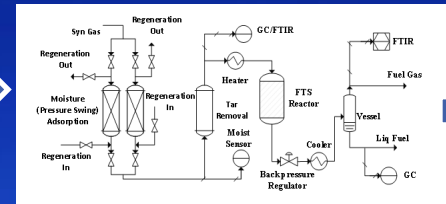
Landfills



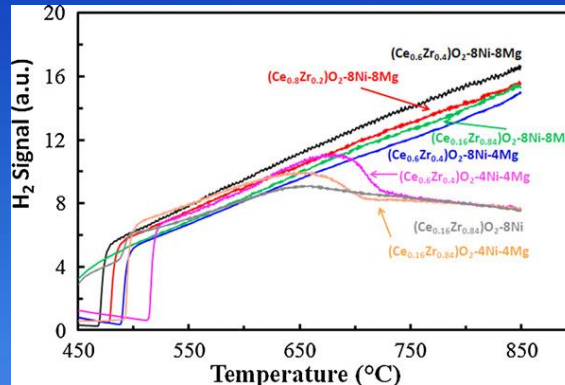
Tri-reforming



Fischer-Tropsch Synthesis



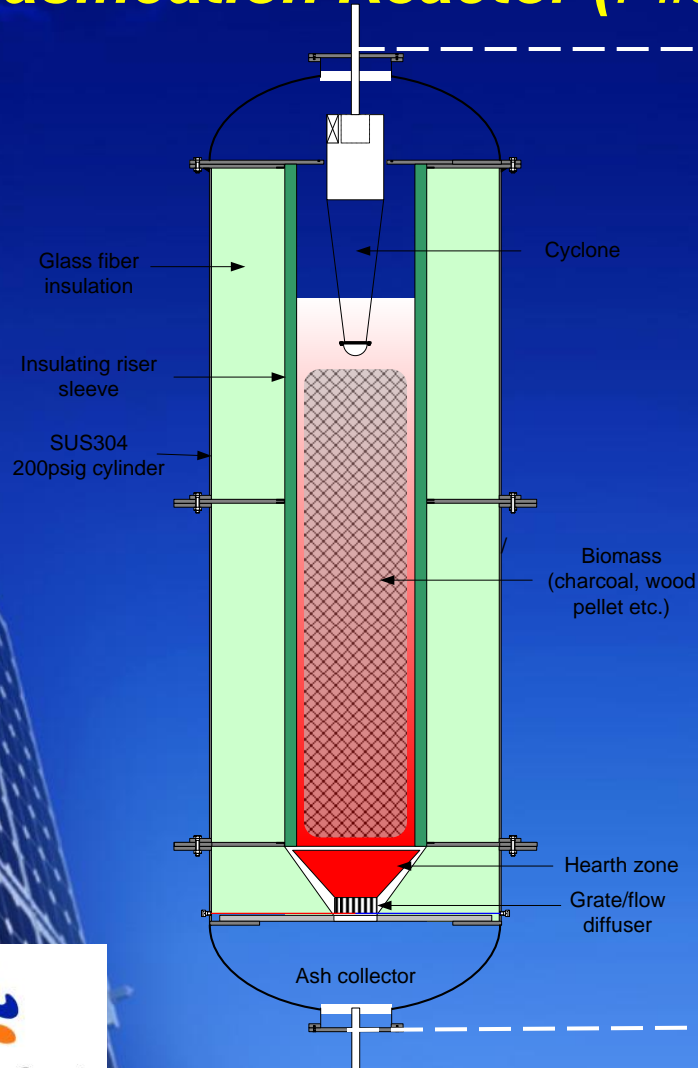
Diesel, Jet Fuel



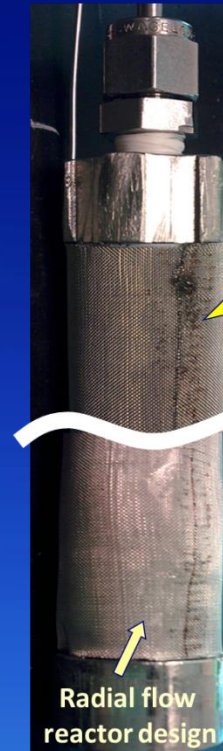
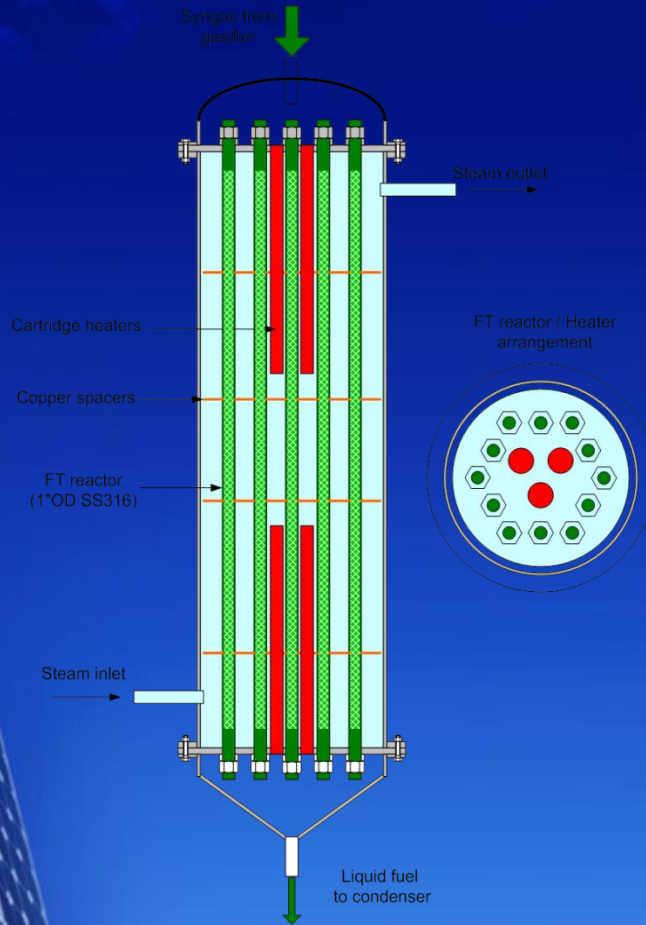
- Trash 2 Cash – Start-Up
- Winner of Megawatt Venture Award
- Devin Walker, CEO, listed in Forbes 30 under 30

3rd Generation Biofuels via Gasification & FT Synthesis (FSEC)

Gasification Reactor (Pilot Scale)



Fischer-Tropsch Reactor



Power, Water, Heat, and Cooling By Dr. Lear



- **Single unit for power, water, cooling, heat**
- **Life cycle cost advantage**
- **Increased design efficiency**

Fuel and Emissions

- Ultra-low emissions
- Fuel flexibility
- Cost-driven fuel choices
- Enables opportunity fuels
- Enhanced energy security

Grid Impact

- Sub-second response time
- High part-load efficiency
- Operate ~75% load
- Vary output for frequency control
- Reduce spinning reserves
- Increased stability, decreased cost

Demonstration/Test Facilities



Biomass to Electricity Demo Units

Demonstration/Test Facilities

Cellulosic Ethanol:



Stan Mayfield Biorefinery Pilot Plant in Perry, FL

Thank you

UF UNIVERSITY of
FLORIDA



FAU
FLORIDA
ATLANTIC
UNIVERSITY



USF UNIVERSITY OF
SOUTH FLORIDA

