Center for Energy and Environmental Sustainability

Bioenergy Thrust Area

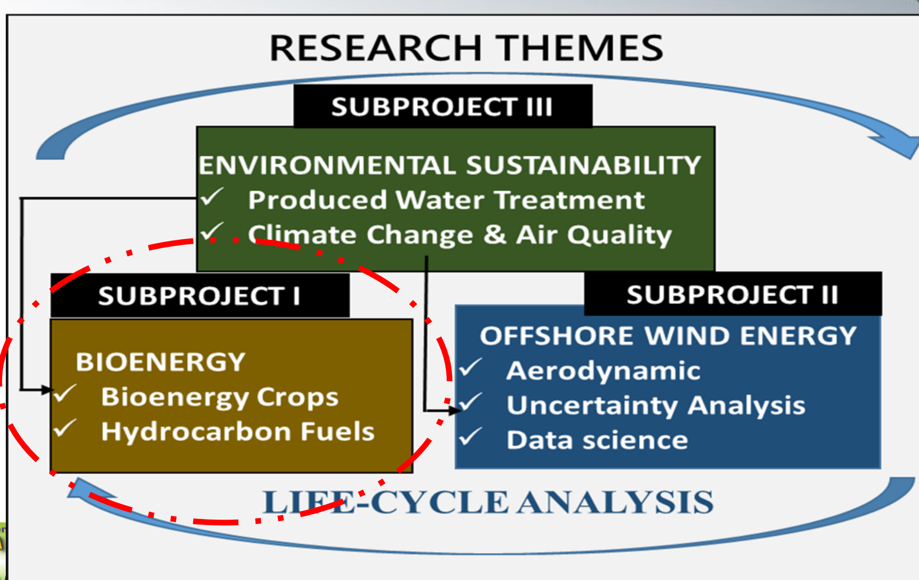
EAB/ISC Meeting
September 17, 2021

Ananda Amrarasekara, PhD
Bioenergy Group leader
Professor & Interim Head, Department of Chemistry & Physics
Prairie View A&M University

1

1

CEES Phase II Research Thrusts



2

Thrust Area 1: BioEnergy

Group

- Dr. Ananda Amarasekara (Chem), Group Leader
- Dr. Peter Ampim & Dr. Ripendra Awal (CARC), and Dr. April Lovelady (Mech Eng).

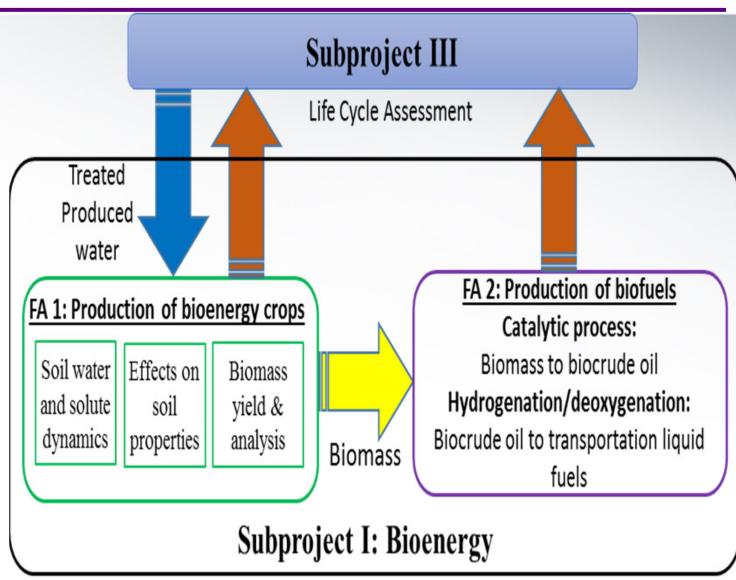
Goal

- Study the potential of using treated produced water to irrigate perennial grasses switchgrass grown as bioenergy feedstocks
- Develop an innovative, energy-efficient, recyclable, catalytic process for the transformation of biomass to biocrude oil.
- Two focus areas:
  - (1) Energy Crop Cultivation
  - (2) Conversion of Biomass into Bio Crude Oil

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

3

Thrust Area 1: BioEnergy



Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

4

Use of Fracking Water to Grow Energy Crops

- Planted propagates made from giant miscanthus and miscane plants acquired

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

5

Use of Fracking Water to Grow Energy Crops

- Layout of the field plots

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

6

Focus Area 2: Chemocatalytic Conversion of Biomass

- **1st generation – ethanol from starch/sugars**
  - Corn ethanol - 13.9 BGY^{-1}, US, 64% world production. Sugar cane ethanol – 5.6 BGY^{-1}, Brazil, 25% world production
- **2nd generation – cellulosic ethanol from non-food biomass**
  - About 20 ~ 20 MGY^{-1} plants in US + EU, few in operation, mostly under construction
- **3rd generation (drop-in) – hydrocarbon fuels comparable to gasoline, diesel, and jet-kerosine from non food biomass**
  - One plant in US, ~ 11 MGY^{-1}

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

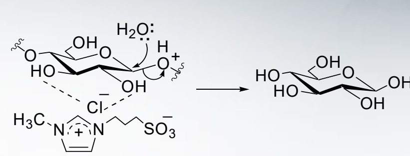
7

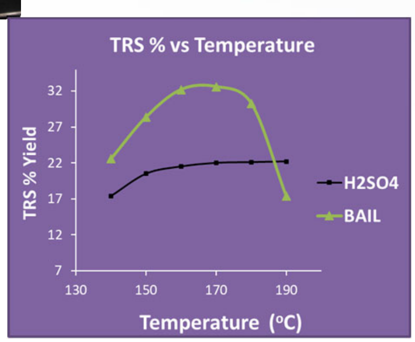
7

Phase I: Acidic ionic liquids as homogeneous catalysts in water

High pressure reactor
140-190 ^0C,
0.36 -1.25 MPa

Hydrolysis of cellulose





BAIL, 170 ^oC, 3 h. 33 % TRS
H_2SO_4, 170 ^oC, 3 h. 21 % TRS

$[H^+]$ = 0.032 M

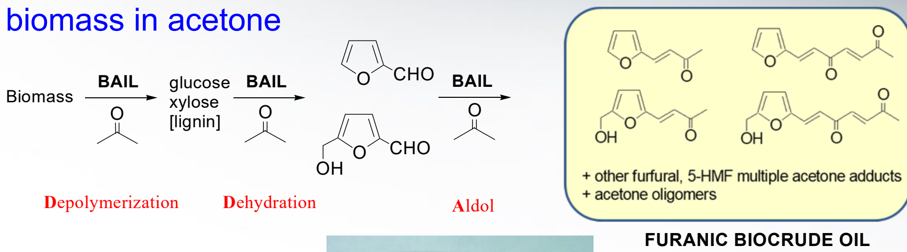
A.S. Amarasekara et al. *Ind. Eng. Chem. Res.* **2011**, 50, 12276

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

8

Phase II: Focus Area 2

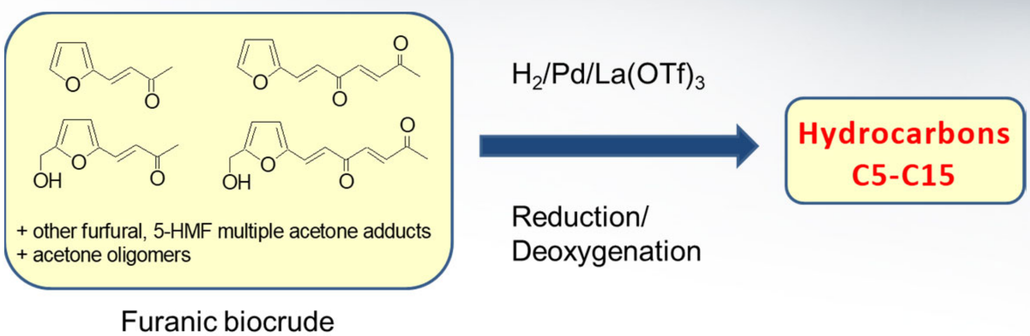
- Brönsted acidic ionic liquid (BAIL) catalyzed degradation of cellulosic biomass in acetone



9

Phase II: Focus Area 2

- Conversion of furanic biocrude oil to C5-C15 hydrocarbon mixture



10

Phase II :Focus Area 2

- Advantages
  - Single reactor process
  - Mild conditions, 120°C, 3h
  - Use biomass derived acetone - all carbons are
  - From renewable resources
  - Excess acetone can be recovered for reuse
  - Good catalyst recovery and reuse

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

11

Future Work

- Use of giant miscanthus and miscane as biomass feedstocks
- Reductive deoxygenation of furanic biocrude
- Improvements in catalyst reuse

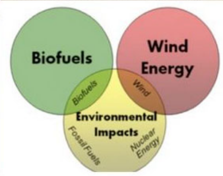
Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

12

Visit Us Online:

WWW.PVAMU.EDU/CEES

CENTER FOR ENERGY & ENVIRONMENTAL SUSTAINABILITY (CEES)



Questions/Further Information?
Please contact:
Ziaul Huque
Center for Energy & Environmental Sustainability
Professor of Mechanical Engineering
Roy G. Perry College of Engineering
rrkommalapati@pvamu.edu, (936) 261 9957

Center for Energy and Environmental Sustainability
CEES
PRAIRIE VIEW A&M UNIVERSITY

13