

FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

Regional Supply Chain Analysis for Alternative Jet Fuel Production in the Tropics

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Overview



- Introduction/motivation
- Objectives
- Selected results
- Summary

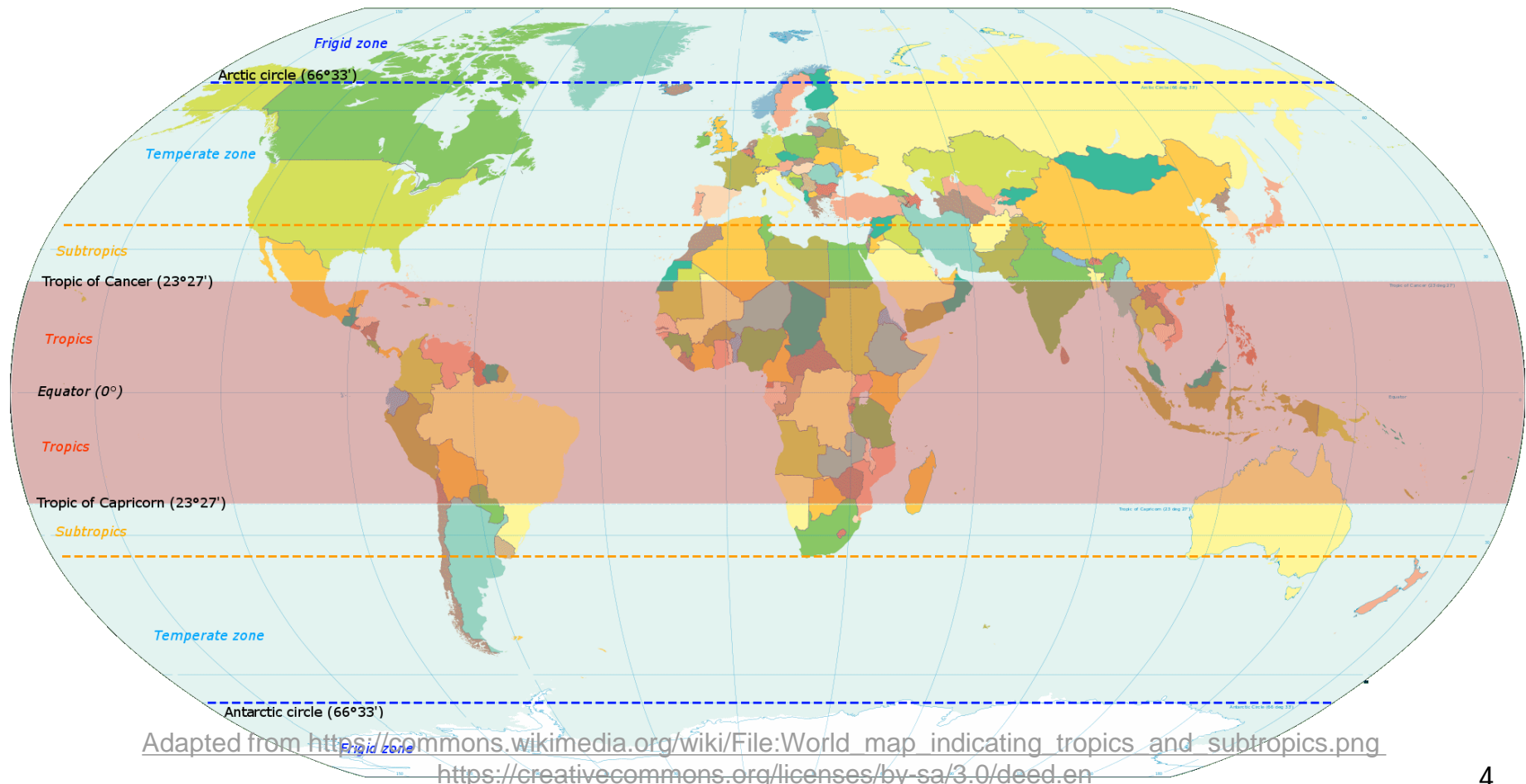
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Alternative Jet Fuel Supply Chain, Tropical Region Analysis -- Motivation

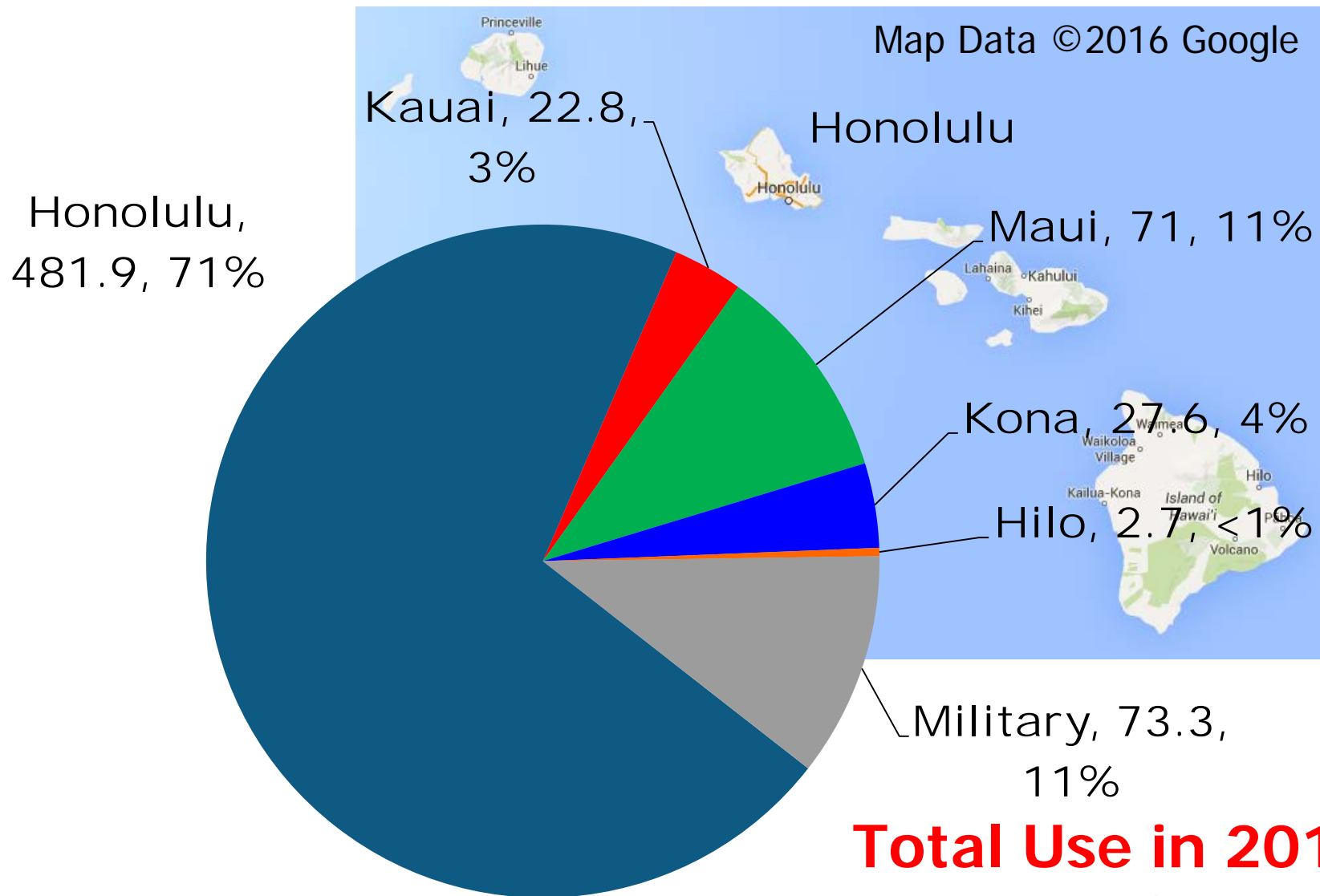
- The tropics account for 36% of the world's land mass
- Tropics are home to unique biomass materials, production practices/systems, and temporal availabilities



Jet Fuel Use in Hawaii, 2015

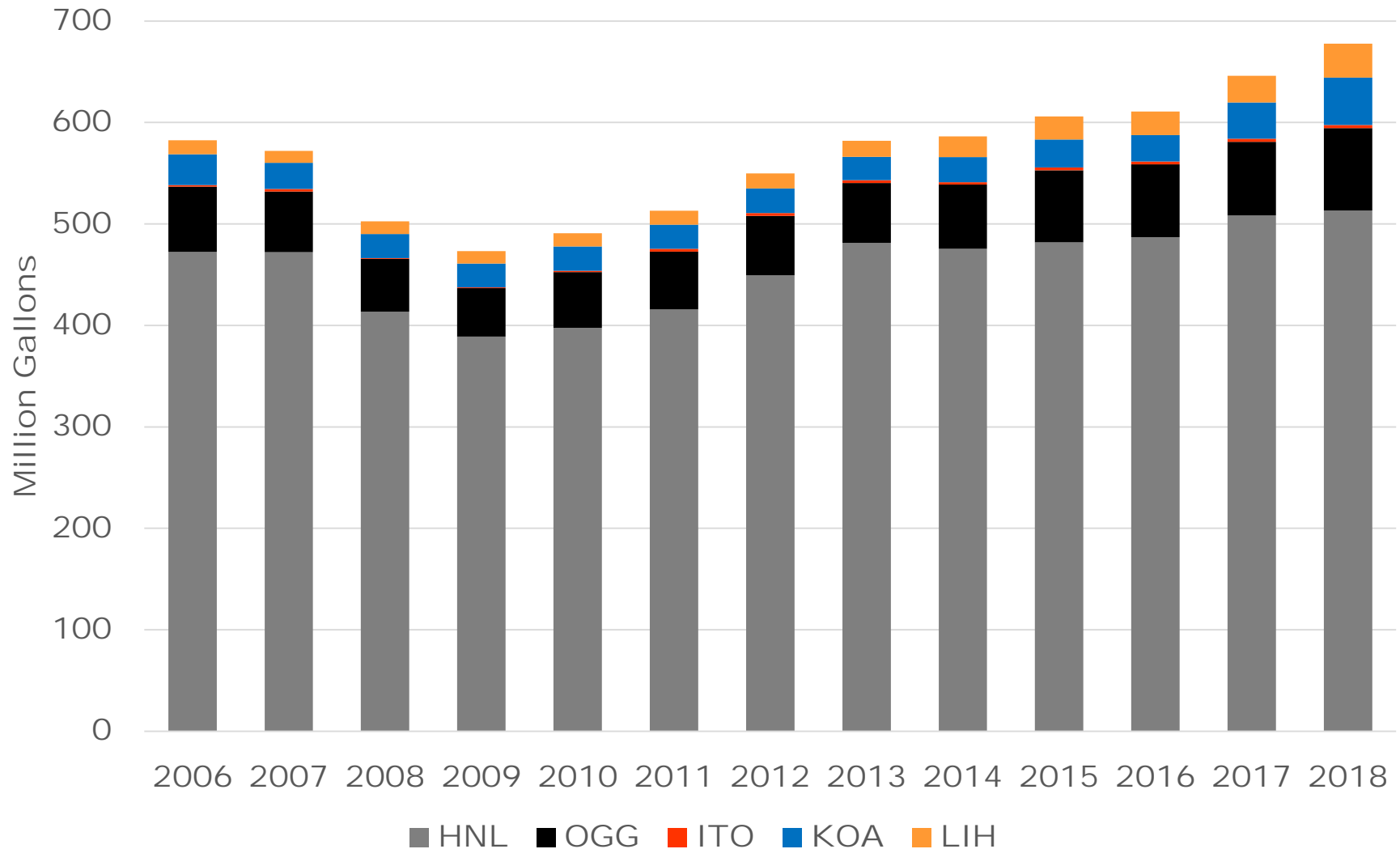
Commercial Airports and Military

(million gallons)



Total Use in 2015
678.4 M Gallons

Commercial Jet Fuel Consumption in Hawaii

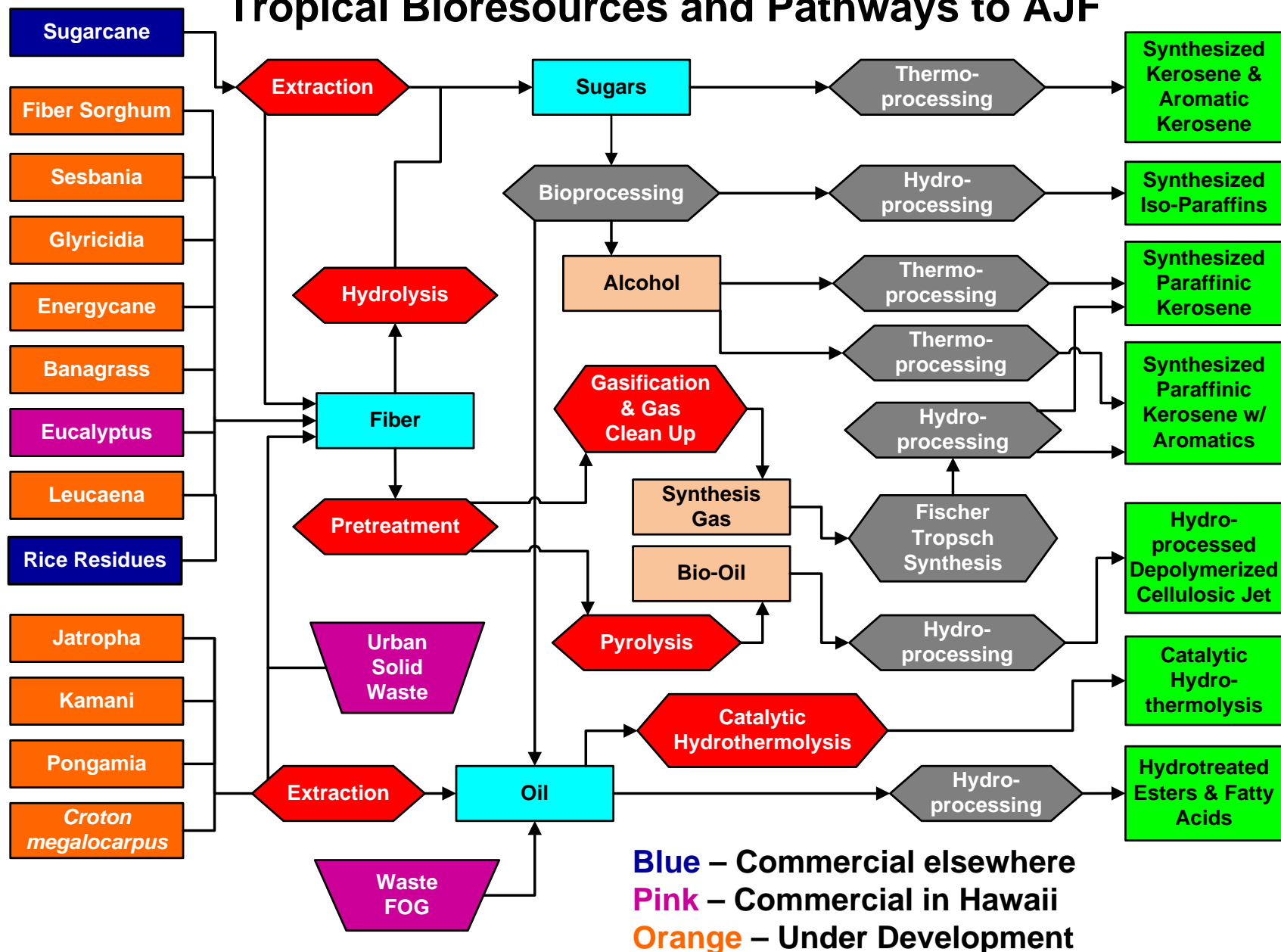


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Tropical Bioresources and Pathways to AJF



Bioresource

Intermediate Products & Conversion Technologies

Alternative
Jet Fuel

University of Hawaii Objectives

- Conduct literature review of tropical biomass feedstocks and data relevant to their behavior in conversion systems for AJF production¹
- Engage stakeholders to identify and prioritize general AJF supply chain barriers (e.g. access to capital, land availability, etc.)
- Develop geographic information system (GIS) based technical production estimates of AJF in Hawaii
- Develop fundamental property data on biomass resources
- Develop and evaluate regional supply chain scenarios for AJF production in Hawaii



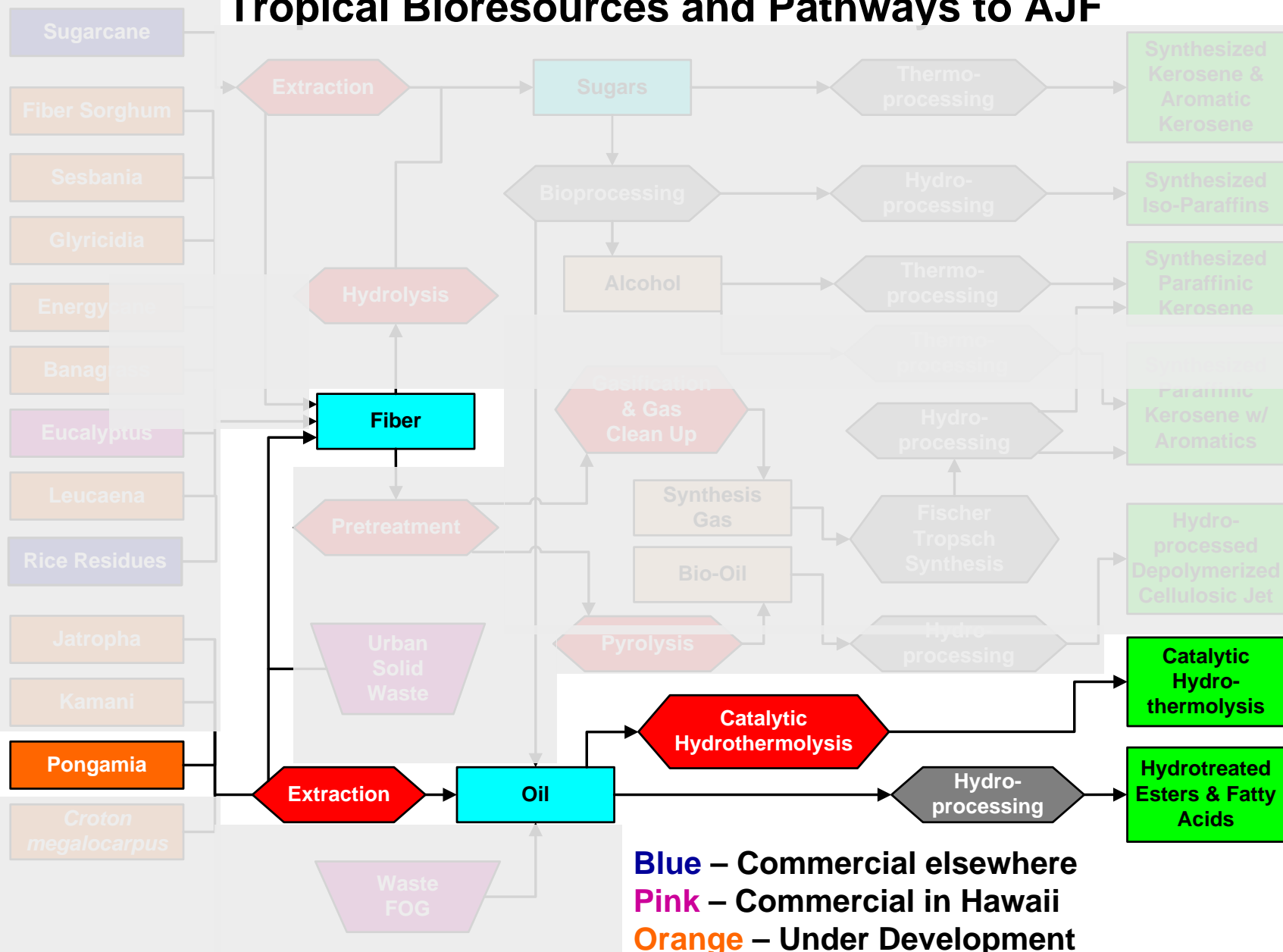
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Tropical Bioresources and Pathways to AJF

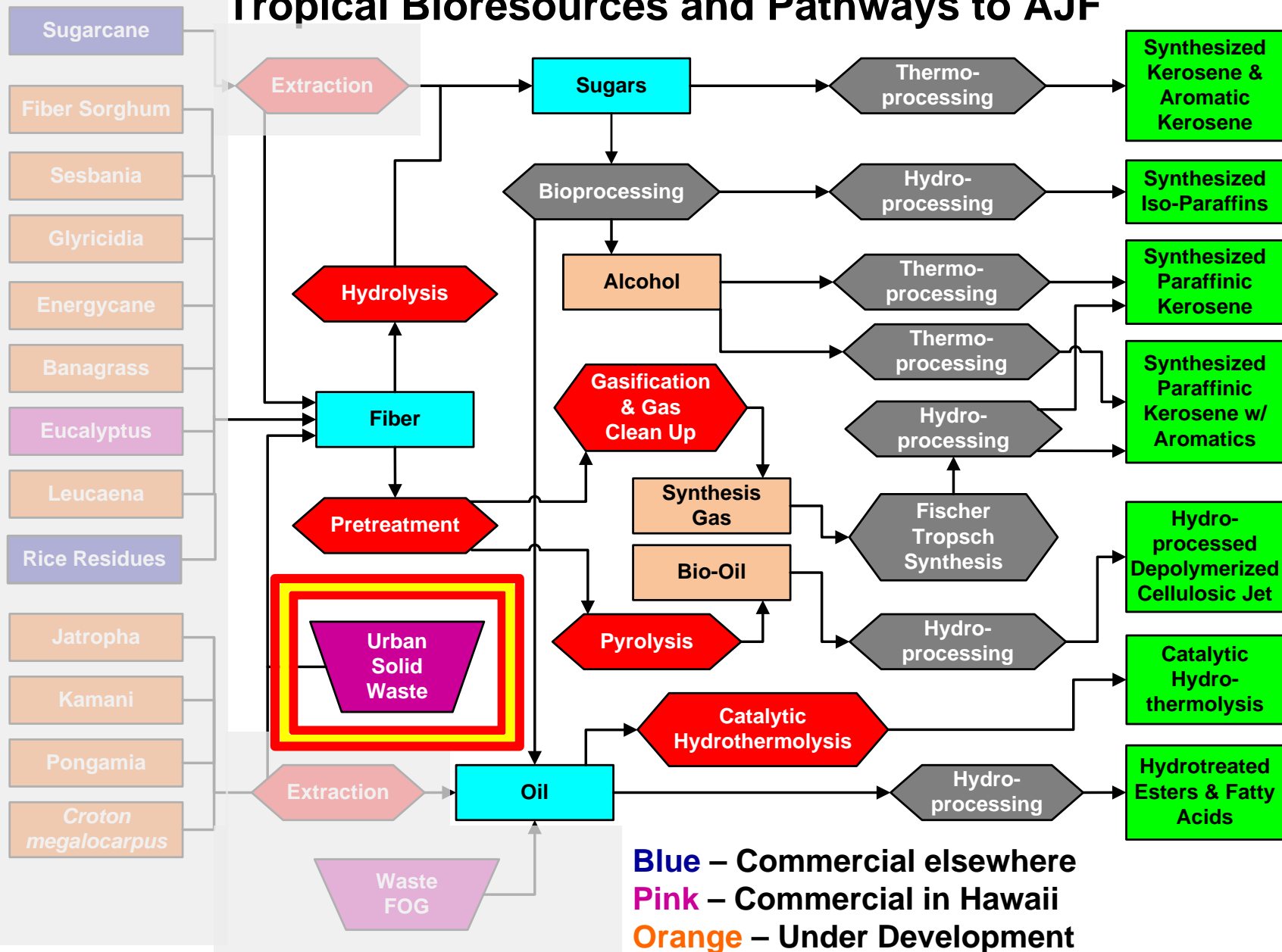


Bioresource

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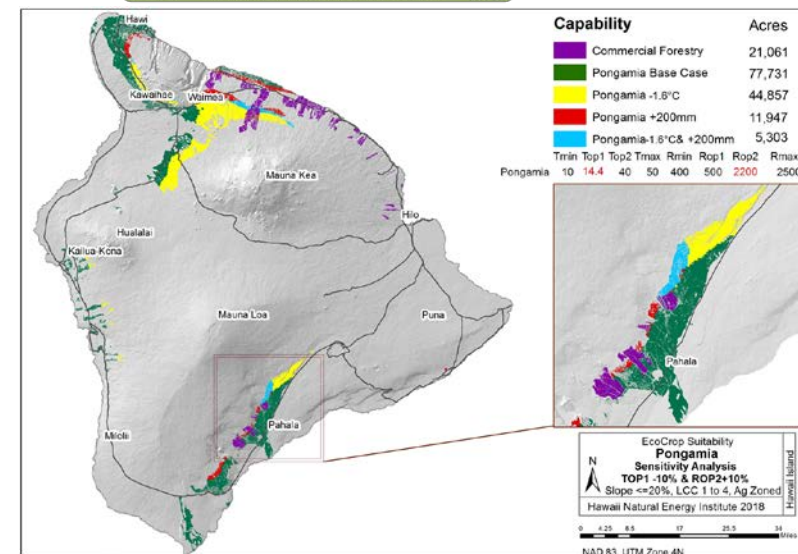
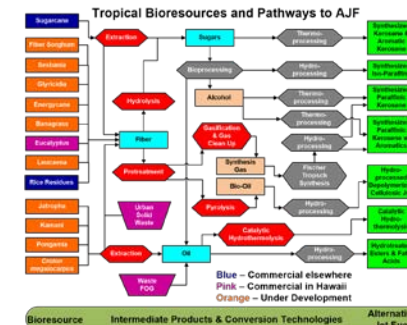
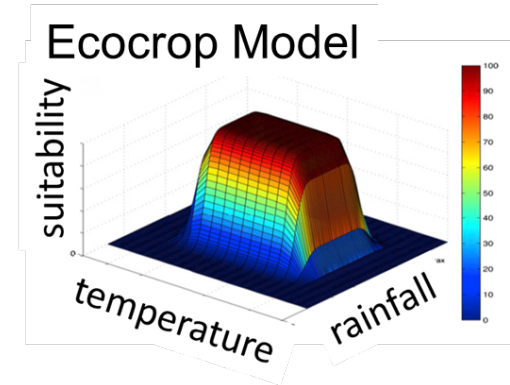


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GIS Feedstock Estimates

- Assessment criteria:
 - Soil capability class
 - Temperature (minimum mean monthly vs. mean annual)
 - Annual rainfall (taking into account soil permeability and slope)
 - Soil slope
 - Zoning
- EcoCrop model assessments
 - 14 feedstocks completed
 - Sensitivity analysis completed
 - Summary maps, tables
 - Implementation scenarios
 - Analysis & report preparation



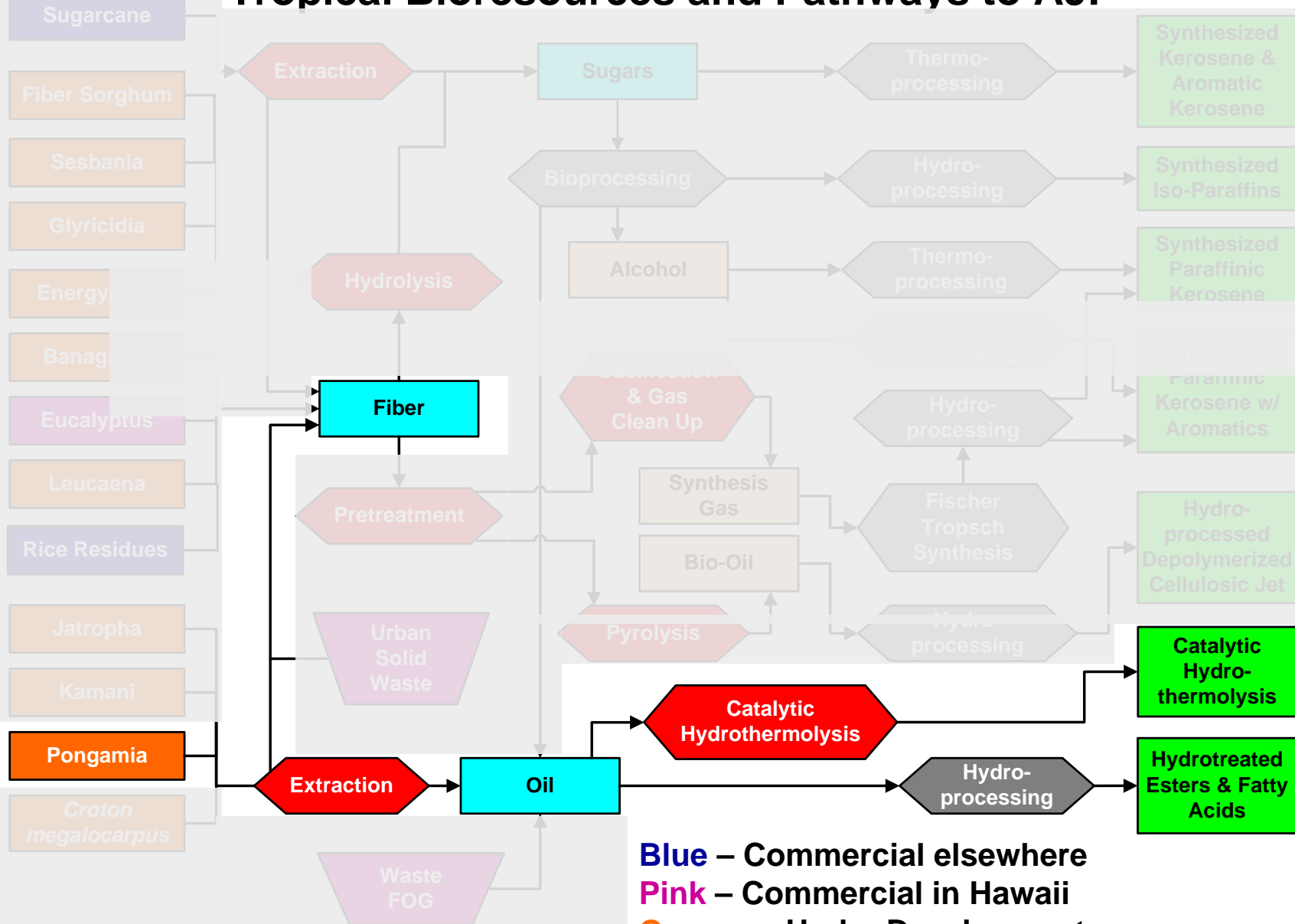
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Tropical Bioresources and Pathways to AJF



Bioresource

Intermediate Products & Conversion Technologies

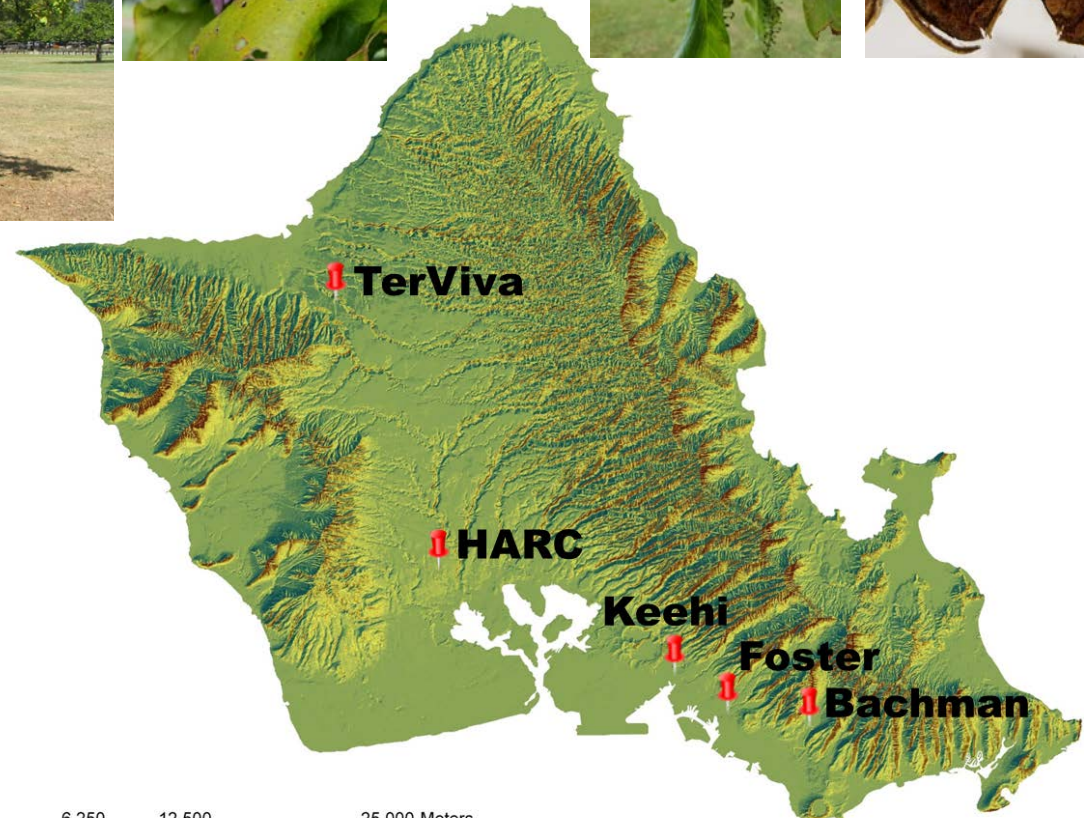
Alternative
Jet Fuel

Develop fundamental property data for tropical biomass resources



- Pongamia (*Millettia pinnata*) – initial focus
 - Leguminous oil seed tree with current productivity estimated ~5 Mg/ha/year
 - Production potential in Hawaii, Florida, Puerto Rico, USVI
 - *Terviva* – start up company focused on providing pongamia germplasm for agricultural producers and value added processing
 - 100 ha planted on Oahu and 100 ha scheduled for Maui
 - Property data to focus on characterization of pongamia oil, oil seed press cake, seed pod material
 - Invasiveness assessment based on plants already established in Hawaii
 - Longer term goal -- energy input/output analysis of pongamia production system

Pongamia on O`ahu



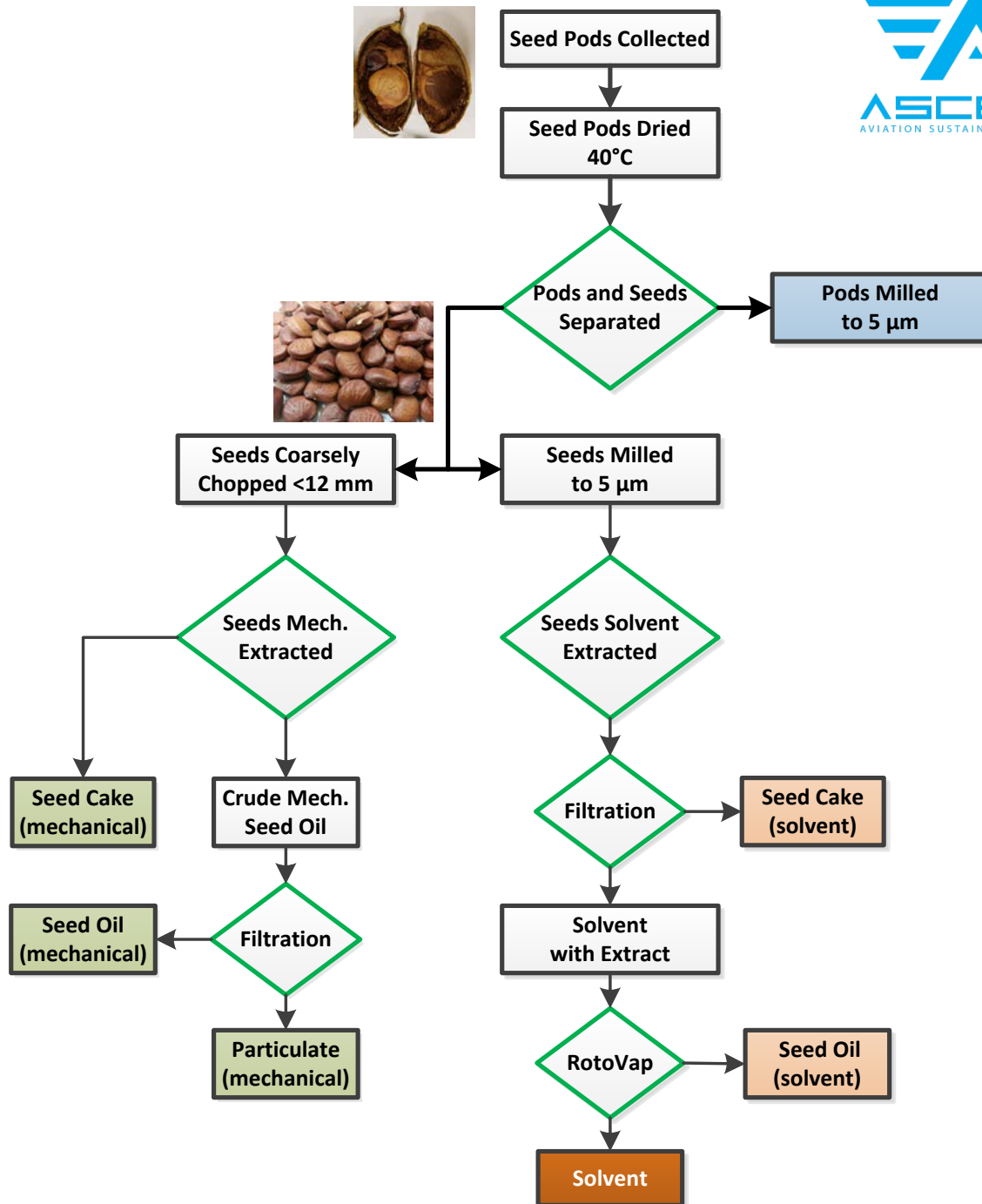
Pongamia Sample Preparation



Cryogenic Mill



Ptiba Screw Press



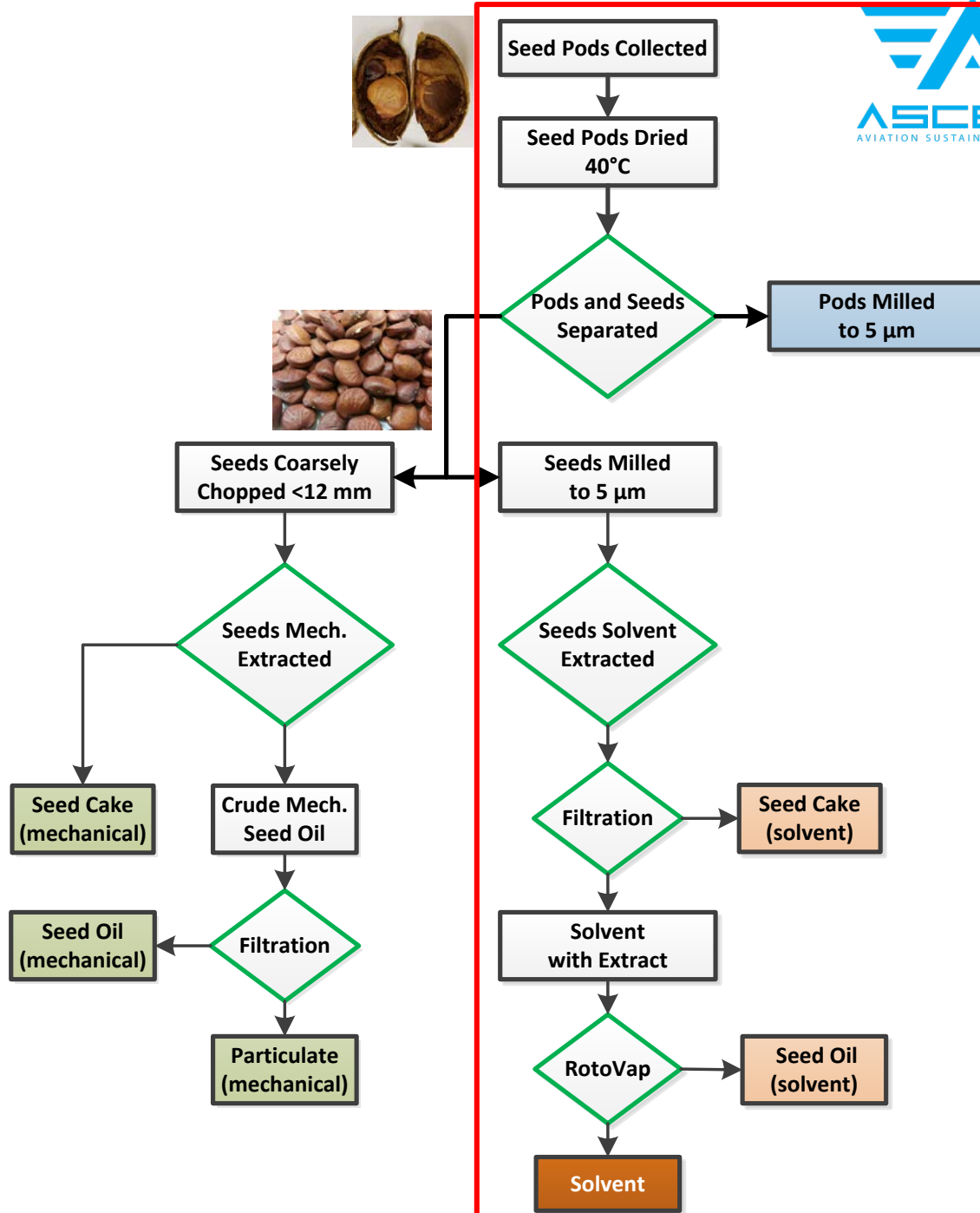
Pongamia Sample Preparation



Cryogenic Mill



Ptiba Screw Press

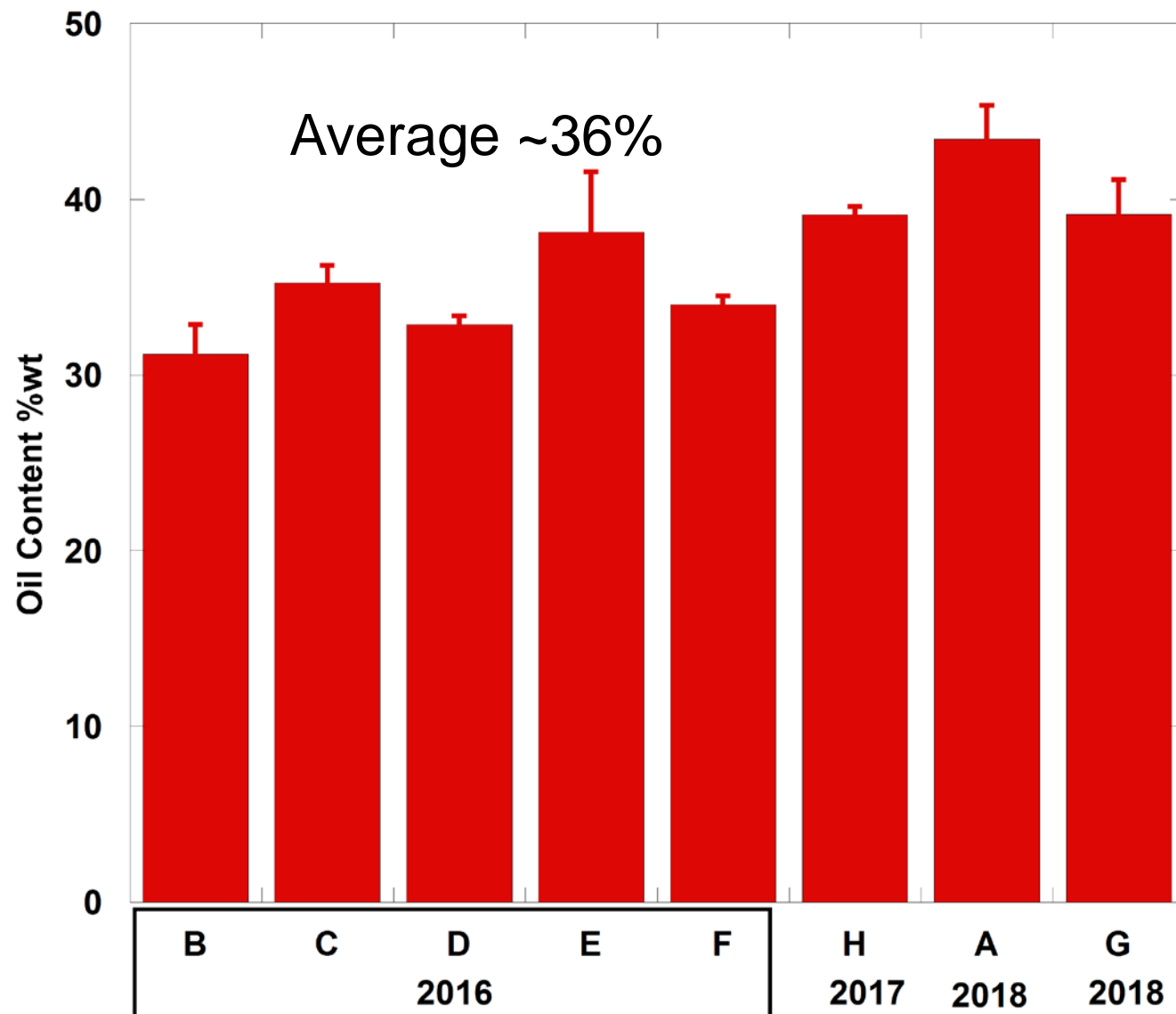


Pongamia Characterization

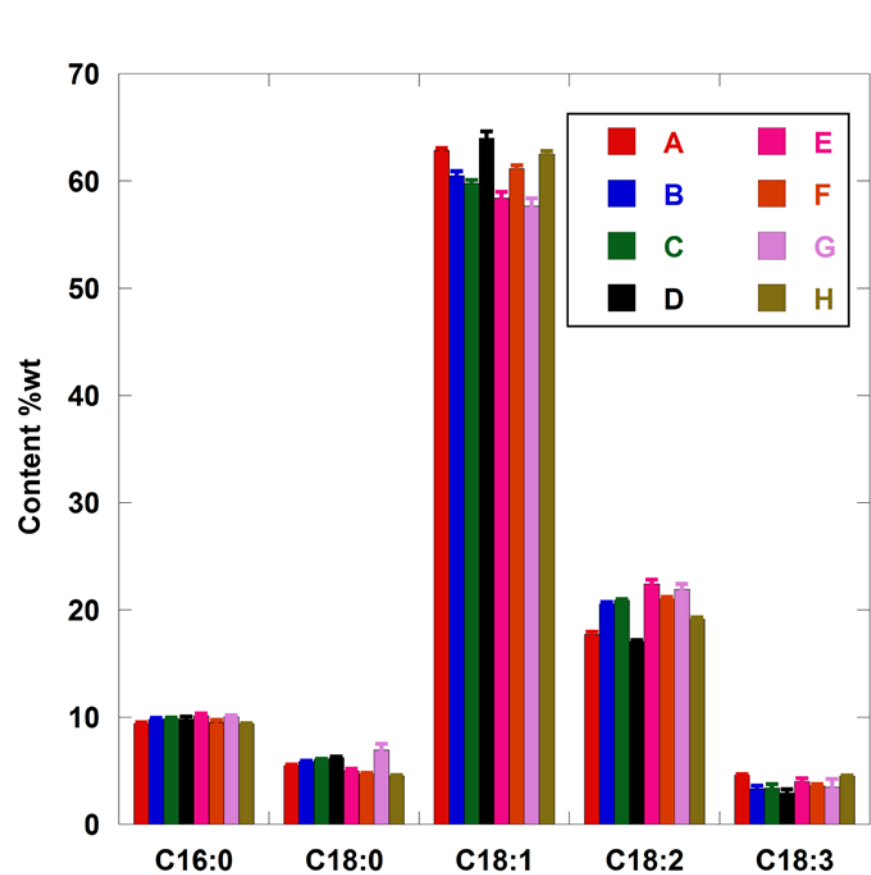
- Oil properties
 - Viscosity, density, iodine number, free fatty acid content, fatty acid profile, flashpoint, phase transition temperatures
- Seed, oil, seed cake, pods
 - Ultimate analysis for major elements: C, H, O, N, S
 - Proximate analysis § : volatile matter, fixed carbon and ash
 - Major ash species: K, Cl, Na, P, Mg, Si, Fe, Ti, Al, and Ca
 - Minor ash species: Mn, Fe, Cu, Zn, Rb, and Sr
 - Moisture content
 - Energy content or heating value
- Properties needed for logistics: particle size distribution of materials, bulk densities, etc.

§ proximate analysis not performed on oil samples

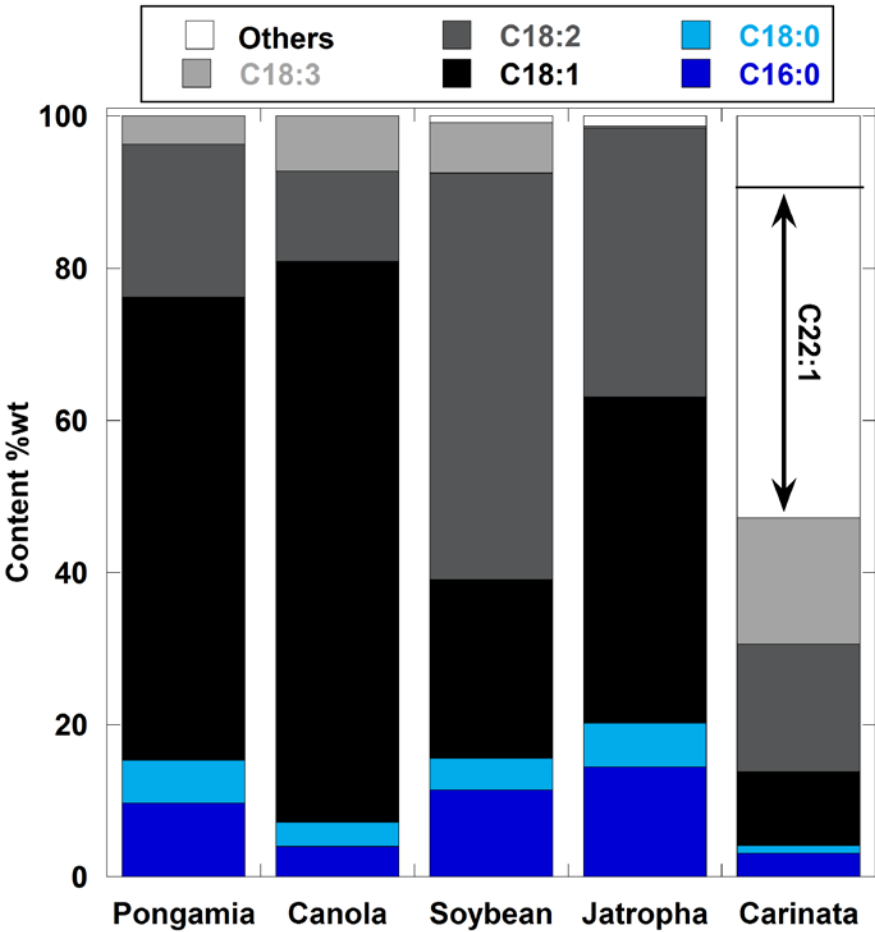
Pongamia Oil Yield



Pongamia Fatty Acid Profiles



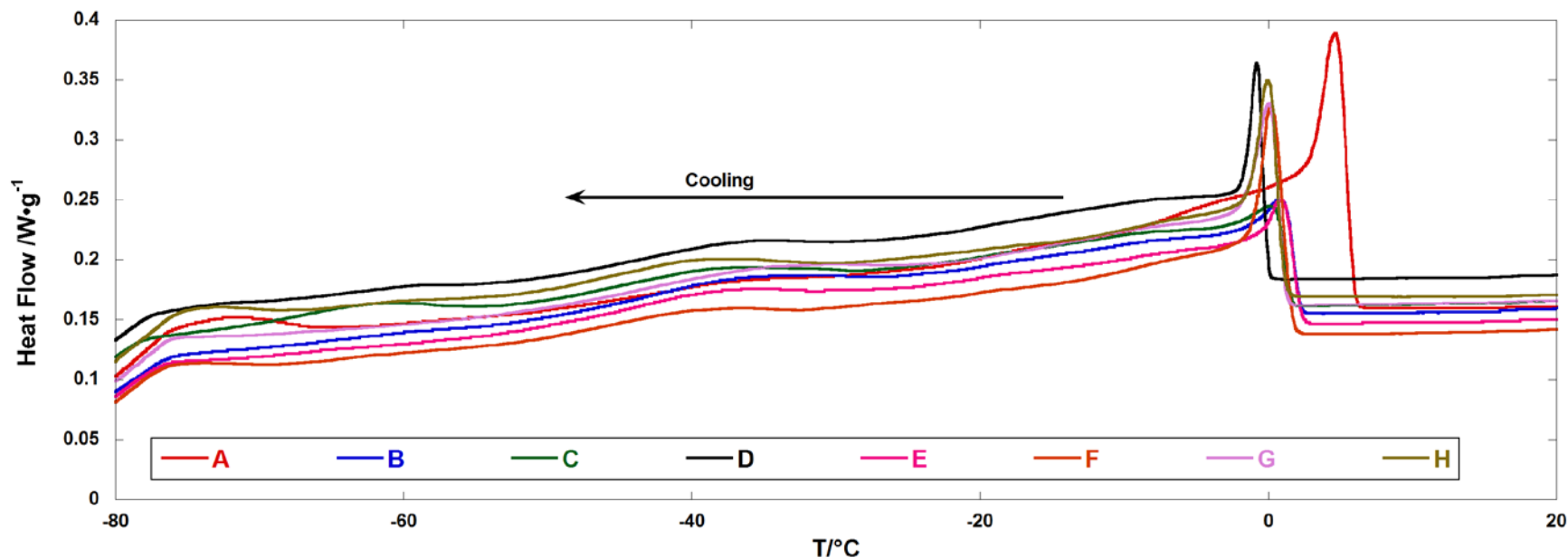
Pongamia Results



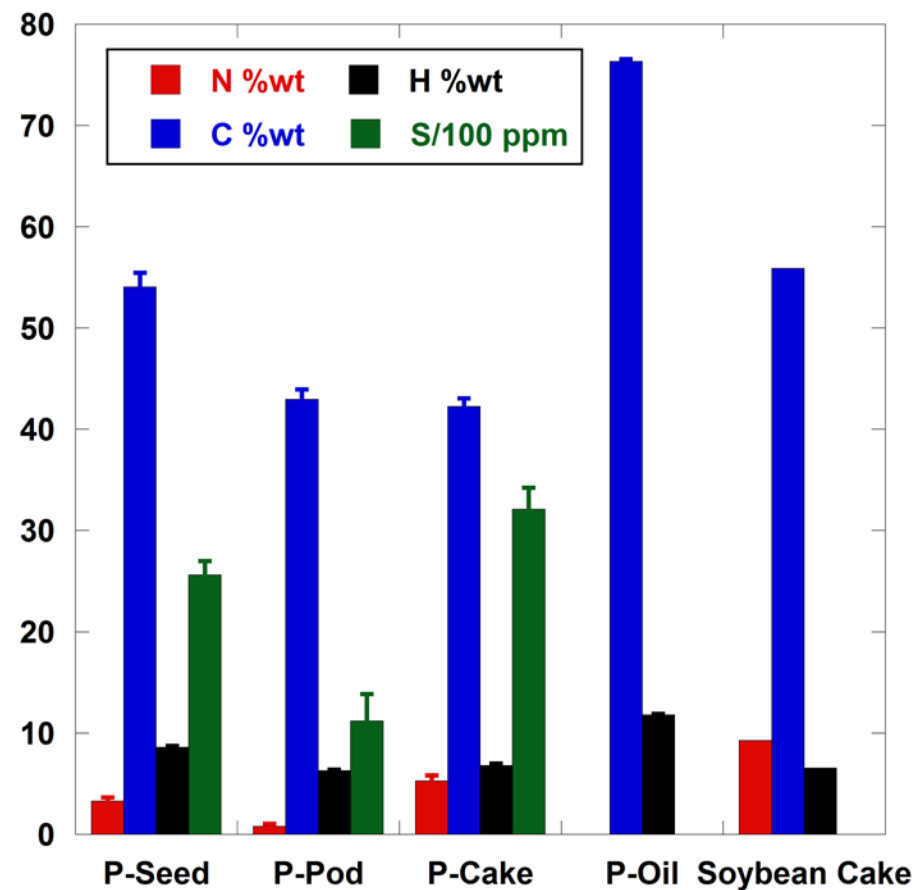
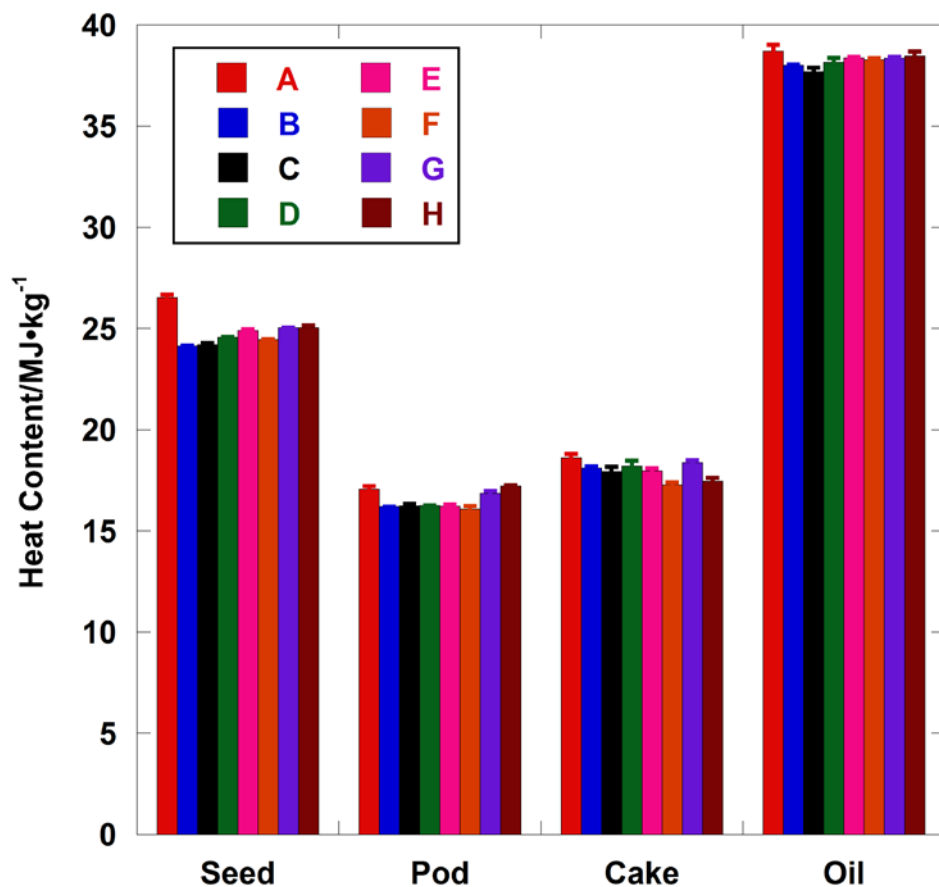
Oil Comparison

Pongamia Oil Properties

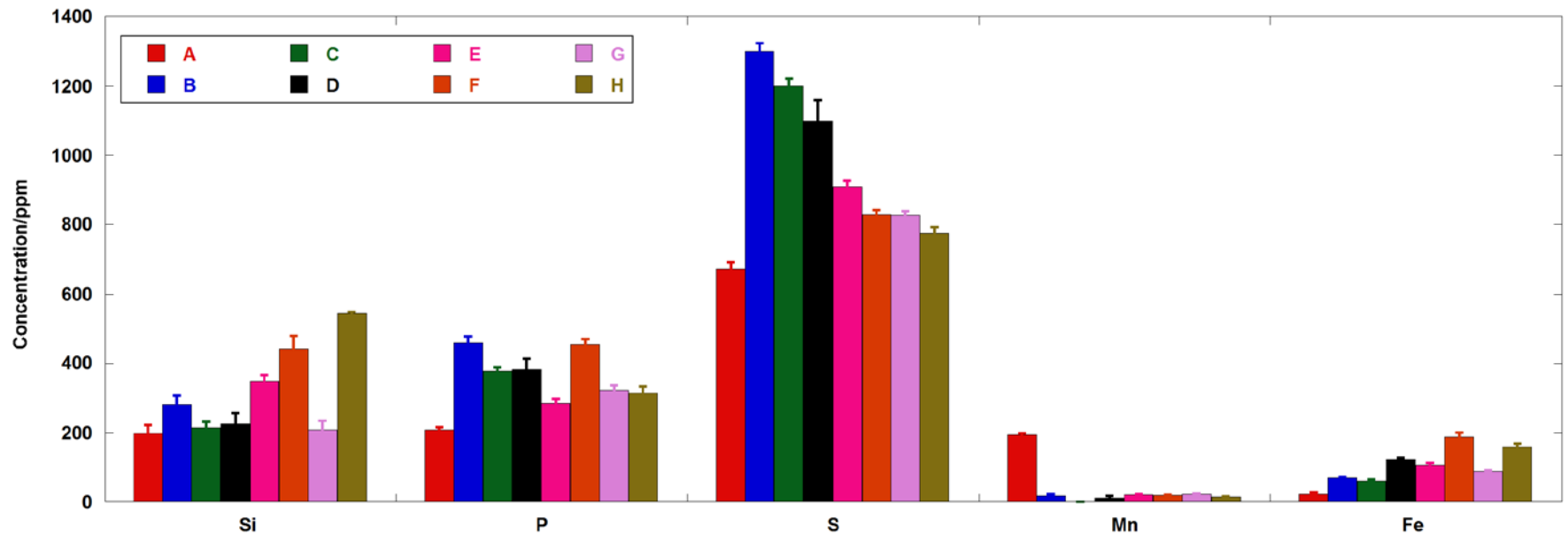
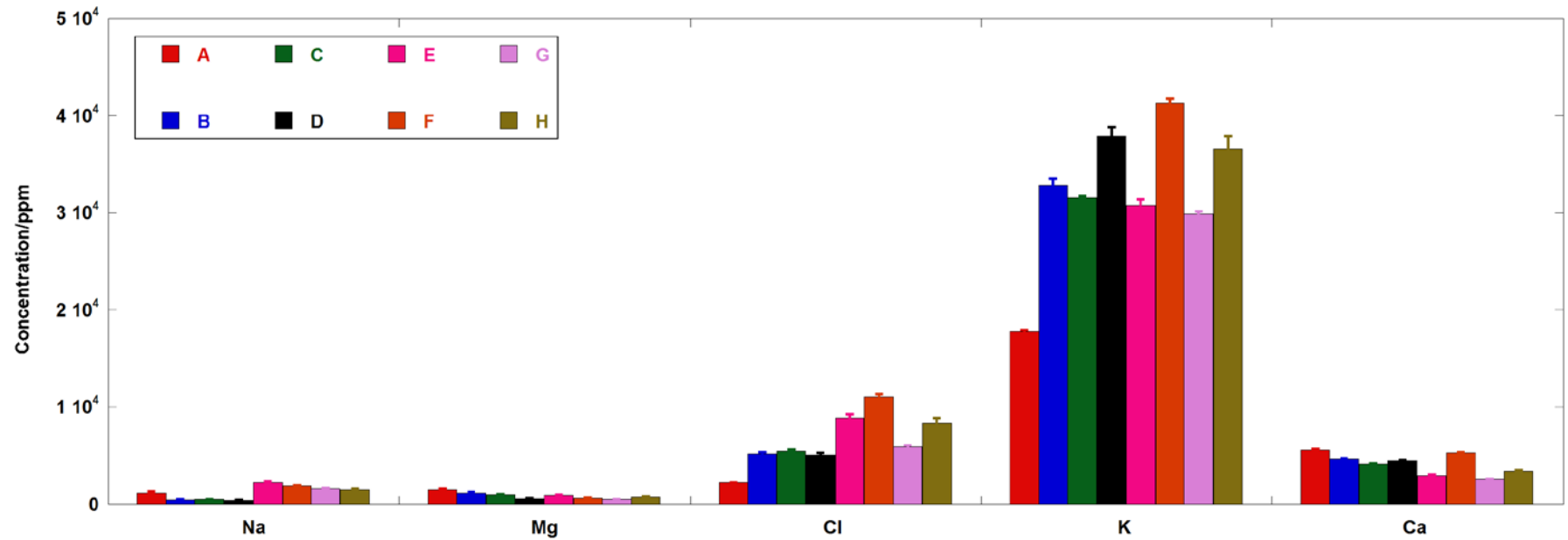
Property	Average Value
FFA (%)	0.66±0.13
Iodine value	50.92±12.91
Kinematic viscosity @ 40°C (mm ² s ⁻¹)	33.887±2.854
Density @ 15°C (g m ⁻³)	0.9346±0.0043
Flash Point (°C)	138±2



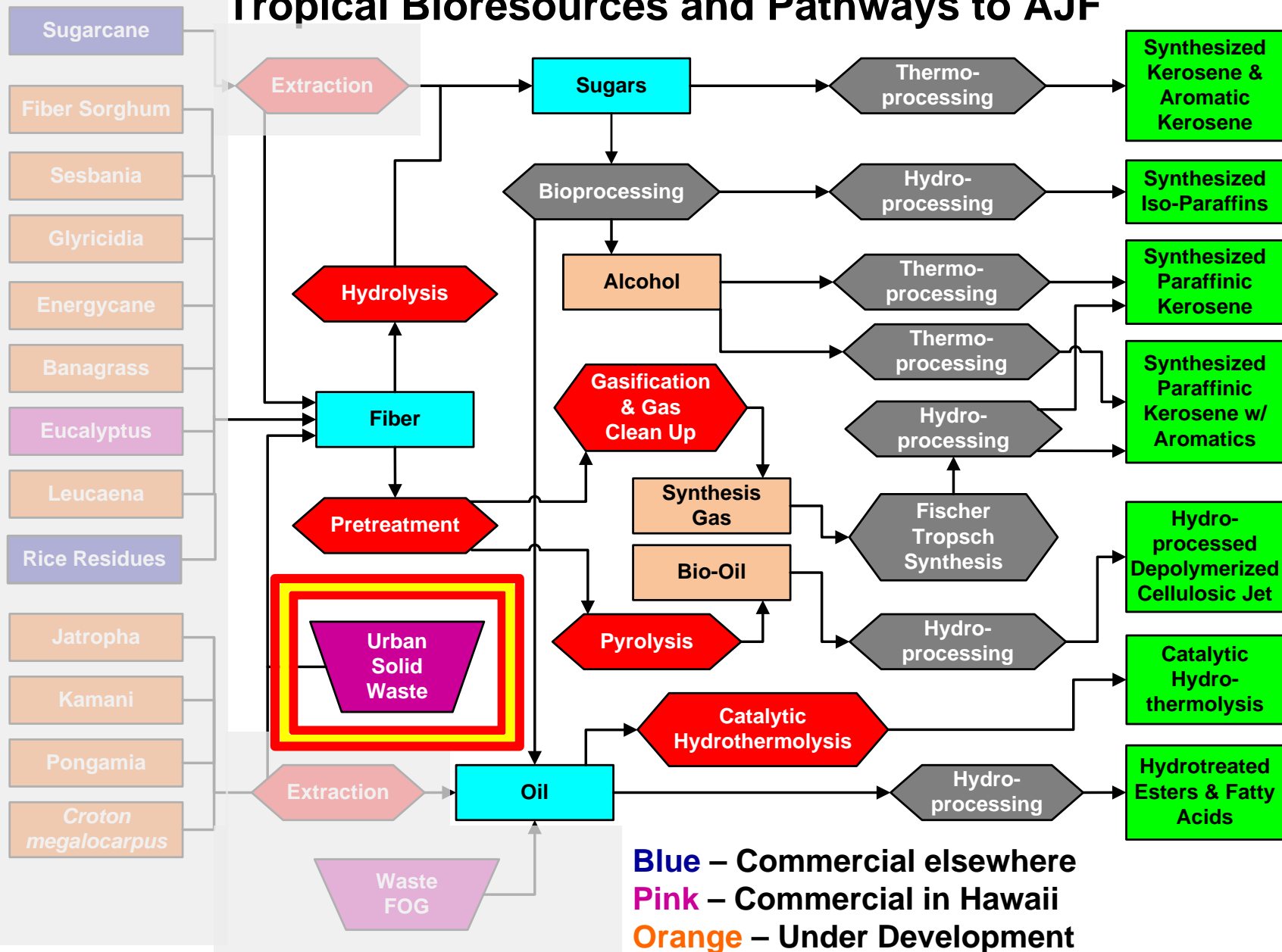
Pongamia Component Analysis



Pod minor elements by XRF



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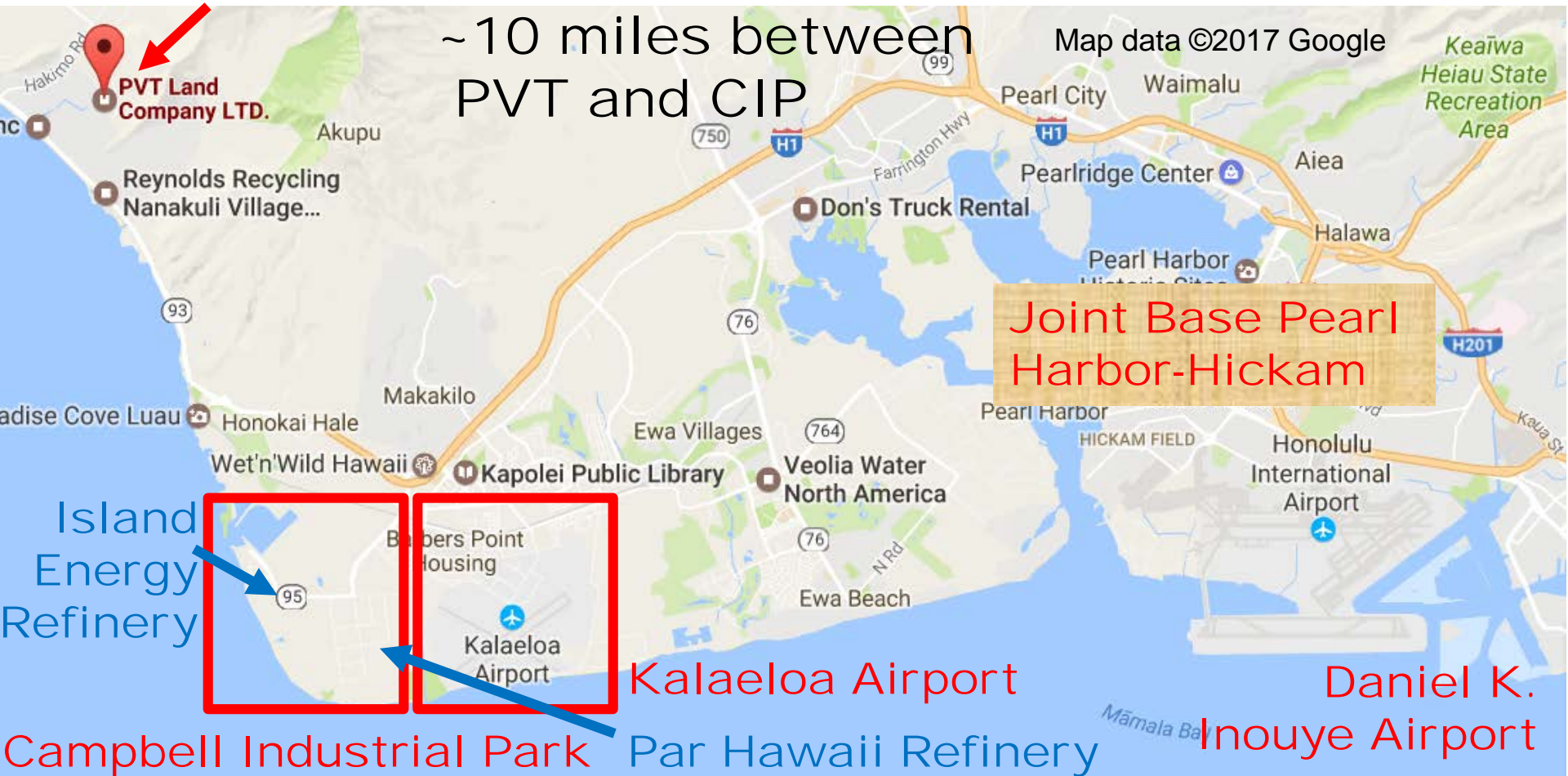
PVT Feedstock Processing Facility



Possible Locations of Value Chain Participants



PVT Land Company





Construction &
Demolition
Waste Intake



Material Processing

~50 kg of nominal
<150 mm
feedstock



Ball mill to
0.2 mm



Analytical Requirement



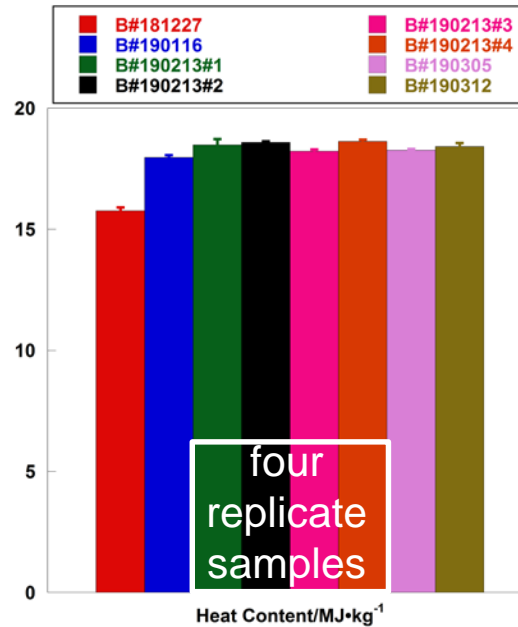
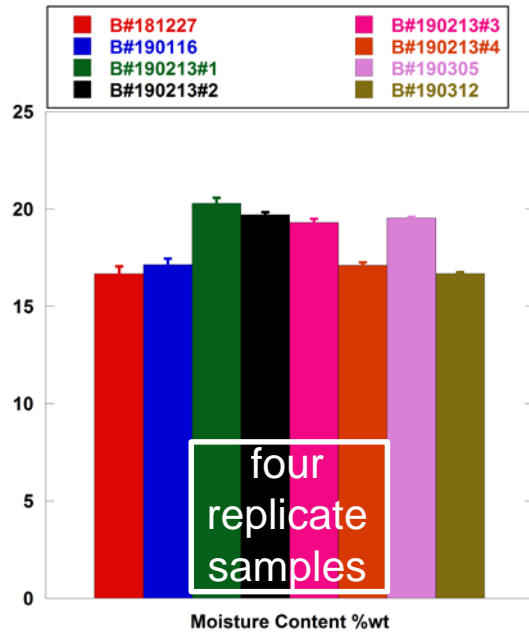
Riffle to 200 g



Mill to <6 mm

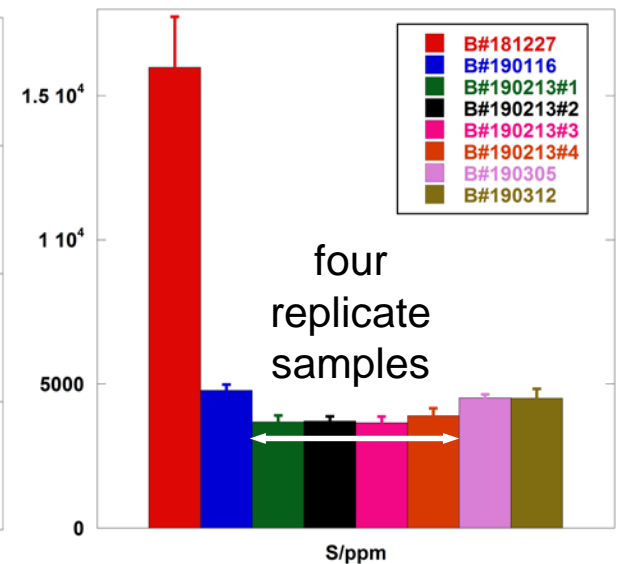
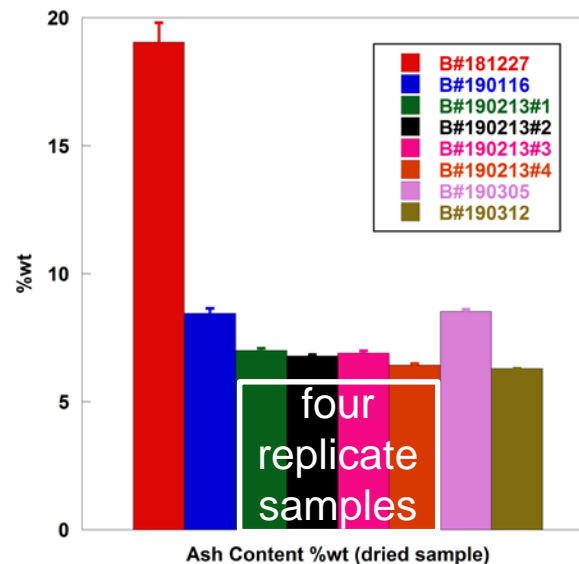
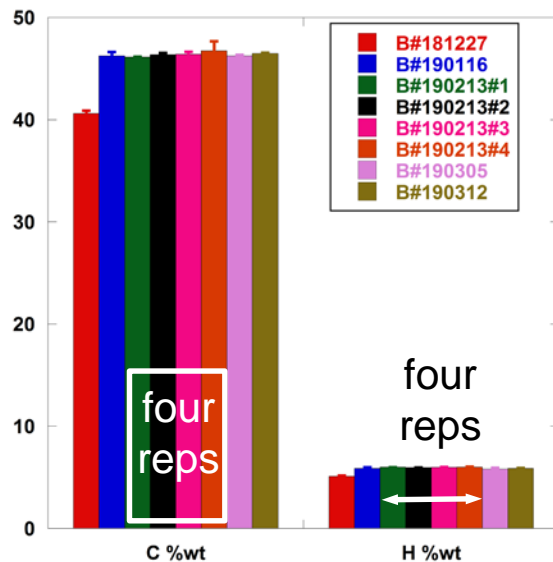
- Characterization of feedstock properties needed to inform conversion process design
 - Ultimate analysis for major elements: C, H, O, N, S
 - Proximate analysis: volatile matter, fixed carbon and ash
 - Major ash species: K, Cl, Na, P, Mg, Si, Fe, Ti, Al, and Ca
 - Minor ash species: Mn, Fe, Cu, Zn, Rb, and Sr
 - Moisture content
 - Energy content or heating value
- Characterization of feedstock properties needed for logistics particle size of materials, bulk densities, etc.
- Time series data to assess variability in supply

Summary of Five Sampling Events

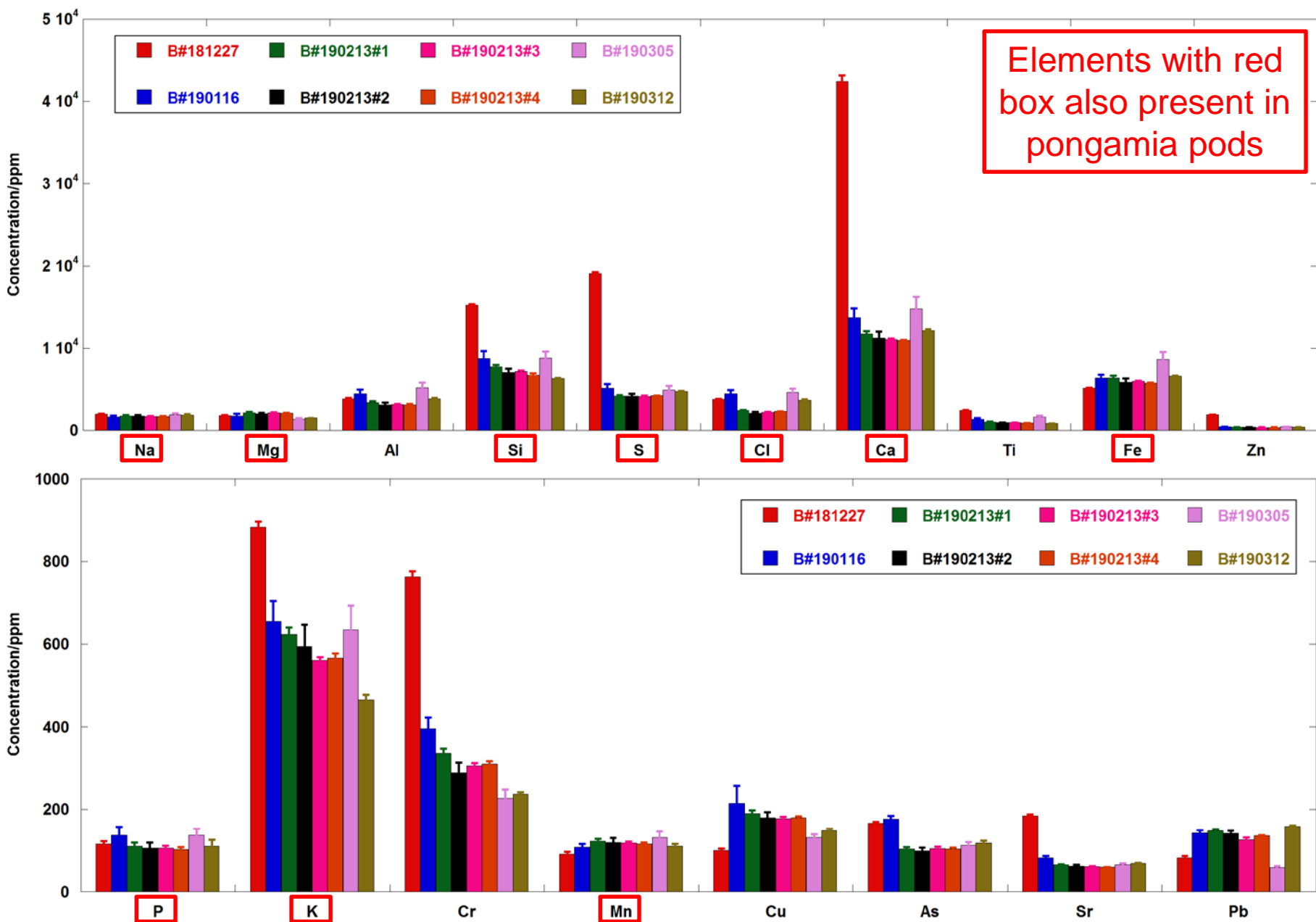


Noncombustible Fraction
 0.18 ± 0.12

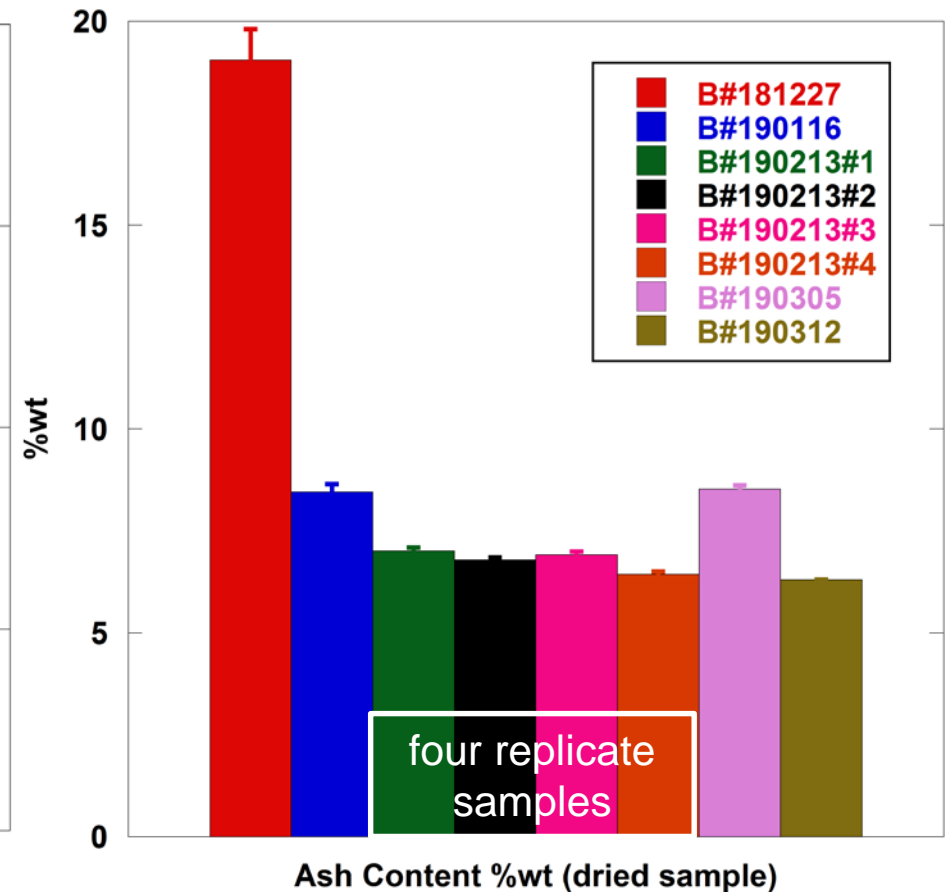
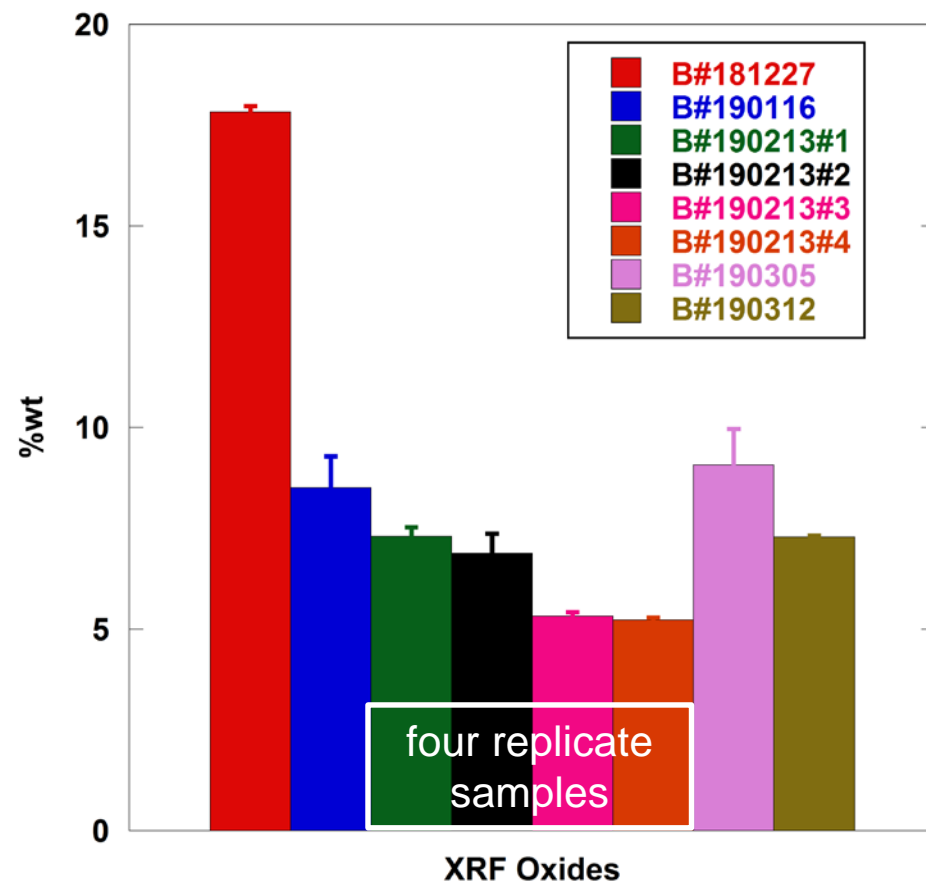
Clean eucalyptus wood
C 51.3%
H 5.78%
N 0.3%
S 0.02%
HHV 19.3 MJ/kg
Ash 0.72%
MC 52%



Lower concentration elements by XRF



XRF oxides vs. total ash



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- Tropics provide unique biorenewable resources for AJF feedstocks
- Review of tropical biomass resources for AJF production published
- Summary report on GIS analysis estimating resource production potential underway
- Physicochemical properties of pongamia samples characterized to inform oil and byproduct utilization
- Physicochemical properties of C&D waste characterized to begin assessing variability of highly heterogeneous material stream

Questions?