Federal Aviation Administration

# Global Sustainable Aviation Fuels (SAF) Supply Chain Development

Presented by: **Prem Lobo**

Presented to: **CAAFI Webinar**

Date: **April 10, 2024**

# FAA SAF Program Focus

## Testing
accelerate SAF development

- Test fuels
- Improve testing methods
- Conduct evaluation
- Streamline approval

## Analysis
environmental and economic sustainability

- Lifecycle emissions
- Cost reduction
- Supply potential
- Supply chain opportunities

## Coordination
support SAF integration

- Public-private partnership – *CAAFI*
- U.S. interagency cooperation
- International cooperation – *ICAO*

## Deployment
enable SAF scale-up

- Build production, transportation, blending and storage infrastructure – *FAST*

https://www.faa.gov/about/officeorg/headquartersoffices/apl/sustainable-aviation-fuels-saf

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# ASCENT Center of Excellence

- For 20 years, FAA Office of Environment and Energy has relied on university centers of excellence to:
- Provide knowledge to inform decision making on environment and energy
- Enable innovative solutions to cost-effectively mitigate aviation's environmental impacts
- Support student instruction on the environmental challenges facing aviation (674 students supported and counting).

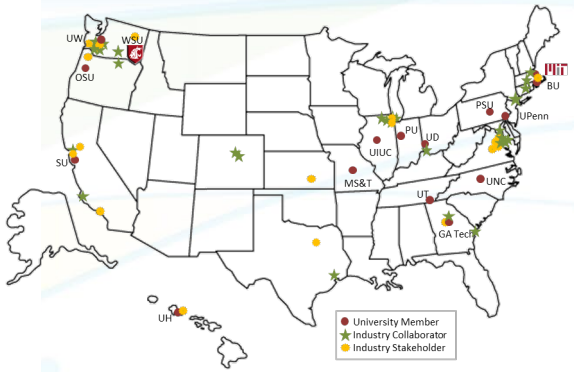
## ASCENT Research Portfolio

- 2013 - ASCENT established
- Portfolio covers SAF, Emissions, Noise, Operations, and Analytical Tools
- Currently overseeing a large increase in the COE portfolio

https://ascent.aero/

**Lead Universities:**
Washington State University (WSU)
Massachusetts Institute of Technology (MIT)*

**Core Universities:**
Boston University (BU)*
Georgia Institute of Technology (Ga Tech)*
Missouri University of Science and Technology (MS&T)*
Oregon State University (OSU)
Pennsylvania State University (PSU)*
Purdue University (PU)*
Stanford University (SU)*
University of Dayton (UD)
University of Hawaii (UH)
University of Illinois at Urbana-Champaign (UIUC)*
University of North Carolina at Chapel Hill (UNC)*
University of Pennsylvania (UPenn)*
University of Tennessee (UT)
University of Washington (UW)




**Multiple international partners**

**Advisory Committee (57 orgs)**
5 airports
4 airlines
9 NGO/advocacy
8 aviation manufacturers
10 feedstock/fuel manufacturers
21 R&D, service to aviation sector

**ASCENT Support**

Federal Aviation Administration
Transport Canada
NASA
Environmental Protection Agency
Defense Logistics Agency - Energy
U.S. Dep't of Energy
U.S. Dep't of Agriculture
Air Force Research Laboratory

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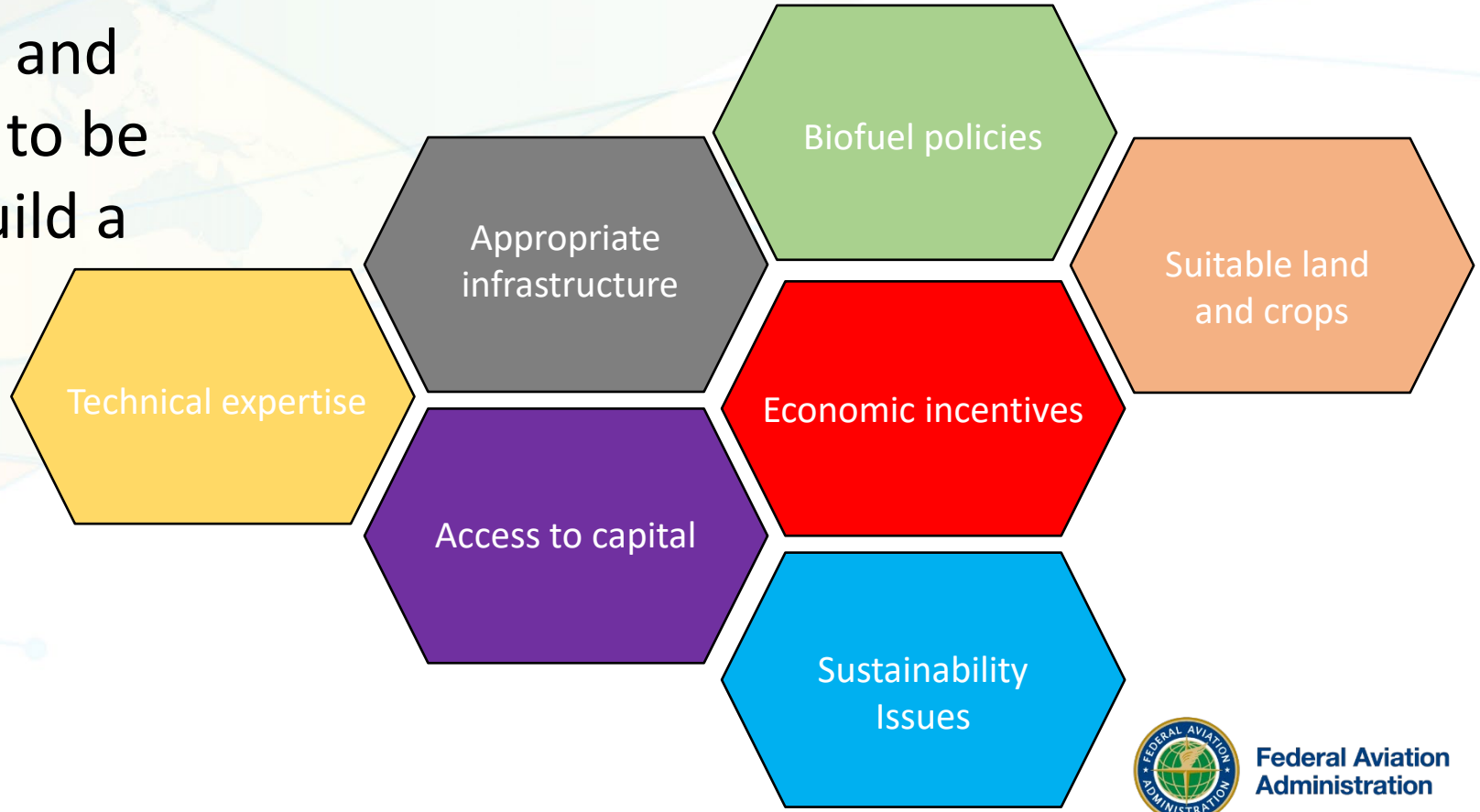
# Global SAF Supply Chain Development

Every country and region has a unique set of challenges and opportunities that need to be carefully evaluated to build a viable SAF supply chain

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# Global SAF Supply Chain Development

**ASCENT Project 93 - Collaborative Research Network for Global SAF Supply Chain Development**

In collaboration with the World Bank

Latin America and Caribbean


Washington State University

Sub-Saharan Africa


MIT/ Hasselt University

Southeast Asia


University of Hawai'i

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# ASCENT Project 93 - Collaborative Research Network for Global SAF Supply Chain Development

- Project Objectives:
  - Identify waste and biomass feedstock availability
    - Updated bottoms-up assessment of global SAF feedstock potential and key barriers
  - Analyze new pathways to optimize SAF production
  - Assess infrastructure needs and logistical requirements for a holistic approach to SAF supply chain development
    - Identify existing industries and infrastructure that could be leveraged for SAF production thus ensuring rapid development
  - Develop a network of PhD students to work with universities in the regions of interest to extend supply chain analysis techniques and tools

# Latin America and Caribbean


PIs: Manuel Garcia-Perez, Michael Wolcott
Co-PIs: Lina Martinez, Kristin Brandt

Students:

- Colombia
  - Marcela Valderrama
- Dominican Republic
  - Raul Perez
- Ecuador
  - Paulina Echeverria
  - Micaela Peralta

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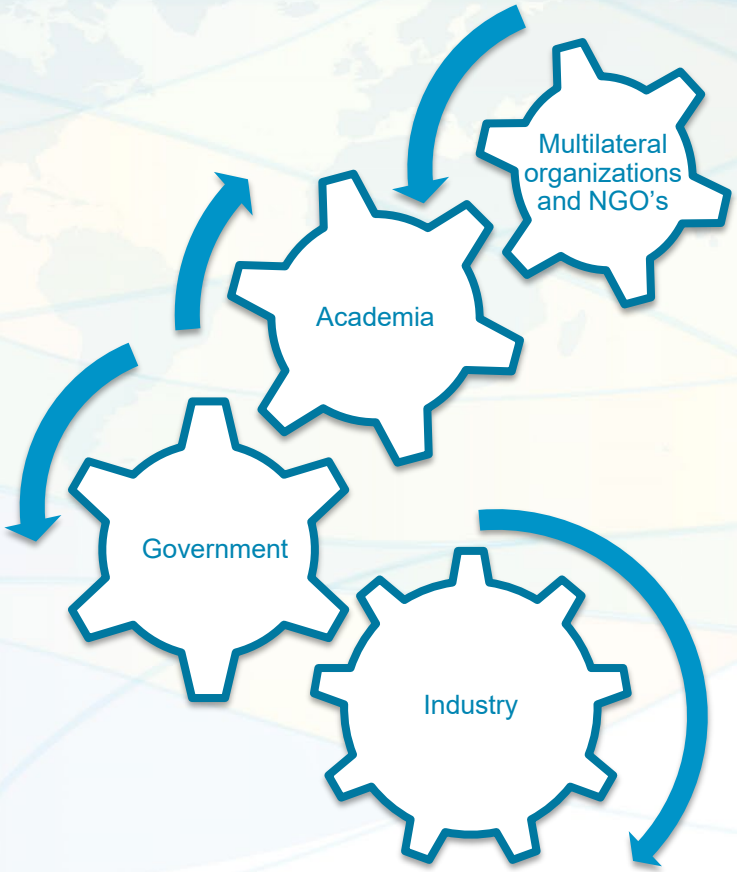
# Working Groups




- Established working groups in each country
  - Multiple stakeholders involved

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# Approach to technical support

**Presentations**

- Tools
- Approaches
- Work done
- Gaps/ Needs

**Discussion**

- Research needs
- Methodologies
- Prioritization
- Collaboration

**Work plan definition**

- To be developed by Ph.D. students
- Projects in collaboration with local institutions

**Outputs**

- SAF Roadmap development
- Potential capacity for SAF production
- Feasible facility sitting

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# Sustainable Aviation Fuel Production in Colombia: Opportunities and Challenges

- Colombian overview
  - Transportation
  - Energy sector
  - Agriculture
- SAF
  - Drivers
  - Pathways
  - Supply chain building
  - Options for production in Colombia
  - Colombian approaches
- Situational analysis


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# Workshops

SAF roundtable in Santo Domingo, Dominican Republic (June 6, 2023) hosted by Instituto Dominicano de Aviación Civil (IDAC) with support from Washington State University through ASCENT project 93

SAF workshops in Bogota, Colombia (March 11 & 15, 2024) hosted by AeroCivil with support from Washington State University through ASCENT project 93

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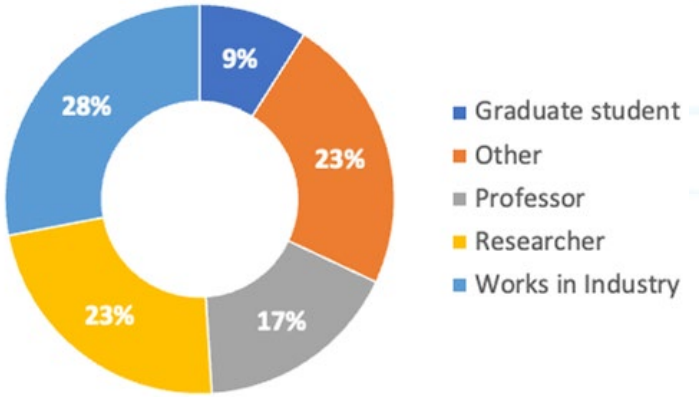
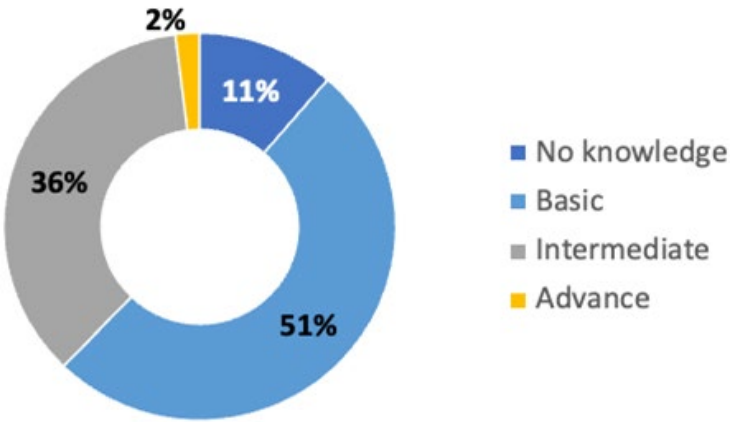
# Virtual Training Series

- Launched on November 2, 2023
  - Concluding in December 2024
- 105 participants registered
- 21 lectures schedule
- Planning additional workshops with multilateral organizations and interested partners
- WSU will provide a certificate for participants who have attended at least 75% of the lectures

53 initial survey responses

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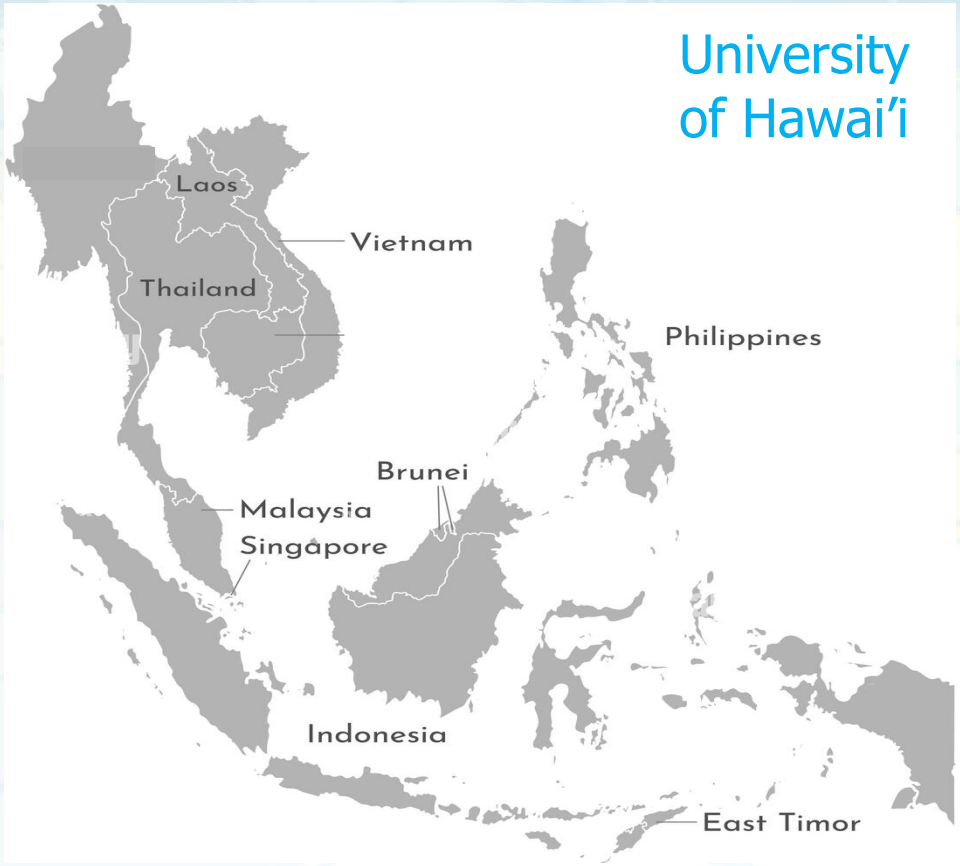
# Southeast Asia




PI: Scott Turn
Co-PI: Quang-Vu Bach

Postdoctoral Researcher (Global Sustainable Aviation Fuel Supply Chains) position announcement posted at:
https://hr.rcuh.com/psp/hcmprd_exapp/EMPLOYEE/HRMS/c/HRS_HRAM.HRS_APP_SCHJOB.GBL?Page=HRS_APP_JBPST&Action=U&FOCUS=Applicant&SiteId=3&JobOpeningId=224129&PostingSeq=1

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# Southeast Asia SAF Workshop


SAF workshop co-hosted by FAA and USTDA in Bangkok, Thailand (May 22-25, 2023) with support from University of Hawai'i and Thai National Energy Technology Center (ENTEC)

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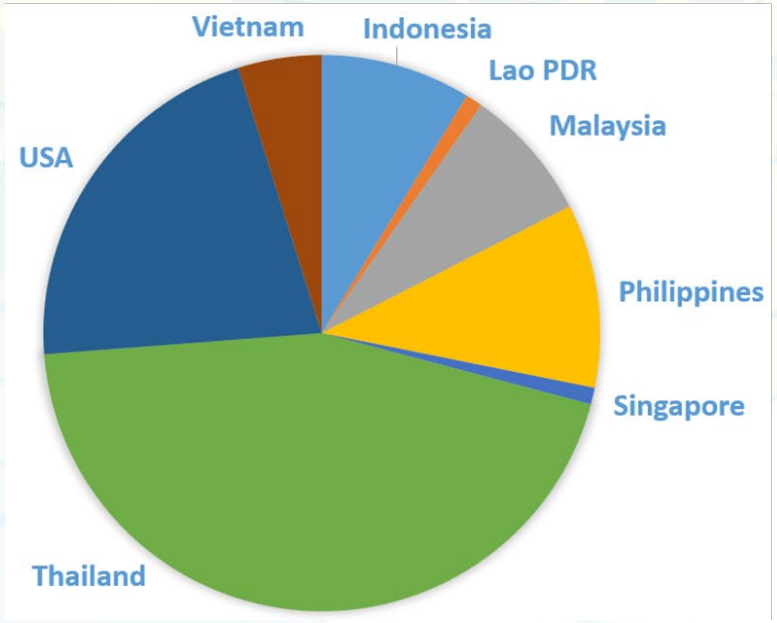
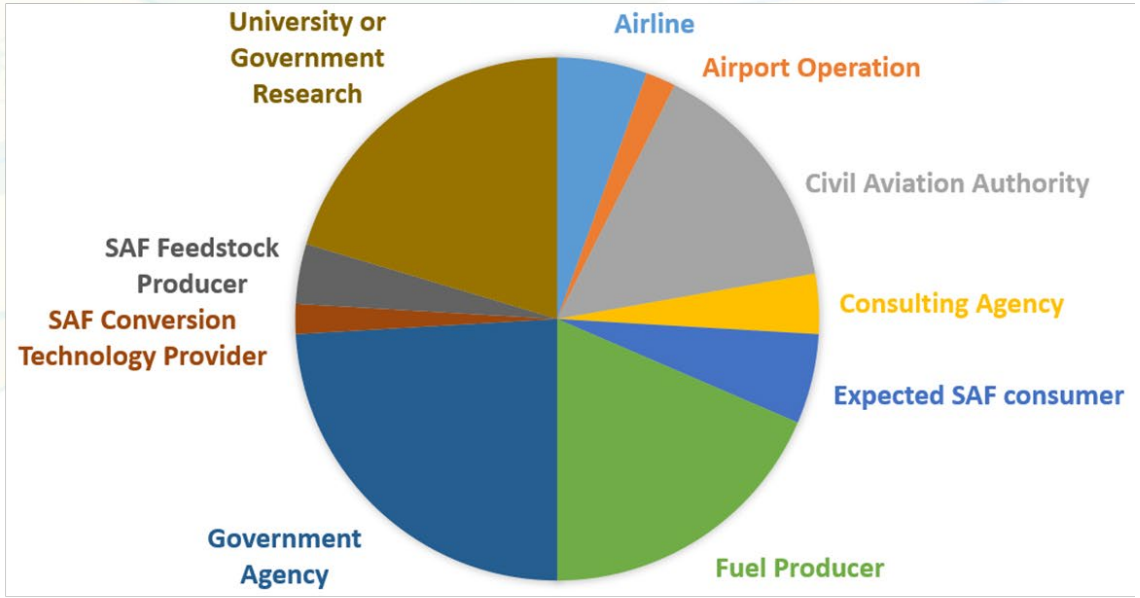
# Southeast Asia SAF Workshop

>100 participants from 54 ASEAN and US organizations

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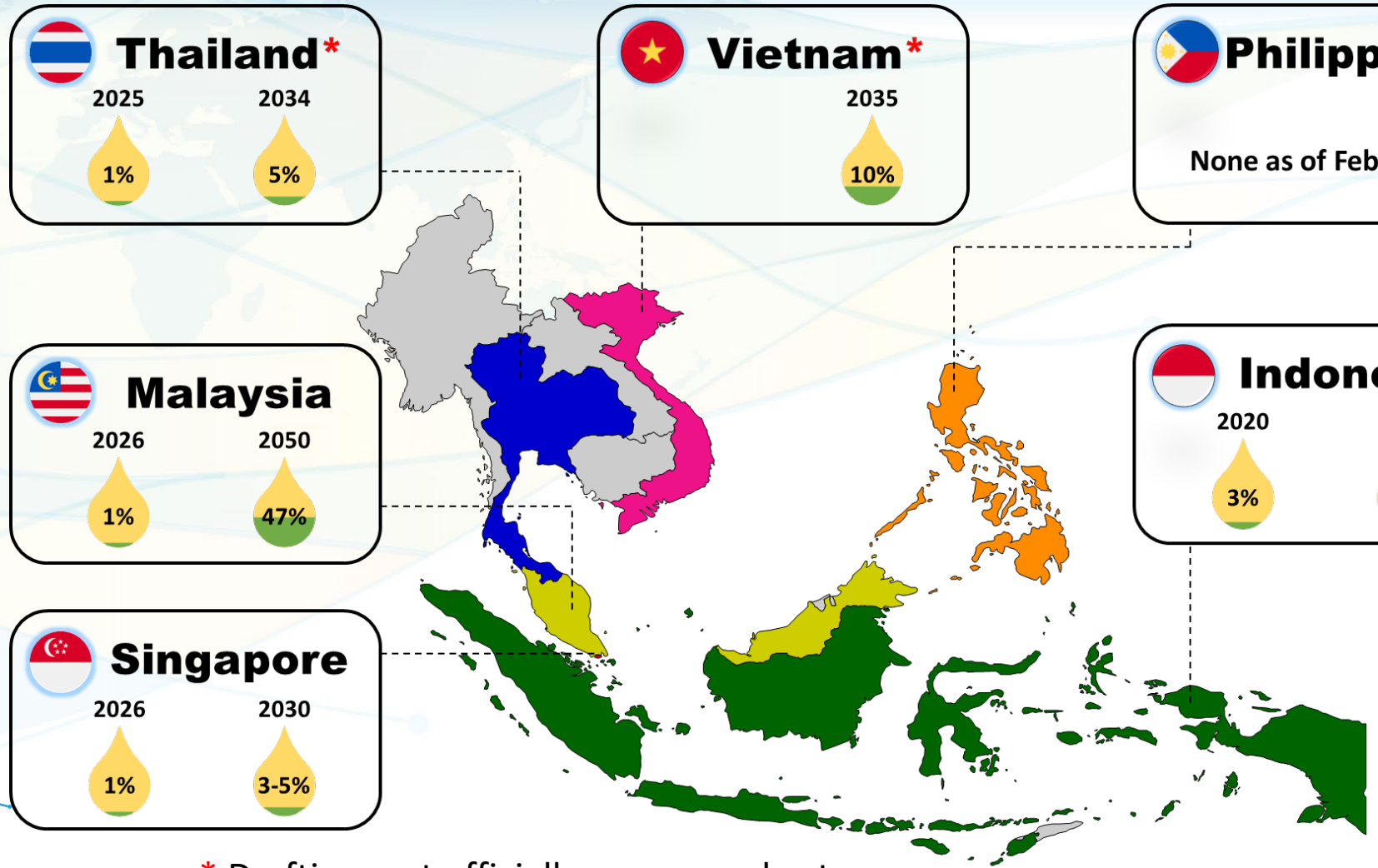
# SAF Mandates in Southeast Asian Countries




* Drafting, not officially announced yet

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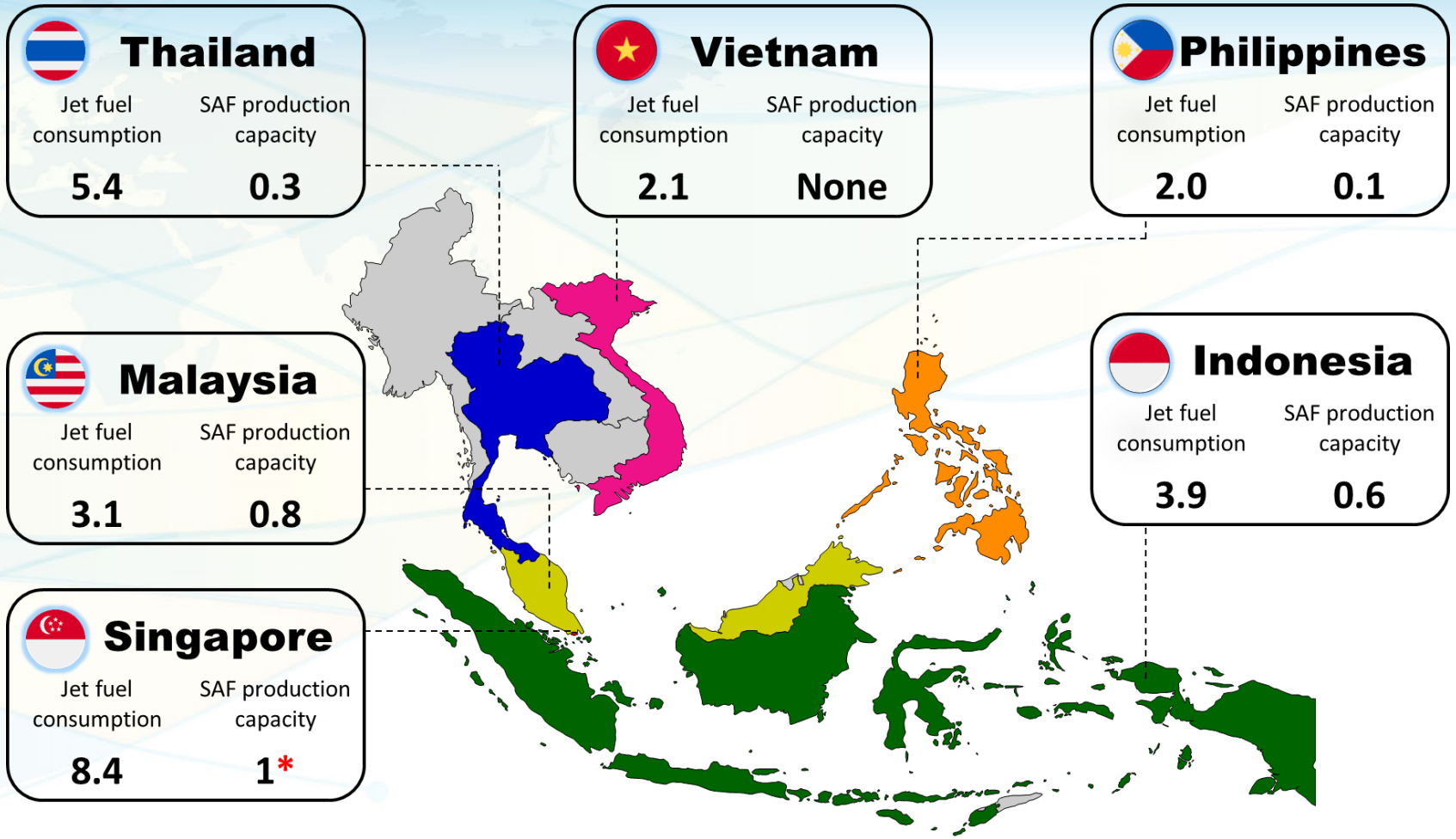
# Jet fuel consumption and SAF production capacity




* Facility currently in operation

**Jet fuel consumption**: Million metric tonnes (in 2019). Source: U.S. Energy Information Administration

**SAF production capacity**: Million metric tonnes per year. Source: Argus Media

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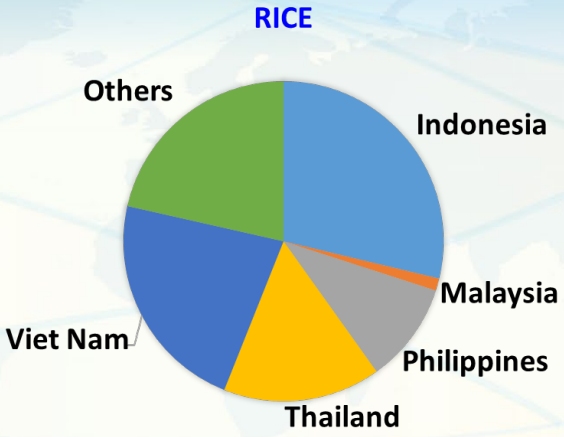
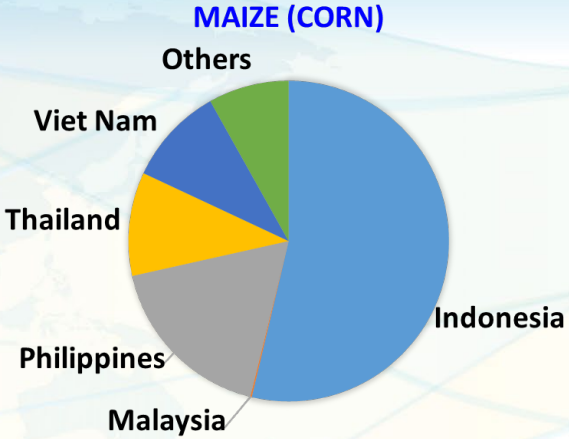
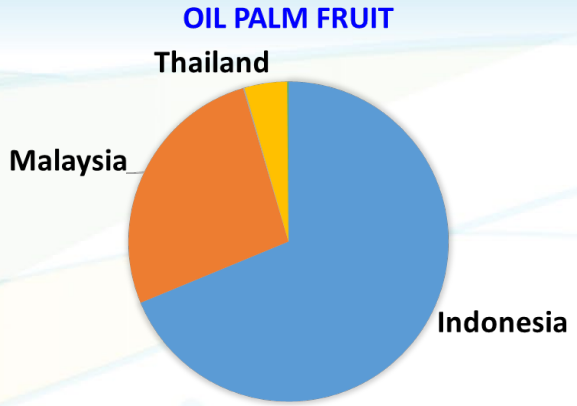
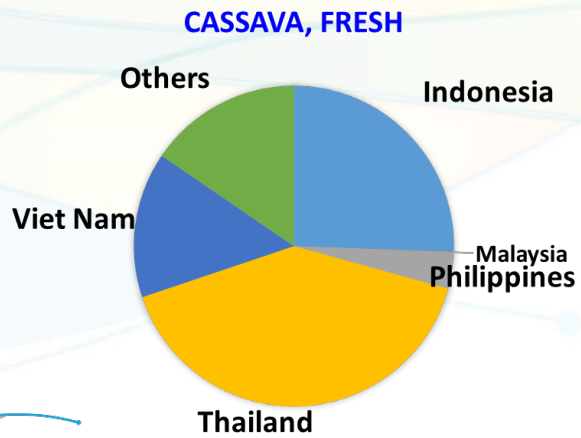
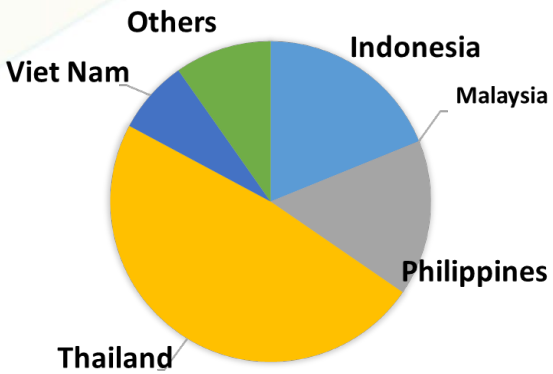
# Country contributions to primary crops

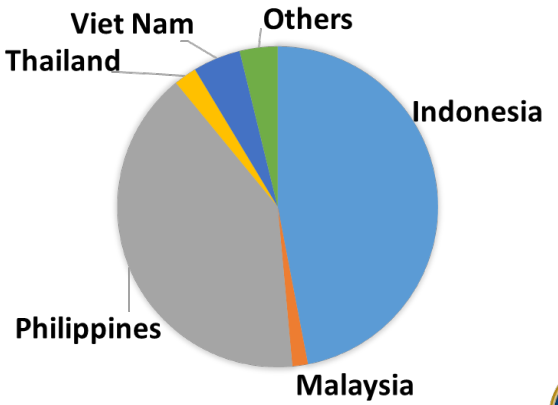



Data from FAO (2021)

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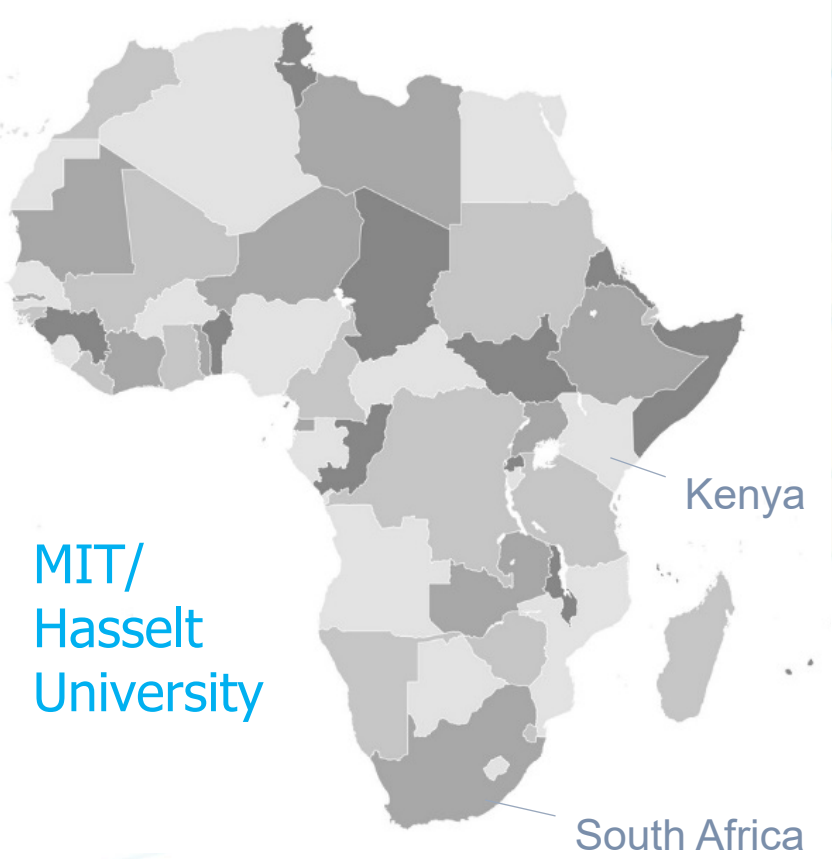
# Sub-Saharan Africa




MIT/
Hasselt
University

PIs: Florian Allroggen, Raymond Speth (MIT), Robert Malina(UHasselt)

Students:

- Kenya
  - Francis Mwangi

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# SAF Workshop and Training - Kenya

MIT and Hasselt University contributed to the ASCENT 93 supported workshop and high-level meeting on the development and deployment of Sustainable Aviation Fuels in Nairobi, Kenya (September 11-12, 2023)

Training on SAF Technology, including PtL, policy, certification, and finance for the aviation sector in Kenya, in collaboration with giz& KCAA, Nairobi, Kenya (September 13-14, 2023)

# Main outcomes of high-level SAF meeting

**Establish a SAF Steering Committee to advance the efforts for a first SAF facility in Kenya**

The Steering Committee shall focus on advancing the following Key Outcomes:

| | | |
|---|---|---|
| Model SAF Finance Case for Kenya | Quantify the socio-economic benefits of domestic SAF production in Kenya | Develop a Domestic SAF policy |
| Conduct a technical analysis of using the Mombasa refinery, and of blendinginfrastructure, as well as of domestication of (certification) standards. | Development of a SAF Roadmap for Kenya | Initiate targeted Capacity Building and Knowledge Transfer |

# Kenya SAF Timeline to date


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# Techno-economic analysis

## Minimum fuel selling price (MSP)

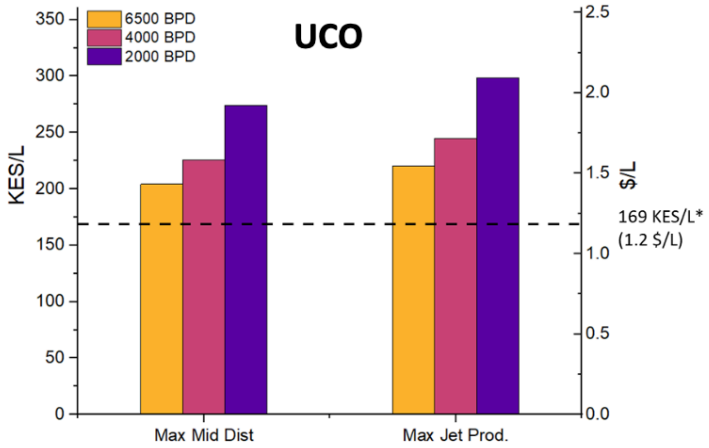
**Minimum fuel selling price**

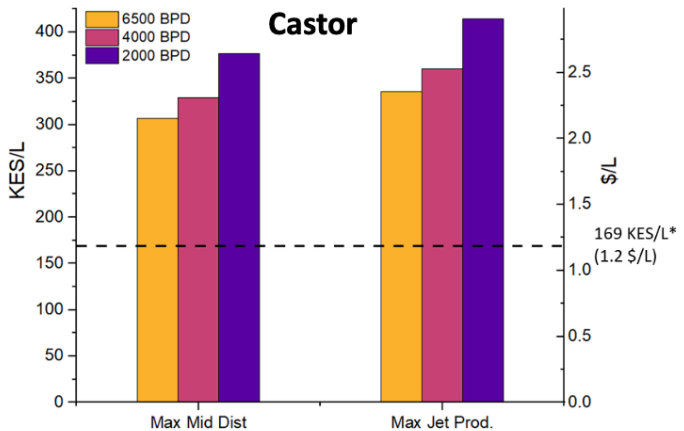
The MSP is the price that the SAF needs to be sold for an investor to meeting the expected rate of return. This is the SAF price at which the net present value of the refinery project equals zero.

Under our baseline assumptions, depending on facility size and product slate assumptions, the MSP for **UCO HEFA** ranges from **204 KES/l - 299 KES/l**.

Under our baseline assumptions, depending on facility size and product slate assumptions, the MSP for **Castor HEFA** lies between **308 KES/l - 414 KES/l**.

If the renewable diesel co-produced cannot be sold at a mark-up needed for SAF, the Castor HEFA MSP increases to **>500 KES/l**.






*Work funded by The World Bank*

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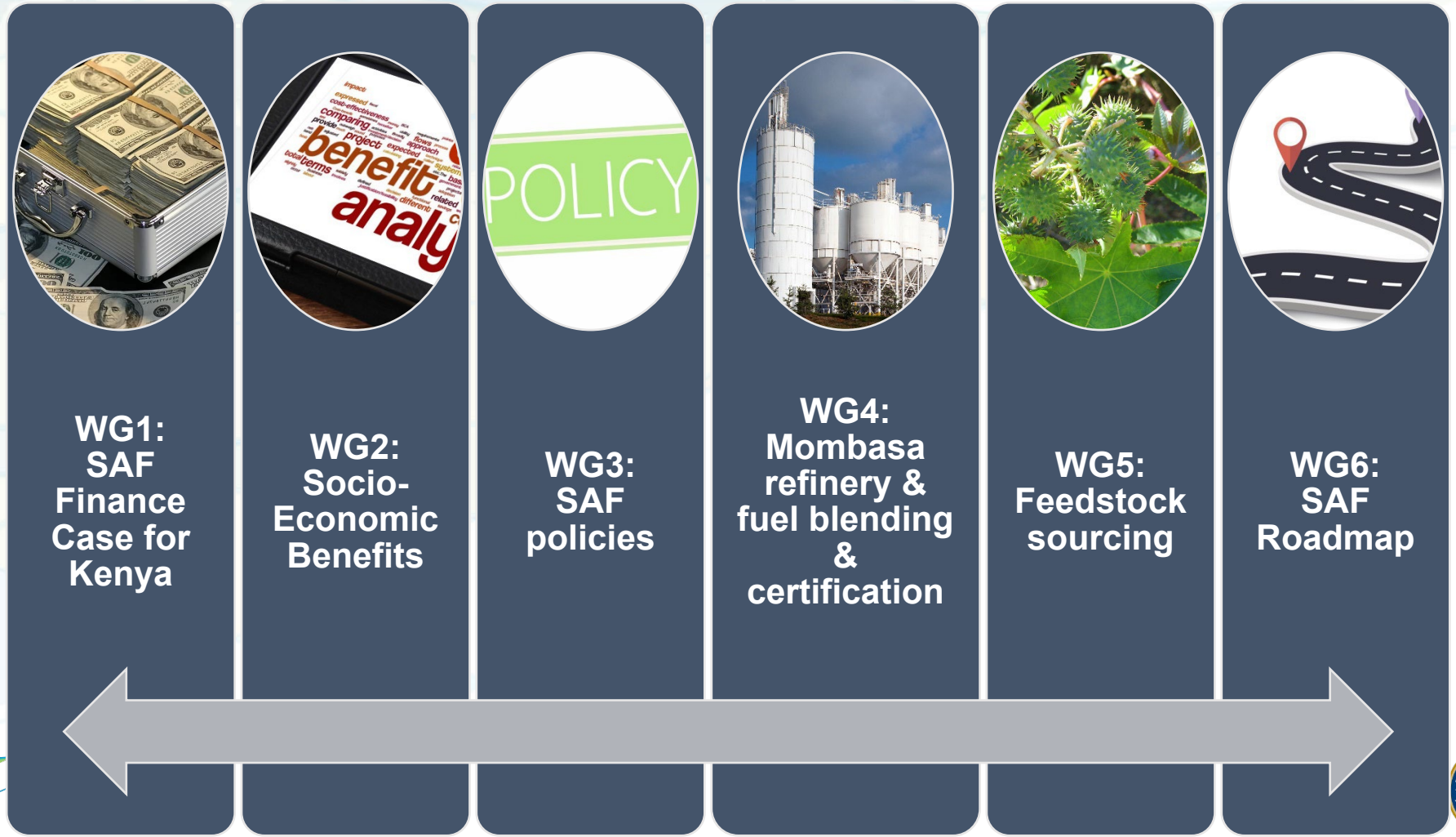
# Tentative list of Working Groups (subject to revision):

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# U.S.-Canada cross-border supply chain analysis

ASCENT Project 100:

- Identify potential for cross-border supply chains with benefit to the U.S. and Canada for SAF production and utilization
- Project launch – Summer 2024

Co-PIs: Kristin Brandt, Michael Wolcott

ASCENT
AVIATION SUSTAINABILITY CENTER

Washington State University

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# U.S.-Canada cross-border supply chain analysis

- Objectives:
  - Identify the cooperative use of feedstock, production facilities, and infrastructure to increase SAF volume
  - Assess the likelihood of meeting federal, state/provincial, and airport specific SAF targets
  - Determine the complexities posed by differing policy support and tariffs

- Initial Study includes partnerships with the Joint Cascadia Airports, including assess their specific SAF targets
  - Seattle-Tacoma International Airport (SEA) – 10% SAF by 2028, 25% by 2035 and max allowable by 2050
  - Portland International Airport (PDX) – 10% SAF by 2030, 100% by 2050
  - Vancouver International Airport (YVR) – 10% by 2030

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# ASCENT 100: Scope of Work – Year 1

- Assess future aviation fuel demand for SEA, PDX, and YVR with SAF volume goals
- Quantify the lipid feedstocks that can supply the Cascadia Corridor (OR, WA, BC)
- Compile a list of operating or planned SAF production facilities within the region
- Identify applicable Canadian policies
- Integrate into U.S. policy tool/create a Canadian specific tool
- Delineate baseline supply chain logistics using FTOT in collaboration with VOLPE
- Assess potential for shared infrastructure and the possible impact on costs with cross-border cooperation

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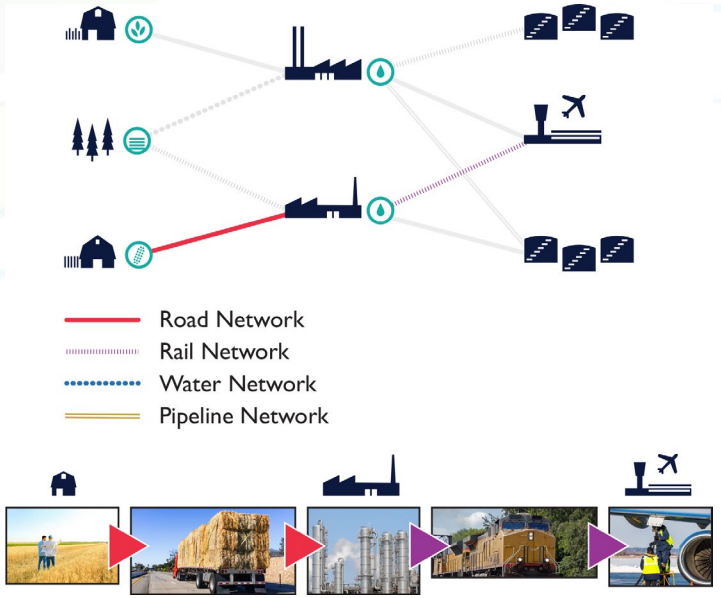
# Transportation Logistics Optimization for Supply Chain Scenario Exploration

PI: Kristin Lewis

- FAA supports the development and use of the publicly available, open-source Freight and Fuel Transportation Optimization Tool (FTOT)
- FTOT can help assess the best-case transportation routing, costs, and associated emissions for supply chain scenarios based on cost and/or $CO_2$ emissions minimization
- Scenario exploration can include factors such as:
  - Transportation infrastructure
  - Supply chain facility options
  - Supply and demand
  - Disruption and resilience
- FTOT enables the use of non-U.S. networks that align with the Generalized Modeling Network Specification.
- FTOT will be used to help evaluate optimal transportation solutions for ASCENT Projects 93 and 100 supply chain studies




https://volpeusdot.github.io/FTOT-Public/

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# Dr. Prem Lobo

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