ASCENT Project 01

Alternative Jet Fuel Supply Chain Analysis - CORSIA Fuels Support

Purdue University
PI: Farzad Taheripour
PM: Anna Oldani
Cost Share Partner: NESTE Corporation

Objective:

- Provide data and modeling practices to **estimate ILUC values for alternative SAF pathways**
- Develop required economic analysis to **assess economic feasibility and profitability of SAF pathways**

Project Benefits:

- Improve ILUC estimation method for SAF pathways
- Develop methodologies to calculate direct land use change (DLUC) emissions
- Improve emissions factor databases and modeling approach

Research Approach:

Sustainable aviation fuels (SAFs) are essential in achieving carbon-neutral growth in aviation

Biomass-based SAFs may induce global land use changes and associated carbon stock

CORSIA Life Cycle Analysis (LCA) has two components: **Core LCA** and **ILUC**

- Use GTAP-BIO model to **assess induced land use change (ILUC) emissions**
- Use PE models for **economic feasibility analysis**
- Use Techno-Economic Analysis to study supply chain from feedstock production to aviation fuel

Major Accomplishments (to date):

Provided required data and modeling practices to **estimate ILUC values for alternative SAF pathways** and **developed required land use analyses** to support the Fuels Task Group (FTG) activities and goals.

Future Work / Schedule:

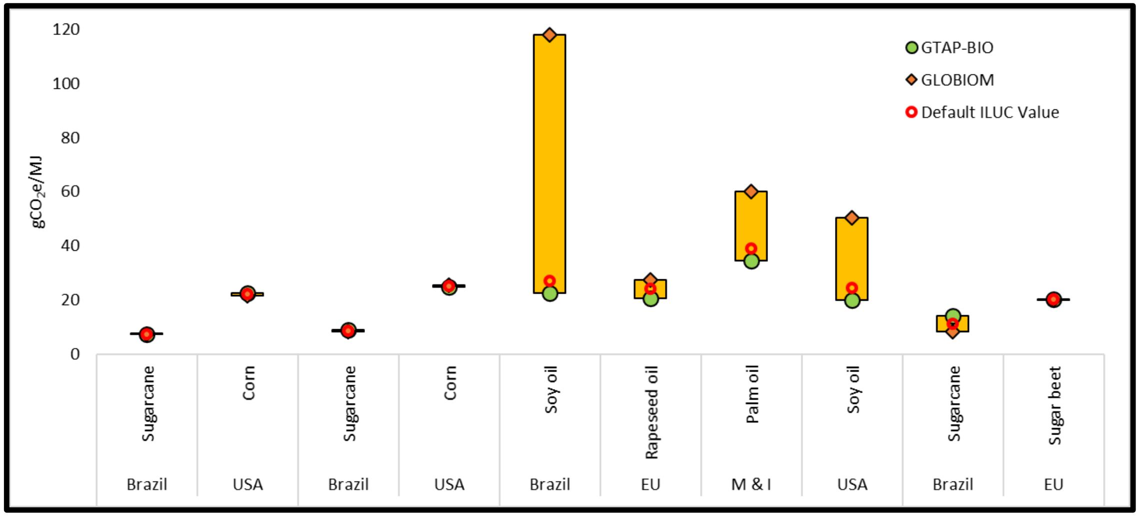
- Further improve the GTAP-BIO model to assess ILUC values for new pathways and new regions
- Develop policy analyses to support SAF production

This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project ASCENT 001 through FAA Award Number 13-C-AJFE-PU under the supervision of Anna Oldani. Any opinions, findings, conclusions or recommendations expressed in this this material are those of the authors and do not necessarily reflect the views of the FAA.

Oilseed cover crops for sustainable aviation fuel production and reduction in greenhouse gas emissions through land use savings

Taheripour F., Sajedinia E., Karami O.

- The CORSIA core life cycle analyses (LCAs) confirm that replacement of SAF produced from food crops with conventional jet fuel could generate some savings in GHG emissions.
- However, induced land use change (ILUC) emissions associated with the use of food crops could eliminate a portion of the emissions savings due to the use of SAF.



Producing SAF from food crops generates some land use emissions

- This paper shows that, unlike the food crops, producing SAF from second oilseed cover crops could generate major savings in GHG emissions due to:
  - Savings in land use,
  - Savings due to replacement of conventional fossil fuels,
  - Potential improvements in Soil Organic Carbon (SOC).

Our contributions

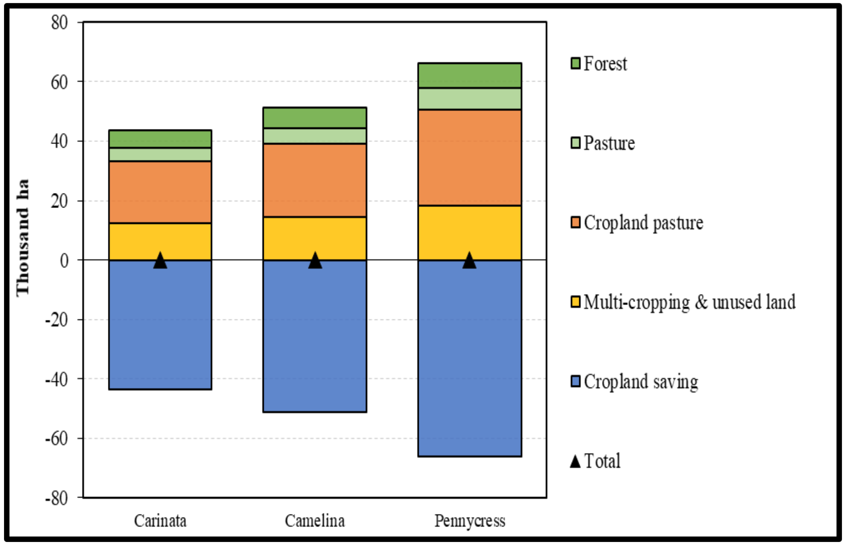
- Oilseed cover crops such as carinata, camelina, and pennycress can be produced across the US in rotation with other crops, in particular with corn and soybean rotation in the Corn-Belt.

Description		Crop year 1												Crop year 2											
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
C-S Rotation	First half of land	F	F	F	C	C	C	C	C	C	C	F	F	F	F	F	S	S	S	S	S	S	S	F	F
	Second half of land	F	F	F	S	S	S	S	S	S	S	F	F	F	F	F	C	C	C	C	C	C	C	F	F
C-SC-S Rotation	First half of land	F	F	F	C	C	C	C	C/SC	C/SC	SC	SC	SC	SC	SC	SC	SC/S	S	S	S	S	S	S	F	F
	Second half of land	SC	SC	SC	SC/S	S	S	S	S	S	S	F	F	F	F	F	C	C	C	C	C/SC	C/SC	SC	SC	SC

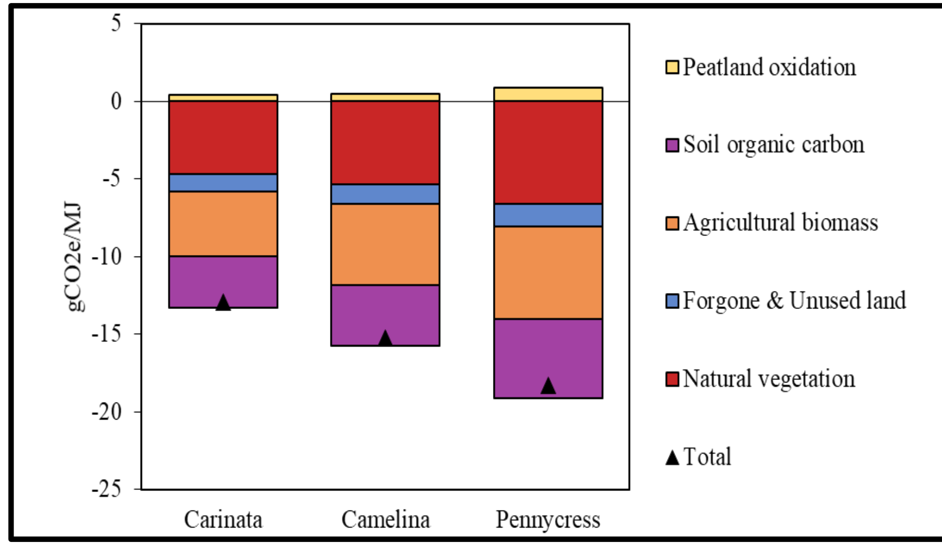
C = Corn, S = Soybeans, SC = Second oilseed crop, F = Fallow land

- Several papers have estimated potential areas for producing second oil crops in the US (e.g., Sindelar et al., 2017; Embaye et al. 2018; Alam and Dwivedi, 2019 Akter et al., 2021).
- Many papers have addressed the use of these crops for SAF production (Zanetti et al., 2019; Alam & Dwivedi, 2019; Trejo-Pech et al., 2019; Robertson, 2020).
- Our contributions:
  - Estimate potential areas for cultivation of these oilseeds for 2021-35, based on Sindelar et al. (2017),
  - Estimate ILUC values for carinata, camelina, and pennycress using the GTAP-BIO model,
  - Determine annual production possibility frontiers for these crops until 2035,
  - Evaluate total savings in GHG emissions by producing SAF from oilseed cover crops.

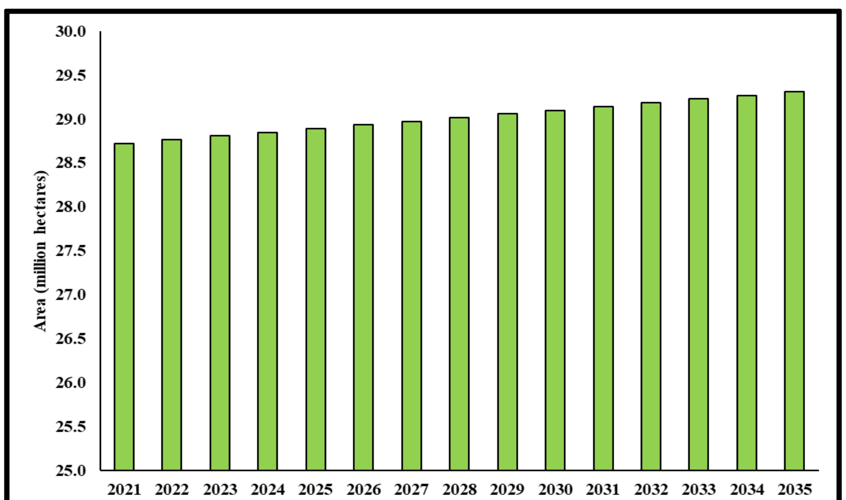
Some major findings



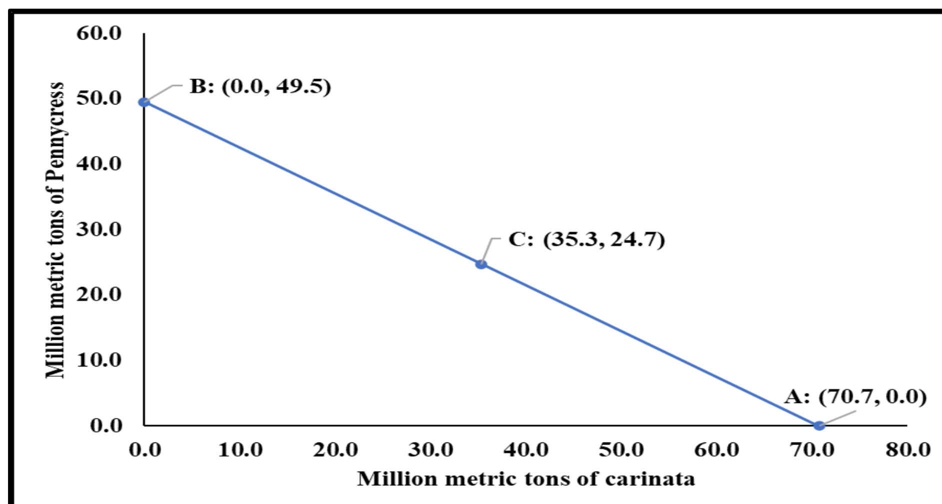
Savings in cropland per 212.9 in million gallons gasoline equivalent GGE



Induced land use emissions savings: Negative ILUC



US potential production area until 2035



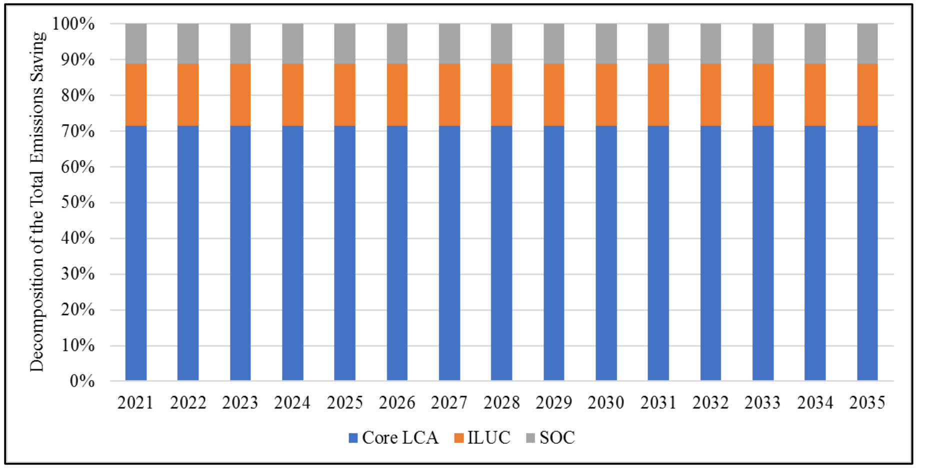
Production possibility frontier for 2035

Potential emissions savings

- At full capacity, total annual emissions savings from SAF produced from oilseed cover crops in 2035 could be between 50 and 92 MMT, depends on the mix of oilseed cover crops produced.
- This is a major source for reducing the carbon footprint of the US aviation.
- The extent to which this potential mitigation option could be realized is uncertain.
- A national mitigation policy that supports SAF production (e.g., financial support, mandates, and low carbon fuel standard) could motivate farmers to sow these crops.
- There should also be some incentives for airlines to use SAFs instead of conventional fuels.

Emissions savings at full capacity (MMT CO_2)

Year	Scenario 1: Carinata	Scenario 2: pennycress	Scenario 3: 50-50%
2021	90.61	49.82	70.21
2025	91.14	50.10	70.62
2030	91.80	50.47	71.13
2035	92.47	50.84	71.65



Decomposition of emissions saving