



Project 100 U.S.-Canada SAF Supply Chain Analysis

Washington State University

Project Lead Investigator

Michael P. Wolcott
Regents Professor
Department of Civil & Environmental Engineering
Washington State University
PO Box 642910
Pullman, WA 99164-2910
509-335-6392
wolcott@wsu.edu

University Participants

Washington State University (WSU)

- P.I.s: Michael P. Wolcott, Regents Professor; Kristin Brandt, Adjoint Faculty
- FAA Award Number: 13-C-AJFE-WaSU-051
- Period of Performance: September 18, 2024, to September 17, 2025
- Tasks:
 1. Quantify Regional Demand
 2. Lipid Feedstock Assessment
 3. Potential Regional Production
 4. State, Provincial and Federal Policy Support
 5. Carbon Intensity (CI) Valuation by Policy
 6. Baseline Freight and Fuel Transportation Optimization Tool (FTOT) Supply Chain Analyses
 7. Shared Infrastructure Review

Project Funding Level

This project has received \$200,000 in Federal Aviation Administration (FAA) funding over its lifetime, \$200,000 in corporate matching funds for cost share from Boeing Environmental Sustainability division.

Investigation Team

Washington State University

Prof. Michael Wolcott (P.I.)
Kristin Brandt (co-P.I.) – Tasks 1, 2, 3, 4, 5, 7
Dane Camenzind (staff engineer) – Task 2
Lina Pilar Martinez Valencia (postdoctoral research associate) – Tasks 4, 5

Collaborating Researchers

University of British Columbia

Jack Saddler
Susan van Dyk – Tasks 1, 3, 5

U.S. Department of Transportation Volpe Center (Volpe)

Kristin C. Lewis – Tasks 6, 7
Kevin Zhang – Tasks 6, 7
Peter Wilke – Tasks 6, 7





Joint Cascadia Airports – Tasks 1, 4

- Seattle-Tacoma International Airport
Stephanie Meyn, Sandra Kilroy
- Portland International Airport
Jennifer Bies
- Vancouver International Airport
Wendy Avis

Project Overview

This project builds on the historically strong trade partnership between the United States (U.S.) and Canada for both agricultural and energy products (Canada Energy Regulator, 2025; Government of Canada, 2025; U.S. Energy Information Administration, 2023; USDA, 2025a). Data was compiled to support initial supply chain analyses that model potential sustainable aviation fuel (SAF) production and use among the U.S. and Canada, building on tools and information from the regional supply chain analyses completed as part of ASCENT Project 001. These tools were used to assess potential SAF production and consumption locations utilizing compiled data detailing feedstock volume and location, announced potential and operational SAF production facilities, existing transportation networks, and governmental policies.

This first project year focused on the largest airports in the primary region, denoted Cascadia and defined as Oregon (OR), Washington (WA), and British Columbia (BC) (Figure 1). Those airports include Portland International Airport (PDX), Seattle-Tacoma International Airport (SEA), and Vancouver International Airport (YVR). The near-term (2030) goals are likely to be met by SAF made using lipid feedstocks with hydroprocessed esters and fatty acids (HEFA) as the conversion technology. HEFA is mature technology, although it is deployed to manufacture renewable diesel (RD) on a larger scale than for SAF. No other technology has been successful at multiple commercial-scale facilities. Potential feedstock sources were considered for the U.S. and Canada. The primary region was extended for potential SAF production options to the expanded region (Figure 1).



Figure 1. Primary and expanded study regions.



Progress made on the project was shared at a stakeholder meeting in July 2025. Attendees included corporate partners (airlines, renewable fuel producers, petroleum refiners, original equipment manufacturers [OEM]), airport representatives, state, provincial, and federal government employees, and University of British Columbia researchers. Attendees provided feedback on work completed to date and suggested next steps. Follow-up meetings allowed for additional information sharing.

Task 1 – Quantify Regional Demand

Washington State University
University of British Columbia

Objective

The objective of this task is to quantify the Jet A/Jet A-1 fuel and SAF demand at the three major Cascadia airports. PDX, SEA, and YVR. Additional airports could be included in future work.

Research Approach

A review of public information was completed, including conversations with airport representatives, to determine the conventional Jet A/Jet A-1 fuel use and SAF goals at each of the three primary airports. SEA has recent public information; PDX and YVR values were provided by airport representatives (Port of Seattle, 2024). SAF demand was estimated for each airport as a portion of the Jet A/Jet A-1 fuel consumption follows:

1. PDX – 10% to align with U.S. SAF Grand Challenge (U.S. Department of Energy et al., 2021)
2. SEA – 10% per SEA goal for 2028 and aligning with U.S. SAF Grand Challenge (U.S. Department of Energy et al., 2021; Port of Seattle, 2024)
3. YVR – 3% per BC mandate up to 10% per Canadian federal aspirational goal (British Columbia, 2024; Government of Canada, 2022)

Additional information was collected on the fuel delivery methods for each airport for use in supply chain analyses. Expansion beyond the initial airports is being explored to determine a more complete regional demand value.

Major Accomplishments

The Jet A/Jet A-1 fuel consumption and estimated SAF demand for 2030 were estimated and existing fuel delivery systems were collated (Table 1).

Table 1. Current fuel delivery method, Jet A/Jet A-1 fuel consumption, and 2030 estimated SAF demand. PDX: Portland International Airport, SEA: Seattle-Tacoma International Airport, YVR: Vancouver International Airport.

Airport	Current Fuel Delivery	Jet A/Jet A-1 Fuel Consumption (BLY)	2030 Estimated SAF Demand (BLY)
PDX	Pipeline and barge	0.8	0.08
SEA	Pipeline, limited ability to use trucks	2.3-3.0	0.2-0.3
YVR	Pipeline, rail, truck, barge	1.8	0.05-0.2
TOTAL	-	4.9-5.6	0.3-0.6

Task 2 – Lipid Feedstock Assessment

Washington State University
University of British Columbia

Objectives

The objectives of this task are to assess the lipid feedstocks within the U.S. and Canada, including imports and exports, and to geolocate lipid volumes for use in supply chain analyses. Lipid feedstocks assessed for SAF production include oilseed oils, animal fats (beef tallow, pig fat, poultry fat), and used cooking oil (UCO). These feedstocks are energy dense,

and the conversion process has a high yield, making them inexpensive to transport. For this reason, lipids were quantified and geolocated for the entire U.S. and Canada. Imported lipids were quantified but have not been geolocated.

Research Approach

Oilseed production, primarily canola in Canada and soybeans in the U.S. and the subsequent processing to oil at geolocated and scaled crushing facilities were determined. Animal fat production was estimated using public resources and geolocated at slaughterhouse locations. UCO was determined using a per capita estimation. These sources were combined to generate the total supply (Figure 2).

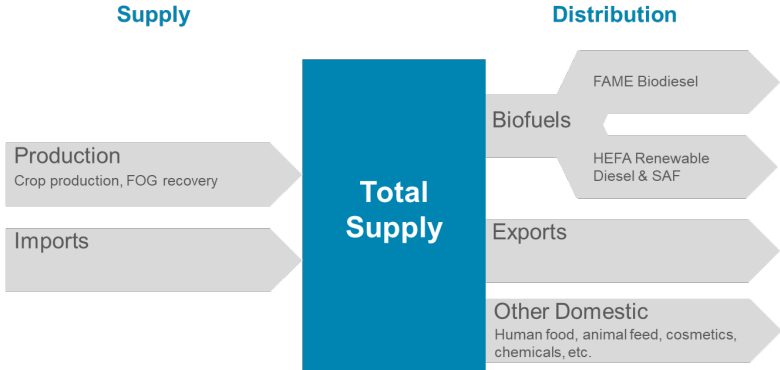


Figure 2. Components considered in U.S. and Canada lipid feedstock inventory.

Oilseed crushing facilities were identified, geolocated, and described according to type and volume of seeds processed using public sources as possible. Crushers were eliminated from the potential feedstock value if public information stated that the oil produced is specifically for food, seeds are not soy or canola oil, are organic, or if the facility is idled/closed/closing or co-located with an operational renewable fuel facility. For Canada, seed capacity was available for all fourteen identified crushers with a total annual output of 4.8 million tons. The survey for the U.S. resulted in 63 operational facilities with five more under construction. The operational U.S. facilities have a nameplate annual capacity of 11.2 million tons. The crushers that are under construction add an additional 0.8 million tons per year. Two-thirds of the U.S. facilities have public crush capacities. The sum of these values was subtracted from the total U.S. volume. The remainder was divided evenly among the facilities without public scale information. The oil production at each crusher was calculated using average oil yields (wt/wt) for soybeans and canola of 17.8% and 42.1%, respectively (USSEC, 2025; Secchi, 2023).

Animal fat production was estimated by creating fat production coefficients that relate total animal fat production in the U.S. to total meat production and/or total head slaughtered in the U.S. for beef, pork, chicken, and turkey (USDA, 2024a; USDA, 2025b; USDA, 2025c; USDA, 2025d; USDA, 2025e). The U.S. and Canada have similar livestock systems, thus it was assumed that the same coefficients are applicable in both countries. Animal fat production was then calculated for facilities that have known slaughter capacities. For facilities with unknown slaughter capacities, the remaining production capacity was divided evenly among facilities on a state or provincial basis. In 2023, the U.S. and Canada produced 4.3 and 0.44 million tons of animal fats, respectively.

UCO was determined by applying a production coefficient of 6.3 kg/year/capita to all locations with a minimum population of 100,000. This estimate aligns with the domestically produced UCO for consumption and trade in the U.S. (United States Census Bureau, 2025; U.S. Energy Information Administration, 2025). However, there are currently no comprehensive inventories of UCO produced within the U.S. so this should be considered an estimate. The quantity of UCO was collated on a county (U.S.) or census division (Canada) level and geolocated at the population-weighted centroid of the census (U.S.) or dissemination (Canada) blocks (Table 2, Figure 3).



Table 2. U.S. and Canada geographies used in collating and geolocating estimated UCO volumes.

Country	Primary Geography	Splitting Geography	Geography for Centroid Calculation
U.S.	urban areas	counties	census blocks
Canada	population centres	census divisions	dissemination blocks

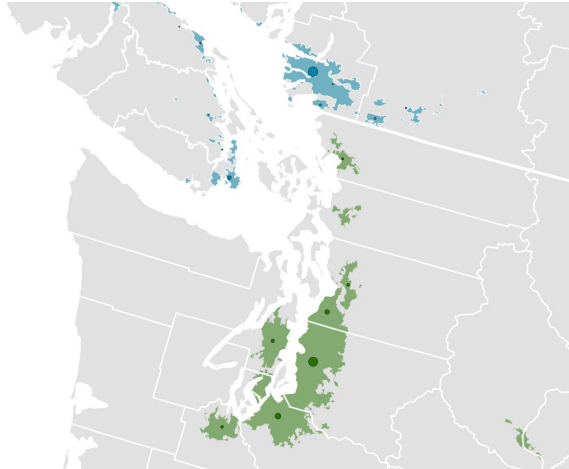


Figure 3. Visualization of the method used for geolocating used cooking oil (UCO) based on minimum population and population centers.

Major Accomplishments

U.S. and Canadian lipid feedstocks were quantified and geolocated for use by the Volpe team in FTOT. The map in Figure 4 includes shaded areas of U.S. and Canada representing canola and soybean cropland. In addition, the location and scale of existing crushing facilities are shown as scaled circles. Of note is that only one crushing facility is located inside of the primary region. The map in Figure 5 shows the location and scale of large slaughterhouses separated by beef, pork and poultry. Figure 6 shows the estimated quantity of UCO produced in each county (U.S.) or census division (Canada).

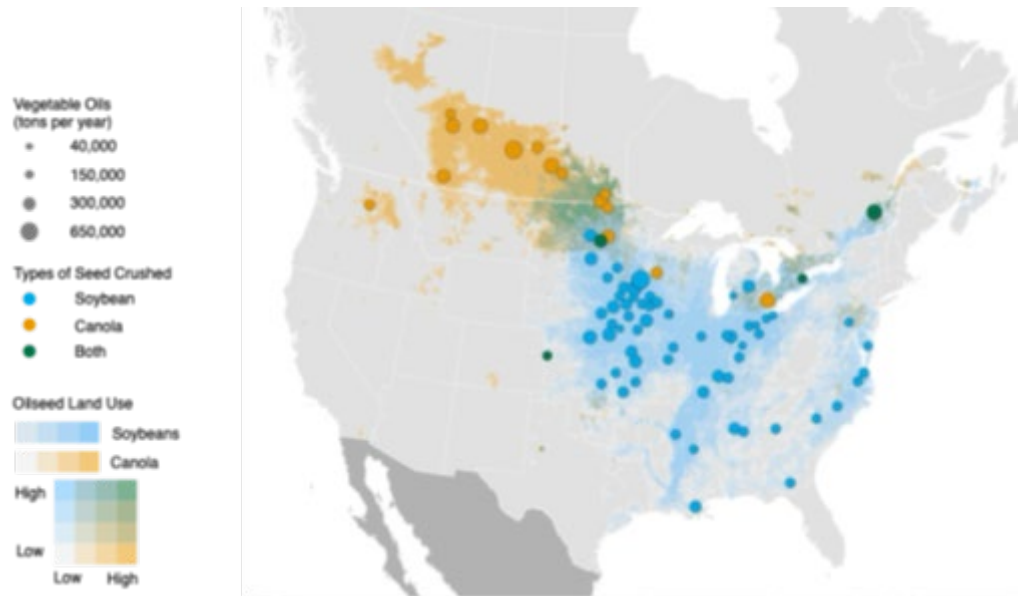


Figure 4. U.S. and Canada soybean and canola cropland (2023) and crushing facilities (2025) scaled to annual seed oil output.

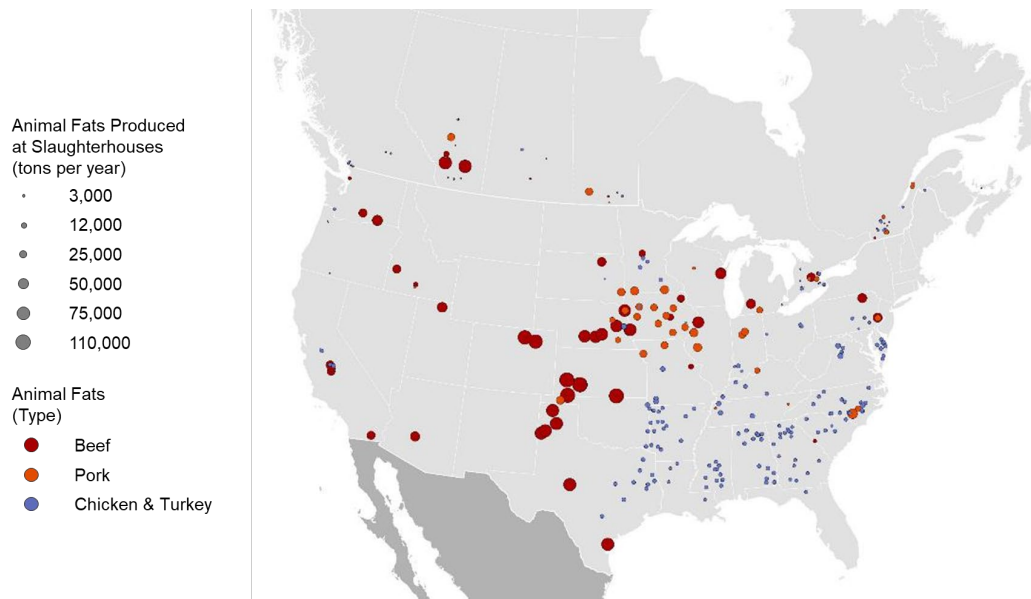


Figure 5. 2025 annual U.S. and Canada production of animal fat (beef, pork and poultry) located at slaughterhouses.



Figure 6. Estimated 2024 Annual UCO production in U.S. and Canada for locations with a population of at least 100,000.

Total lipid supply establishes an upper limit of SAF potential. However other uses like human food, animal feed, other biofuels, chemical processing, and exports compete for the same feedstocks. Figure 7 illustrates current uses divided into renewable fuels, exports and other domestic consumption and separated by country. Figure 8 shows the relative impact of U.S. and Canadian trade rose from 2018 to 2023. Canadian exports of lipids to the U.S. reached a peak in 2023 with 64% of the total Canadian supply was exported to the U.S., which corresponds to 13% of the U.S. supply.

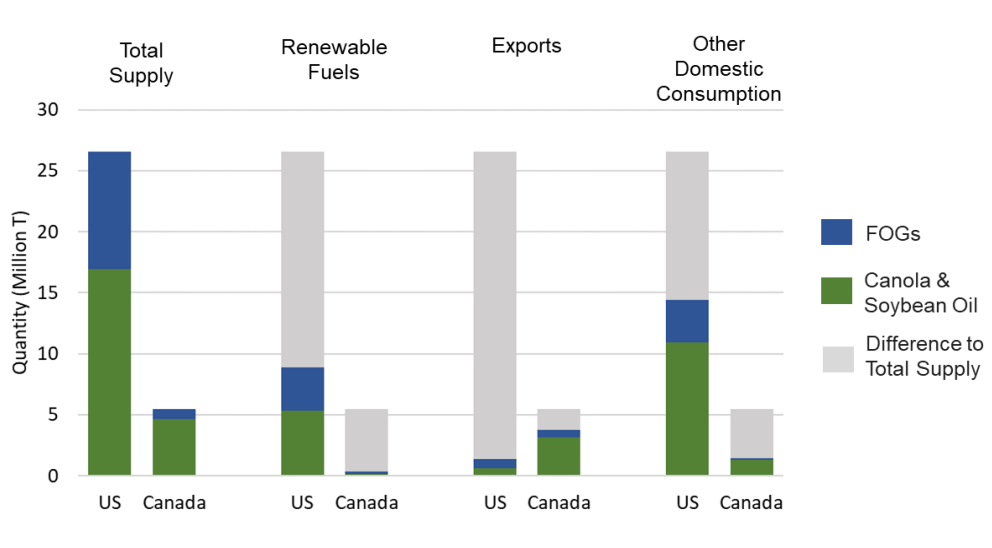


Figure 7. Annual U.S. and Canada lipid supply, biofuel use, exports and other domestic consumption (Canada Meat Council, 2024; Danielson, 2023; Danielson, 2024; GlobalData, 2023; Government of Canada, 2024; United States Census Bureau, 2025; U.S. Energy Information Administration, 2025; Statistics Canada, 2024; Statistics Canada, 2025; USDA, 2023; USDA, 2024a; USDA, 2024b; USDA, 2024c; USDA, 2025b; USDA, 2025d). FOGs: Fats, Oils, and Greases.

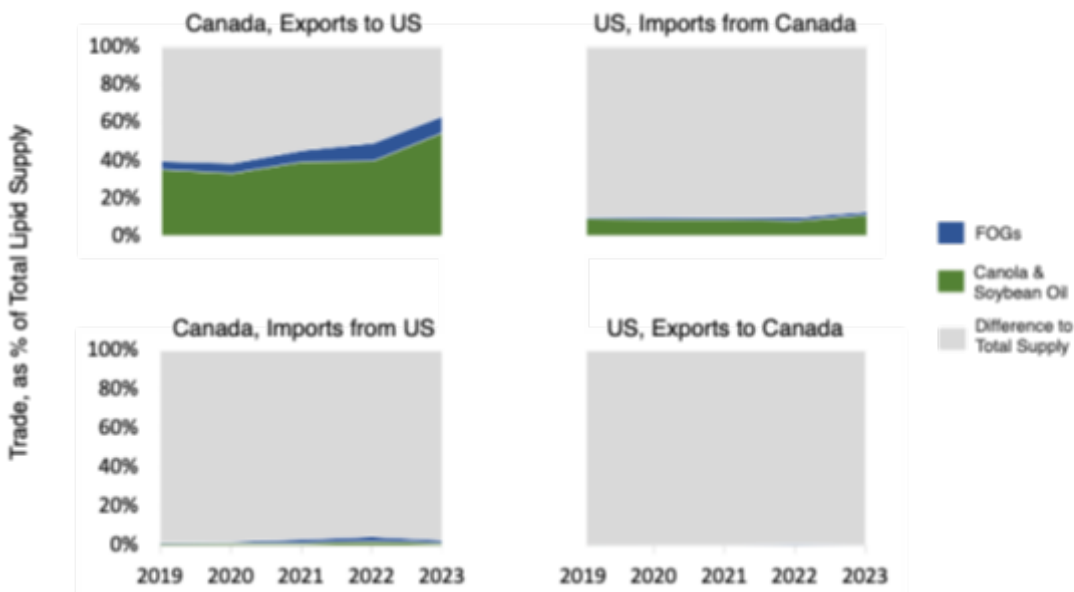


Figure 8. U.S. and Canada trade summary for lipids (2019-2023) (Canada Meat Council, 2024; Danielson, 2023; Danielson, 2024; GlobalData, 2023; Government of Canada, 2024; United States Census Bureau, 2025; U.S. Energy Information Administration, 2025; Statistics Canada, 2024; Statistics Canada, 2025; USDA, 2023; USDA, 2024a; USDA, 2024b; USDA; 2024c; USDA, 2025b; USDA, 2025d).

Task 3 – Potential Regional Production

Washington State University
University of British Columbia

Objectives

The objective of this task is to compile a list of regional facilities that produce or could potentially produce SAF. The potential SAF production in the expanded region was determined from a list of operational, under construction and planned facilities. Additional potential volume from co-processing at petroleum refineries was also assessed.

Research Approach

Utilize the U.S. and global databases of potential SAF production from ASCENT Project 001A and public petroleum refinery information to identify, scale, and geolocate current and potential SAF production.

Major Accomplishments

Primary and extended region facilities were identified, verified, scale determined, and located (Table 3, Table 4). The facilities listed must have public records of location, scale, start-up date, and either use HEFA or co-processing to produce renewable fuels. Existing petroleum refineries could be used to co-process lipids with crude oil or converted renewable fuels. It is important to note that not all of these refineries have expressed interest in renewable fuel production. In addition, petroleum refineries that produce only asphalt, road oil, and/or heavy oils were not included.

The potential SAF production volume at biorefineries is either the publicly stated volume or an estimate calculated using the SAF distillate cut from the ASCENT HEFA Techno-Economic Analysis (TEA) (Brandt et al., 2021). The total lipid demand was back calculated using the ASCENT HEFA TEA yield and the announced fuel production volume. For the petroleum refineries, it was assumed that each refinery would co-process the maximum feedstock fraction allowed by ASTM D1655 (ASTM International, 2023), i.e. 5%. The SAF volume was then calculated after accounting for loss of biogenic carbon, yield, total non-fuel products, and the average Jet A/Jet A-1 fuel cut of 10% at U.S. refineries (Brandt et al., 2026).



Capital costs were estimated using a combination of public announcements and the ASCENT HEFA TEA (Brandt et al., 2021). Co-processing costs were calculated following the methodology defined in Brandt et al. (2026). Costs will be used in future FTOT scenarios as part of the decision matrix in modelling the order that new capacity could come online.

Table 3. Announced and operational renewable fuel facilities in the primary and expanded region that have the potential to produce sustainable aviation fuel (SAF).

Company	Country	Location	Estimated Potential SAF Production (MLY)	Estimated Lipid Demand (t/y)
Parkland	Canada	Burnaby, BC	10	364,000
Tidewater Renewables*	Canada	Prince George, BC	25	42,000
Tidewater Renewables*	Canada	Prince George, BC	207	344,000
GETI	Canada	Calgary, AB	207	344,000
Imperial Oil	Canada	Edmonton, AB	100	913,000
BP America	U.S.	Blaine, WA	10	228,000
NEXT Renewable Fuels	U.S.	Clatskanie, OR	1249	2,074,000
XCF Global Capital	U.S.	Reno, NV	102	170,000
Edgewood	U.S.	Clark County, NV	250	415,000
Montana Renewables*	U.S.	Great Falls, MT	114	484,000
Montana Renewables*	U.S.	Great Falls, MT	511	657,000
Marathon/Neste	U.S.	Contra Costa County, CA	1532	2,544,000
Phillips 66	U.S.	Rodeo, CA	1666	2,766,000
Aemetis	U.S.	Riverbank, CA	45	82,000
Kern Energy	U.S.	Bakersfield, CA	4.8	110,000

*locations have multiple projects and/or potential expansion plans.



Table 4. Primary and expanded region petroleum refineries that could potentially choose to add or expand co-processing to produce sustainable aviation fuel (SAF).

Company	Country	Location	Estimated Potential SAF Production (MLY)	Estimated Lipid Demand (t/y)
Tidewater Midstream	Canada	Prince George, BC	2.2	26,000
Suncor	Canada	Edmonton, AB	27	321,000
Shell	Canada	Edmonton, AB	21	249,000
NWR Sturgeon	Canada	Redwater, AB	15	176,000
BP Americas (expand to 5%)	U.S.	Blaine, WA	36	550,000
Sinclair	U.S.	Anacortes, WA	28	328,000
Marathon	U.S.	Anacortes, WA	22	262,000
Phillips 66	U.S.	Ferndale, WA	19	231,000
Par Pacific	U.S.	Tacoma, WA	8	92,000
Phillips 66	U.S.	Billings, MT	11	128,000
Par Pacific	U.S.	Billings, MT	12	139,000
CHS	U.S.	Laurel, MT	11	132,000
Calumet	U.S.	Great Falls, MT	0.3	4,000
Chevron	U.S.	Richmond, CA	45	539,000
PBF Energy	U.S.	Martinez, CA	29	344,000
Valero	U.S.	Benicia, CA	27	319,000
San Joaquin	U.S.	Bakersfield, CA	3	33,000

The total feedstock required to meet the demands for the facilities listed in Table 3 is 11.5 million t/yr with an additional 3.9 million t/yr if the refineries in Table 4 are included. While this is less than the total feedstock determined in Task 2, it is unlikely that the available lipids would fully cover these after considering biofuel demands from other regions and demands from other sectors. It should be noted that the regional SAF demand is less than 10% of the volume included in Table 3.

Task 4 – State, Provincial and Federal Policy Support

Washington State University

Objectives

The objective of this task is to update U.S. policy in the ASCENT U.S. Policy Applicability and Value Estimation Tool and expand tool to include federal Canadian and BC policies (Brandt et al., 2025).

Research Approach

The U.S. tool was updated with new California CI targets, changes to the Clean Fuel Production Credit (45Z) based on the One Big Beautiful Bill Act (OBBBA), and market values. The tool also includes the U.S. Renewable Fuel Standard (RFS), Oregon’s Clean Fuel Program (CFP) and Washington’s Clean Fuel Regulation (CFR). Canadian Clean Fuel Regulation (CFR) and the BC Low Carbon Fuel Standard (LCFS) were added to the policy tool. This tool will be published to the WSU repository concurrent with a peer-reviewed paper that is under internal review.



Major Accomplishments

Tool updates and expansion needed to determine disparate policy support that can be used in future FTOT runs were completed. In addition, the stakeholder meeting provided guidance on valuing the BC low carbon jet fuel incentive program (LCJFIP). For HEFA, the value of this incentive is 0.75 CAD/liter (YVR, 2025). However, the funds for this incentive are based on the BC Low Carbon Fuel Standard (LCFS) credit value and the number of credits used to fund it. This information is not public, but industrial partners estimated that it would be paid at approximately 10-25%. This is a result of on the policy funding each liter of fuel equally combined with the expected underfunding compared to the demand.

Task 5 – CI Valuation by Policy

Washington State University

Objectives

The objective of this task is to quantify and compare fuel CI values using policy-specific values (from GREET®, GHGenius, etc.). Each policy has a unique methodology to calculate the CI of the fuel, which is used to determine the estimated monetary value. The differences in the policies need to be understood and CI values identified to allow for future supply chain analyses that will include the impact of disparate policies.

Research Approach

The life cycle assessment (LCA) methodology used to calculate CI for each applicable policy within the primary region was reviewed. Public CI values were collated to allow for value estimation.

Major Accomplishments

Table 5 lists the policies selected for use in supply chain analyses in the primary region. Future supply chain analyses will likely include production and markets outside of this region and additional policies will be assessed, for example California’s LCFS.

Table 5. Summary of major policy attributes of policies in the primary region. BC: British Columbia, CI: carbon intensity, CFP: Clean Fuel Program, CFR: Clean Fuel Regulation, ILUC: indirect land use change, LCFS: Low Carbon Fuel Standard, LCJFIP: low carbon jet fuel incentive program, OR: Oregon, RFS: Renewable Fuel Standard, WA: Washington.

Jurisdiction	Policy	Volume Target	CI Target	ILUC	Support	Penalty	Jet Specified
Canada							
Federal	CFR	X	X	Risk	X	X	
Province	BC LCFS	X	X		X	X	X
Province	BC LCJFIP		Follows BC LCFS	Follows BC LCFS	X		X
U.S.							
Federal	45Z		X		X		
Federal	RFS	X	X	X	X	X	
State	OR CFP, WA CFR		X	X	X	X	

The CI for canola oil, calculated for each policy using the corresponding LCA tool/methodology is listed in Table 6. For CFR, BC LCFS, OR CFP and WA CFR, the CI was compared to the average target CI for 2025-2030 to calculate the number of credits earned. All policies except 45Z and BC LCJFIP are market based and historical medians were used from 2025 (January-August), except for CFR which used 2024 data as it is the most recent publicly available.

® GREET (Greenhouse gases, Regulated Emissions, and Energy use in Technologies) is a registered trademark of the U.S. Department of Energy.



Table 6. Canola oil carbon intensity (CI) and estimated SAF policy value for selected primary region policies. BC: British Columbia, CFP: Clean Fuel Program, CFR: Clean Fuel Regulation, ILUC: indirect land use change, LCFS: Low Carbon Fuel Standard, LCJFIP: low carbon jet fuel incentive program, OR: Oregon, RFS: Renewable Fuel Standard, USD: United States dollar, WA: Washington.

Value	CFR	BC LCFS	BC LCJFIP ^a	45Z ^b	RFS	OR CFP	WA CFR
CI (g CO ₂ e/MJ)	42.2	35.5	35.5	20.1	32.0	55.0	55.1
USD/liter	0.18	0.33	0.15 ^c	0.16	0.29	0.05	0.03

^a policy in effect through 2026, ^b policy in effect through 2029, ^c value is assumed to be 25% of policy max for conversion technology, set per stakeholder feedback.

Task 6 – Baseline FTOT Supply Chain Analyses

U.S. Department of Transportation Volpe Center

Objectives

The objective of this task is to complete baseline FTOT supply chain analyses for the U.S. alone, Canada alone and joint U.S. and Canada without constraints.

Research Approach

Expand FTOT to include Canadian roads, rail, pipelines and barge routes.

Major Accomplishments

The Volpe FTOT team completed three baseline runs representing the technical potential for delivery of SAF to YVR, SEA, PDX, and San Francisco International Airport (SFO) given the feedstock assessment and existing/current operating infrastructure noted in Tasks 1-3. California feedstock supply, refinery infrastructure, and SAF demand at SFO were incorporated due to the relative efficiency of production and cost-effective transportation options to the primary region. The FTOT-optimal supply chains for a U.S.-Canada combined scenario were compared to the U.S. only and Canada only scenarios. Preliminary results were presented to project stakeholders. After the stakeholder event Canadian intermodal facilities were added to the FTOT North American multimodal network to better reflect existing infrastructure.

Task 7 – Shared Infrastructure Review

Washington State University

Objectives

The objective of this task is to determine if additional infrastructure is needed to promote SAF use in the primary region and if shared infrastructure will benefit SAF utilization.

Research Approach

Use supply chain analysis results to identify shared infrastructure locations.

Major Accomplishments

For the baseline U.S.-Canada supply chain analyses which encompass the expanded region, all fuel was produced and blended in California and did not require additional infrastructure. These baseline runs did not include needed constraints to feedstock availability and policy was not incorporated. Future work with this additional information is likely to produce disparate results that could demonstrate a need for infrastructure within the primary region.



All Tasks

Publications

None.

Outreach Efforts

- BC Smart – Vancouver, BC, Canada, February 2025
- ASCENT spring meeting – Knoxville, Tennessee, April 2025
- Stakeholder Meeting and follow-ups – online, July 2025

Awards

None.

Student Involvement

None.

Plans for Next Period

- Expand demand for additional primary and secondary region airports.
- Evaluate feedstock reductions based on realistic assumptions regarding lipid availability.
- Complete shared infrastructure review.
- Hold stakeholder review meeting.

References

ASTM International. (2023). *ASTM D1655-23a - Standard Specification for Aviation Turbine Fuels*.

<https://www.astm.org/workitem-wk88158>

Brandt, K., Martinez Valencia, L., Camenzind, D., & Wolcott, M. (2025). *U.S. Policy Applicability and Value Estimation Tool* (v.2). Washington State University. <https://doi.org/10.7273/000007300>

Brandt, K., Martinez-Valencia, L., Camenzind, D., Martulli, A., Malina, R., Allroggen, F., & Wolcott, M. (2026). Pragmatic assessment of meeting the 2030 U.S. sustainable aviation fuel goal. *Biomass Bioenergy*, 206.

<https://doi.org/10.1016/j.biombioe.2025.108516>

Brandt, K., Tanzil, A. H., Martinez-Valencia, L., GARCIA-PEREZ, M., & Wolcott, M. P. (2021). *Hydroprocessed esters and fatty acids techno-economic analysis* (v.3.1). Washington State University. <https://doi.org/10.7273/000001460>

British Columbia. (2024). *LCFS Requirements, British Columbia*. <https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/renewable-low-carbon-fuels/requirements>

Canada Energy Regulator. (2025). *Market Snapshot: Overview of 2024 Canada-U.S. Energy Trade*. <https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/market-snapshots/2025/market-snapshot-overview-of-2024-canada-us-energy-trade.html>

Canada Meat Council. (2024). *Industry Resources Archive*. <https://cmc-cvc.com/industry/industry-resources-archive/>

Danielson, E. (2023). *Biofuels Annual, Ottawa*. U.S. Department of Agriculture, Foreign Agriculture Service.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Biofuels%20Annual_Ottawa_Canada_CA2023-0030.pdf

Danielson, E. (2024). *Oilseeds and Products Animal, Ottawa*. U.S. Department of Agriculture, Foreign Agriculture Service.

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Oilseeds%20and%20Products%20Annual_Ottawa_Canada_CA2024-0008.pdf

GlobalData. (2023). *UCO Supply Outlook*. https://cleanfuels.org/wp-content/uploads/GlobalData_UCO-Supply-Outlook_Sep2023.pdf

Government of Canada. (2022). *Canada's Aviation Climate Action Plan 2022-2030*. <https://tc.canada.ca/en/corporate-services/policies/canada-s-aviation-climate-action-plan>

Government of Canada. (2024). *Supply comparison by species between Canada and the United States*.

<https://agriculture.canada.ca/en/sector/animal-industry/red-meat-and-livestock-market-information/supply-comparison-species-between-canada-and-united-states>



- Government of Canada. (2025). *Canada-United States agriculture and agri-food trade in 2024*. <https://agriculture.canada.ca/en/international-trade/agriculture-and-agri-food-trade-between-canada-and-united-states/canada-united-states-agriculture-and-agri-food-trade-2024>
- Port of Seattle. (2024). *Sustainable Aviation Fuels, Port of Seattle*. <https://www.portseattle.org/page/sustainable-aviation-fuels#:~:text=The%20Port's%20goals%20are%20ambitious,produced%20locally%20from%20sustainable%20sources>
- Secchi, M. A., Fernandez, J. A., Stamm, M. J., Durrett, T., Prasad, P. V. V., Messina, C. D., & Ciampitti, I. A. (2023). Effects of heat and drought on canola (*Brassica napus* L.) yield, oil, and protein: A meta-analysis. *Field Crops Research*, 293. <https://doi.org/10.1016/j.fcr.2023.108848>
- Statistics Canada. (2024). *Number of cattle, by class and farm type (x1,000), Table: 32-10-0130-01*. <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210013001>
- Statistics Canada. (2025). *Canadian International Merchandise Trade Web Application*. <https://www150.statcan.gc.ca/n1/pub/71-607-x/71-607-x2021004-eng.htm>
- U.S. Department of Energy, U.S. Department of Transportation, U.S. Department of Agriculture, U.S. Environmental Protection Agency. (2021). *SAF Grand Challenge Roadmap: Flight Plan for Sustainable Aviation Fuel*. <https://www.energy.gov/sites/default/files/2022-09/beto-saf-qc-roadmap-report-sept-2022.pdf>
- U.S. Energy Information Administration. (2023). *Higher energy prices push United States energy trade with Canada to a record-high value*. <https://www.eia.gov/data-analysis/energy-markets/market-snapshots/2025/market-snapshot-overview-of-2024-canada-us-energy-trade.html>
- U.S. Energy Information Administration. (2025). *Monthly Biofuels Capacity and Feedstocks Update, Petroleum & Other Liquids*. <https://www.eia.gov/biofuels/update/>
- United States Census Bureau. (2025). *USA Trade Online*. <https://usatrade.census.gov/>
- USDA. (2023). *Grain Crushings and Co-Products Production 2022 Summary*. U.S. Department of Energy. <https://downloads.usda.library.cornell.edu/usda-esmis/files/v979v304g/sq87d9947/3n205h555/cagcan23.pdf>
- USDA. (2024a). *United States and Canadian Hogs*. U.S. Department of Agriculture, National Agricultural Statistics Service, National Agricultural Statistics Service. <https://esmis.nal.usda.gov/sites/default/files/7h149p85x/xd07jf68t/dv141f23z/usch0324.pdf>
- USDA. (2024b). *Oil Crops Yearbook*. U.S. Department of Agriculture, Economic Research Service. <https://www.ers.usda.gov/data-products/oil-crops-yearbook/>
- USDA. (2024c). *Feed Grains Database - Feed Yearbook: Report Tables*. U.S. Department of Agriculture, Economic Research Service. <https://www.ers.usda.gov/data-products/feed-grains-database/feed-grains-yearbook-tables>
- USDA. (2025a). *USMCA, Canada, & Mexico - Canada: Trade & FDI*. U.S. Department of Agriculture, Economic Research Service. [https://www.ers.usda.gov/topics/international-markets-us-trade/countries-regions/usmca-canada-mexico/canada-trade-fdi#:~:text=Canada%20is%20a%20major%20participant,Agreement%20\(NAFTA\)%20in%201994](https://www.ers.usda.gov/topics/international-markets-us-trade/countries-regions/usmca-canada-mexico/canada-trade-fdi#:~:text=Canada%20is%20a%20major%20participant,Agreement%20(NAFTA)%20in%201994)
- USDA. (2025b). *Fats and Oils: Oilseed Crushings, Production, Consumption and Stocks*. U.S. Department of Agriculture, National Agricultural Statistics Service. <https://esmis.nal.usda.gov/publication/fats-and-oils-oilseed-crushings-production-consumption-and-stocks>
- USDA. (2025c). *Livestock Slaughter Annual Summary*. U.S. Department of Agriculture, National Agricultural Statistics Service. <https://esmis.nal.usda.gov/publication/livestock-slaughter-annual-summary>
- USDA. (2025d). *United States and Canadian Cattle*. U.S. Department of Agriculture, National Agricultural Statistics Service. <https://esmis.nal.usda.gov/publication/united-states-and-canadian-cattle>
- USDA. (2025e). *Poultry Slaughter Annual Summary*. U.S. Department of Agriculture, National Agricultural Statistics Service. <https://esmis.nal.usda.gov/publication/poultry-slaughter-annual-summary>
- USSEC. (2025). *Conversion Table*. U.S. Soybean Export Council. <https://ussec.org/buyer-tools/conversion-table/>
- YVR. (2025). *Low Carbon Jet Fuel*. <https://www.yvr.ca/en/about-yvr/environment/low-carbon-jet-fuel>