Alternative Jet Fuel Supply Chain Analysis Project 001A

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Project 001A

Alternative Jet Fuel Supply Chain Analysis:

ICAO Technical Support

Washington State University

PI: Michael Wolcott

PM: Prem Lobo

Cost Share Partner(s): Washington State Sustainable Aviation Biofuels Work Group and faculty time

Objective:

Support ICAO/CAEP as technical experts to WG5 through tasks including:

1. Production databases – global and U.S. used to calculate potential production and project future volumes
2. Fuel accounting and reporting systems – document to explain common terms, current status of the industry, existing programs
3. SAF Rules of Thumb – requested update using updated TEAs published in 2025

Project Benefits:

The work on this project supports technical progress in ICAO/CAEP WG5 by providing information to advise FAA decision making.

Research Approach:

Support is provided to the U.S. ICAO/CAEP/WG5 delegation on tasks using ASCENT-developed tools and expertise including on the following topics:

1. Fuel accounting and reporting systems – expanded previous ICAO working paper using information currently under publication review in addition to new research.
2. Monitoring and updating global and U.S. production databases using public information. U.S. data base details include updates in volume, distillate cuts, timelines, status of a project, permitting, etc. as available.
3. Implement the ASCENT harmonized, open-source TEAs to develop U.S.-centric Rules of Thumb for minimum selling prices based on changes to yield, feedstock prices and capital investment required for publication on ICAO website.

Major Accomplishments (to date):

1. Initial draft of the fuel accounting and reporting systems report has been circulated by a Ad Hoc Group within WG5.
2. Overview of fuel accounting and reporting systems progress presented to WG5.
3. Production database is updated. Global information compiled for U.S. DOE. U.S. data used in publication out for review. Global data used in second publication that is out for review.

Future Work / Schedule:

1. Fuel accounting and reporting draft will be presented at WG5/2 meeting, October 2025 meeting in Brazil.
2. Continued work on production database and projection methodology.
3. Update SAF Rules of Thumb.

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Outline

- U.S. and Global Production Data
  - Database explanation
  - Example analysis provided to DOE
  - Global projection methodology
- Fuel Accounting and Reporting Systems
  - Past request/WSU response
  - Overview of information current request
  - Status/implications of work
- SAF Rules of Thumb
  - Request for update

PRODUCTION DATABASES

Database Features

- ICAO and U.S. production databases
  - Requires a **public announcement** with: production company, conversion technology, production volume, location, start date
  - Facility must be capable of SAF production (includes RD facilities, co-processing)
  - Tracks active and historic announcements
- ICAO production database (U Hasselt and WSU maintain)
  - Global
  - When data is available track: feedstock, partners, status, SAF cut, public interest in SAF production
- U.S. production database (WSU maintains outside of ICAO)
  - As possible track: feedstock, partners, project status, SAF cut, public interest in SAF production, cost, delays, construction type (greenfield, co-location, conversion), permit status, financial status, name/ownership changes, construction timeline

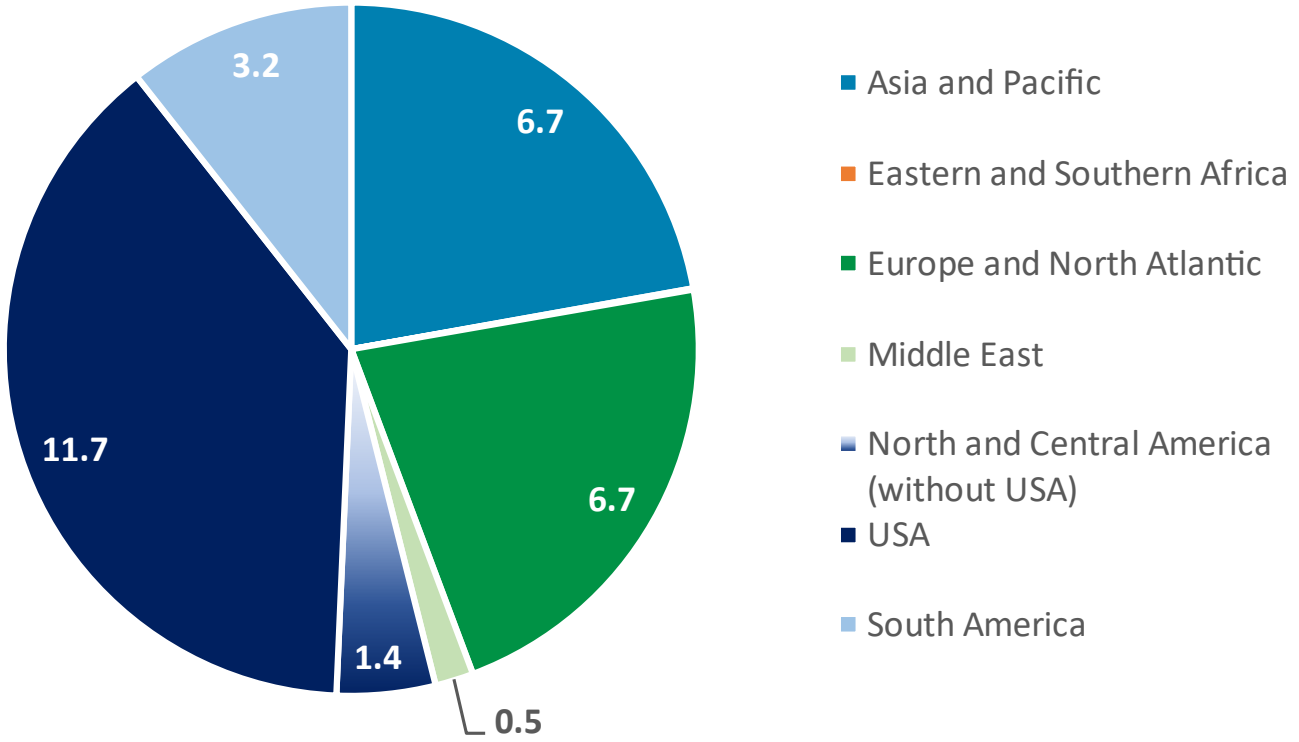
ICAO DATABASE ANALYSIS EXAMPLES

Total Distillate Volume vs. SAF Volume

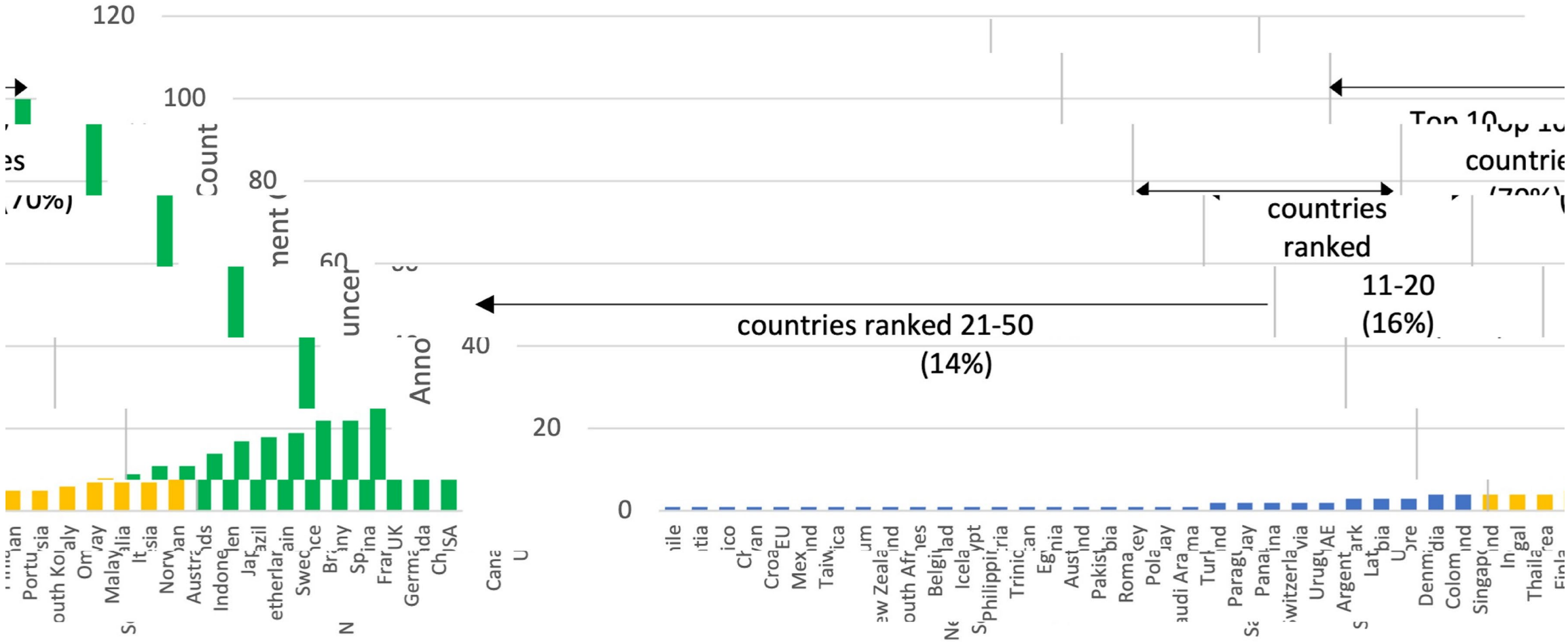
- Volumes reported are for **total distillate production**
  - SAF **could be** a portion of this volume
- A subset of the global announcements include SAF volume
  - Volume-weighted average ratio of SAF to total volume for these is 0.50
  - Range is 0.01-0.9
- For HEFA, technology providers have stated ranges of 35-85% could be SAF
  - 85% requires specific catalysts, CAPEX, optimized operational parameters - may not be realistic at existing RD facilities
  - 35% requires some optimization but is possible at facilities with less tuned processes
- Many data points appear to be optimistic
  - GFT, PtL, and co-processing with 80-90% SAF
- A reasonable estimate might be 30-50% of the total volume could **potentially** be SAF

Announced Global Region Production (BGY)

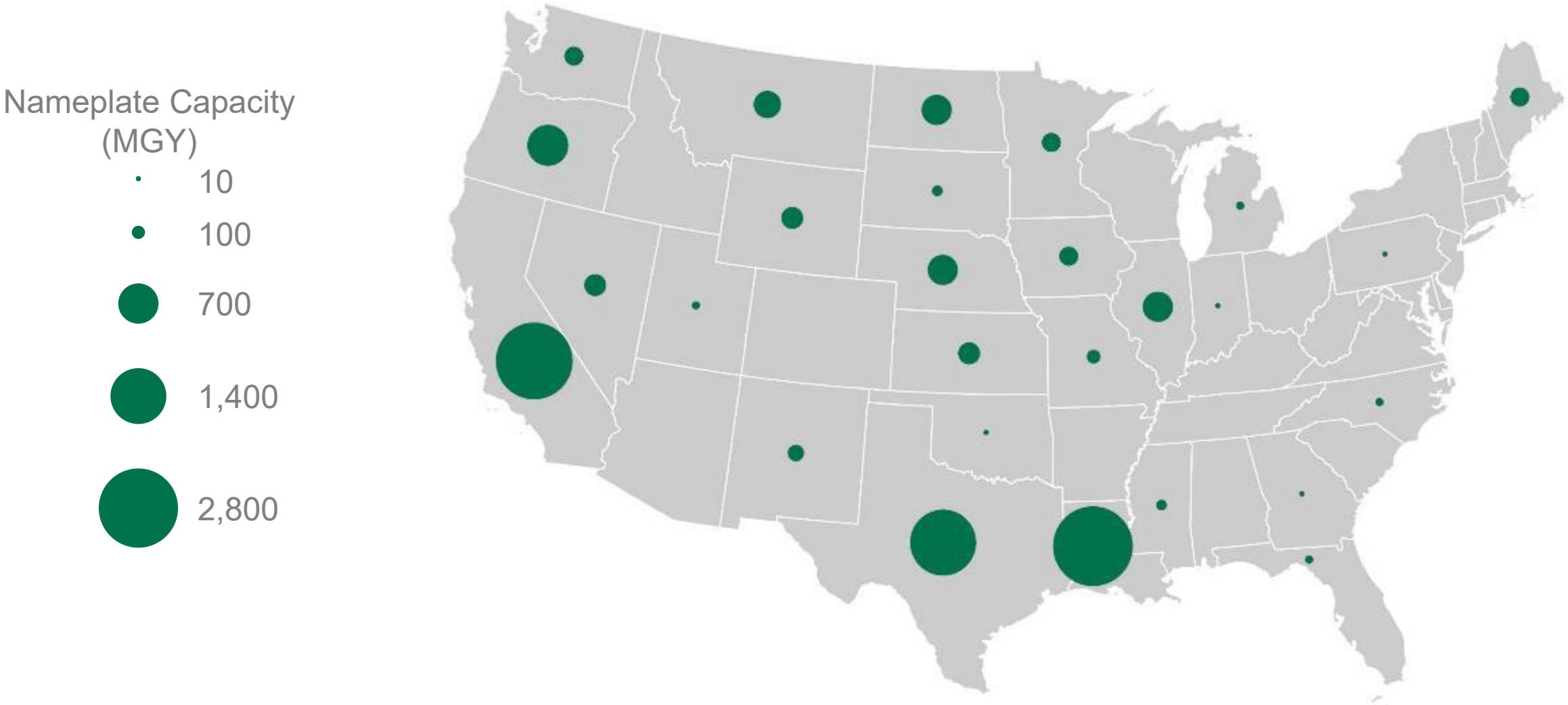
- Announcements with start date in next 5 years (2030)
  - Eliminates 8 of 355 announcements
  - Only **active** announcements (at minimum public update in last 2 years) – from concept to operating
- Assumes **all announcements proceed**
- Reporting based on nameplate total distillate (BGY)



Announced Production by Country



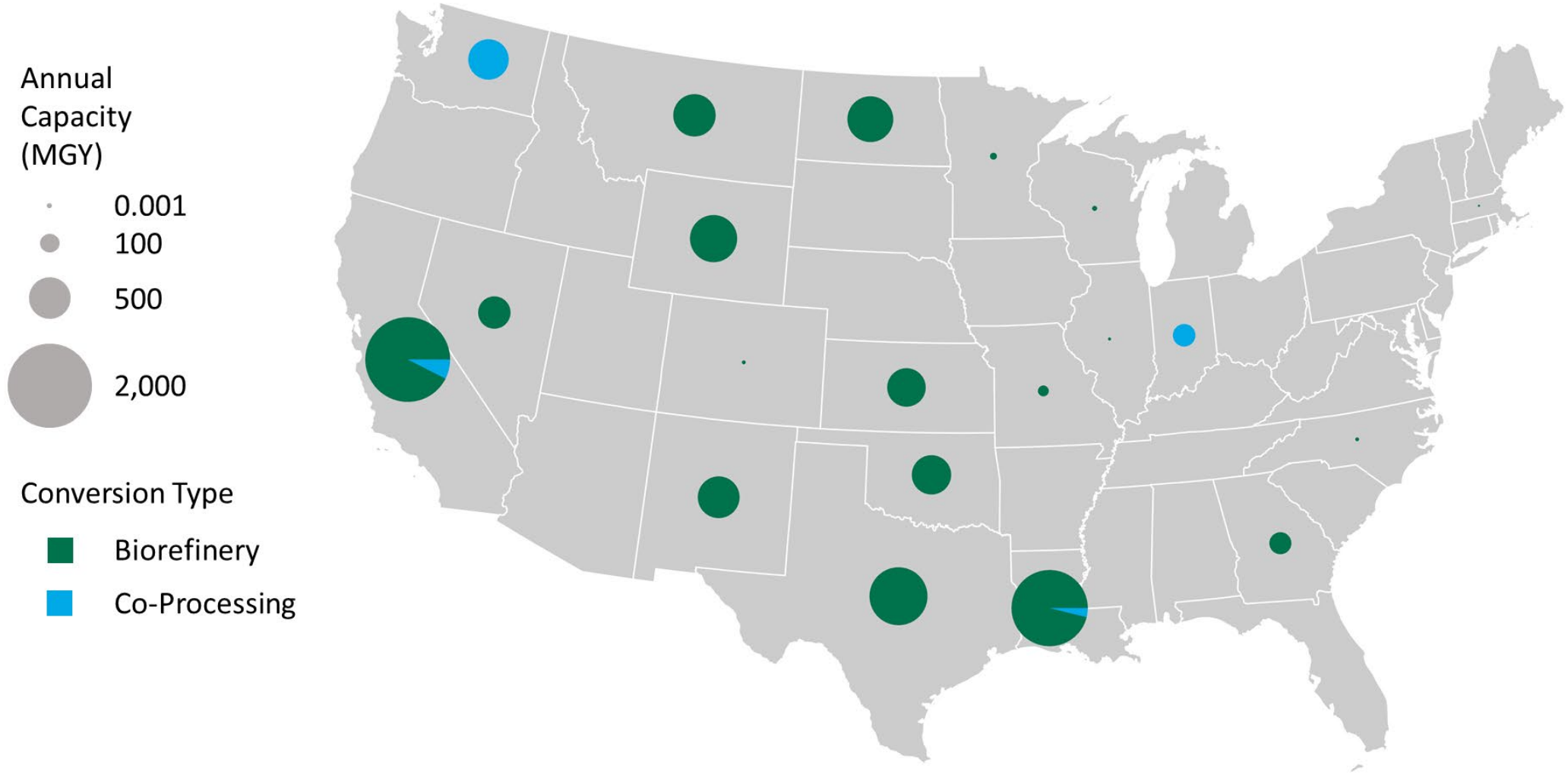
Announced U.S. State Production



Disclaimers

- Data has not been filtered for:
  - Percent of facilities that will proceed (success ratio)
  - Where a facility is in the process (concept, FID, FEED, construction, operational)
- Data only includes public announcements
  - Not all entities announce prior to starting production (i.e. co-processing)
- No judgement was applied to any single announcement
- The U.S. announcements from the ICAO database were not compared to the detailed ASCENT U.S. SAF production database

Current U.S. Production



SAF Projection methodology

- ICAO projections significantly higher than actual production
- Revising the methodology to include scenarios that reflect current production while still providing a range of values to reflect potential global policies.

FUEL ACCOUNTING AND REPORTING SYSTEMS

Fuel Accounting and Reporting Systems

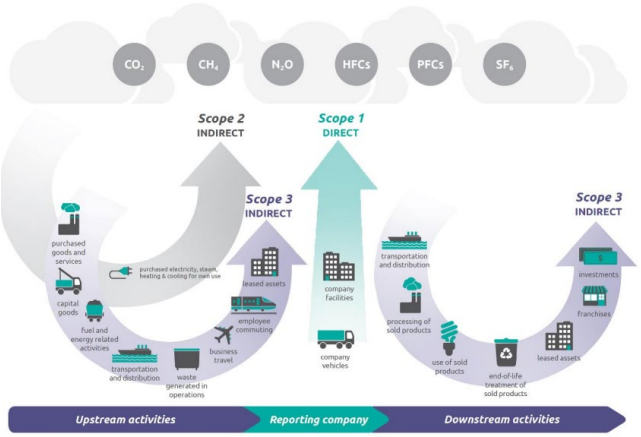
- Past request/WSU response
  - **When:** CAEP Steering Group Meeting, December 2022
  - **Request:** Monitor CEF accounting and reporting systems and develop a CAEP briefing for the CAAF/3 Conference
  - **Response:** WSU experts and TPP co-leads develop briefing material including:
    - Definitions and principles of book and claim systems
    - Description of the CORSIA framework
    - Research about emerging SAF accounting and reporting systems
    - Describe the relationship between the emerging systems and CORSIA
  - **Presentations:**
    - Working paper CAEP briefing
    - Peer reviewed publication in review

Fuel Accounting and Reporting Systems

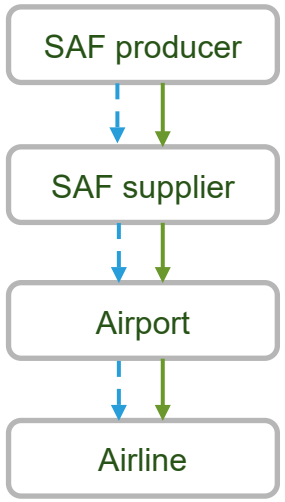
- Overview of information in the current request
  - **When:** CAEP/14 Working Group June 2025
  - **Request:** Based on the CAAF/3 resolution, develop a study on fuel accounting systems for international aviation
  - **Presentations:**
    - An initial report would be presented at ICAO's meeting in October 2025
  - **Response:** WSU experts and the Ad hoc group are developing a report
    - Fundamental concepts of fuel accounting and reporting
    - Description of regulatory frameworks
    - Overview and common elements of Fuel Accounting Systems for SAF and LCAF

Fuel Accounting and Reporting Systems

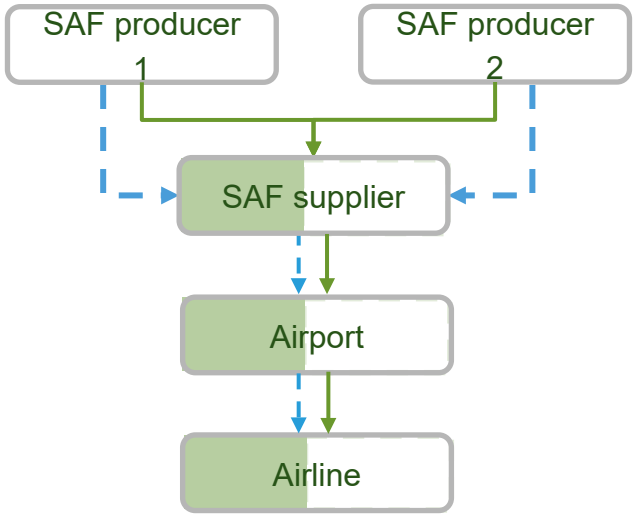
- Overview of information in the current request
  - Fundamental concepts of fuel accounting and reporting
    - Terms and definitions
    - Chain of custody methods
    - GHG Emissions Protocol



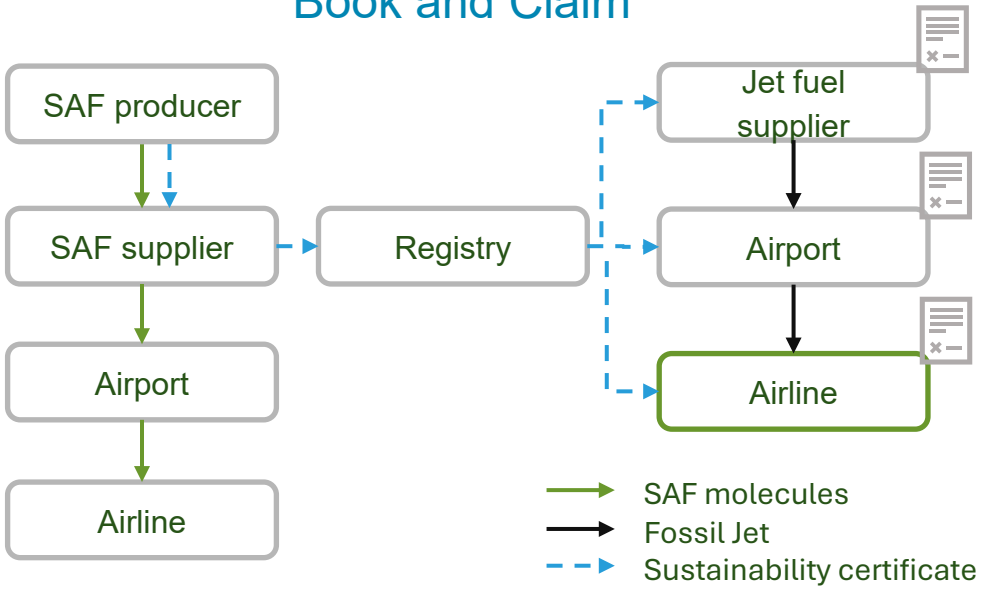
Physical Segregation



Mass Balance



Book and Claim



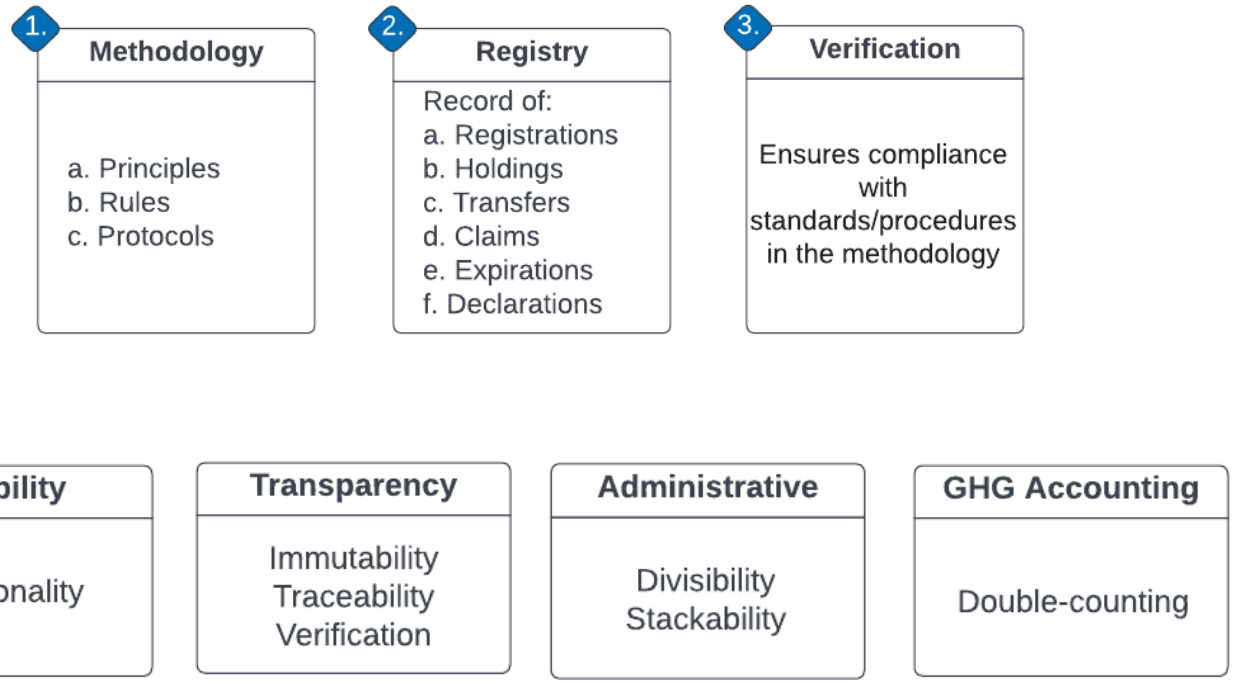
Note: In all cases, SAF must be blended with fossil jet fuel before being supplied to the airport.

Fuel Accounting and Reporting Systems

- Overview of information in the current request
  - Description of regulatory and voluntary frameworks

Fuel Accounting and Reporting Systems

- Overview of information in the current request
  - Overview and common elements of Fuel Accounting Systems for SAF and LCAF



Fuel accounting system
ICAO CORSIA Central Registry (CCR)
EU Union Database (UDB)
CADO SAF Registry (IATA)
RSB Book & Claim System
ISCC Credit Transfer System
SAFc Registry
123Carbon Platform
Assure SAF Registry (4AIR)
Avelia (Shell)
Nabisy
CarbuRe
Fly-I

Fuel Accounting and Reporting Systems

- Status/implications of work
  - WSU has contributed to developing the first draft, which has been shared with the experts of the Ad hoc group within ICAO/CAEP/WG5
  - Identify any possible ICAO role in fuel accounting systems
  - During the CAEP/14 cycle, provide technical support in the development of a globally harmonized framework

ICAO SAF RULES OF THUMB

ICAO SAF Rules of Thumb

- Generalized SAF TEA data including:
  - Pioneer and nth plant - scale and MSP
  - Feedstock, capital, and operating costs
  - Impact of changes to yield, feedstock price, and facility scale (charts currently down)
  - U.S. centric values for 2017 cost year
- Last updated March 2023
- Update requested that will include
  - Updated cost year
    - capital
    - operating costs (feedstock, electricity, natural gas, hydrogen, labor, etc.)
  - Weighted average cost of capital analysis method

https://www.icao.int/environmental-protection/saf-rule-of-thumb

Upcoming Work

- Maintaining databases
- Fuel capacity estimates and projections with updated methodology
- Continuing to provide requested analyses by DOT, DOE, USDA
- Continued support of Fuel Accounting and Reporting Systems document
- Compilation of updated SAF Rules of Thumb

QUESTIONS?