CAAFI Webinar Series:
The State of Sustainable Aviation Fuel (SAF)

Steve Csonka
Executive Director, CAAFI

Brought to you by the R&D Team Co-Chairs & CAAFI ALT
1) Foreword
2) State of SAF qualification
3) State of SAF market pull
4) State of SAF production
5) The future State of SAF: Commercialization challenges and recommendations
1) Foreword: Aviation commitments

Through new technology, improved operational measures and more efficient infrastructure, the industry has avoided 8.5 billion tonnes of CO₂ since 1990.

**GOAL 1:** +1.5%/2.0% annual efficiency

**GOAL 2:** CORSIA

**GOAL 3:** -50%

Emissions trajectory if we were still operating at the same efficiency levels as in 1990.

Where emissions would be if efficiency does not improve from today.

With constant efficiency improvement through the pillars of technology, operations and infrastructure.

With gradual introduction of radical new technologies and sustainable alternative fuels.

6 May 2020

Courtesy of ATAG: [www.atag.org/our-publications/latest-publications.html](http://www.atag.org/our-publications/latest-publications.html); Beginner's Guide to Sustainable Aviation Fuel; Business Aviation made similar commitments
1) Foreword: SAF approach

- Significant effort being expended on SAF, under key guiding principles
  - Sustainability; Availability, world-wide; Pathway to competitive pricing
- ICAO finalizing initial implementation of CORSIA
  - Monetizes carbon, enables SAF to reduce offsetting obligations
- Airlines engaged, but progress is challenging – due chicken-egg conundrum
  - Only able to purchase initiating volumes due high SAF pricing, and SAF pricing will likely not reduce until higher volume production
- Additional policy support warranted, but has not been broadly forthcoming
  - SAF community evaluating many opportunities to close gaps, including additional policy
  - Some third parties seek acceleration - Some (EU) looking at use of mandates
  - CAAFI and Sponsors continue to focus on fundamentals: R&DDD, Tools, PPP Initiatives, ...
2) State of SAF qualification

* Overview of the approval process
* Approved pathways
* Pathways in process
* Promising emerging technologies
* Improvements to the qualification process
* Other efforts outside D4054
Aviation industry path to SAF evaluation and qualification – foundation of enabling specifications

- **ASTM D1655 - Standard Specification for Aviation Turbine Fuels**
  - A1.1.2 ... Aviation turbine fuels with synthetic components produced in accordance with Specification D7566 meet the requirements of Specification D1655.

- **ASTM D4054 - Standard Practice for Qualification and Approval of New Aviation Turbine Fuels**
  - 1.1 This practice covers and provides a framework for the qualification and approval of new fuels and new fuel additives for use in commercial and military aviation gas turbine engines...

- **ASTM D7566 - Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons**
  - 1.2 ... Aviation turbine fuel manufactured, certified and released to all the requirements of this specification, meets the requirements of Specification D1655 and shall be regarded as Specification D1655 turbine fuel.
A rigorous process of testing whereby industry OEMs can be assured that new fuel compositions enable essentially identical performance as petroleum-derived jet fuel.
Industry approved SAF Pathways

Find additional details in either ASTM D7566 or keep up to date at: http://www.caafi.org/focus_areas/fuel_qualification.html
Published 29Jan’20

Feedstock is fatty acids and fatty acid esters (FOG)

Process – Catalytic Hydrothermolysis

Blending required, 50% max blend limitation

ARA intent to commercialize with Hydrothermal Clean Up (HCU) front end, expanding availability of previously unused feedstock sources

Work underway with producers on multiple facilities

Euglena operating pilot facility in Japan
Driven by Ishikawajima-Harima Heavy Industries (IHI), a comprehensive heavy-industry manufacturer working to create value for customers in four main areas including Aero Engines, Space and Defense. Intending to use fuel to support pending Olympic flights. ([https://www.ihi.co.jp/csr/english/index.html](https://www.ihi.co.jp/csr/english/index.html))

- Approval balloting finalized 02Apr. To be published 2Q'20.
- Tweak to HEFA production that utilizes biologically derived hydrocarbons (*Botryococcus braunii* produced triterpenes), or Bb oil, as opposed to fatty acids and fatty acid esters only
- First pathway to utilize FAA Clearinghouse as well as D4054 Fast Track Process
- Blending required, 10% max blend limitation
In process SAF Pathways, via D4054 process
Additional technologies applicable to SAF

- Vertimass
- Forge
- Others

**Tier 2**
- Specification Properties
- Fit-For-Purpose Properties

**Tier 3**
- Component/Rig Testing
- OEM Review & Tier 3 & 4 Requirements

**Tier 4**
- Engine/APU Testing
- Phase 2 ASTM Research Report
- OEM Review & Approval

- HFP-HEFA (HDRD or Renewable Diesel) as blending agent
- Global Bioenergies Isobutene to jet
- Shell IH2
- ATJ-SKA (Swed Biofuels)

- Virent SAK
- Shell IH2
- Global Bioenergies Isobutene to jet
- ATJ-SKA (Swed Biofuels)

**Annex A1**
- FT-SPK

**Annex A2**
- HEFA-SPK

**Annex A3**
- HFS-SIP

**Annex A4**
- FT-SKA

**Annex A5**
- ATJ-SPK (Isobutanol & ethanol)

**Annex A6**
- CHJ

**Annex A7**
- "HHC-SPK"

6 May 2020
<table>
<thead>
<tr>
<th>Approach</th>
<th>Feedstock</th>
<th>Companies</th>
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</thead>
<tbody>
<tr>
<td>ATJ Expansion</td>
<td>Alcohols (via sugars)</td>
<td>Swedish Biofuels*, Byogy</td>
</tr>
<tr>
<td>HDCJ (direct or co-processing)</td>
<td>Lignocellulose</td>
<td>Ensyn/Envergent, REC</td>
</tr>
<tr>
<td>Microbial conversion</td>
<td>Isobutene (via sugars)</td>
<td>Global Bioenergies*</td>
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<tr>
<td>HTL</td>
<td>Lignocellulose</td>
<td>Steeper, Genifuel, ...</td>
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<tr>
<td>Catalytic HTL</td>
<td>Lignocellulose</td>
<td>Licella, Muradel, QUT</td>
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<tr>
<td>Thermal Deoxygenation</td>
<td>Lipids</td>
<td>Forge Hydrocarbons*</td>
</tr>
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<td>SBI CGC PICFTR</td>
<td>Lipids - biodiesel</td>
<td>SBI Bioenergy / Shell</td>
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<tr>
<td>Acid Deconstruction</td>
<td>Lignocellulose</td>
<td>Mercurius</td>
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<tr>
<td>Bio-TCat (thermal catalytic)</td>
<td>Lignocellulose</td>
<td>Anellotech*</td>
</tr>
<tr>
<td>CCL</td>
<td>Lipids</td>
<td></td>
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<tr>
<td>CHyP (syngas, non-FT)</td>
<td>Lignocellulose</td>
<td></td>
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<tr>
<td>Hydrogenotrophic Conv.</td>
<td>CO2 / Producer Gas</td>
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<tr>
<td>Cyanobacterial Prod.</td>
<td>CO2</td>
<td></td>
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<td>STG+ GTL</td>
<td>C1-C4 Gas / Syngas</td>
<td></td>
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<tr>
<td>Ionic Liquid Decon.</td>
<td>Lignocellulose</td>
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<tr>
<td>Metal Catalytic Conversion</td>
<td>Lignocellulose</td>
<td></td>
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<tr>
<td>Enzymatic Conversion</td>
<td>Lignocellulose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lignin</td>
<td></td>
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</table>

* Recent outreach to CAAFI R&D Team, ASCENT C.H. and/or OEMs
Promising emerging technologies

- Those that lower cost or increase value
  - Lower CapEx
  - Lower OpEx – enabling use of low-cost, plentiful, 24x7 type feedstocks
  - Integrated systems
  - Finding higher value for production slip streams or byproducts
  - Capturing value from other environmental services
  - Driving to ultra low CI scores to increase value from rewarding policy
- Steady stream of low TRL examples for the above
- In some other cases, difficult to envision near-term tangible progress
D4054 Process Improvement: D4054 Clearinghouse

Structured as a Cost Share Arrangement
Accepts In-Kind Contributions (testing partners)
Also Accepts Direct Contributions
Stakeholder Engagement/Support Needed!
Final Research Report Out

FAA Seed Money Under ASCENT Center of Excellence

University of Dayton Research Institute (UDRI)

Candidate AJF In

UDRI Contact
Dr. Steven Zabarnick
Steven.Zabarnick@udri.udayton.edu
(937) 255-3549

Mark Rumizen
November 14, 2019
D4054 Process Improvement: Fast Track Annex

For AJF’s with Conventional Hydrocarbon Compositions

Limited to a 10% Blend Percentage
Utilization of knowledge being gleaned from National Jet Fuel Combustion Program (NJFCP), multi-year collaborative effort initiated under FAA ASCENT

* Assist OEMs in understanding implications of shifts in jet fuel composition by using a simpler set of physical tests and analysis …
  * Referee combustor rig, spray rig, CFD, DCN calculation
  * … that can predict combustion behavior for pinch points
  * Lean blow-out, cold start, altitude relight, transient operation
* Potentially giving OEMs more confidence for limiting Tier 3 or 4 mandated testing => leading to savings in time, money and use of scarce testing resources
* Could eventually lead to changes in D4054 process
  * Back-to-back work being done with Shell IH² candidate fuel with this in mind

Hypothetical D4054 revision:

- Hot LBO
- Cold LBO
- Alt. Ignition
As identified historically by OEMs, and recently validated via the work of the NJFCP, the most important fuel properties affecting airplane/engine operability are:

- Viscosity at -20 and -40 °C
- Distillation curve
- Mass density
- Flashpoint temperature
- Derived Cetane Number (DCN)
- Surface tension

What is the most expeditious way to determine if candidate fuel components meet these needs?
Tier $\alpha$ - testing methods for chemical composition characteristics that require very low volumes of fuel have been identified to predict key performance properties:

- GCxGC (<1 mL)
- Mid-IR absorption (<100 mL)
- NMR (<10mL).

Tier $\beta$ - the evaluation of fuels with the listed methods facilitates the direct comparison of AJFs to conventional fuel and previously approved AJF, minimizing future uncertainty.

Note that Tier $\alpha$ and Tier $\beta$ testing collectively requires only ~500 mL of neat fuel for limited and targeted tests that might save voluminous fuel and cost requirements.

**Table 1: Minimally Recommended Tier ’ZERO’ properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM Test Method</th>
<th>Approximate Volume Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>D445</td>
<td>20 mL</td>
</tr>
<tr>
<td>Distillation</td>
<td>D2887</td>
<td>From GC x GC/Tier $\alpha$</td>
</tr>
<tr>
<td>Density</td>
<td>D4052</td>
<td>5 mL</td>
</tr>
<tr>
<td>Flash Point</td>
<td>D56</td>
<td>50 mL</td>
</tr>
<tr>
<td>Surface Tension</td>
<td>D1331A</td>
<td>10 mL</td>
</tr>
<tr>
<td>DCN</td>
<td>D6890</td>
<td>200 mL</td>
</tr>
<tr>
<td>Swelling</td>
<td></td>
<td>150 mL</td>
</tr>
</tbody>
</table>

6 May 2020
19 Fuels Currently Being Evaluated Under NJFCP Methods (P25 & 65)

- 19 fuels are being evaluated via Tier α, β, and 2.5
- DOE funding for some testing
- Properties are used to predict Tier 2.5 behavior (FOM) as learned through the NJFCP.

Find additional guidance at:
Other qualification tid-bits

- CAAFI to continue conferring producers from R&D to Qualification
- EU and UK considering European Clearinghouses
- ASTM D02.J Task Force established to evaluate considerations for blending of blending components
- Working toward consideration and approval of 100% drop-ins
  - Primary need is to demonstrate process performance, control, and management of change, suggesting the need for data from several production facilities before consideration
- With continued amassing of data and experience, will we in the long term be able move to more of a compositionally based spec?
3) State of SAF Market Pull

* Current market pull and influencing factors
* Offtake agreements
* Other commitments
* Other efforts

* More information about current-event impacts to airlines can be found at:
  https://www.iata.org/en/publications/economics/
* Commercial and Business Aviation really are interested in acquiring supply, but with some caveats, the most important being affordability.
* Despite distractions (COVID, price of oil, survival), activities continue, including the last several weeks:
  * Several new producer explorations and outreach
  * Introductions to airlines and fuel suppliers
  * Airport instigation of broader engagement by State governments (SFO)
  * Third party explorations, including from trend-setting corporations
  * Heightened government interest in helping (both with R&DD and policy)
* Expect interest to continue to develop based on societal influence, policy, regulation, …
* Industry working a policy approach to level the playing field with diesel, and enable petro-jet price parity for some cases.
* Difficult environment at present … We’re in it for the long haul!
SAF offtake agreements
Beyond numerous demonstration programs

- Up to 5 M gpy from 2016 (LAX)
- Multi yr agreement
  30/70 blend
- Misc Flights, e.g. SFO
- Bioports on demand, et al.
- 37.5 M gpy
- 90-180 M gpy
- 50 M gpy

* WEP also continues supplying fuel for multiple trial and research activities. Also moving forward with $350M expansion to enable 306M gpy total capacity & jet capacity of 150M gpy; 24Oct’18

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Beyond numerous demonstration programs

- 3 M gpy each, 7 yrs (Bay Area, CA)
- 10M gpy, 10 yrs (JFK)
- 4M gpy, 10 yrs (LAX)
- 24M gpy, 10 yrs
  SAF Supply collaboration
- Supply from 2021
- UK DfT F4C Funding: ATJ Development

* 100M gpy by 2024 from 4 facilities
SAF offtake agreements – pg 3

SAF Supply explorations

SAF Q4’18 restart at Porvoo, ~33M gpy rate, 330M gpy with Singapore by 2022;
Supply to SFO, AMS; Supply agreement with AA

Up to 1M gpy, 5 yrs+ / France & EU supply

No detail released

10M gpy, from 2022/2023 term/blend unspecified

Grays Harbor, WA feasibility study, and offtake agreement, tbd

Combined, these offtakes/efforts represent >350 M gpy, and account for the total production slate of the first several commercialization efforts

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Other recent announcements

- Multiple Producers, TBA
- Gothenburg Refinery
- Others, TBA
- TBA
- Multiple Producers & Suppliers
- Airports and Airline Tenants

- World Fuel Services
- SAS
- Cathay Pacific
- Alaska
- Delta
- China Airlines
- jetBlue
- ANA
- Finnair

- Full production slate offtakes
- New Aircraft Deliveries from Airbus and Boeing
- Customer funding of SAJF purchase from 2019
- Exploration of Greater ambition

6 May 2020
Other recent announcements

- VELOCYS + BRITISH AIRWAYS = In negotiation
- AGRISOMA + QANTAS = Carinata supply development
- Shell = MSW-based FT-SPK evaluations
-努力
- BTL #1, Natchez, MS
- 1,400 bpd

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Airline commitments of greater ambition

Obtain 30% of jet fuel from alternative sources by 2030; 06Nov‘17

First U.S. Airline to Pledge to Reduce Own Emissions by 50% (vs. 2005) by 2050; 13Sep‘18. $40M SAF Investment Fund; 27Oct‘19

Commits to flying 100 M passengers on SAF by 2030; 23Sep‘19

Horizon 2030: offset 100% of domestic CO2 from 2020; reduce 2030’s CO2/pax-km by 50% from 2005; R&D for French SAF industry; 01Oct‘19

Net-zero carbon by 2050, offsetting all domestic emissions by 2020; 10Oct‘19

Net-zero carbon by 2050, CNG from 2020 on all emissions, $33M investment in SAF by 2030, matching of customer offsets; 25Nov‘19

SAF corresponding to the total jet consumption used in all SAS domestic flights, by the year 2030; 14Nov‘19

Reduce its net emissions by 50% from 2019 by the end of 2025, and achieve carbon neutrality by 2045 at the latest; 09Mar‘20

Multiple airlines now committing to net zero carbon by 2050.
Pressure to look at more progress by 2035.
Commitments of Greater Ambition
Airlines using passenger booking options to offset cost

- **Customer option to pay for incremental price of SAF of €29.50 on any flight**

- **Customer option to pay for incremental price of SAF in 20-min blocks of flight time** for €10 / block (up to 80% CO2 reductions); fuel being allocated to future flights

- **Compensaid** – calculates specific cost of SAF for specific flights and enables customer to pay for incremental price

- **Customer option to pay for incremental price of SAF for 3 categories of flight**: intra-Finland (€10), intra-EU (€20), International (€65); fuel being allocated to future flights
Other commitments of greater ambition

Norway's government introduces 0.5% blending mandate for advanced aviation biofuels from 2020; 04Oct’18

Netherlands committed to transition all military aircraft to 20/80 AJF blend by 2030 and 70% by 2050; 23Jan’19

France, in alignment with EU Green Deal goals, announces SAF targets: 2% of SAF from 2025, 5% in 2030 and 50% in 2050; 27Jan’20

DG Move have now put together a comprehensive "roadmap" as a potential way forward for an integrated approach for policy intending to foster SAF commercialization in the European Union - ReFuelEU
Paradigm changing announcements
Intent to help close price premiums

Clean Skies for Tomorrow Program

Resilient and Sustainable Aviation Fuel (RSAF) credit

Purchased of SAF for US-Netherlands flights (beyond offsetting employee travel)

SAF Now Consortium launch, 15 Nov’19
4) State of SAF production

* 2016 - 2019 production and use
* Current commercial capacity & Near term projections
* Long term projections
Where we stand on U.S. SAF commercialization
Initiation under way, still early

* Four years of sustained commercial use
* Commercial & General Aviation engaged
* One+ facilities in operation
* Two facilities under construction, others in development
* Cost delta still a challenge, with renewable diesel favored policies
* We know what impact policy had on the ramp-up of ethanol and bio-diesel / renewable diesel – it can be replicated for SAF

U.S. Annual SAF Procurements*

Credit: FAA
*Reflects voluntarily reported data on use by U.S. airlines, U.S. government, manufacturers, other fuel users, and foreign carriers uplifting at U.S. airports. ^2018 & 2019 calculation includes reported RFS2 RINs for jet fuel.*
## Worldwide SAF production forecast

Announced intentions with specific commitments to SAF

<table>
<thead>
<tr>
<th>Year-end Production Levels (M gpy)</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
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<tbody>
<tr>
<td>Paramount Porvoo</td>
<td>3+</td>
<td>#1, 7</td>
<td>Lakeview 6</td>
<td>NESTE Singapore 330</td>
<td>Go Sunshine New Orleans 29</td>
<td>worldwide energy Paramount 150</td>
<td>~70</td>
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<tr>
<td>Porvoo</td>
<td>33</td>
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<td></td>
<td>SkyNRG Delfzijl 33</td>
<td>Fulcrum #2, Gary, IN 21</td>
<td>world energy</td>
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<td>gevo Silsbee Demo quant’s</td>
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<td>gevo Luverne 10</td>
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<tr>
<td>~36 M</td>
<td>~43 M</td>
<td>~49 M</td>
<td>~422 M</td>
<td>~496 M</td>
<td>~816 M</td>
<td>~?? M</td>
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</table>

Not comprehensive; CAAFI estimates (based on technology used & public reports) where production slates are not specified.

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U.S. commercialization activity / intent
HDRD (& SAF?) from lipids/F.O.G.

- Diamond Green: Norco, LA
- REG: Geismar, LA
- World Energy: Paramount, CA
- Diamond Green expansion (275 -> 675M)
- REG Geismar expansion (75 -> 115+M)
- World Energy Paramount (40 -> 305M)
- Andeavor Dickinson, ND conv. (180+M)
- Phillips 66 / REG: Ferndale, WA
- Rhyze / Phillips 66: Reno & Las Vegas, NV (150+M)
- SG Preston: pivot announcement pending
- NEXT / Shell (575M)
- ARA licensing build-out (4+ activities)
- HollyFrontier (125 M)
- Texmark HDRD distillation
- Emerald (100M gpy)
- Tolling (Steamboat - 100M) / Co-processing

In Production:
- 390 M gpy Nameplate @ YE ’19

In Development:
- Greater than 2.2B gpy capacity by 2025 !?!

Pertinent to aviation interests in 3 ways:
- HFP-HEFA
- Direct HEFA-stream distillation pivot
- Downstream fractionation

... necessitates serious engagement with purpose grown oilseed & F.O.G. development / expansion
IATA/ATAG Waypoint 2050 activity in process

ICAO funded research on long term possibilities of SAF penetration

Scenario analysis found an extremely broad range of outcomes, from 0 to 100% replacement by SAF. ICAO defined a Vision 2050 level of 50% SAF replacement.

Laundry list of support identified. Key criteria summarized as:

...encourage States to implement the proposed developments in policy, technology and financing in order to ... progress towards the ICAO Vision

CAAFI is often asked about SAF scale-up, and responds with observation that airlines will buy all available SAF when it is competitively priced, including consideration of policy mechanisms
We need answers to these questions first:

* What is the long-term price trend for petroleum?
* What will be the impact on fuel prices from demands to lower fuel sulfur content or HAPs to meet air quality mandates due health impacts?
* What will be the impact of refineries having to rebalance the production of gasoline, diesel, and jet as the former two decline due to technology shifts, while the latter climbs?
* What will be the pricing trend (based on availability of quality offsets) of a CORSIA based carbon credit over the next 25 years? How much competition for such offsets?
* Will businesses, and their related CSR obligations (either subscribed voluntarily, or driven their by their activist shareholders), drive use of SAF, as opposed to the airlines themselves?
* When will society agree on a true price of carbon? Beyond just nebulous Paris commitments.
* Will we see monetization of environmental services, and when?
* What happens with policy (regional, federal, world-wide), and how?
* How long do “low cost feedstocks” remain low cost?? How does conversion tech progress?
* What happens to other feedstock costs as a result of growing population and farming paradigms?
* Does renewable power become ubiquitous and sufficiently low cost to accelerate PtL?
5) Moving forward

* Challenges
* Recommendations to overcoming challenges
Overall industry summary on SAF:

- SAF are key for meeting industry’s commitments
  - Delivers net GHG reductions of 65-100%, other enviro services
  - Aviation enterprise aligned, representing a ~27B gpy US & ~96B gpy worldwide opt’y
  - CAAFI and growing cohort are working to foster, catalyze, enable, facilitate, ...
  - Segment knows how to make it; Activities from FRL 1 to 9
  - Pathway identified for fully synthetic (50% max blend today)
  - First 2 facilities on-line, producing SAF at various run-rates
  - Commercial agreements being pursued, fostered by policy and other unique approaches

- Making progress, but still significant challenges – only modest production: focus on enabling commercial viability for which waste streams will play significant role

- Potential for acceleration a function of engagement, first facilities’ success replication, additional technologies that continue to lower production cost
Potential for U.S. SAF build-out
Targets of opportunity that do not compete for food or land use change

SAF from various 24x7 feedstocks (GPY, using standard conversions and product slates)

- **3.8 B** Wet Waste (manures, sanitary, misc streams)
- **3.1 B** MSW (municipal solid waste: wood, paper, yard, plastics, textiles, food)
- **6.1 B** Agricultural residues (primary crop residues only, 31% removal)
- **0.4 B** Forestry residues (30% of production uncommitted; potential of under-reporting in Billion Ton study)
- **0.8 B** F.O.G. (Fats oils and greases: estimates vary significantly, up to 3.0B)
- **1.3 B** Industrial off-gases (steel, aluminum, petroleum)
- **0.8 B** Other (C&D waste, telephone poles, rail ties, invasive tree removal)

**~15.6+B** Current Total Potential (approx. 58% of total 2019 U.S. jet fuel demand)

Additionally ... Significant potential from sustainable, purpose-grown approaches under development (e.g. in SPARC and IPREFER)
Addressing Challenges – matrix of approaches

- A4A working general Federal policy approach – tax treatment
- Low Carbon Fuels Coalition working State Approaches – LCFS
- ABFA CARRI working shortcomings of current policy – RFS
- Multiple entities lobbying Congress for funding of Agency efforts
- CAAFI advocating for continued Agency focus and collaboration, aligning SAF development with stated priorities
  - FAA, DOE and USDA have multiple targeted efforts aligned with SAF development
- EU just announced their intention for DG MOVE to develop a comprehensive SAF development roadmap – “ReFuelEU Aviation – SAF”
- Unfortunately, many challenges are unique to specific pathways, diluting messaging that we actually need an “all of the above” approach
E.g. General challenges – forestry feedstocks

* Volumes of policy-viable amounts (RFS restrictions); without policy, business case difficult
* Aggregation
  * Amounts from processing and mills are not “huge”
  * Collection of thinnings, and allowable thinning, tbd
  * NARA in-depth look at most commonly unused/wasted supply – slash piles
* Hauling (cost of moving air and water, nuisance issues)
* Although desire to use undergrowth (CA fire abatement) or dead material (BANR) is strong, have yet to see full business case pencil-out; RFS restrictions on use of feedstock from Federal Land
* Coppicing plantations
  * Establishment costs and time-to-harvest delay (AHB ongoing effort to find workable solutions)
  * Energy densification technologies unproven or unintegrated – will potentially stay that way with uncertainties above, continued public deification of forests, forests used for “generating offsets,” ...
* Competition from pellets, mass-burn, ...
Be informed, help dispel the misconceptions

- SAF are still somehow unproven, unsafe, or inferior ❌
- SAF are a decade away from reality ❌
- SAF must be sequestered, or burden infrastructure / handling ❌
- SAF will have burdensome tracking requirements ?/❌
- The low price of oil has stopped all such efforts ❌
- All SAF is “food versus fuel” and ILUC beware ❌
- Feedstock or conversion process xyz will not be a major contributor ❌
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Upcoming Events

Pending CAAFI Webinars – stay tuned for announcement with dates

- EU supported R&D activity summary, 27May
- Economic Development tools review
- Canadian Challenge finalists update

ICAO has rescheduled Stocktaking Seminar: (gathering info similar to today’s discussion content from worldwide participants)

- Online Preview held on 28Apr’20 Online Stocktaking Preview: Reducing Aviation In-Sector CO₂ Emissions
- Physical meeting in Montreal on 8-10Sep’20 Seminar on aviation in-sector CO₂ emissions reductions

ABLC – 08-10Jul’20 in D.C.

GARDN SAF Talk – being rescheduled

CAAFI CBGM – Summer 2021 in D.C.

Have an idea or interest? Let us know at info@caafi.org