Policy Panel Discussion:
Updates on International, US Federal, and State approaches

CAAFI Biennial General Meeting
Washington 4th December 2018

Robert Boyd

To represent, lead and serve the airline industry
<table>
<thead>
<tr>
<th>GOAL 1</th>
<th>GOAL 2</th>
<th>GOAL 3</th>
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</thead>
<tbody>
<tr>
<td><strong>PRE-2020 AMBITION</strong></td>
<td><strong>IN LINE WITH THE NEXT UNFCCC COMMITMENT PERIOD</strong></td>
<td><strong>ON THE 2°C PATHWAY</strong></td>
</tr>
<tr>
<td>1.5% ANNUAL AVERAGE FUEL EFFICIENCY IMPROVEMENT FROM 2009 TO 2020. TOI</td>
<td>STABILISE NET AVIATION CO₂ EMISSIONS AT 2020 LEVELS WITH CARBON-NEUTRAL GROWTH. TOI+M</td>
<td>REDUCE AVIATION’S NET CO₂ EMISSIONS TO 50% OF WHAT THEY WERE IN 2005, BY 2050. TOI</td>
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Aviation’s global market-based measure has been agreed

Historic decision at ICAO Assembly
Nearly all 191 ICAO States supported ‘CORSIA’

Ten years since industry set goals and started pushing for a global MBM
CORSIA represents a significant policy change for aviation.
An offsetting scheme…including SAF

Each company must compensate for emissions above its baseline with emission reductions achieved elsewhere or with sustainable aviation fuel.
CORSIA Eligible Fuels (CEF)

CEF provide a secondary means to comply with CORSIA Offsetting Requirements
1. Emissions Units
2. Claiming Emissions Reductions from CORSIA Eligible Fuels (CEF)

\[
\text{Emissions Reduction} = 3.16 \times \left[ \sum \text{Neat Fuel Mass} \times \left(1 - \frac{\text{Life Cycle Emissions}}{89 \text{g CO2/MJ}} \right) \right]
\]

To be eligible for CORSIA, a fuel needs to meet the CORSIA Sustainability Criteria as certified by a CORSIA Approved Sustainability Certification Scheme (SCS)

- CEF shall achieve net greenhouse gas emissions reductions of at least 10% compared to the baseline life cycle emissions values for aviation fuel on a life cycle basis.
- CEF shall not be made from biomass obtained from land converted after 1 January 2008 that was primary forest, wetlands, or peat lands and/or contributes to degradation of the carbon stock in primary forests, wetlands, or peat lands as these lands all have high carbon stocks.
- Work is ongoing on additional criteria within ICAO CAEP.
Potential CORSIA Sustainability Criteria

Work is ongoing on additional criteria within ICAO CAEP

Sustainable = environmental + social + economic

greenhouse gas (1) +
carbon in the land (2) +
water quality (?) +
soil quality (?) +
air quality (?) +
conservation (?) +
waste / chemicals (?) +
human and labor rights (?) +
land use rights (?) +
water use rights (?) +
local and social development (?) +
food security (?)
Induced Land Use Change (ILUC): included for fuels not derived from wastes, residues, or by-products

Core LCA
Stage #1: Production at source (feedstock cultivation)
Stage #2: Conditioning at source (harvest, collection, recovery)
Stage #3: Feedstock processing and extraction
Stage #4: Feedstock transportation to processing and fuel production facilities
Stage #5: Feedstock-to-fuel conversion process
Stage #6: Fuel transportation and distribution to the blend point
Stage #7: Fuel combustion in aircraft engine

Life cycle values calculated by international team of experts:

Default Core LCA Values:
- DOE Argonne National Laboratory
- Massachusetts Institute of Technology
- E.U. Joint Research Centre
- University of Toronto
- Brazilian Bioethanol Science and Technology Laboratory (CTBE)
- Universidade Estadual de Campinas

Default ILUC Values:
- Purdue University (GTAP-Bio)
- International Institute for Applied Systems Analysis (GLOBIOM)
Life Cycle Emissions for CORSIA Eligible Fuels

Two methods to determine life cycle emissions value for CORSIA Eligible Fuels

1. CORSIA default life cycle emissions values
2. CORSIA methodology for calculating actual life cycle emissions values

Default LCA values

- Values in CORSIA SARP Package calculated by team of international experts and approved by ICAO Council

Actual LCA values using CORSIA Methodology

- Airline operator / fuel producer can work with an eligible SCS to seek a core LCA value representative of their specific fuel production pathway
- SCS will need to prepare a technical report justifying actual LCA value
- Methodology uses attributional process with energy allocation of emissions among co-products to determine core LCA value
- Methodology potentially provides a means to get an ILUC value of zero for using land use change-risk mitigation practices (this aspect is still under development)
- Methodology potentially provides credits for MSW Landfill and Recycling Emissions (this aspect is still under development)
Adding New Default Life Cycle Values

*CORSIA SARP Package contains default life cycle emissions values for a number of fuel pathways.*

**Adding default life cycle values for a new fuel pathway**

- Working out final details on process and expect it to be completed in 2019. The following points are likely to be requirements.

- Key question - is the feedstock of interest a waste, residue, or by-product?
  - Yes – then no ILUC value is needed and you can use the CORSIA methodology for calculating an actual LCA value.
  - No – then a default ILUC value needs to be calculated and approved by ICAO.
  - Final definitions of main product, by-product, residue, and waste are expected in 2019.

- Key information required for adding a new fuel pathway
  - Pathway uses ASTM certified conversion process, or conversion process with Phase 2 ASTM Research Report that was reviewed and approved by OEMs.
  - Conversion process has been validated at sufficient scale to establish a basis for facility design and operating parameters at commercial scale.
  - There is sufficient data on conversion process, feedstock, and region of interest to perform life cycle modelling.
CORSIA Monitoring, Reporting and Verification

Kerri Henry
Transport Canada
December 4, 2018
PHASED APPROACH TO IMPLEMENTATION

- January 1 2019: Start of Monitoring, Reporting and Verification (MRV)
  - Operators in all states with at least 10,000 tonnes of in scope emissions

- January 1 2021: Start of Compliance phase
  - All operators continue to undertake MRV on all in scope routes
  - A subset will also need to meet offsetting compliance obligations
COVERED OPERATIONS

- Scheme targets operators on international flights that emit more than 10,000 tonnes of CO2 emissions annually.

- New entrants are exempted from the application of the offsetting portion of CORSIA for the first 3 years or until its annual emissions exceed 0.1% of total 2020 emissions, whichever comes first (still have to do MRV).

- MRV not required for (out of scope emissions):
  - Domestic aviation
  - Aircraft with less than 5,700 kg Maximum Take Off Mass
  - Humanitarian, medical or firefighting operations
  - Helicopter operations
  - State/military aircraft
MONITORING

- Starting January 1, 2019

- **Monitoring** of fuel use on each flight and calculation of CO₂ emissions (1 tonne fuel burn = 3.16 tonnes CO₂ emissions) based on approved eligible method
  - All operators have access to 5 direct monitoring methods
  - Small operators also have access to a tool from ICAO that estimates emissions based on flights ([https://www.icao.int/environmental-protection/CORSIA/Pages/Agreement.aspx](https://www.icao.int/environmental-protection/CORSIA/Pages/Agreement.aspx))

- All operators must develop an Emissions Monitoring Plan to explain their proposed approach
  - Approved by state only once, unless material changes
OPERATOR REPORTS

- On annual basis, submit **Emissions Report**
  - Baseline period (2019-2020):
    - Due by May 31 of subsequent year
    - Includes identification, fuel, airplane, flight, emissions information

- Starting in 2021
  - Due by April 30
  - Also include CORSIA eligible fuels information

- Every 3 years starting in 2025, submit **Emissions Unit Cancellation Report**
  - Due by April 30
  - Includes detailed information on units cancelled
  - Preceded by public communication of offset cancellations by Feb 7
VERIFICATION

- Verification of reported information to ensure completeness and to avoid misstatements.
  - Voluntary pre-verification modules for industry
  - Third party verification according to ISO 14064.3 required for all in scope operators
  - Order of magnitude verification by states

- Third party verification of emissions reports and emissions units report

- Verification bodies accredited to ISO 14065 and CORSIA and carry out verifications in accordance with ISO 14064.3 and CORSIA

- Verification reports also due to state by May 31 in 2020, 2021 then by April 30
INFORMATION FLOW EXAMPLE

Verifier
Verification documents

Operator
Operations information

State
Oversight: Order of magnitude checks

ICAO
Compile data
Generate implementation elements

Public
CORSIA website/registry

Verifier
Verification reports

State
State reports, lists, participation information

Operator
Emissions monitoring plans, Operator reports

ICAO
Default LCAs, SCS, ILUC …

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Default LCAs, SCS, ILUC …

Public
CORSIA website/registry
ANNUAL CEF REPORT CONTENT

Contact info, neat fuel producer  
Production location  
Production date  
Purchase date of neat fuel  
Proportion of neat batch purchased, total mass of each neat batch  
Name and contact information of intermediate producer, party shipping to blender and blender  
Location of blender  
Date the fuel received by blender  
Blend ratio  
Documentation of blend to aviation fuel  
Evidence that meet sustainability criteria  
LCA and ILUC values  

(Aggregated by state)  
Mass of neat CORSIA eligible fuel blended  
Reduction claim  

Production year  
Name of producer of neat fuel  
Batch number  
Mass of each batch of neat fuel  
Type of fuel  
Feedstock  
Conversion process
Overview of CORSIA and the Role of Alternative Jet Fuel (Meeting Certain Criteria …)


Nancy N. Young, Vice President, Environmental Affairs

December 4, 2018
ICAO’s “Carbon Offsetting & Reduction Scheme for International Aviation” (CORSIA)

» **Global Carbon Offsetting Scheme**
  - Not a carbon tax or emissions trading scheme

» **Applies to Aircraft Operators, International Only**
  - Exemptions for aircraft ≤ 5,700 kg, operators with ≤ 10,000 metric tons CO2, and humanitarian, medical, firefighting flights

» **Offsetting to Help Meet the Carbon Neutral Growth from 2020 Goal**
  - Offset the increase in CO2 emissions of international flights between participating countries after 2020, from averaged 2019-2020 baseline
ICAO CORSIA (cont.)

» Timeframe for Offset Requirement: 2021-2035

» But, Operators’ Emissions Monitoring, Reporting & Verification (MRV) Begins in 2019 and Is Annual

  • Alternative fuel is NOT included in the 2019-2020 period; only becomes relevant in 2021 when the offsetting obligation begins

» Demonstration of Compliance with Offset Requirement Every 3 Years

» Country-by-Country Implementation, with Certain Reporting to and Determinations by ICAO
Emissions Savings from an Operator’s Purchase of “CORSIA Eligible Fuels” (CEF) Reduces Individual Operator Offset Obligations

- Emissions savings from CEF are NOT separately accounted for during the 2019-2020 period; they become relevant in 2021 when the offsetting obligation begins.

CORSIA Is In Lieu of Other Measures Imposed by States on International Aviation

“Determines that the CORSIA or any other scheme decided by the Assembly is to be the market-based measure applying to CO2 emissions from international aviation.”
How/When the **Offsetting** Obligation Applies

- **2021-2026**, Voluntary “Phase In” for **Countries**
- **2027-2035**, Mandatory Other than Exempt Countries and Routes to/from Those Countries
  - Exemptions for certain least developed countries (unless volunteer)
- **No Offsetting Obligation** for Flights to/from Exempt Countries (but All Countries Must Do Emissions Monitoring)
- **76 Countries**, Representing 76% of International Aviation Activity, Have Volunteered So Far

List of Countries on ICAO Website:
[https://www.icao.int/environmental-protection/CORSIA/Pages/state-pairs.aspx](https://www.icao.int/environmental-protection/CORSIA/Pages/state-pairs.aspx)
What Is CEF as Defined by CORSIA?

Note: What Is Typically Considered “Alternative” Fuel Is a Subset

- A “CORSIA Sustainable Aviation Fuel” or a “CORSIA Lower Carbon Aviation Fuel”
  - “CORSIA Sustainable Aviation Fuel”: renewable or waste-derived aviation fuel that meets the CORSIA Sustainability Criteria
  - “CORSIA Lower Carbon Aviation Fuel”: fossil-based aviation fuel that meets the CORSIA Sustainability Criteria

Defined in the “Standards & Recommended Practices” (SARPs) Package that Establishes the “Rules” for Implementing CORSIA, in Volume 4, Annex 16, to the Chicago Convention.
ICAO CORSIA and the Role of CEF
Approach to “Crediting” CEF

» Lifecycle GHG Emissions Savings from CEF Reduces Individual Operator Offset Obligation

» ICAO CORSIA SARPs Package includes:
  • Lifecycle GHG emissions analysis (LCA) methodology
  • Sustainability requirements: (1) >10% relative LCA benefit; (2) protection for high carbon stock land
  • Sustainability certification requirements
  • SAF purchase monitoring, reporting & verification

» ICAO to Consider Additional Sustainability Criteria Before 2021 Implementation
If You Want to Feel Good About the Future, Look Up!

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CAAFFI®
FUELING SOLUTIONS FOR SECURE & SUSTAINABLE AVIATION
RFS2 and U.S. Federal Alternative Fuels Regulation

Michael McAdams
Advanced Biofuels Association

December 4, 2018
Who We Are
# RVO Mandates, 2015-2020

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<tbody>
<tr>
<td><strong>Cellulosic biofuel</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(D3) (million gallons)</td>
<td>123</td>
<td>230</td>
<td>311</td>
<td>288</td>
<td>418</td>
<td></td>
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<tr>
<td><strong>Biomass-based diesel</strong></td>
<td></td>
<td></td>
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<tr>
<td>(D4) (billion gallons)</td>
<td>1.73</td>
<td>1.90</td>
<td>2.00</td>
<td>2.1</td>
<td>2.1</td>
<td>2.43</td>
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<td><strong>Advanced biofuel</strong></td>
<td></td>
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<tr>
<td>(D5) (billion gallons)</td>
<td>2.88</td>
<td>3.61</td>
<td>4.280</td>
<td>4.29</td>
<td>4.92</td>
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<tr>
<td><strong>Renewable fuel (D6)</strong></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>(billion gallons)</td>
<td>16.93</td>
<td>18.11</td>
<td>19.28</td>
<td>19.29</td>
<td>19.92</td>
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2019 Regulatory Priorities

- 2019 RVO
- E-15/ Transparency Rule
- Set vs. Reset and 2020 RVO
- Biointermediates
  - Segregation vs. aggregation
  - Mass balance vs. C-14 dating
- Pathways
- Small Refinery Exemptions (SREs)
Alternative Jet Fuel Policy Goals

Consumers are increasingly aware of aviation carbon impact, and want to participate in real change

Now is the time to drive policies to enable alternative jet fuel commercialization, to build positive perceptions of the aviation industry and its brands
Low Carbon Fuel Standard Initiative

Joint Effort

Airlines
particularly United Airlines

Airports
particularly San Francisco International Airport

Alternative Jet Fuel Producer Group

AJF Producer Group

Airlines for America™
We Connect the World

United Airlines

Fulcrum
BIOENERGY

gevo

Red Rock Energy

Velocys
California’s Low Carbon Fuel Standard (LCFS)

- Authorized by AB 32 and SB 32 and supported by Executive Order
- Developed by California Air Resources Board (CARB)
- Regulated parties must obtain LCFS Credits by blending low carbon fuels or buying credits to meet annual standard for their transportation fuel volume
- Annual standard is a carbon intensity measurement: **GHG Performance Efficiency**
- Declines 1.25% per year through 2030
LCFS Rulemaking

- 2 ½ year process
- Extensive engagement with CARB
- Informal meetings
- Workshops
- Formal rulemaking process
- Succeeded in bringing AJF into LCFS on opt-in basis
- Effective January 1, 2019
Generate Credits for Carbon Intensity Below Annual CI Benchmark for Jet
Clean Fuels Program (CFP) Rulemaking

- Comparable program
- Oregon Department of Environmental Quality (DEQ)
- Began five years later
- Leverages California program
- Pathways are similar
- Approved by EQC to bring AJF into CFP on opt-in basis
- Effective January 1, 2019
Value of LCFS Credit per MT

Carbon Impact (CI) for AJF is variable

Feedstock
Process
Other Factors

Recent Value

Per CA Gallon
MT = $186
CI = 40 = $1.19
CI = 10 = $1.83

Per OR Gallon
MT = $102
CI = 40 = $0.65
CI = 10 = $1.00

This chart tracks credit prices and transaction volumes over time. Monthly average credit prices reported by Argus Media and OPIS [used with permission] are shown along with ARB monthly average price.

Click to download the Excel spreadsheet of this graph.
LCFS Cost Impact on Diesel Fuel

<table>
<thead>
<tr>
<th>Product</th>
<th>Low</th>
<th>High</th>
<th>Mean</th>
<th>Change</th>
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<tbody>
<tr>
<td>Carbon Credit ($/MT)</td>
<td>140.000</td>
<td>145.000</td>
<td>142.5000</td>
<td>1.0000</td>
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<tr>
<td>CI Pts Ethanol ($/Cl)</td>
<td>0.01141</td>
<td>0.01182</td>
<td>0.011615</td>
<td>0.000080</td>
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<tr>
<td>CI Pts Biodiesel ($/Cl)</td>
<td>0.01766</td>
<td>0.01829</td>
<td>0.017975</td>
<td>0.000125</td>
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<tr>
<td>Carbon CPG Diesel (cts/gal)</td>
<td>6.72</td>
<td>6.96</td>
<td>6.840</td>
<td>0.050</td>
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<td>Carbon CPG Dsl 95% (cts/gal)</td>
<td>6.38</td>
<td>6.61</td>
<td>6.495</td>
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<tr>
<td>Carbon CPG Gasoline (cts/gal)</td>
<td>10.43</td>
<td>10.80</td>
<td>10.615</td>
<td>0.075</td>
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<tr>
<td>Carbon CPG Gas 90% (cts/gal)</td>
<td>9.38</td>
<td>9.72</td>
<td>9.550</td>
<td>0.070</td>
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LCFS addresses the toughest GHG sector: value of 10x plus over cap-and-trade

With OPIS copyright approval; data from March 29, 2018
Cap & Trade Costs

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<tr>
<th>Product</th>
<th>Price</th>
<th>Wk Avg</th>
<th>30-Day Avg</th>
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<tr>
<td>Summer CARB RFG-R</td>
<td>11.83</td>
<td>11.848</td>
<td>11.881</td>
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<tr>
<td>Summer CARB RFG-M</td>
<td>11.80</td>
<td>11.818</td>
<td>11.852</td>
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<tr>
<td>Summer CARB RFG-P</td>
<td>11.79</td>
<td>11.808</td>
<td>11.842</td>
</tr>
<tr>
<td>Winter CARB RFG-R</td>
<td>11.80</td>
<td>11.818</td>
<td>11.858</td>
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<tr>
<td>Winter CARB RFG-M</td>
<td>11.80</td>
<td>11.818</td>
<td>11.858</td>
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<tr>
<td>Winter CARB RFG-P</td>
<td>11.82</td>
<td>11.834</td>
<td>11.871</td>
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<td>CARB No.2</td>
<td>15.03</td>
<td>15.052</td>
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<tr>
<td>B5 Biodiesel</td>
<td>14.28</td>
<td>14.302</td>
<td>14.347</td>
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<tr>
<td>Propane</td>
<td>8.25</td>
<td>8.262</td>
<td>8.288</td>
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<tr>
<td>LNG (cts/DGE)</td>
<td>10.75</td>
<td>10.762</td>
<td>10.796</td>
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Cap-and-trade remains inapplicable to jet fuel and AJF

With OPIS copyright approval; data from March 29, 2018
2019 US Opportunities

- Develop optimal policy structure for airlines
- Need public support from aviation industry to keep succeeding
Essentials for 2019

- Continued leadership from A4A, CAAFI
- Sustained support for federal agencies and U.S. military
- Public and vocal support from aviation industry in Washington state and potentially other states
- Optimal Policy Structure for decarbonizing aviation
- Cannot win policy battles from the sidelines
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