South African Airways Biofuel Program

25 October 2016

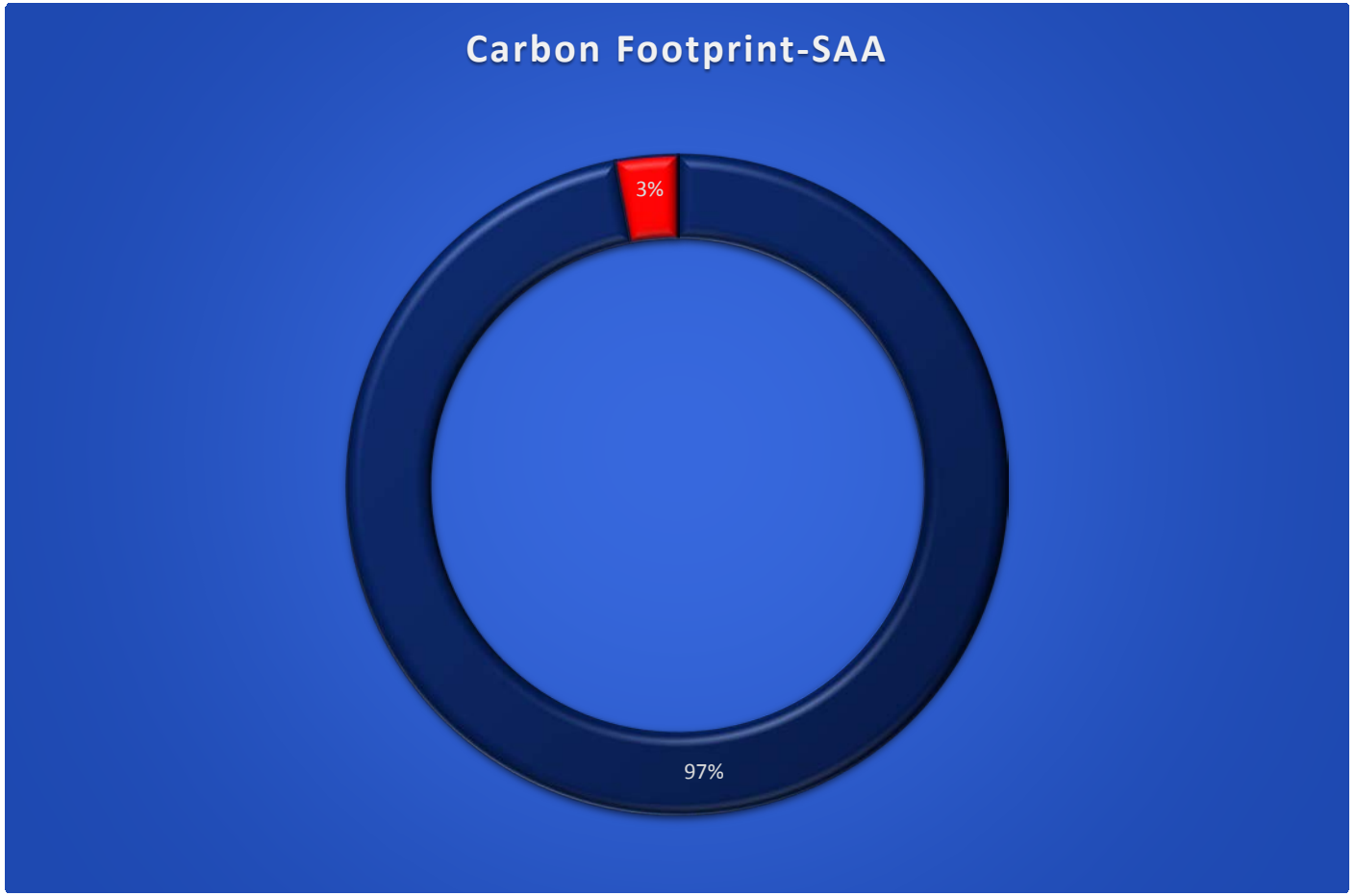
SOUTH AFRICAN AIRWAYS

SAA's environmental sustainability

The South African Airways Group aspires to conduct business in the most sustainable way possible and aims to actively contribute to the South African National Climate Change Response goals and global industry commitments and to become
the most environmentally sustainable airline group in the world.

SOUTH AFRICAN AIRWAYS

SAA's footprint



South African Airways

Biofuels, biofuels and biofuels

Biofuels can be created from:

Waste Gas

Sunlight

Waste oils

Municipal So

Seemingly, al

SOUTH AFRICAN AIRWAYS

Project Solaris-the right project for Africa

- Low tech-small hold farmers already do it;
- Proven technology-HEFA process;
- By-product or co-product-Not solely for biofuel;
- Rotation crop-Excellent rotation crop that mitigates food vs fuel;
- Labour intensive;
- Regional aggregation and development;
- Central refinery (complex tech) requires Hydrogen

Project Solaris-the right project for Africa

SOUTH AFRICAN AIRWAYS

RSB
ROUNDTABLE ON SUSTAINABLE BIOMATERIALS

- Social protection
- Environmental sustainability-water, food vs fuel
- Credibility
- WWF-SA|RSB Biofuel Project-no unintended consequences

THE END GAME

Goals

Utilise 20 million litres of Bio Jet fuel by Q4 2017

Produce 500 million litres of bio jet fuel by Q4 2023

The 'HOW'

- Regional approach- Solaris to be grown throughout the region
- Beneficiation in each region and in each country-each region or country presses it's own production and produces seed cake and oil.
- Oil to be sold to South Africa
- South Africa to establish a bio-refinery for bio diesel and bio jet fuel

Macro economics for the region

- Security of supply-SA to produce it's own fuels and de-couple from the global oil supply and the volatility around the oil price
- Social impacts-thousands of jobs + empowerment of small hold farmers
- Retained tax revenues
- Balance of payments-contribute to a positive trade balance and currency appreciation
- Reduced currency exposure and outflows of foreign currency

THANK YOU

aireg

Aviation Initiative for Renewable Energy in Germany e.V.

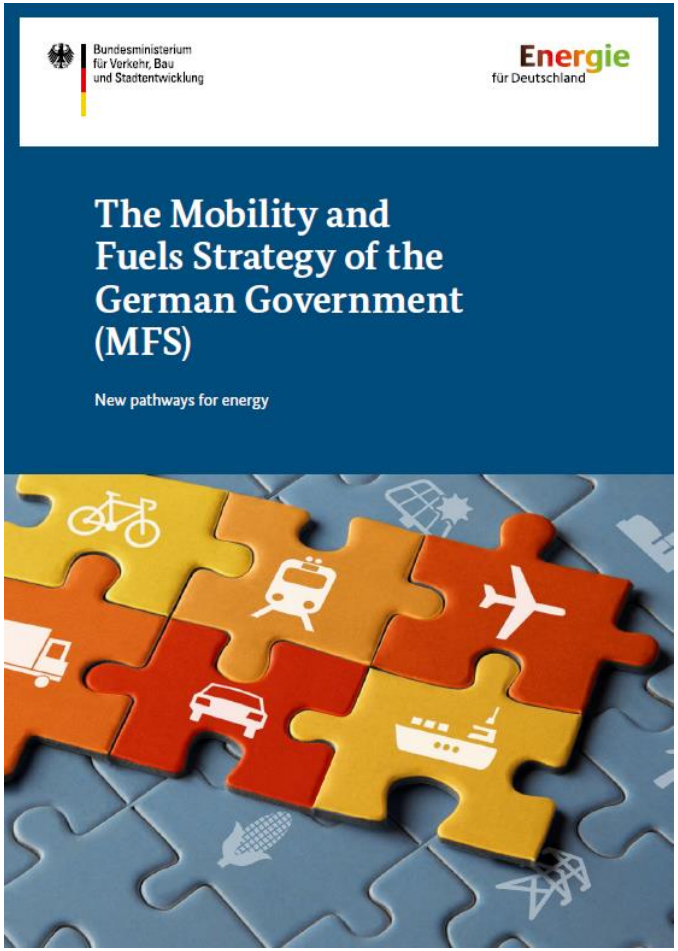
The future of climate-friendly aviation:
Ten percent alternative aviation fuels in Germany by 2025

aireg
Aviation Initiative for
Renewable Energy in Germany e.V.

Project No. 1

aireg
Aviation Initiative for
Renewable Energy in Germany e.V.

- **Feasibilty Study for a commercial scale HEFA bio-refinery in Germany with hydrogen supply based on Biomethane reforming and PtG Power-to-Gas**
- **Sponsored by BMVI (German DOT)**
- **Headed by DBFZ (German Biomass Research Institute, Leipzig)**



Project No. 2

aireg
Aviation Initiative for
Renewable Energy in Germany e.V.

- **Benchmark study IATA 2050 – requirements and next steps based on German Air Traffic development and jetfuel uplift**
- **Sponsored by BMVI (German DOT)**

- **Headed by Technical University Hamburg-Harburg**

Project No. 3

aireg
Aviation Initiative for
Renewable Energy in Germany e.V.

- **Multiblend Study consisting of**
  - AtJ blend
  - BtL blend
  - Farnesan blend
  - HEFA blend
  Four blends to be mixed with JET A-1 from one batch
- **Sponsored by BMVI (German DOT)**
- **Headed by DBFZ (German Biomass Research Institute, Leipzig)**

Project No. 4 (planned)

aireg
Aviation Initiative for
Renewable Energy in Germany e.V.

- **Behaviour of jetfuel blends in airport fuel storages and hydrant systems in daily operations at MUC airport**
- **„Fit-for-purpose“ test during regular airport operations**
- **To be sponsored by the Bavarian State Ministry of Economics, Munich**
- **Headed by aireg, Berlin**

Celebrating 5 years….

aireg
Aviation Initiative for
Renewable Energy in Germany e.V.

- aireg was founded in June 2011 in Berlin under the patronage of Secretary of Transport, Dr. Peter Ramsauer
- aireg enjoys partnering with CAAFI, the world‘s leading initiave for sustainable aviation!
- aireg is a strategic partner of IATA

AIR CANADA

PROJECT ACTIVITY IN CANADA

Mena Salib

Manager, Aircraft Noise and Emissions

Oct 2016

What's been done

AC Bio Fuel Flights - 2012

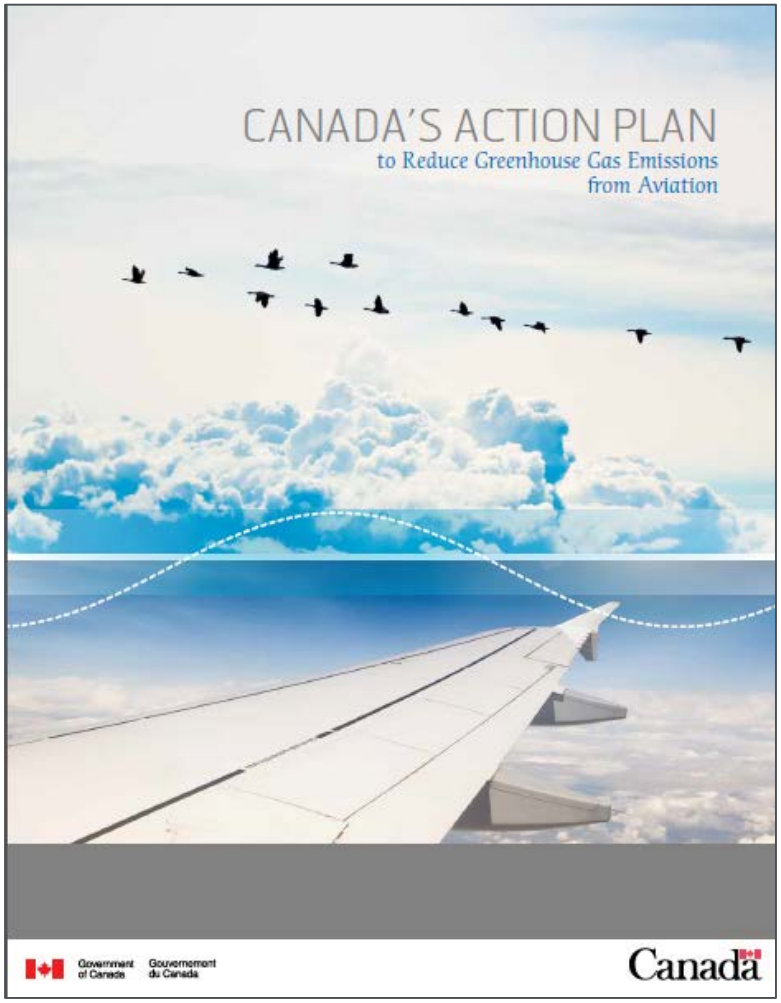
Perfect Flight: Rio+20 UN Sustainable Development

- Airbus and SkyNRG
- Cooking Oil feedstock
- AC991 Toronto-Mexico City
- Airbus A319
- 40% CO2 emission reduction

Olympic Biofuel Flight

- Flew Canadian Olympic Team Members to London Games
- Used remainder of fuel from Perfect Flight
- AC864 Montreal-London
- Airbus A330
- 10% CO2 emission reduction

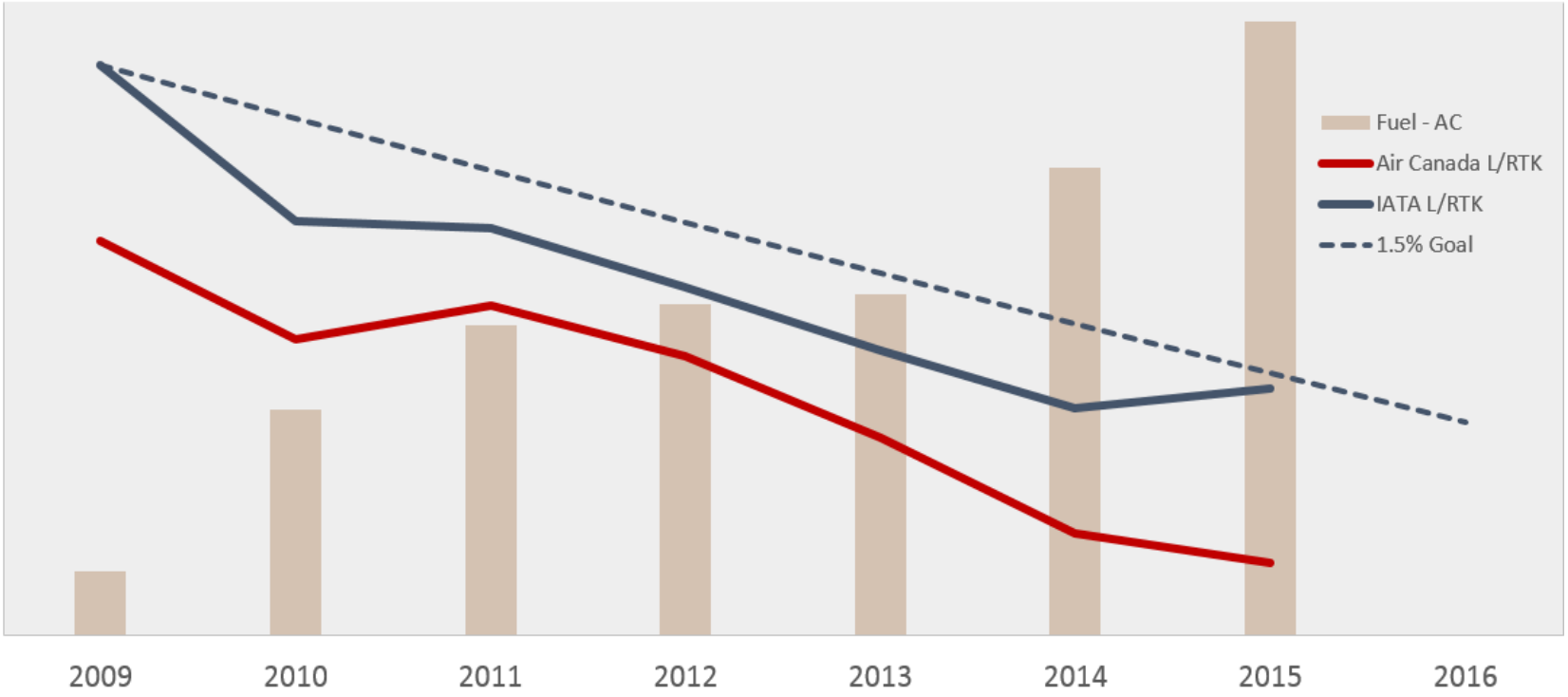
Canada's Aviation Action Plan to Reduce Greenhouse Gas Emissions



- **1.5% target** per year fuel efficiency improvement until 2020 from a 2005 baseline
- **2% aspirational goal** per year fuel efficiency improvement until 2020 from a 2005 baseline
- **Carbon neutral growth**
  Support for ICAO's 2020 MBMs

Fuel Efficiency Progress

- **Fuel Efficiency Improves**
- **Net emissions continues to grow with increased traffic demand**

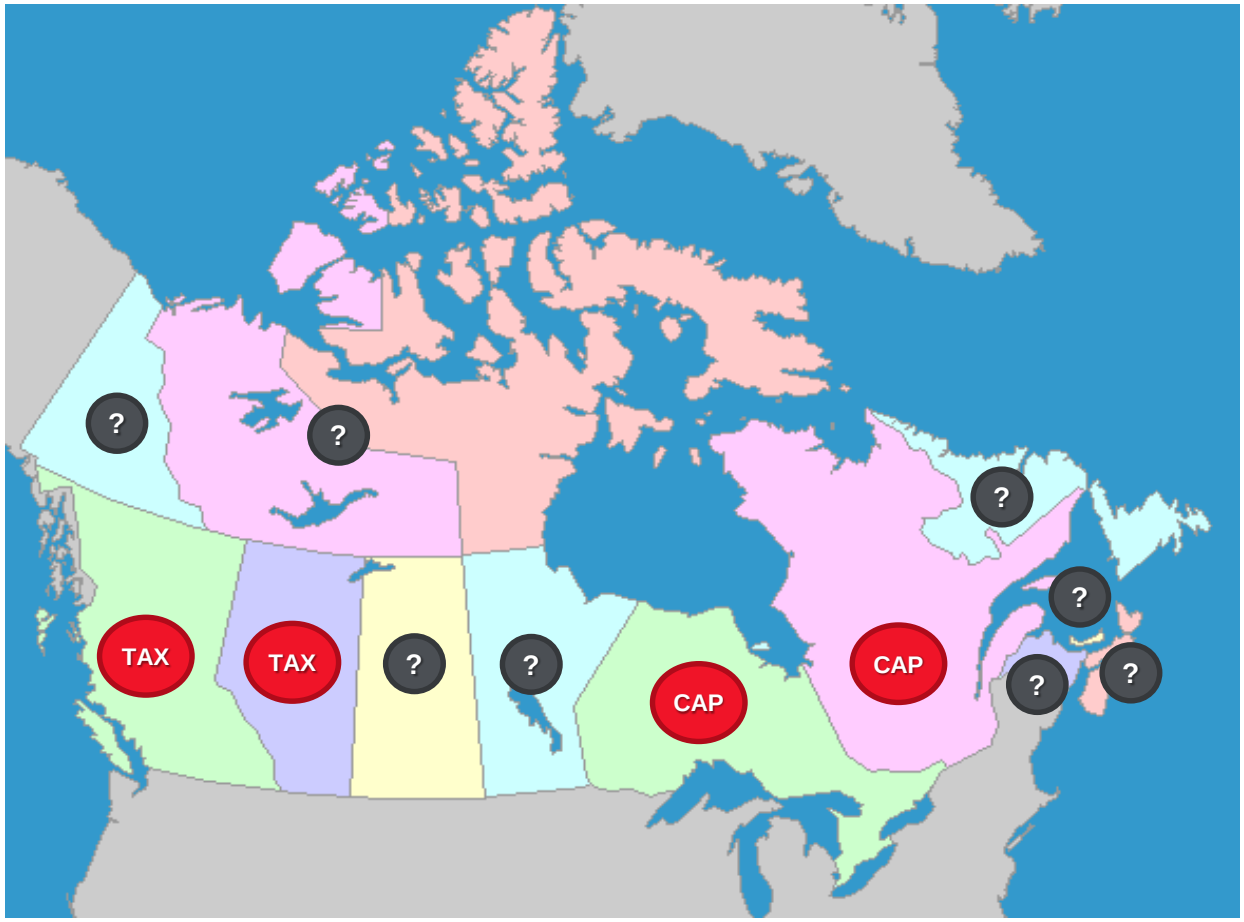


Carbon Pricing

Carbon Tax

- **Minimum cost on Carbon**
  - 10$ per tone by 2018
  - 20$ per tone by 2019
  - 30$ per tone by 2020
  - 40$ per tone by 2021
  - 50$ per tone by 2022
- **Left for the Provinces to implement**

Creates a Patchwork



Not feasible to manage 10 different carbon tax systems

Negative impacts of Carbon Pricing

- **Move passengers towards competing airports**
- **Reduces access to travel lower & middle income families**
- **Indirectly increase cost of goods moving in Canada**
- **Indirectly impacts northern and aboriginal communities**
- **Revenue is not required to be recycled into an Aviation Solution**

Negative impacts of Carbon Pricing

- Move passengers towards competing airports
- Reduces access to travel lower & middle income families
- Indirectly increase cost of goods moving in Canada
- Indirectly impacts northern and aboriginal communities
- Revenue is not required to be recycled into an Aviation Solution
- **Does not reduce Carbon Emissions**

Canada's Sustainable Aviation Bio-Fuels

Opportunity

The Great Canadian Potential

With Canada's abundance in natural resources, scientific leadership and experience with fuel refinement, we believe there is a Canadian potential for:

- Canadian sourced feedstock
- Refinement of final product in Canada
- Supply fulfill all types of energy demands

This can be achieved with the development of the right policy and government incentives.

Looking Ahead

Air Canada's Bio-Fuel Projects

Clean Transportation Initiative (CTI)

Completed

Project Scope:

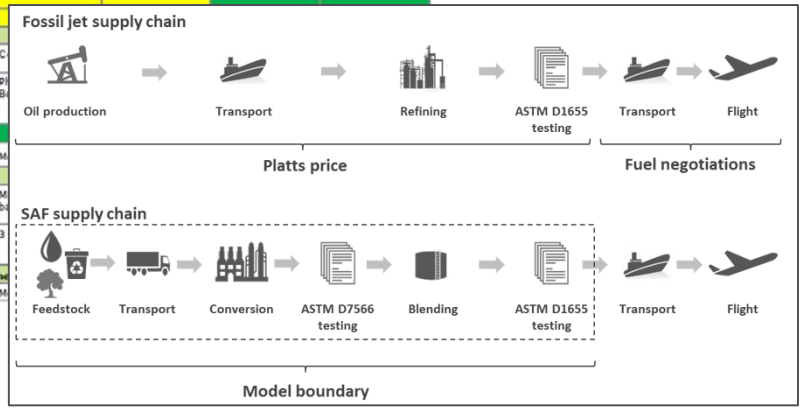
- **Assess the feasibility, cost, and environmental impact of establishing aviation biofuel supply chains at key locations in Canada**

AIR CANADA · IATA · waterfall group · novoenergy · AirTrav · Pierre Poitras et Associés · SkyNRG · Réseau BIOFUELNET Canada

Canadian Assessment of

- **Feedstock**
- **Sustainability**
- **Economics**
- **Supply chain**
- **Policy**

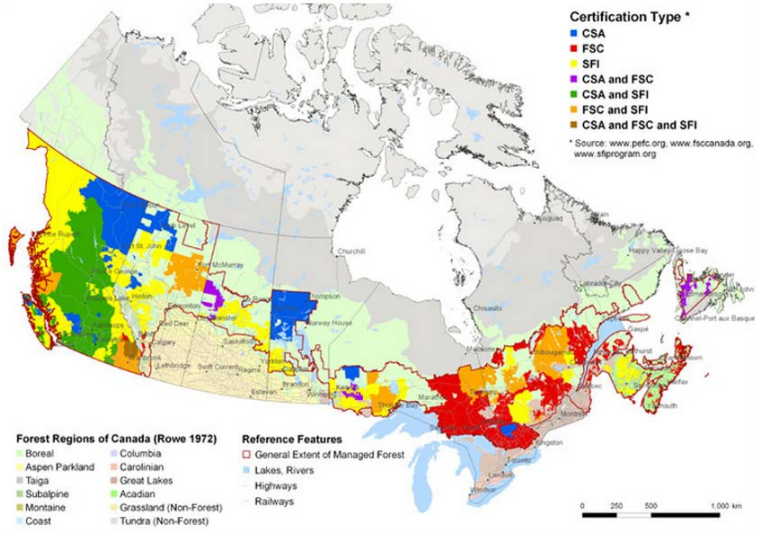
Aspect	2BSvs	Bonsucro EU	ISCC EU	RSB EU RED	RSPO-RED
Scope					
Feedstock coverage	All	Sugarcane	All	All	Palm Oil
Recognition of other EU schemes					
Mandatory Sustainability criteria					
Coverage of RED land criteria					
Soil, water and air protection					
Social					
Economic					
Chain of Custody (CoC) and Traceability					
Mass balance	Continuous	C			
Further CoC options	No	Pl Ba			
Unique ID number for consignment					
Coverage of tracked information through the supply chain	Low	M			
Auditing					
Unit of certification	First gathering point and supply base	M ba			
Certificate validity	5 years	3			
Relative cost of compliance compared to other sche					
	Low	M			



CTI: Understanding Canada's Potential

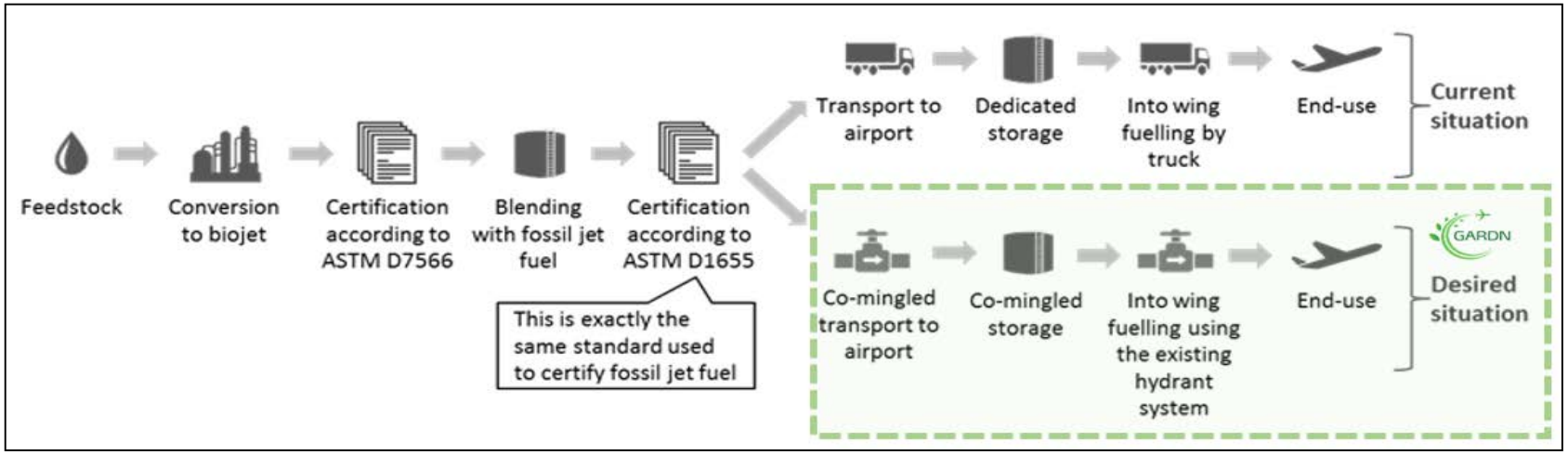
Completed

Biojet Scenario	Technology Scenario	West	East
2020	Hydrotreated Esters and Fatty Acids (HEFA)	AB: Edmonton Region	ON: Southwestern Ontario / Sarnia
2025	Hydrotreated Depolymerized Cellulosic Jet (HDCJ) via pyrolysis	AB: Northern Alberta / Edmonton Region BC: Prince George	ON: Southwestern Ontario / Sarnia QC: Montreal/Quebec City



Canadian Biojet Supply Chain Initiative (CBSCI)

Directly introducing bio-fuel into a shared airport fuel tank



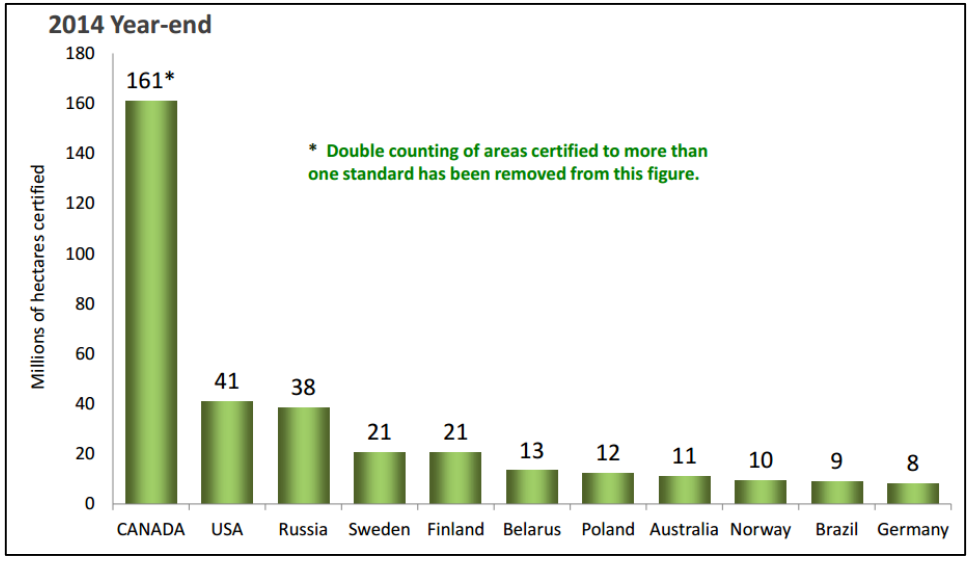
AIR CANADA · RÉSEAU BIOFUELNET CANADA · IATA · waterfall group · GARDN · Green Aviation Research & Development Network · Groupement Aéronautique de Recherche et Développement en eNvironnement · CAAFI · Transport Canada · Transports Canada · BOEING · Queen's University · McGill University · University of Toronto · SkyNRG Future Friendly Flying · ASCENT · NRC·CNRC

THE ATM PROJECT

- Assessment of likely Technology Maturation pathways used to produce biojet from forest residues

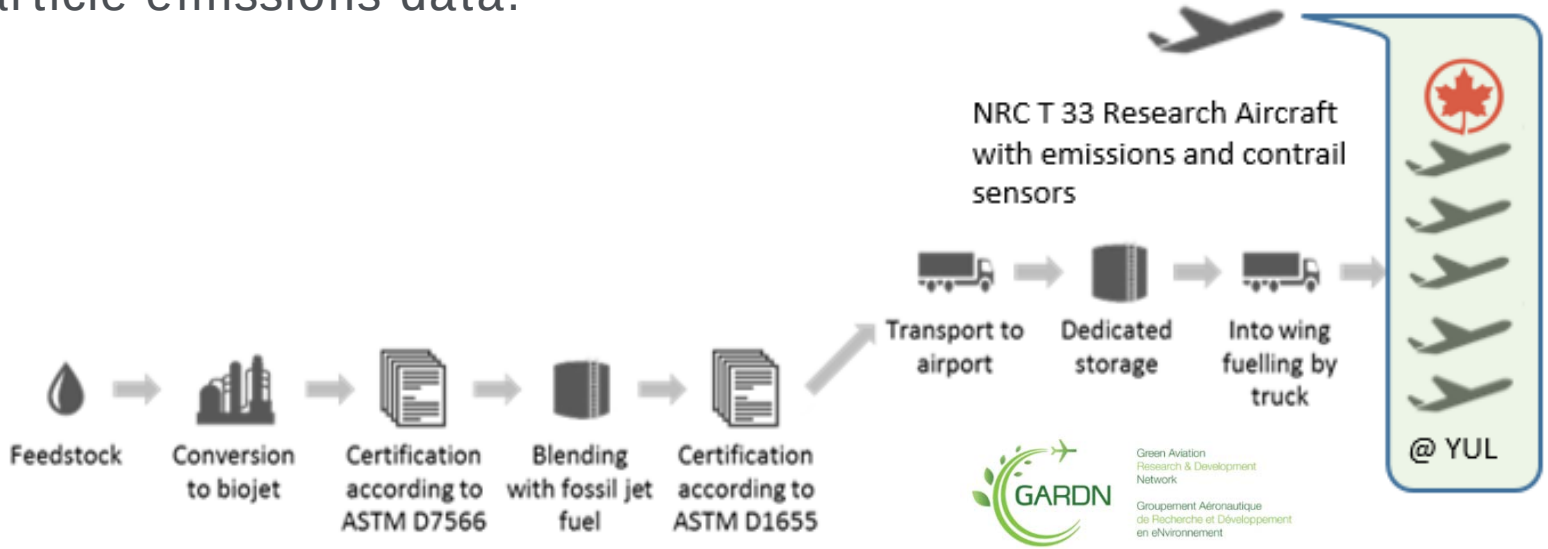
GARDN
Green Aviation Research & Development Network
Groupement Aéronautique de Recherche et Développement en eNvironnement

BOEING NORAM UBC SkyNRG WESTJET BOMBARDIER the evolution of mobility



Civil Aviation Alternate Fuel Contrail and Emissions Research (CAAFCER)

- Trailing aircrafts with contrails with a T33 collecting Biofuel particle emissions data.



Thank You