Feasibility of a biojet fuel supply chain in Canada

A project under Canada's Clean Transportation Initiative (CTI)

April 28, 2014

Fred Ghatala
Partner, Waterfall Group

NORTHWEST WOOD-BASED
BIOFUELS + CO-PRODUCTS
CONFERENCE

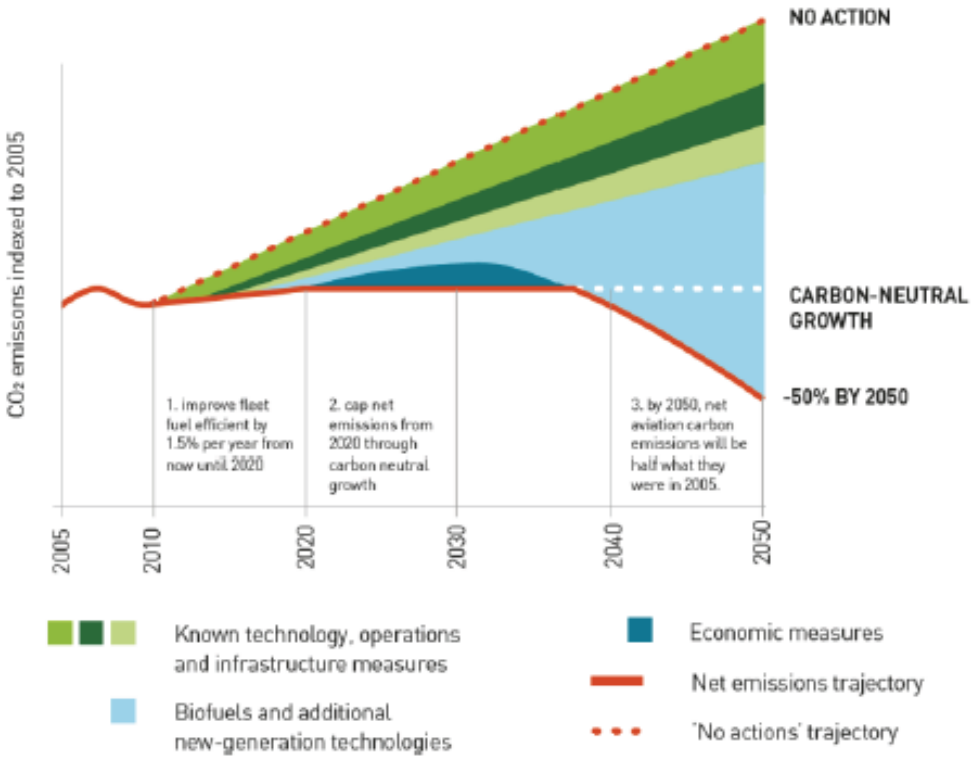
Presentation Outline

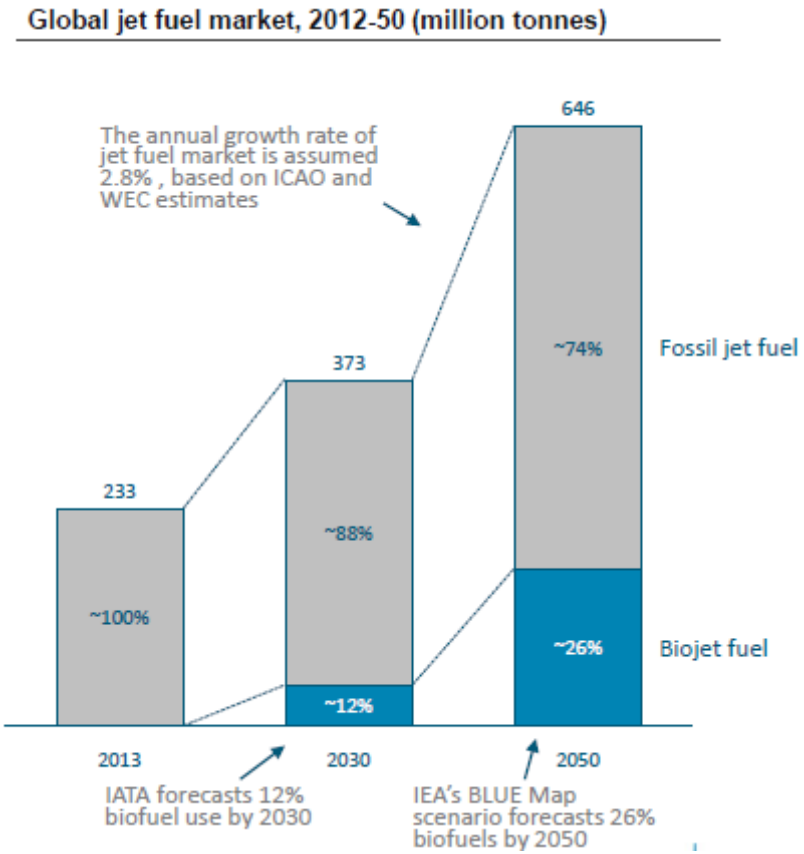
- Biojet for reducing aviation GHG emissions
  - Technology
  - Initiatives
  - Sustainability
- Project under Transport Canada's 'Clean Transportation Initiative' Aviation Sector
- Observations

Select Information and Observations on Biojet

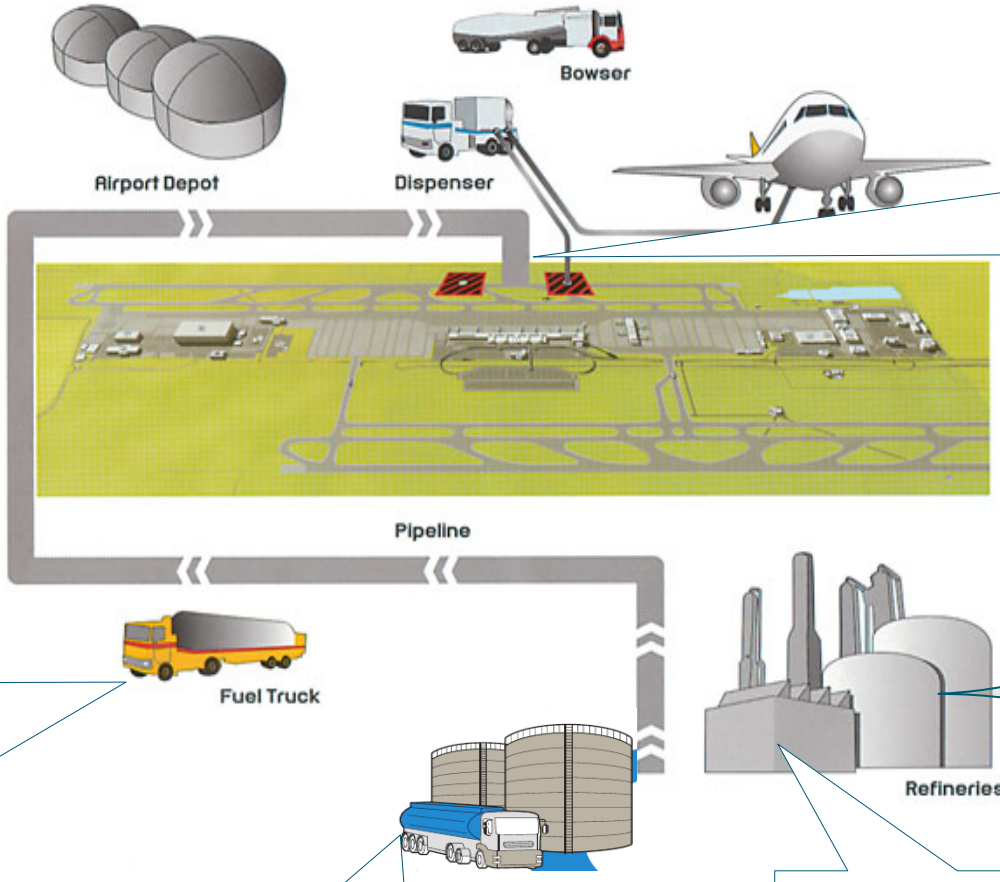
Biojet basics, briefly

- Biojet – considered a drop In fuel
- Existence of technical specification allowing up to 50% biojet fuel content
  - ASTM D67566 (biojet spec) into ASTM D1655 (Jet A spec)





Upstream/Downstream Logistics



4. Options for into plane logistics:

- With Bowser trucks
- Using the airport's fuel hydrant system (unique)
- Trials expected at Schipol and Valencia airports

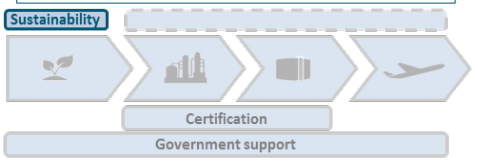
Multiple Feedstocks

3. Options for transport to the airport:

- Pipeline connection
- Trucking
- Rail tank car
- Shipping

2. Physical blending & Re-certification to jet A(A1) (ASTM D1655)

1. Certification of biojet fuel (ASTM D7566)



Overview of conversion pathways

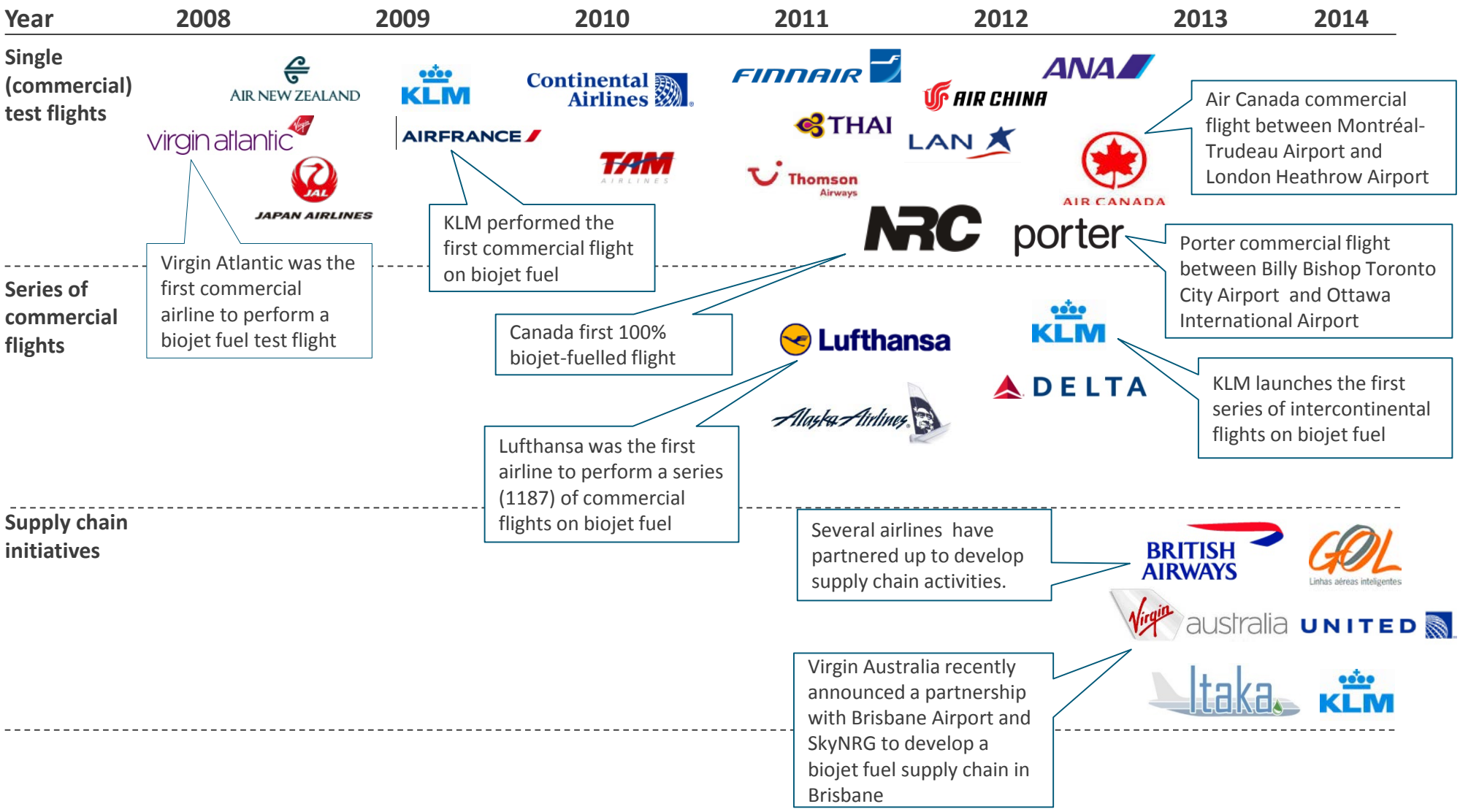
Pathway	ASTM certified	Description	Target feedstock	1st commercial facility expected to be available
Fischer-Tropsch (FT)	✓	Converts any carbon-rich material (e.g. biomass) into sugars which is then catalytically converted to jet	All biomass & MSW	Unclear. Large uncertainties
Hydrotreated Esters and Fatty Acids (HEFA)	✓	Converts oil to jet via deoxygenation with hydrogen and cracking	Oils and fats	2010
Alcohol to Jet (ATJ)	2014***	Uses alcohols derived from sugars and starches and converts them to jet via dehydration, oligomerization and hydrogenation	All alcohols (based on biomass, MSW and waste gases)	2017
Direct Sugars to Hydro Carbons (DSHC)*	2014***	Ferments plant sugars and starches to hydrocarbons which are subsequently thermo-chemically upgraded to jet fuel	Sugars (incl. C6 cellulosic sugars)	2017
Hydrotreated Depolymerized Cellulosic Jet (HDCJ)**	2015***	Converts any carbon-rich material into a bio-crude oil via thermochemical depolymerization which can then be upgraded to jet	All biomass & MSW	2018

*This includes Direct Sugars to Hydrocarbons (DSHC)

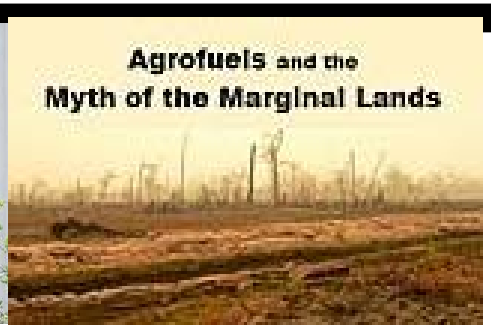
**This includes, amongst others, pyrolysis and Hydro Thermal Upgrading (HTU)

*** Expected year of certification

The biojet fuel market for aviation is growing; shift from single flights towards supply chain development initiatives



‘Sustainable’ biomass feedstock is the key to ‘sustainable’ biofuels



Project Introduction

Project Overview

Project Team

SkyNRG
Sky Energy | The Fuel Future

External Advisors

Pierre Poitras et Associés

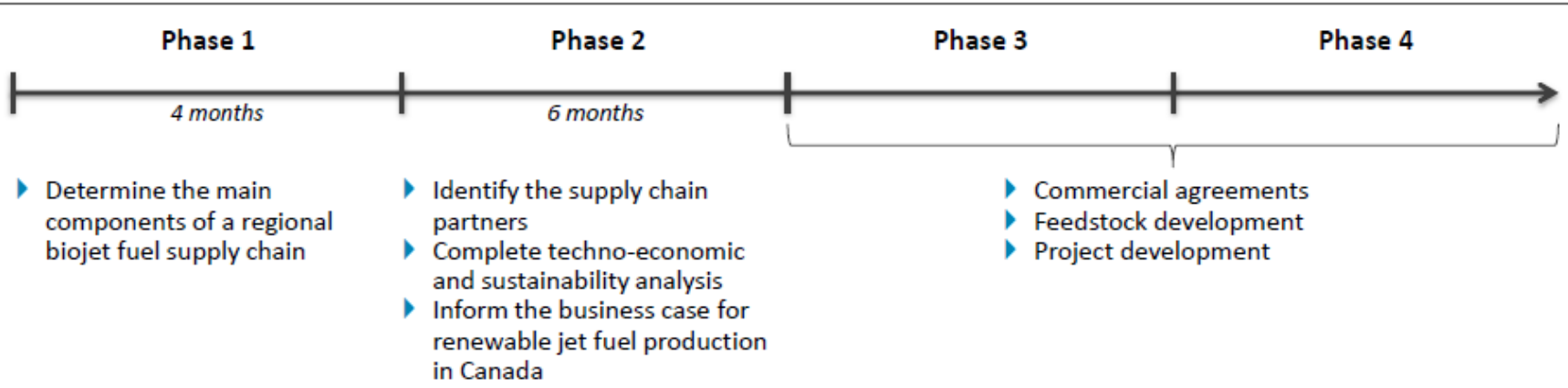
Funding

+ Partners

Project Objectives

- Characterize Canadian regional capacities for biojet production and supply chain development
- Assess the potential performance of biojet supply chains across sustainability metrics
- Structure a partnership model for a pre-commercial biojet supply chain
- Determine enabling conditions for biojet supply chain, take into account issues of competitiveness with other jurisdictions, feedstock availability, market access, risk, etc.
- Relate applicability of the aviation sector research to other Transport Canada priority sectors (rail, marine)

Timeline



Value Proposition

- Multidisciplinary team with technical and commercial understanding of conventional fuels, biofuels, and aviation sector
- Experience earned through ‘1G’ renewable diesel sector and ‘2G’ drop-in sector in Canada
- Research team based at University of British Columbia
- Knowledge of sustainability via its assessment methodologies (standards e.g. ISO, ISCC, RSB), its practical application in policy (Canada, US, EU) and its relevance to project success
- Canadian aviation industry engagement with IATA and Air Canada participation as external advisors
- Commercial purpose

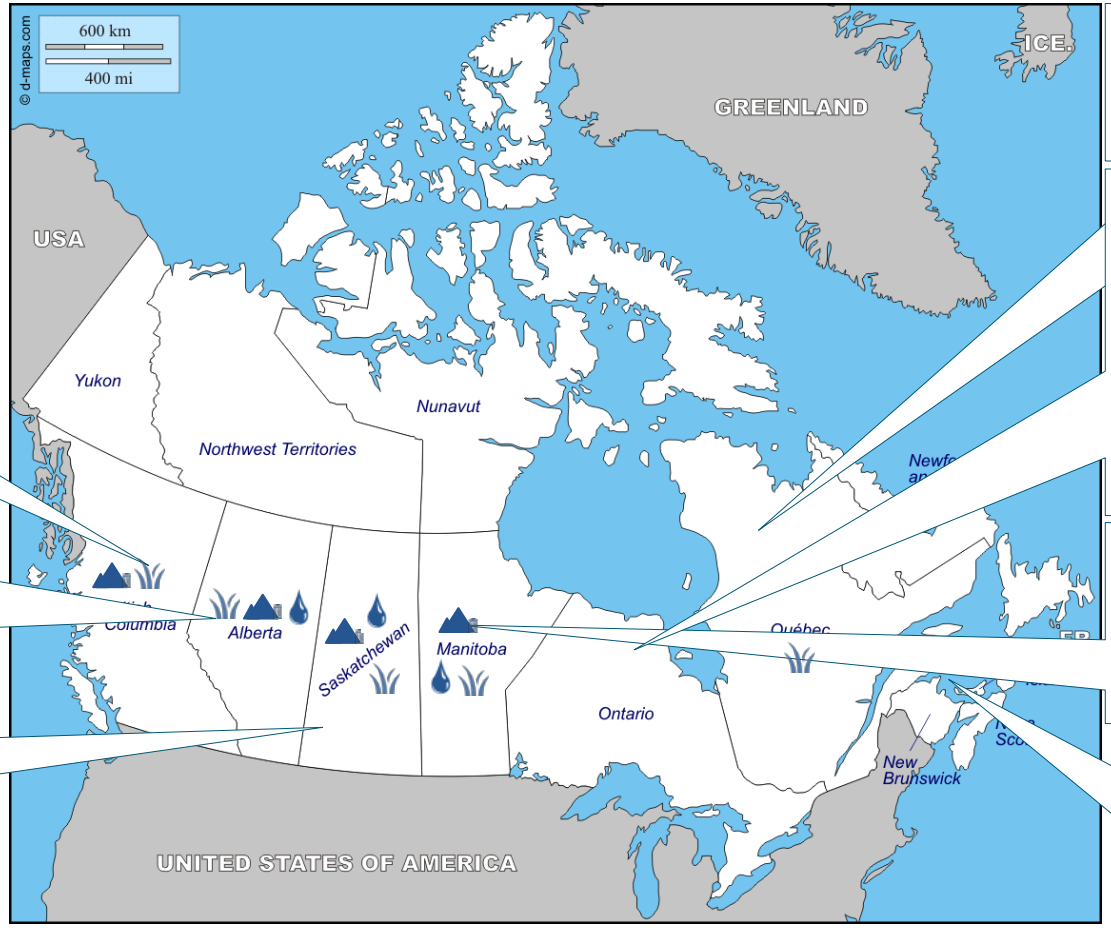
A scan of Canadian feedstock potential

- This project will seek to build on the results of completed studies and initiatives

BRITISH COLUMBIA
- Forestry
- Mountain pine beetle timber
- Agriculture/Residues
- Natural Gas
- Low CI electricity
- Mining

ALBERTA
- Forestry
- Agriculture/Residues
- Oilseeds (Canola)
- Petroleum/Natural Gas
- Agricultural/Residues
- Chemical industry cluster

SASKATCHEWAN
- Agriculture/Residues
- Oilseeds (Canola)
- Petroleum
- Mining



QUEBEC
- Forestry
- Low CI electricity

ONTARIO
- Forestry
- Agriculture/residues
- Chemical industry cluster
- Mining
- Petroleum refining
- Tech, financial

MANITOBA
- Agricultural/Residues
- Forestry
- Oilseeds (Canola)
- Low CI electricity

Atlantic Provinces
- Agricultural/Residues
- Forestry
- Ocean Protein

Observations:

- Overcoming sustainability concerns may be harder than overcoming technical barriers
- High expectations on biojet

- Aspirations:

IATA: '*Meet sustainability criteria such as lifecycle carbon reductions, limited fresh water requirements, no competition with food production and no deforestation*'

ATAG: *The aviation industry is seeking biofuels made from crops that:*

- *are fast growing, non-food plants that don't take up productive arable land which would otherwise be used for food production;*
- *do not require excessive supplies of pesticides, fertiliser or irrigation and do not threaten biodiversity;*
- *do not require excessive amounts of fresh water to grow;*
- *provide socio-economic value to crop-growing local communities;*
- *result in a lower carbon footprint on a total carbon lifecycle basis and provide an equal or higher energy*

- ***Outside perspective: operating under (very) aspirational voluntary targets on biofuels may be preferable to regulatory requirements***

Challenges

- Market access
  - Complex area with overlapping initiatives, suitability of existing policy designs (ETS, RFS, LCFS)
  - Life Cycle Assessment (LCA) – multiple models, multiple jurisdictions
  - Indirect Effects (e.g. iLUC) and coverage of concept on any commoditized biomass
  - Integration with existing energy infrastructure – Bowser vs. Hydrant
  - Technical certification process for new pathways

- Competitive fiscal environment
  - Capital availability: high volume, low margin
  - Limited production capacity
  - Build vs. buy (e.g. domestic production or imports to CDA)
  - Perpetual Drive to Reduce risk: commercially available, viable technology and feedstock

- …but notwithstanding, biojet a large and important opportunity

Thank You!

Fred Ghatala
(on behalf of the CTI project team)

Partner, Waterfall Group
fghatala@waterfall.ca
waterfall.ca

waterfall group