

# AVIATION CO<sub>2</sub> REDUCTIONS



## STOCKTAKING SEMINAR

TECHNOLOGY · OPERATIONS · SUSTAINABLE AVIATION FUELS



# Sustainable Aviation Fuels (SAF)

**Kevin R. Weiss P.E,**  
Chief Executive Officer, Byogy



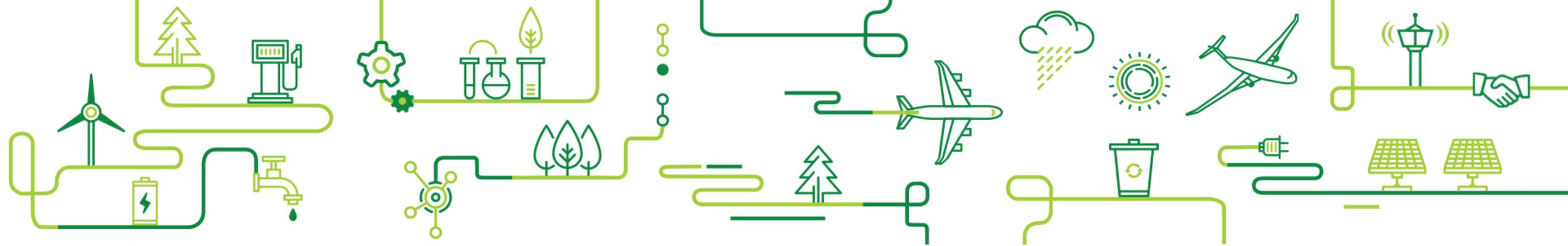


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*Chief Executive Officer*

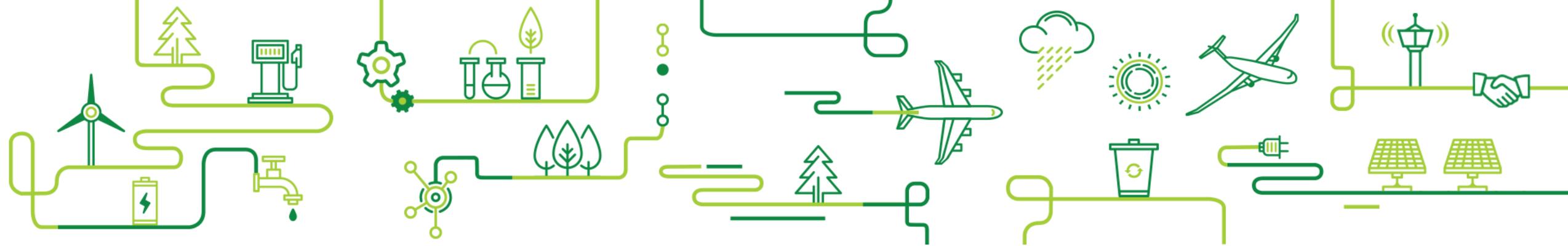
**Advancing “Alcohol To Jet”  
To Full Replacement Fuel  
(ATJ-SKA)**



# ASTM ADOPTED ALTERNATIVE AVIATION FUEL SPECIFICATIONS

D7566 ANNEX	YEAR	PROCESS/NAME	PRIMARY FEEDSTOCK
1	2009	Fischer-Tropsch Synthetic Paraffinic Kerosene (FT-SPK)	MSW, AG Wastes...
2	2011	Hydroprocessed Esters and Fatty Acids (HEFA-SPK)	FOGs
3	2014	Hydroprocessed Fermented Sugars (HFS-SIP)	Sugar/Starch
4	2015	FT + Synthetic Aromatics (FT-SPK/A)	MSW, AG Wastes...
5	2016	Alcohol To Jet Paraffinic (ATJ-SPK – Blend-stock version)	Sugar/Starch
6	2020	Catalytic Hydrothermolysis (CHJ)	FOGs
7	2020	Hydroprocessed Hydrocarbons (HC-HEFA-SPK)	FOGs/Algae

**Processes that can produce full replacement SAF**



# Key Alcohol To Jet (ATJ) Global Technologies

**BLENDSTOCK FUEL**

**FULL SYNTHETIC REPLACEMENT FUEL**

**ATJ-SPK**  
 BLENDED WITH FOSSIL FOR A "DROP-IN"



**ATJ-SKA**  
 100% FUEL



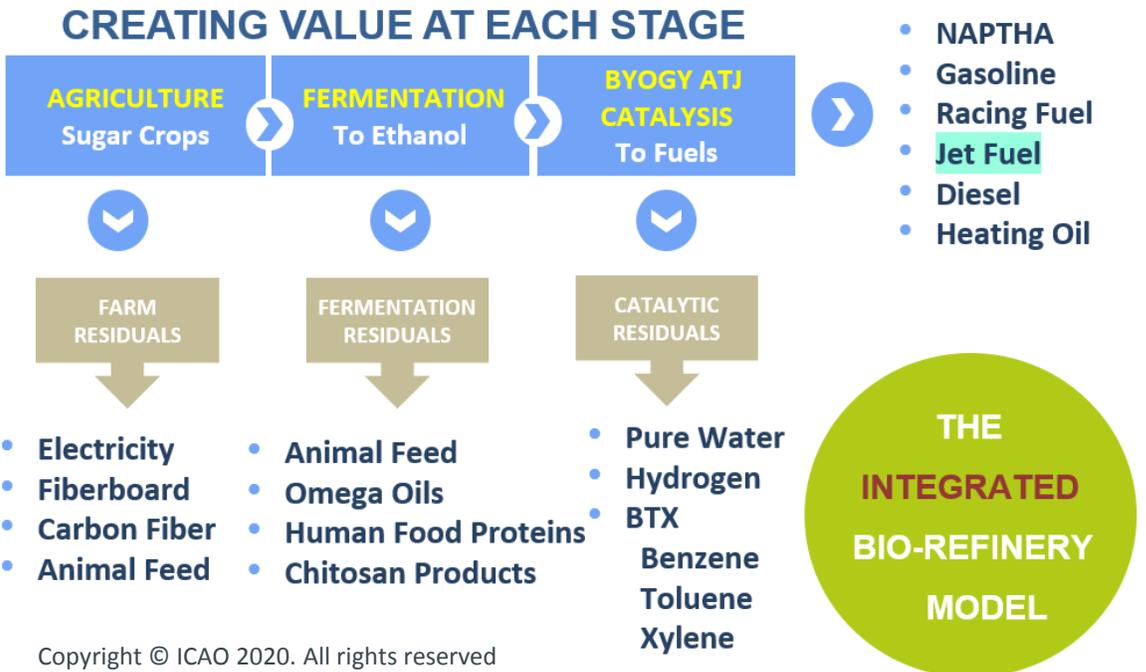
# Full Replacement Sustainable Aviation Fuel

## Alcohol To Jet : **“ATJ-SKA”** (Full Aromatic Fuel)

### Aviation Fuels

Feedstock type	Conversion process
Ethanol / Butanol	<b>ATJ-SKA Catalytic Process</b> Full Replacement Fuel

Proven industry processes uniquely integrated to produce Full Replacement Fuels.



**CO<sub>2</sub> reductions per flight** **>80%**  
With clean energy & co-products

**Level of finance required** **25%**  
For ATJ-SKA Commercialization From ATJ-SPK

**Timeframe** **2025**  
For ATJ-SKA Commercialization

**Main “remaining” challenges** **20%**  
From ATJ-SPK

NOTE: Statistics above represent the metrics to advance ATJ-SPK blend-stock to ATJ-SKA full replacement SAF



## Full Replacement Sustainable Aviation Fuel Alcohol To Jet : **“ATJ-SKA”** *(Full Aromatic Fuel)*

### Aviation Fuels (cont.)



### **BYOGY – Advancing the ATJ specification to full replacement fuel**

- 2007 - 2010 **US Air Force testing** results demonstrated the unique ability to produce complete hydrocarbon fuels
- 2010 Gevo and Byogy start **ASTM Task Force** for ATJ
- 2011 **Byogy splits ATJ ASTM task force** with Gevo, to drive ATJ-SKA pathway
- 2015 **FAA CLEEN Program** validated Byogy ATJ-SKA Fuel as a 100% fuel achieving increased “Fuel Burn Efficiency” from fossil fuel
- 2018 **DOE Grant Program** To Design Commercial Demonstration Plant – currently underway
- 2019 **Japan (NEDO) Project #1** - Byogy received an order from the Government of Japan (NEDO) to build, deliver, assemble, and demonstrate a pilot ATJ-SKA catalytic conversion plant for the 2020 Summer Olympics. Plant commissioned in March 2020 in Japan.

# The ATJ key advantage to leverage existing supply chains and link into existing infrastructure

## Technology



### Feedstock (Ethanol)

- Proven (*fermentation of sugars*)
- Low-cost Price – advanced with cellulosic
- Significant Globally Availability  
(2 MM barrels/DAY today = 20% of total global aviation demand)
- Ethanol market glut as EV's displace ICE's (E15 to EV)

### Technology

- Unique integration of proven petrochemical processes...  
*...leveraging crude oil industry*
- Chemical process; not relying on synthetic biology
- Produces 100% replacement renewable fuels ...  
*...gasoline, jet fuel, diesel*
- No external hydrogen ... *no hydro-cracking*
- Clean water as primary residual off-stream

	<b>CO<sub>2</sub> reductions per flight</b>	<b>&gt;80%</b> With clean energy & co-products
	<b>Level of finance required</b>	<b>20%</b> From Gen1 ETOH & ATJ SPK
	<b>Timeframe</b> For ATJ-SKA Commercialization	<b>2025</b>
	<b>Main “remaining” challenges</b>	<b>20%</b> From ATJ-SPK

NOTE: Statistics above represent the metrics to advance ATJ-SPK blend-stock to ATJ-SKA full replacement SAF



# Improving flight efficiency and CO<sub>2</sub> reduction with full replacement premium fuel

## Operations

- ATJ-SKA reduces CO<sub>2</sub> emissions by at least 80% used Neat  
*ATJ-SKA can reach the highest CO<sub>2</sub> reductions with higher blend penetration*

Other SAF fuels are “*blend limited*” and will NEVER achieve 80%

- Proven petrochemical equipment ... “*Low Risk to Scale-Up*”
- ATJ-SKA is a Premium Grade SAF which Delivers:
  - More “MPG” ... *better fuel burn efficiency*
  - Lower Maintenance Costs
  - Longer engine time on wing for airline operators



	<b>CO<sub>2</sub> reductions per flight</b>	<b>&gt;80%</b> With clean energy & co-products
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# Full Replacement Fuel Importance Safety & Cost Reduction

## Operations (cont.)

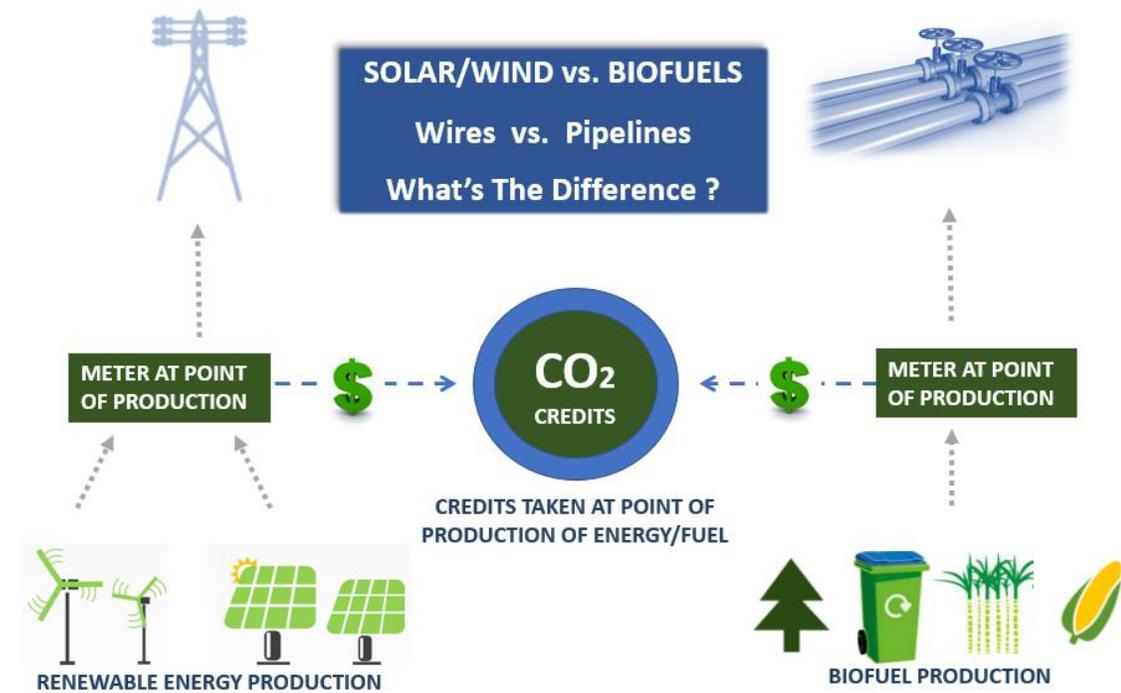
Adopting full replacement fuels will save cost and minimize safety concerns by eliminating the downstream issues of:

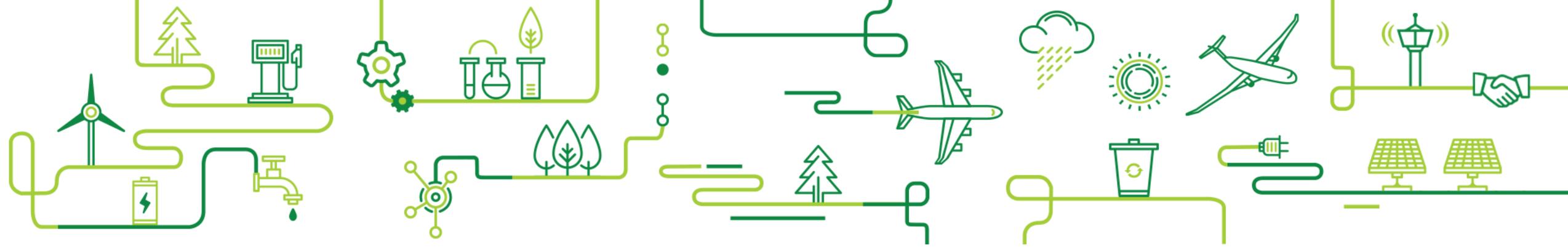
- Blending Logistics
- Storage, Handling, Distribution
- Transportation Infrastructure Accounting



## THE IMPORTANCE OF FULL REPLACEMENT FUELS

Eliminate The Downstream  
and take “carbon credits” at point of production





*Byogy was the original inventor of the Alcohol To Jet technology and perfected the process to produce complete replacement Sustainable Aviation Fuel.*

*Byogy developed the ATJ pathway by leveraging already proven petrochemical processes to upgrade GEN1 biofuel (ethanol) into complete “premium quality” hydrocarbons that are invisible to the existing crude oil infrastructure...*

*...If you're paying a price premium anyway, why not get a premium fuel ?*

**ATJ has a significant advantage to lead the global production of SAF**

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# Thank You

