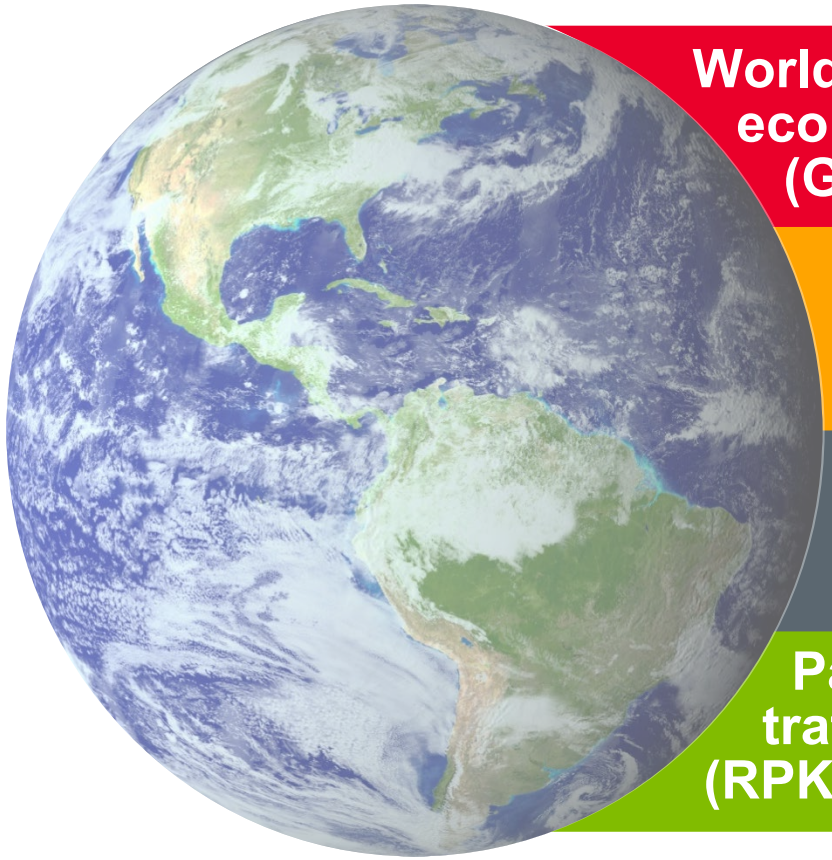
Boeing and Sustainable Aviation Fuels

Sean Newsum | Director Environmental Strategy, Boeing Commercial Airplanes

November 2018

20-year forecast: continued long-term growth

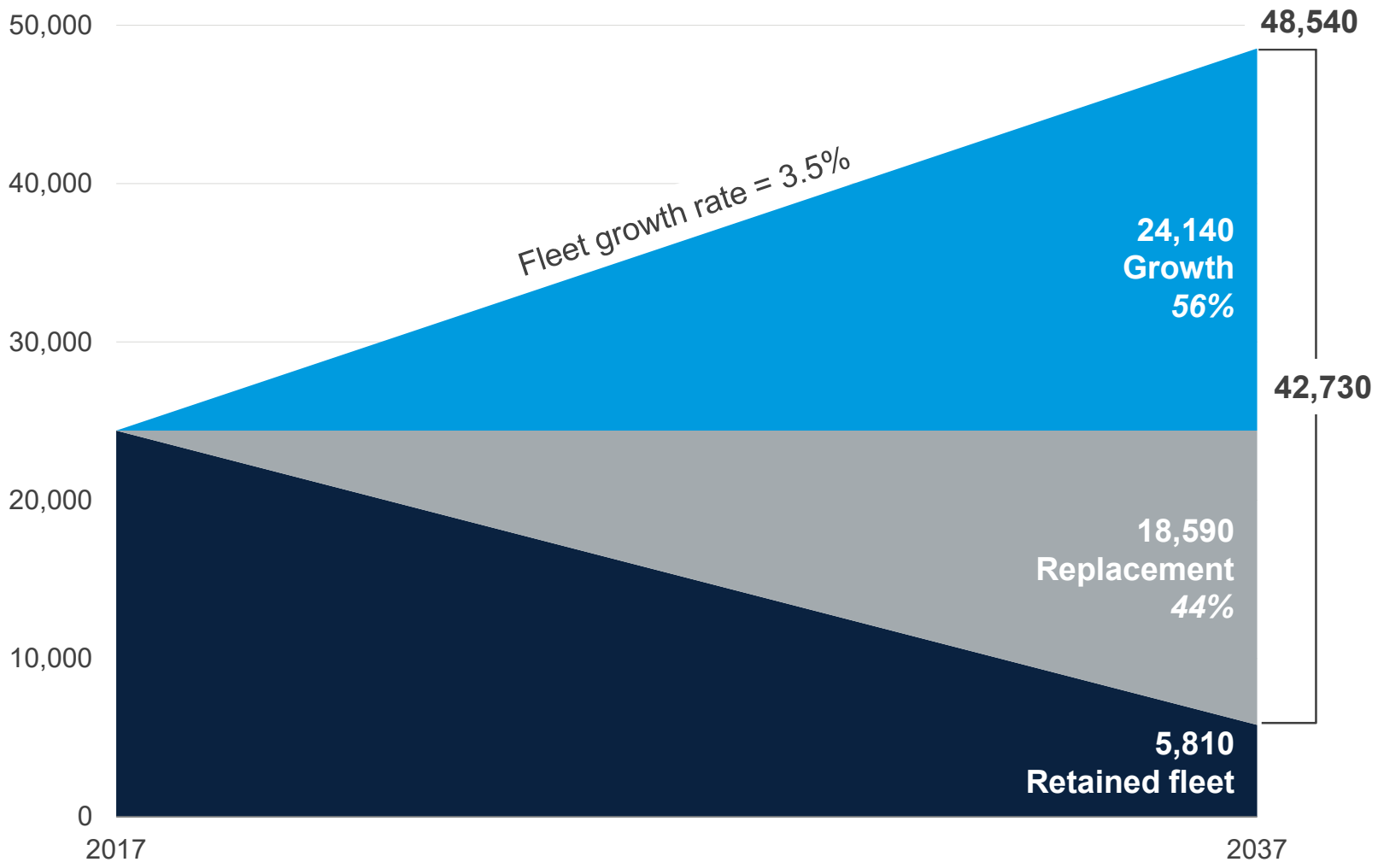
Average annual growth



World economy (GDP)	2.8%
Number of airline passengers	4.0%
Cargo traffic (RTK)	4.2%
Passenger traffic (RPK)	4.7%

20-year forecast: Airline fleet will double

Airlines will need 42,700 new airplanes valued at $6.3 trillion



Source: Boeing Commercial Outlook 2018 - 2037

Boeing's role and actions

Boeing's role

Protect the environment

Assure industry growth

Act as industry catalyst to accelerate commercialization

Address customers' needs

Core activities

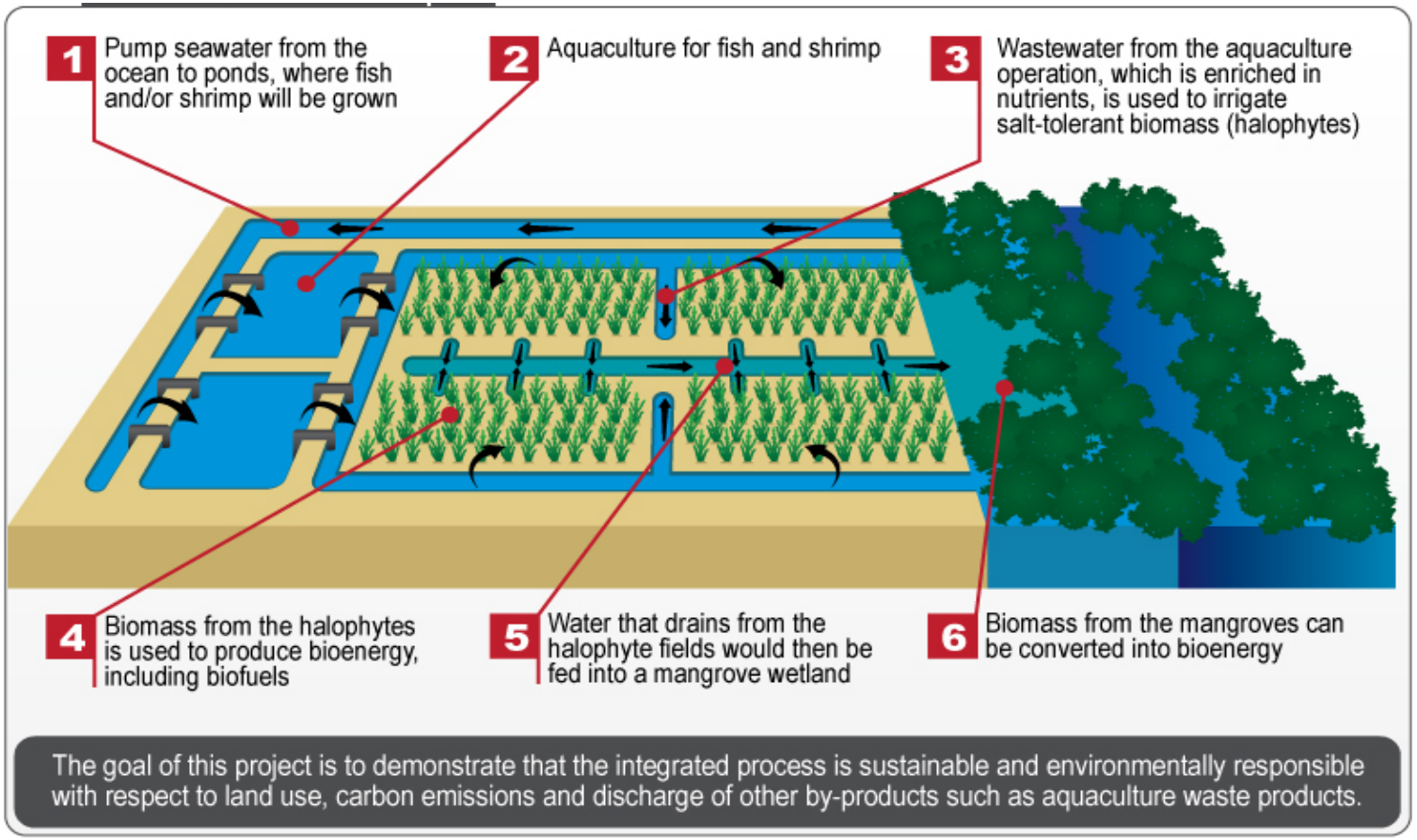
Support and advocacy

Feedstock and pathway R&D

Fuels approval

Ultimate goal is to catalyze a vibrant commercial market

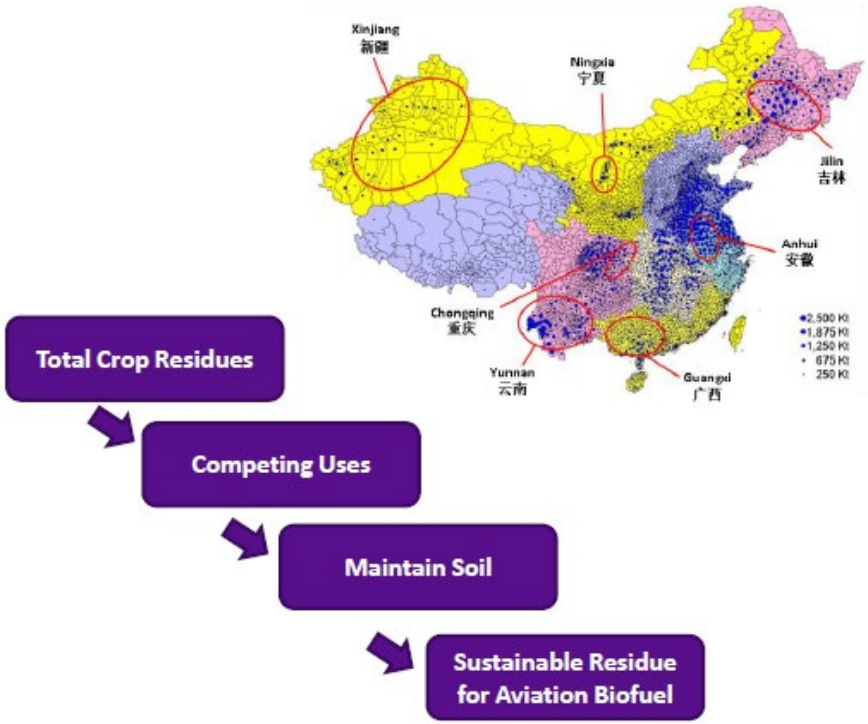
UAE - SEAS concept: Combining food and energy



China – Agricultural residues potential

Huge capacity, addresses air pollution issue

- **Feedstock availability**
  - Evaluation of collectable quantity based on retaining soil sustainability
- **Conversion technologies**
  - Process assessment and technical optimization



Collaboration with Guangzhou Institute of Energy Conversion

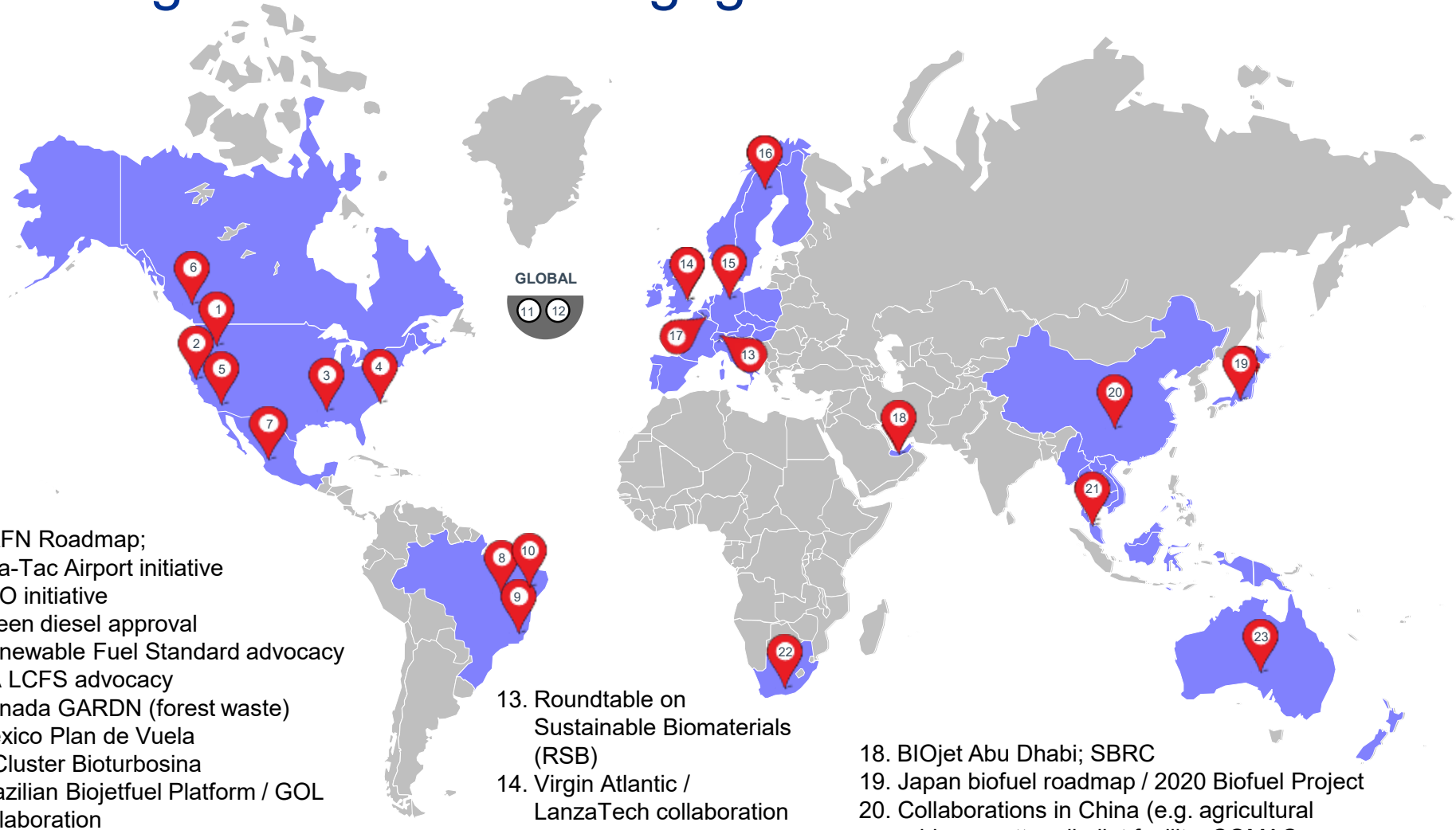
- Lab-scale feasibility demonstrated
- 2 pilot plants built
- Techno-economic analysis performed

Pilot Plant (Yingkou, Liaoning)
Capacity: 165 gallons/day

Aviation biofuel in South Africa

Nicotine free tobacco plants

Boeing Global Biofuel Engagements



1. SAFN Roadmap; Sea-Tac Airport initiative
2. SFO initiative
3. Green diesel approval
4. Renewable Fuel Standard advocacy
5. CA LCFS advocacy
6. Canada GARDN (forest waste)
7. Mexico Plan de Vuela & Cluster Bioturbosina
8. Brazilian Biojetfuel Platform / GOL collaboration
9. Brazil incentive advocacy
10. Joint Research Center with Embraer
11. SAFUG organization
12. ICAO Alternative Fuels Task Force
13. Roundtable on Sustainable Biomaterials (RSB)
14. Virgin Atlantic / LanzaTech collaboration
15. AIREG Membership
16. Nordic Initiative for Sustainable Aviation
17. EU RED advocacy
18. BIOjet Abu Dhabi; SBRC
19. Japan biofuel roadmap / 2020 Biofuel Project
20. Collaborations in China (e.g. agricultural residues; gutter oil pilot facility; COMAC collaboration)
21. Southeast Asia farm initiative
22. South Africa / Solaris
23. Australia biofuel roadmap

Boeing is committed to a better future


BOEING

ADVANCE QUEENSLAND

The Global Scene

Queensland Investment Opportunity

December 2018

Chris Tindal
Queensland Strategic Biofutures Advisor
Queensland University of Technology Adjunct Professor
CAAFI Assistant Director

Queensland Government

Queensland, Australia

About Biofutures in Queensland

- Biorefining of fuels and chemicals from biomass
- Potential for both technology developers and agricultural producers in Queensland.
- 95% of Australian sugarcane and 60% Australian sorghum are grown in Queensland.
- Diverse feedstocks: native grasses, crop stubble, eucalypts, acacia, mallee, cassava, agave, algae, pongamia, exotic pines, municipal waste, fats and oils and woody biomass.
- Biofuels mandate introduced - 3% increasing to 4% to stimulate new ethanol production.
- The Queensland Government has directly supported new biofutures projects across the state, including ten new or expanded biorefineries.

Biofutures Queensland

Leading Australia's bio-revolution

Our vision

A $1 billion sustainable and export-oriented industrial biotechnology and bioproducts sector attracting significant international investment and creating regional, high-value and knowledge-intensive jobs.

Advance Queensland Biofutures 10-Year Roadmap and Action Plan has committed **$20 million over three years** through the:

- ***Biofutures Acceleration Program***
- ***Biofutures Commercialisation Program***
- ***Biofutures Industrial Development Fund***

The Queensland Government recently announced the ***Resource Recovery Industry Development Program*** in which they are committing **$100 million over three years**

Key achievements: The first 12 months

2016

June 2016

Roadmap launch

Queensland Biofutures 10-Year Roadmap and Action Plan launched by the Premier of Queensland, investing almost $20 million.

September 2016

US trade mission

Minister for State Development leads trade mission to meet with biofuel companies in North America.

November 2016

Biofutures Industry Development Fund

Launch of the $5 million Biofutures Industry Development Fund, a repayable fund to help well-advanced industrial biotech proponents to progress large-scale projects through the final stage of financial due diligence.

December 2016

Queensland Government - US Navy Biofutures Industry Forum

Queensland Government partners with the United States Navy on a Biofutures Industry Forum that attracts 150 industry and research representatives to discuss Queensland supplying the US Pacific Fleet with advanced 'drop-in' fuels.

April 2016

Research boost

$1.2 million invested in science research funding to develop alternative energy sources and technology.

August 2016

US Navy agreement

Statement of Cooperation between the United States Navy and the Queensland Government to explore the research, development, supply and sale of advanced 'drop-in' alternative fuels.

November 2016

Biofutures Acceleration Program

Opening of the $4 million Biofutures Acceleration Program to attract and support new or expanded biorefinery projects.

November 2016

Bioenergy conference

Queensland hosts the 17th annual Bioenergy Australia Conference, attracting nearly 230 delegates.

December 2016

Key appointment

Industrial biotech expert Professor Ian O'Hara appointed as Queensland Biofutures Industry Envoy.

2017

January 2017

Biofuels mandate

Introduction of the Queensland Biofuels Mandate, a step towards growing the biofuel and bio-manufacturing industries.

February 2017

Biofutures Commercialisation Program

Opening of the $5 million Biofutures Commercialisation Program to attract bioindustrial expertise to partner with Queensland researchers and businesses to scale-up and test new or improved bioindustrial technologies and processes at the pilot or demonstration scale.

June 2017

US trade mission

Premier of Queensland leads a trade and investment mission to the United States, including the Biotechnology International Convention.

June 2017

Funding announcements

Announcement of successful proponents under key biofutures funding programs.

July 2017

World Congress

Minister for State Development leads a delegation to the BIO World Congress on Industrial Biotechnology, the world's premier industrial biotechnology event, to promote Queensland's benefits as a biofutures investment destination to an industry-leading audience.

Feedstocks – fats and oils

- Queensland is one of the world's largest beef producers
- Queensland: 230,840 tonnes animal fats (22 facilities)
- Australia: 611,180 tonnes tallow (~50% to Singapore for biofuels)
- Tallow Ined. <1FFA ~US$605/tonne
- 80% (2.36 million tonnes) of Australia's canola is exported to Europe mostly for biodiesel
- Agrisoma's Brassica Carinata – successful field trials completed (2017). Goal to grow 400,000 ha of carinata (~200 million litres of bio-jet fuel per year)

Demand for fuel – diesel and jet

- Queensland diesel figures 1.8B gallons (28% of Australia)
- Queensland jet fuel figures 0.5B gallons (21% of Australia)
- Brisbane Airport aviation fuel consumption – currently 0.7M gallons per day (285M gallons per year), projected 1.3M gallons per day (475M gallons per year) in 2034
- Qantas and Virgin Australia account for approximately 75% of use (190.2M gallons p.a.)
- Below 50 Australia (Queensland Renewable Fuels Association)

Australian airline commitments to renewable jet fuel

Virgin Australia

- 2010 Queensland Sustainable Aviation Fuel Initiative (QSAFI)
- 2013 Brisbane bioport proposed with SkyNRG
- 2016 VA/Air NZ Request For Information (200ML)
- 2018 Brisbane Airport hydrant refuelling biojet pilot project with Gevo

Virgin australia

gevo®

Australian airline commitments to renewable jet fuel

Qantas

- 2012 Study with Shell (Australian Renewable Energy Agency - ARENA funded)
- 2017 S.G. Preston Off-take for US uplift
- 2018 (28 Jan 2018) LAX to MEL flight fuelled by Agrisoma's carinata.

QANTAS

AGRISOMA

Investors

- Clean Energy Finance Corporation – specialist clean energy financier.
- Australian Renewable Energy Agency – funds projects that drives innovation and commercialisation of renewable energy technologies.
- Queensland Biofutures Industry Development Fund – is designed as a repayable fund to help well-advanced industrial biotech proponents to get large-scale projects through to investor readiness.
- Potential partners could include KKR, Macquarie, Japanese trading houses.

CEFC
CLEAN ENERGY FINANCE CORP

ARENA
Australian Government
Australian Renewable Energy Agency

MACQUARIE

KKR

Why Queensland?

- Strong economy
- Strategic location
- Determined political will
- Highly skilled and multi-lingual workforce
- Business friendly regulatory environment
- Focus on innovation and R&D
- Idyllic lifestyle and high quality of life
- Queensland is well placed to be at the forefront of the global biorefinery industry

Additional support

The Queensland Government can assist:

- Central contact for government and private sector
- Business case information
- Project facilitation and site visits
- Suitable site identification
- Point of contact for the government funding programs
- Pre-planning and development assistance
- Making introductions to industry and services

Thank You

Future of Alternative Fuels in Dominican Republic

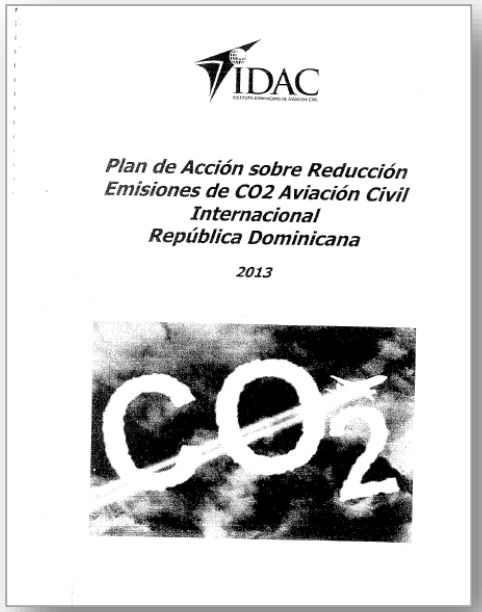
Instituto Dominicano de Aviación Civil

Content

- The Dominican Republic Action Plan on Emissions Reduction (DRAPER)
- The sustainability concepts
- Technologies for SAF production
- Feedstock
- The regulatory framework
- Jet fuel infrastructure
- Market barriers and solutions
- Blending mandate
- Benefits through economic development
- CO_2 emissions savings
- Stakeholders

Dominican Republic Action Plan on Emission Reduction (DRAPER)

2013



The ICAO – EU project has been providing continuous assistance for updating the plan in accordance with the ICAO Standards

2015-2018

2019-2022

The new DRAPER will be available by June 2018

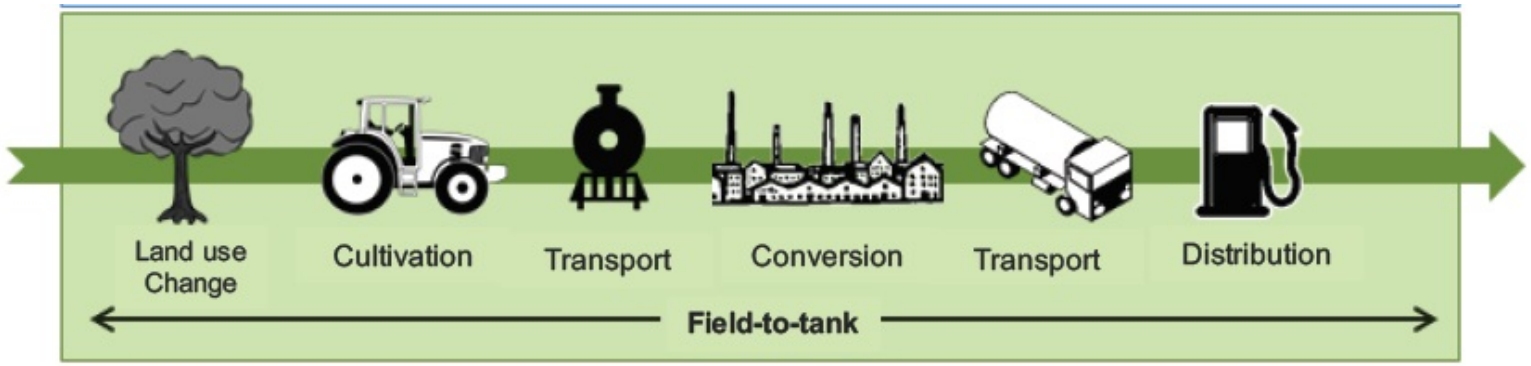
Initiatives on SAFs supported by the ICAO - EU project

Feasibility studies on SUSTAINABLE AVIATION FUELS ✓✓

Punta Cana Declaration (2016)

Sustainability Concept

GAME CHANGER



The multiple steps from feedstock production to final combustion of a fuel, constitute its life-cycle. To assess the emissions savings from the use of alternative fuels, a comprehensive accounting must be done of all emissions across all steps of the fuel's life-cycle, called a life-cycle analysis. If the total emissions from an alternative fuel are less than the total emissions from fossil fuel, there is an environmental benefit attributable to that fuel.

Technology for SAFs

Technology	Maximum Blend (v/v)	Feedstocks (examples)
Fischer-Tropsch (FT) & (FT-SKA)	50%	Wastes (as MSW, coal, gas, sawdust…
Hydroprocessed Esters and Fatty Acids (HEFA)	50%	Palm oil, camelina oil, jatropha oil, usedcooking oil…
Synthetic Iso-Paraffin (SIP)	10%	Sugarcane, sugar beet
Alcohol To Jet (ATF) (from Isobutanol)	30%	Sugarcane, sugar beet, sawdust, lignocellusic residues (i.e. straw)

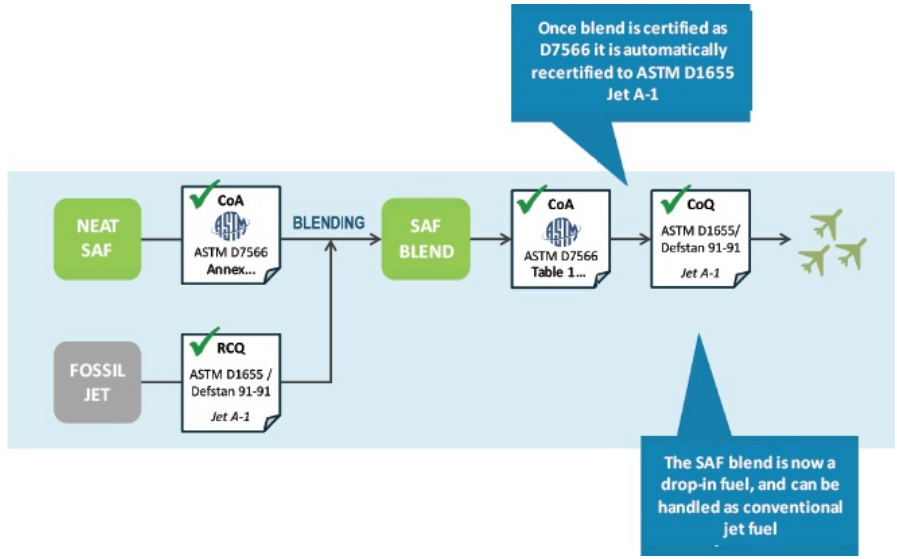


FIGURE 4
Diagram showing the blending and use process for the synthetic fuels (in this case AAF) and the different quality standards AAF meets at different steps[18] (Source: ICAO).

Feedstock

One of the primary criteria for assessing the feasibility of the local production of alternative fuels relates to access to adequate feedstock. A stable, reliable and cost-competitive supply of sustainably obtained feedstock is key for any SAF production facility. When the feedstock can be produced locally, there are additional local benefits (wages, taxes, rural development, etc.) that are highly valuable.

Vegetable oils constitute the feedstock type that can most easily be converted into fuel.

In the Dominican Republic, accessible volumes of unused wastes, including municipal solid wastes (MSW), are not available in sufficient quantities.

Evidenced by its historic production, the Dominican Republic has a significant potential for the production of SAF from sugarcane, that has being declining for the last 30 years

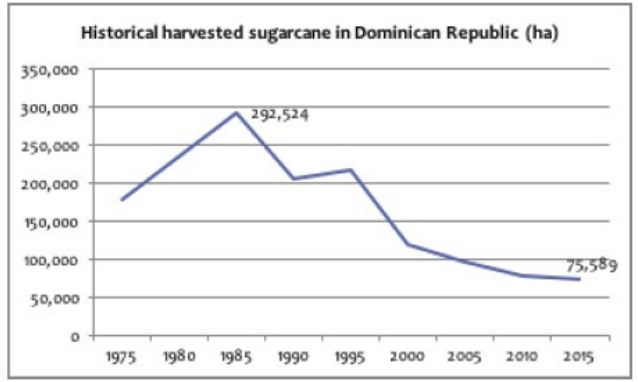


FIGURE 5

Changes in the surface of sugarcane crop considering the harvested sugarcane areas. Data obtained from INAZUCAR (www.inazucar.gov.do)

Regulatory Framework

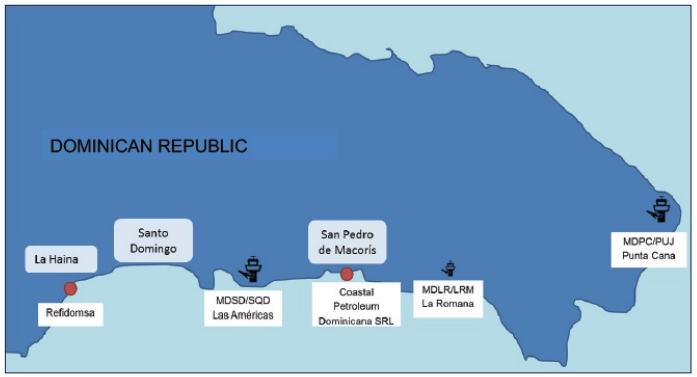
- The Dominican Republic includes in its regulatory system relevant laws and decrees concerning benefits and incentives for the production of alternative fuels and renewable energy.
- These correspond to a national strategy driven by energy dependence and the countries' vulnerability to climate change. The most representative regulations are the Law 57-07 on Incentives for renewable energies and special regimes, and the Decree 202-08.
- The Dominican Republic regulates prices and commercial margins for distributors of all hydrocarbons. This regulation helps to establish incentives and/or regulations for the introduction of alternative fuels, as stakeholders are already accustomed to a regulated market.

Jet Fuel Infraestructure

- From there, the aviation kerosene is transported to the airports' fuel farms by truck. At the major airports, the fuel is uplifted by hydrant systems available at some gates, while others need to be served by refuelling vehicles (tanker trucks). At the remaining airports, the fuel is served by refuelling vehicles.

- Each airport (group) in the Dominican Republic has a unique jet fuel supplier. This limits price competition, but as selling prices are regulated by the government, those managers consulted at major airports indicated that this system makes the management of the fuel supply simpler.

FIGURE 7
Location of the alternative import dock and storage owned by Coastal Petroleum Dominicana that could be available for JetA1. Source: (Author)



Barriers and Solutions

Market Barriers

- Usually, AAF production depends on feedstocks that are indexed commodities. This means that commodities' prices are dependent on market competition arising from uses other than AAF production.
- Some cosmetics, plastics, chemicals or even road fuels in strongly environment-regulated markets, such as in the United States or the European Union, usually have a higher selling price than jet fuel.
- In general, it is expected to be challenging for AAF to reach price parity with the price of conventional jet fuel even if production costs can be lowered, and regardless of the fossil fuel price, because when the cost of fossil fuel rises again, commodity prices will likely increase as well.

- Solutions:
  - Confine the value chain. Restrict, by contract or regulation, the final destination of the possible final products to AAF fuel.
  - Use feedstocks and inputs that are not commodities (like some wastes). Here, neither the feedstock nor the intermediate products have a potential market other than AAF.
  - Using low volume/high value chemicals to compensate price changes. Some high value chemicals could be produced during the refining process (saleable by-products as financial supporters to the global business case).
  - Subsidizing. The market inefficiency in the form of a price gap can be offset through governmental support.

Benefits Through ED

- It is expected that an increase in the development of sugarcane production in the Dominican Republic would imply, directly and indirectly, various benefits for the country.
- These benefits can be summarized according to the tax revenues generated on imports (materials, machinery), on the generated added value, incomes from farmers and workers at the mills, transport, and storage.
- Considering that a farmer could economically depend on sugarcane production with a minimum of 8 ha, the direct employment could increase (without considering the transport, mill or later processing) to at least 3,000 stable jobs in 2050.

Making a Cleaner Aviation

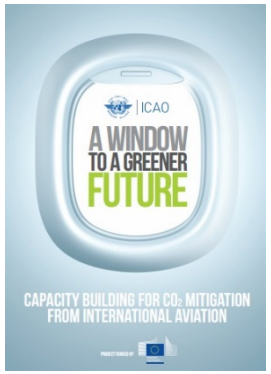
Feasibility Study

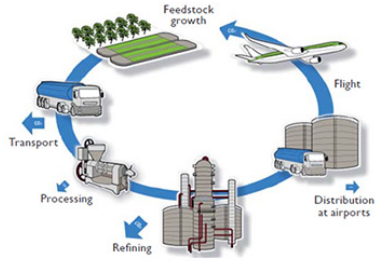
DRWG7 | Alternative Fuels

Research on Alternative Fuels

- Feasibility studies on Bio fuels
- Incentives
- Partnerships

Project funded by the EUROPEAN UNION





Emissions Savings

TABLE 3
Savings of CO2 equivalent due to the use of AAF according to the two different blending roadmaps analysed in the case study using a theoretical maximum GHG savings of 80%.

Pathway		2020	2030	2050
ATJ	Targeted blend %	5.0%	7.1%	29.3%
	GHG savings (t CO_{2eq})	63,281	104,983.07	795,259.03
SIP	Targeted blend %	1.0%	1.4%	5.9%
	GHG savings (t CO_{2eq})	12,656	20,996.61	159,051.81


IDAC
INSTITUTO DOMINICANO DE AVIACIÓN CIVIL
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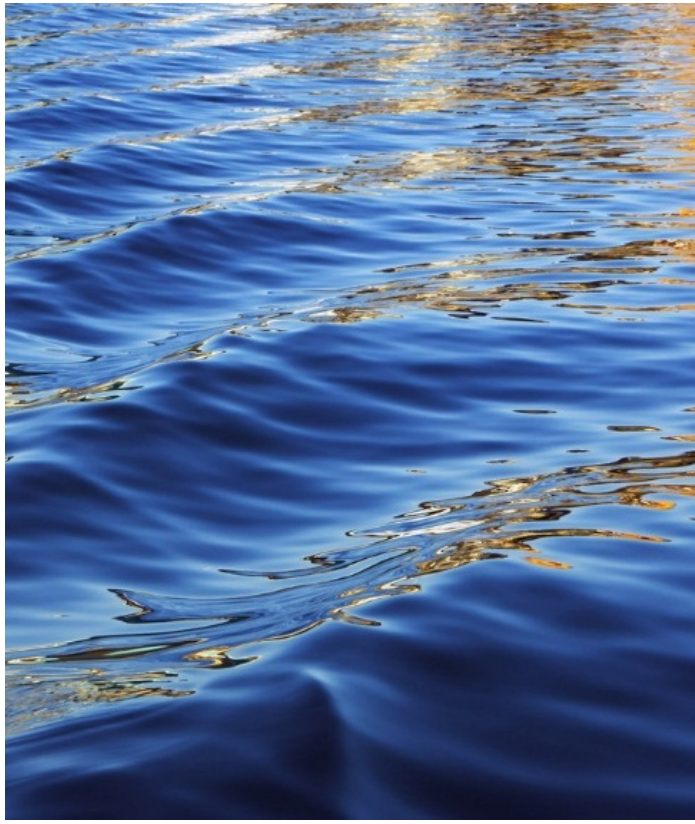
Making a Cleaner Aviation

Stakeholders

Aviation making a better tomorrow…..Today

Juan Jose Veras
Juan.veras@idac.gov.do



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Aviation Initiative for Renewable Energy in Germany e.V.

The future of climate-friendly aviation:
10% SAJF by 2025

CAAFI Biennial General Meeting
December 4-6, 2018, Washington, DC

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32 members

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Working groups

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Provision of Feedstock and Technologies of Fuel Production

Fuel Utilisation, Quality and Certification

Sustainability

Task Force

Economy and Production

3 Working groups and 1 Task Force cover the core areas from crop to tank

R&D: Latest projects

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Power-to-Liquid Demo Plant

- Renewable power for SAJF demonstration plant
- Successfully demonstrated at lab scale
- However, industrial-scale production missing
- Plan: 10,000t/y
- Projected partners: Dow Chemical, BP, Hamburg Airport, Airbus, airline etc.
- Start Q4/2018 (pre-engineering phase)
- Production by 2020/21

„Sustainable Aviation Fuel for Munich Airport“

- Identification (and removal) of technical, operational, administrative and legal barriers for the use of synthetic kerosene in the regular operation of German airports.
- Proof of technical compatibility with the existing fuel supply infrastructure.
- Cooperate with suppliers of sustainable aviation fuels and airlines to pave the way for the nationwide launch at German airports.
- Comparative analysis of the expected environmental impact at Munich Airport with different blending ratios of alternative fuels in the kerosene supply of the airport (based on projections of the values determined).

DEMO-SPK | Background and target

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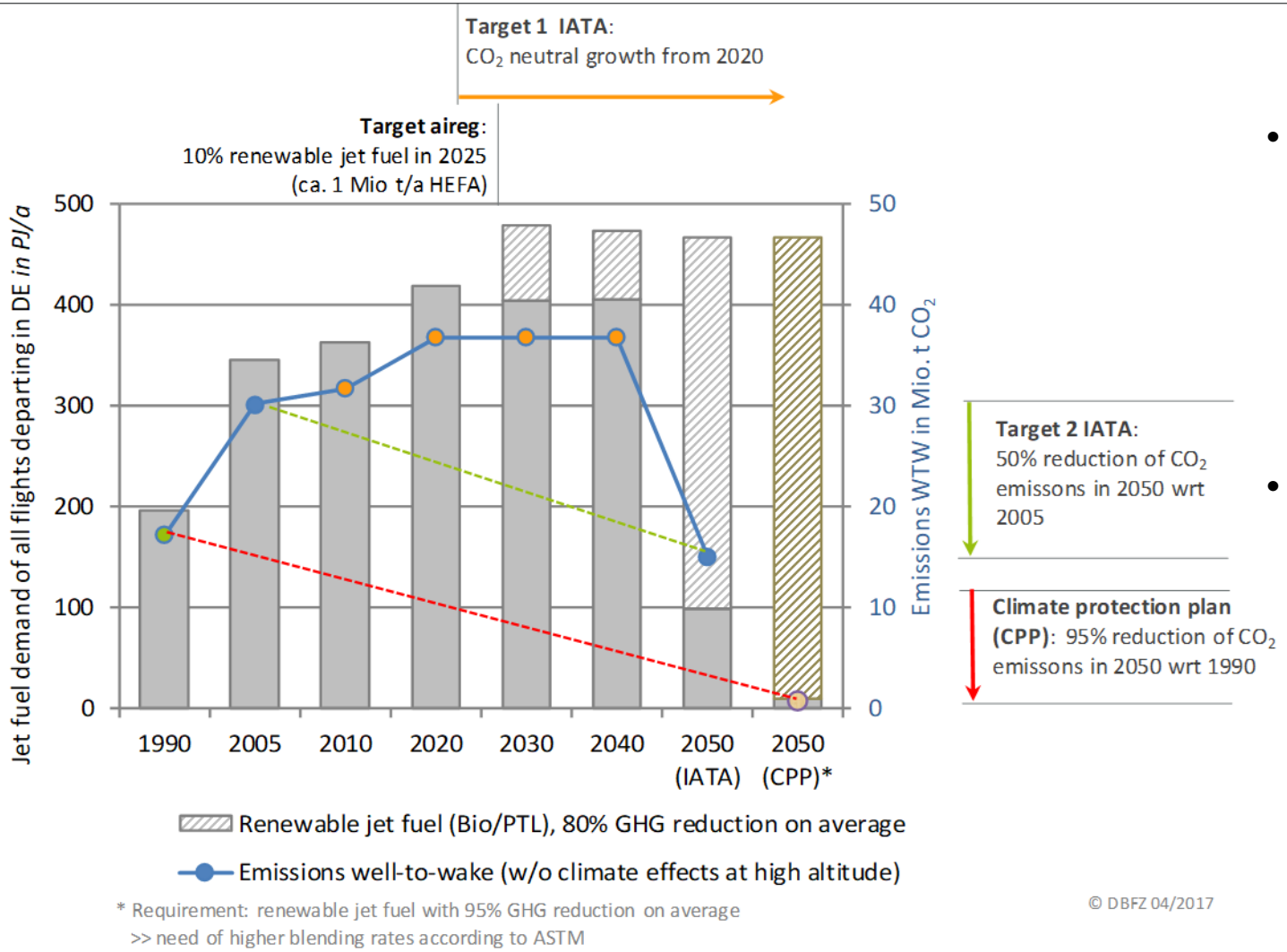

- R&D&D of implementing multiblend JET A-1 into practice as starting point of increasing shares of renewable jet fuel
- DEMO-SPK is (so far) internationally unique >> provide a decisive contribution towards a more sustainable and climate-friendly air traffic.

Federal Ministry of Transport and Digital Infrastructure

DEMO-SPK | Project and partners

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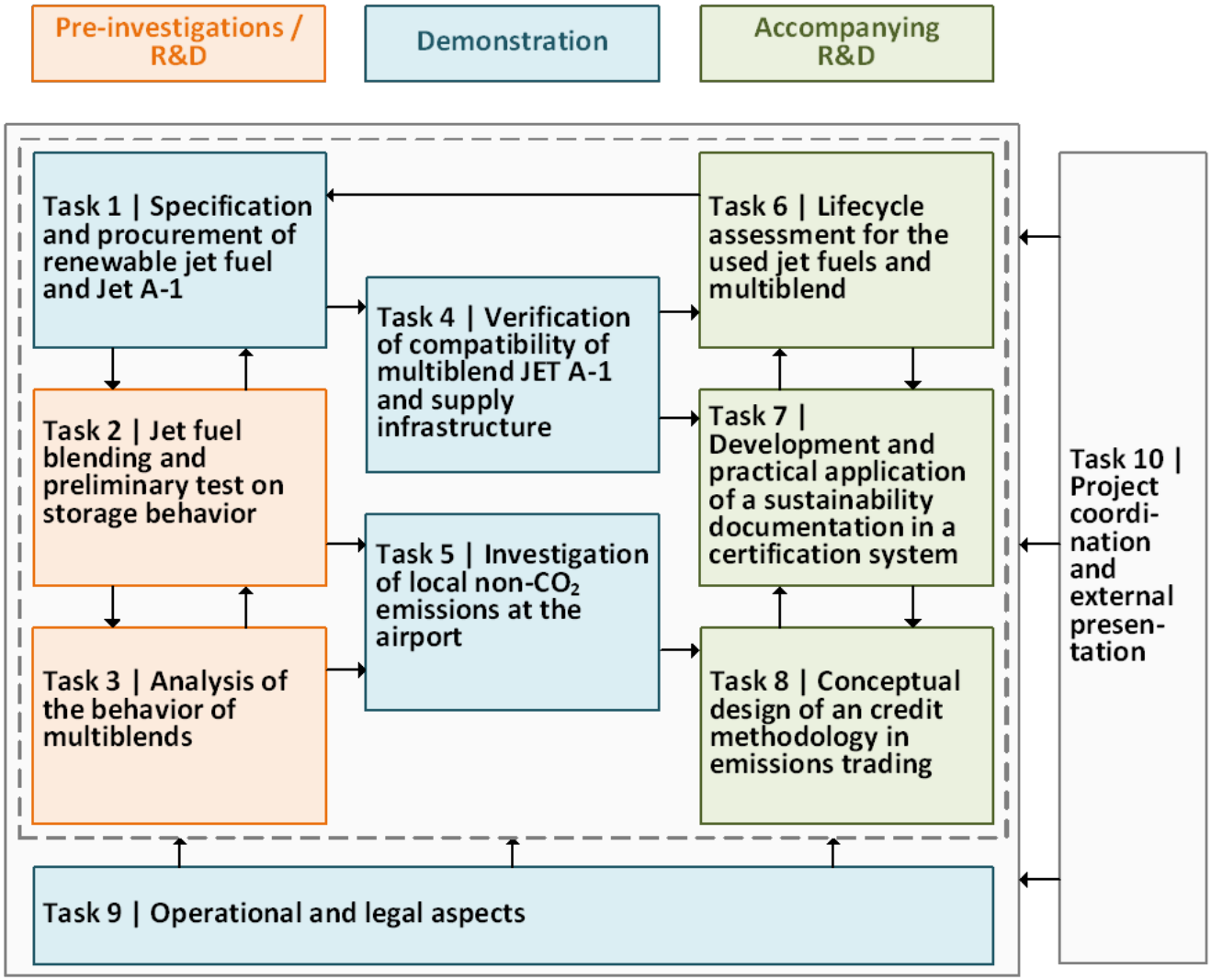

Adeptus Green Management GmbH
Planning. Projects. Procurement.

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ASG Analytik-Service Gesellschaft

bp

DBFZ

Dettmer Rail

DHL

DLR

gevo

IFOK. A CADMUS COMPANY

knoell

meo CARBON SOLUTIONS

NESTE

PETRO LAB GMBH

sunfire

TanQuid

TOTAL

TU BERGAKADEMIE FREIBERG

TUHH Technische Universität Hamburg

VTG

Wehrwissenschaftliches Institut für Werk- und Betriebsstoffe (WIWeB)

world energy

Federal Ministry of Transport and Digital Infrastructure

Project duration: 11/2016 – 04/2019

Current status: pre-investigations / R&D & demonstration almost completed, Accompanying R&D ongoing

Power-to-Liquid (PtL)/ PtX-Alliance

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PtX-Alliance funded by the German government

- Alliance of companies and associations producing Power-to-X systems and Power-to-X products or which are interested in its use.
- Goals:
  - Market introduction of Power-to-X systems and Power-to-X products.
  - Ensure that GHG savings from the use of Power-to-X fuels in road, air and shipping traffic are fully taken into account in national and international regulation.
  - Power-to-X products should be combined with a targeted innovation bonus financed from the federal budget.
- Members: aireg, AUDI AG, Ontras Gastransport GmbH, Uniper SE, DWV (German Hydrogen and Fuel Cell Association) and DVGW (German Technical and Scientific Association for Gas and Water).
- No incentives to use Power-to-X products.

- Politics and some stakeholders (from the aviation sector) in Germany are mainly cheering the PtL option, although the challenging prerequisites are well known, and paying less attention to other feedstocks.

„Incentives“ to promote SAF production and consumption

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EU – Renewable Energy Directive (RED II)

- Goal: 20% of energy from renewable resources in 2020
- Transport sector: min. 10% of fuel from renewable resources
- Fuel producers must meet quota
- “Increased” crediting of sustainable aviation fuels (Multiplier of 1.2)
- Future: Use of second-/third-generation fuels whose raw materials do not require additional land (e.g. algae, fuel from waste, etc.).

United Kingdom – Renewable Transport Fuel Obligation (RTFO)

Netherlands – Biotickets (Goal: 10% renewable energy in transport)

Norway – SAF Mandate (Goal: 0.5% SAF by 2020, 30% SAF by 2030)

Germany – nothing
but: **National Platform for the Future of Mobility** (mandate/quota)

Thank you!

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Bio Jet Fuel
CLUSTER

Alfredo Ramos Aparicio
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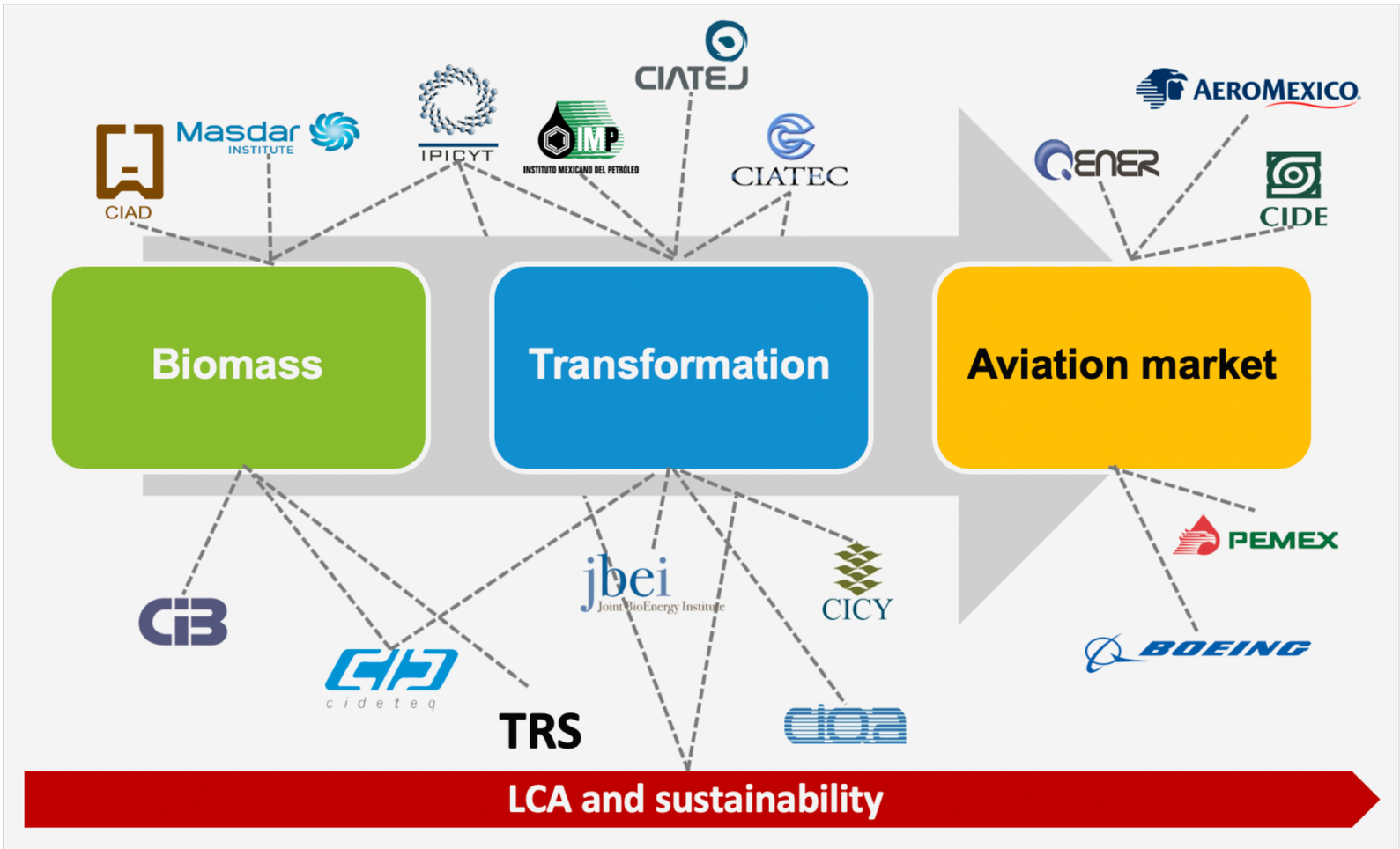
Fondo Sectorial CONACYT-SENER
Sustentabilidad Energética

December 2018

About us?

- We participated in the "Flight Plan" led by ASA (2009)
- Boeing has been a strong supporter of the efforts in Mexico and continues to be so
- We have the support of the largest airline in Mexico
- We have extensive experience in:
  - The development of R + D + i projects
  - Collaboration with specialists from different areas and institutions

Integration



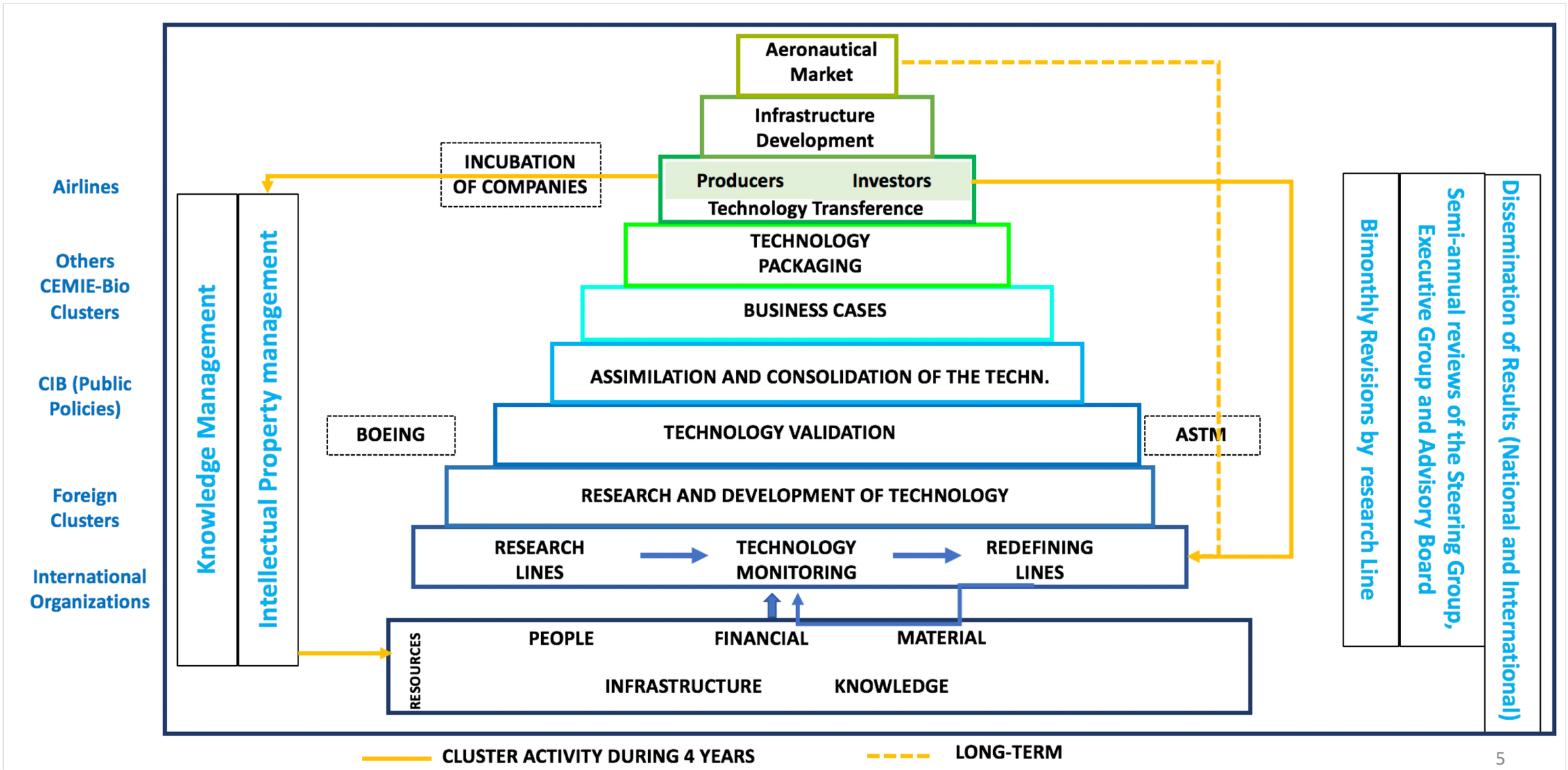
Energy Sustanability Fund
18 million USD
4 year project
2016-2020

CONACYT SENER SECRETARÍA DE ENERGÍA

Four lines of action

- Biomass:
  - Jatropha
  - Salicornia
  - Lignocellulosic residues
  - Waste oil
  - Castor
- Transformation:
  - Fischer-Tropsch
  - HEFA (Hydro-processed Esters and Fatty Acids)
  - DSHC (Direct Sugar to Hydrocarbon)
  - ATJ (Alcohol to Jet)
  - APR (Aqueous Phase Reformation)
- Life cycle and sustainability analysis:
  - 12 Principles of the RSB (Roundtable on Sustainable Biomaterials)
  - Global challenge
- Market

Framework


Airlines
Others CEMIE-Bio Clusters
CIB (Public Policies)
Foreign Clusters
International Organizations
Knowledge Management
Intellectual Property management
Aeronautical Market
Infrastructure Development
INCUBATION OF COMPANIES
Producers
Investors
Technology Transference
TECHNOLOGY PACKAGING
BUSINESS CASES
ASSIMILATION AND CONSOLIDATION OF THE TECHN.
BOEING
TECHNOLOGY VALIDATION
ASTM
RESEARCH AND DEVELOPMENT OF TECHNOLOGY
RESEARCH LINES
TECHNOLOGY MONITORING
REDEFINING LINES
RESOURCES
PEOPLE
FINANCIAL
MATERIAL
INFRASTRUCTURE
KNOWLEDGE
Bimonthly Revisions by research Line
Semi-annual reviews of the Steering Group, Executive Group and Advisory Board
Dissemination of Results (National and International)
CLUSTER ACTIVITY DURING 4 YEARS
LONG-TERM

General Guidelines

- **Development of the sustainable aviation fuel (SAF) industry in Mexico**
- The cluster must have continuity beyond 4 years
- Must develop intellectual property, technology and exploit it in the market, creating resources for new research and technological developments
- The income derived from the sale of the Intellectual Property, technological Products and Services should give sustainability in the long term, creating a virtuous circle with new research projects

"*The vision of the strategic plan should establish the actions necessary for its long-term sustainability. The Cluster should be conceptualized as a long-term project that allows the consortium to continue its mission, once the resources granted by the Fund through this call are exhausted.* **"**

Beyond the Bio Jet Fuel Cluster

Bio jet fuel Cluster

2016-2020
Bio JetFuel CLuster

2020-2022
Building the SAF industry in Mexico

2022-2030
Establishing the SAF industry

2016: Mexico signs the ICAO MBM

2021: CORSIA Pilot Phase

Feedstock
- Castor
- Jatropha
- Salicornia

Transformation demonstrative Plants
- ATJ Plan
- HEFA Plan

Sustainable processes (RSB)

At the end of 2020 ¿have we established the industry?

2020: Bio Jet Fuel Cluster ends.

New funds with the next goals:

Developing the technology for optimizing and increasing productivity of feedstock to get a low cost vegetable oil.

Adopting the technology for processing lignocellulosic biomass (agricultural residues) -> Ethanol Production

New laws and regulations to promote private investment to establish the SAF industry in Mexico

Private funds to build 4 bio refineries to supply 50,000 Bbl/d of SAF to establish the SAF industry in Mexico

MEX (2024), HEFA
12,000 Bdl/d

CUN (2026), ATJ
12,000 Bbl/d

GLD (2028), ATJ
12,000 Bbl/d

MTY(2030), HEFA
14,000 Bbl/d

Bio Jet Fuel
CLUSTER

Thank you for your attention

Alfredo Ramos Aparicio
aramos@qener.com.mx

Fondo Sectorial CONACYT-SENER
Sustentabilidad Energética

December 2018

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

AESA AGENCIA ESTATAL DE SEGURIDAD AÉREA

THE *BALANCED COMPROMISE:*

2% use of Sustainable Aviation Fuels in 2025 through a dialogue between regulator and industry

César Velarde
AESA advisor

A BIT OF HISTORY

2010 – Spanish Bioqueroseno Initiative

bioqueroseno.es

Iniciativa española para la producción y consumo de bioqueroseno para la aviación

Iniciativa Española de bioqueroseno

INICIATIVA ESPAÑOLA DE PRODUCCIÓN Y CONSUMO DE BIOQUEROSENO PARA AVIACIÓN

27 octubre 2011

AESA · SENASA · OBSA · Ciemat · RSB · camelina company España · tecBIO · tecnalia · CLH · pullmantur air · UOP A Honeywell Company · REPSOL · CEPSA · AIRBUS · IBERIA

Itaka

EU ITAKA Project (2012 - 2016)

CORE-JetFuel

EU CORE jet-fuel Project (2013 - 2016)

A BIT OF HISTORY

INTERNATIONAL COOPERATION

2013 MoU US-SPAIN

FAA Home ▸ News ▸ News & Updates

FAA and Spain Cooperate in Alternative Aviation Fuels

February 11–The Federal Aviation Administration (FAA) and the Spanish Aviation Safety and Security Agency (AESA) signed a Declaration of Cooperation to promote the development and use of sustainable alternative aviation fuels in the United States and Spain. The Declaration was signed by Carey Fagan, FAA Executive Director for International Affairs, and Isabel Maestre Moreno, Director of AESA.

MEXICO (2010)

ITALY (2011)

A BIT OF HISTORY

CAAFI COOPERATION

2013 PARIS AIR SHOW

CURRENT SITUATION: GROWTH

Environment is “back” (after the 2012-2016 economic crisis) to be a social priority

CURRENT SITUATION: GROWTH

Part of this environmental social pressure is driven towards jet-fuel taxation

TRANSPORT & ENVIRONMENT

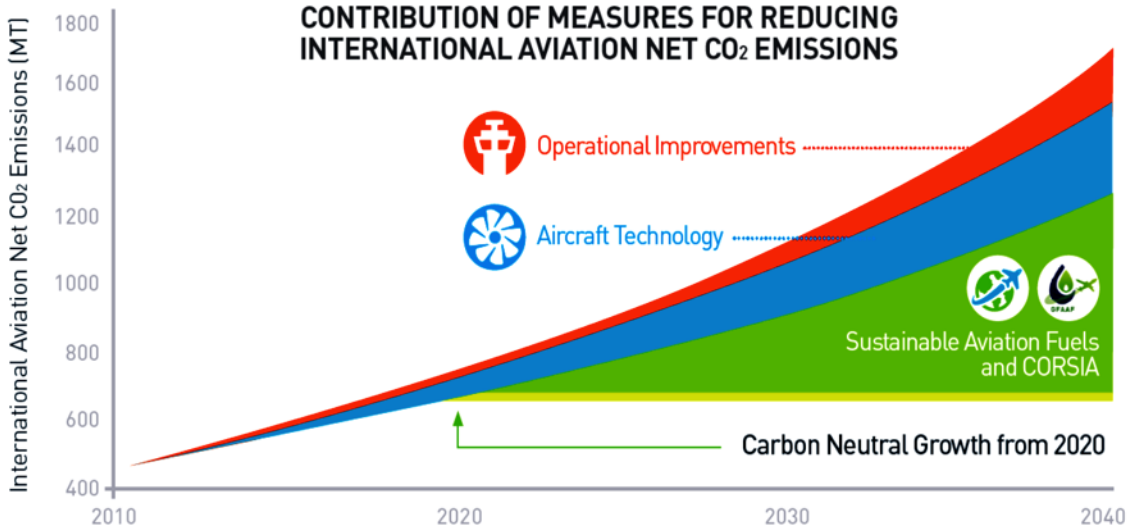
Ending aviation's tax holiday

Published on February 7, 2018 - 18:39

One billion. That's how much in euro that Germany's tax on airline tickets generates every year. A billion is about a quarter of what trucks pay in Maut every year, or about 35 times less than the motor fuel tax.

THE *BALANCED COMPROMISE*: BACKGROUND

- Aviation growth requires introducing new and ambitious LONG-TERM measures to reduce CO2 emissions **beyond ICAO CORSIA**
- If we do not introduce ambitious measures such as sustainable aviation fuels (SAF), it is foreseeable that we will face less effective measures, such as **taxes, in different formats: airports, fuel, etc.**
- The introduction of SAF NEEDS A **MATCH between supply & demand**.



THE *BALANCED COMPROMISE*: BACKGROUND

- Although there should be support to the introduction of SAF, Spain does not contemplate a system based on subsidizing the use or production, but is considering options to establishing a market.
- Creating a market should serve as a booster to improve technologies and lower prices to increase a competitive use in higher percentages.

Requirements to create a real market

✓ The demand by airlines has to assume an extra cost, but small enough to avoid creating markets distortions

✓ The offer by producers must guarantee the return of investments

THE *BALANCED COMPROMISE*

- The Spanish Ministry of Transport proposes the concept of "***balanced compromise***" between regulators and industry for the promotion of sustainable aviation fuels.
- It recognizes that a national objective of using 2% of sustainable aviation fuel in 2025 is a reasonable goal that must be studied through a dialogue between the regulator and the industry.

PROPOSAL

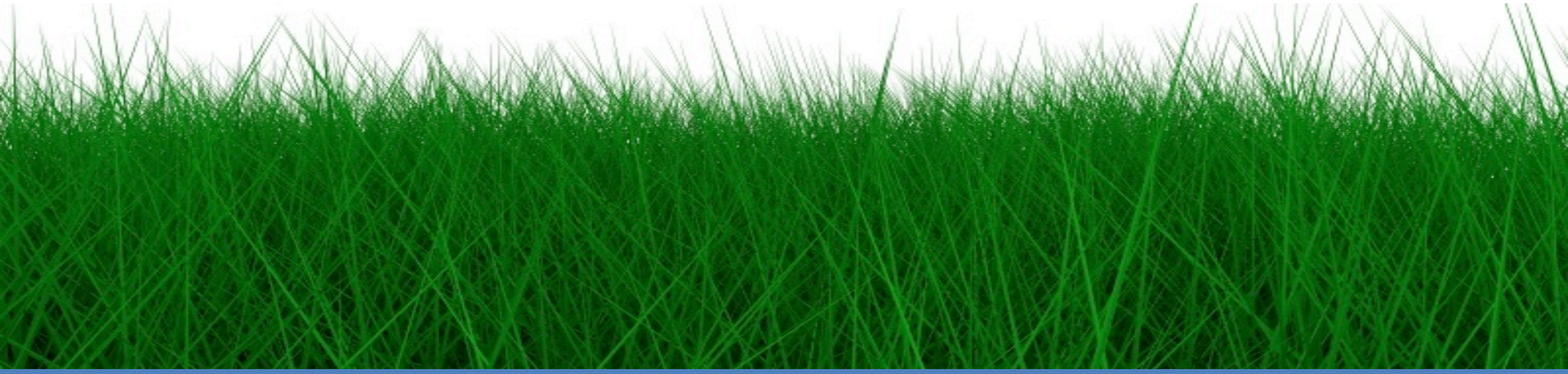
✓ Establish a national obligation to achieve a **2% supply** of SAF in the initial phase of its industrial uptake. Entry into force **in 2025**.

AGREEMENT

✓ Implement in agreement with key industry stakeholders and after a feasibility study to determine it does not compromise the competitiveness of air transport neither introduces fair competition distortions.

THE *BALANCED COMPROMISE*

Incorporating 2 % sustainable aviation fuels in 2025 is considered a reasonable objective to be implemented through a dialogue between the regulator and industry



THANK YOU

AESA AGENCIA ESTATAL DE SEGURIDAD AÉREA

Sustainable Aviation Fuel Special Interest Group (SAF SIG)

Building the UK Supply Chain

Michelle Carter
Head of Transport
SAF SIG Manager
Knowledge Transfer Network

Innovate UK
Knowledge Transfer Network

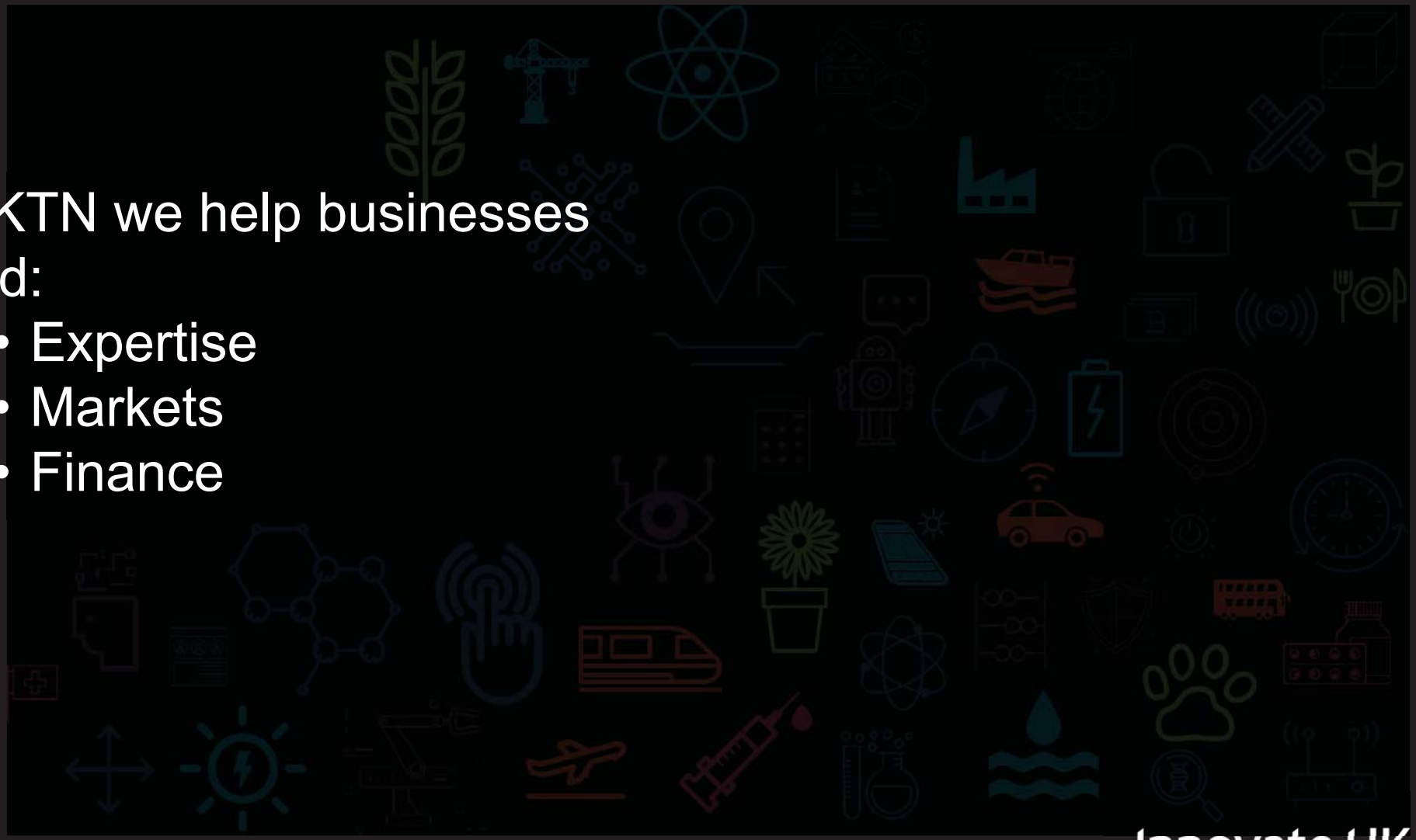
ktn-uk.org @KTNUK

Overview

- About Knowledge Transfer Network
- Rationale for a Sustainable Aviation Fuel Special Interest Group
- What SAF SIG has done
- Technology analysis of UK companies
- UK SAF Policy & Investment
- UK presence at CAAFI

At KTN we help businesses
Find:

- Expertise
- Markets
- Finance



Innovate UK
Knowledge Transfer Network

The Sustainable Aviation Fuel Special Interest Group is….

- UKs 1st & only Public:Private initiative focused on SAF
- Sponsored by Innovate UK, Department for Transport & Sustainable Aviation
- 2 year programme (launched 1st March 2017)
- Helping to build the UK SAF Supply Chain
- Delivered by the Knowledge Transfer Network

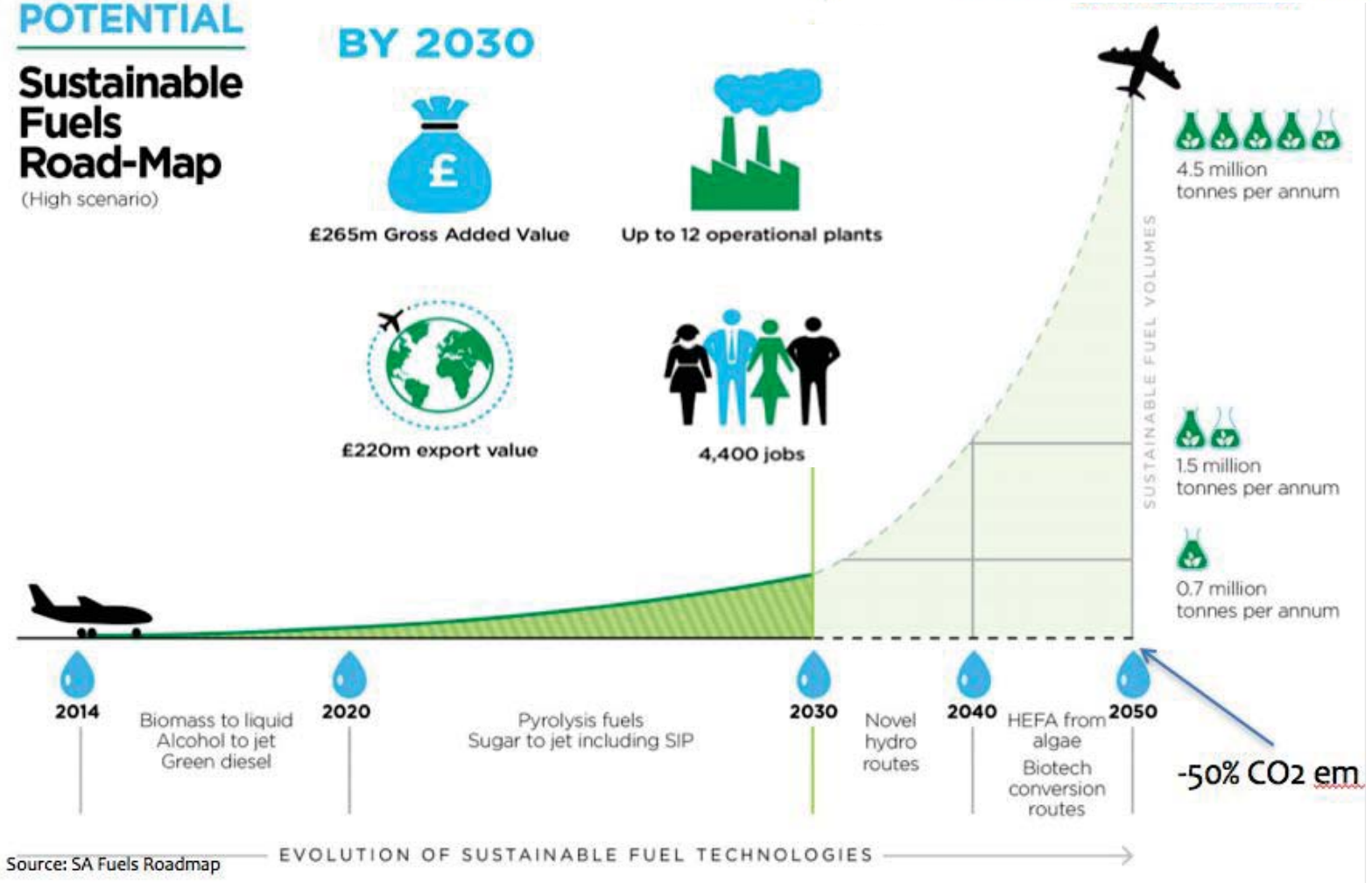
UK POTENTIAL

Sustainable Fuels Road-Map

(High scenario)

SUSTAINABLE AVIATION

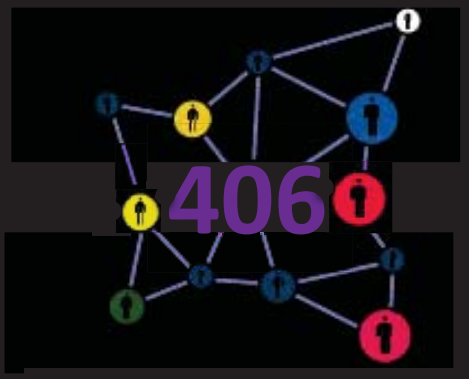
CLEANER | QUIETER | SMARTER



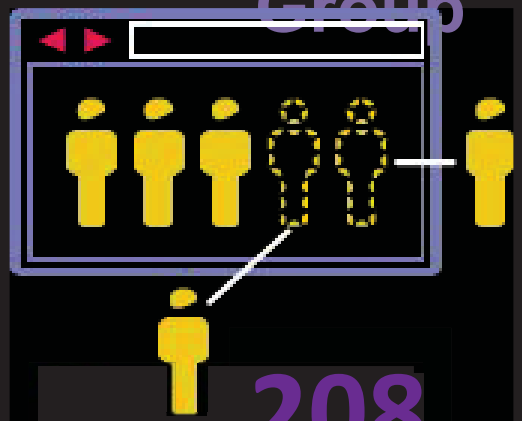
Source: SA Fuels Roadmap

SAF SIG Team will bring together the supply chain

Sustainable Aviation Fuel Special Interest Group



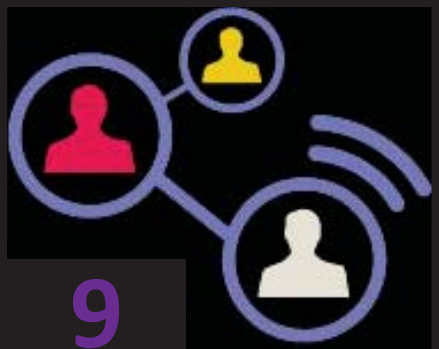
people in our network



208

organisations in our network

companies met with & supporting



9

new collaborations facilitated

250

delegates registered for our events

events held

74

B2B & B2R introductions

Innovate UK
Knowledge Transfer Network

Understanding the ASTM D4054 process: a step-by-step guide to jet fuel approval

The ASTM D4054 flowchart has been created by KTN and Sustainable Aviation to support new fuel producers navigate the complexities of approving new aviation fuel. The chart takes the user through the four main tiers from fuel specification and fit-for-purpose
navigating the appr

Fl

This tier requires r
properties. If there
fuel will progress r
airframe safety, pe

Cleared For Offtake

Supplying Sustainable Aviation Fuels

Prepared by:

Knowledge Transfer Network

Sustainable Aviation

Chris Lewis Fuels Consultancy

#SustainableAviationFuel

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Sustainable Aviation Fuel UK Landscape[BETA]

Overview

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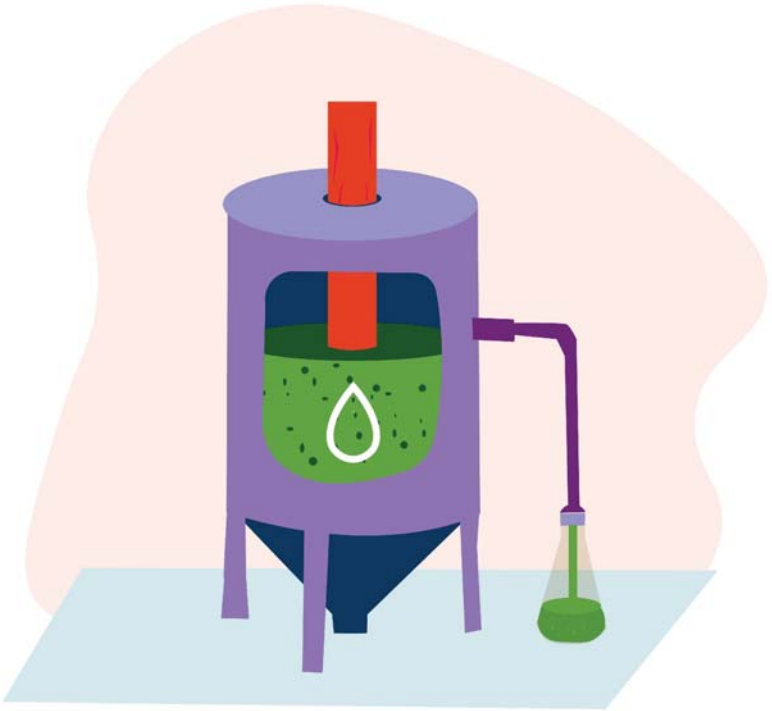
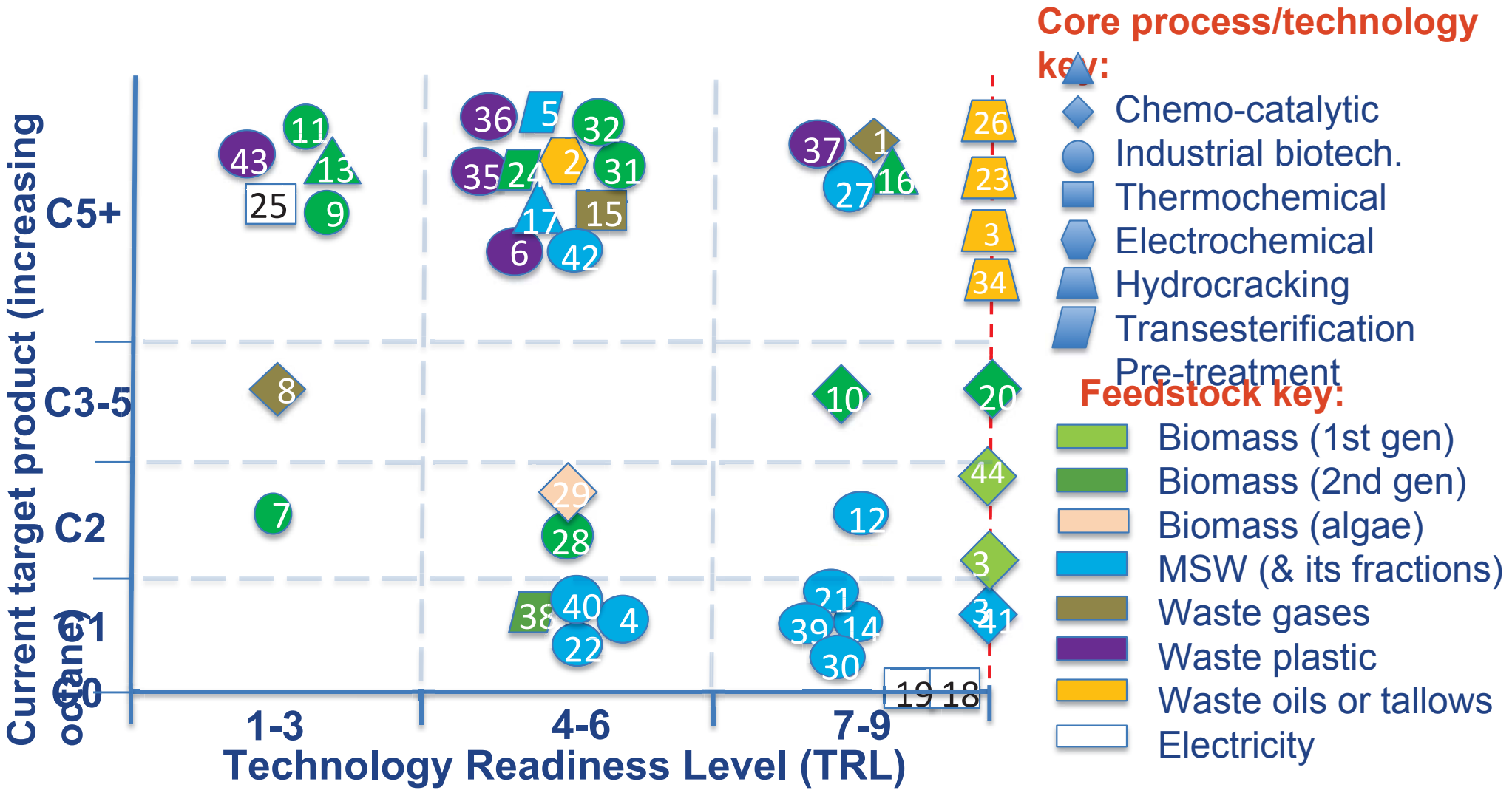
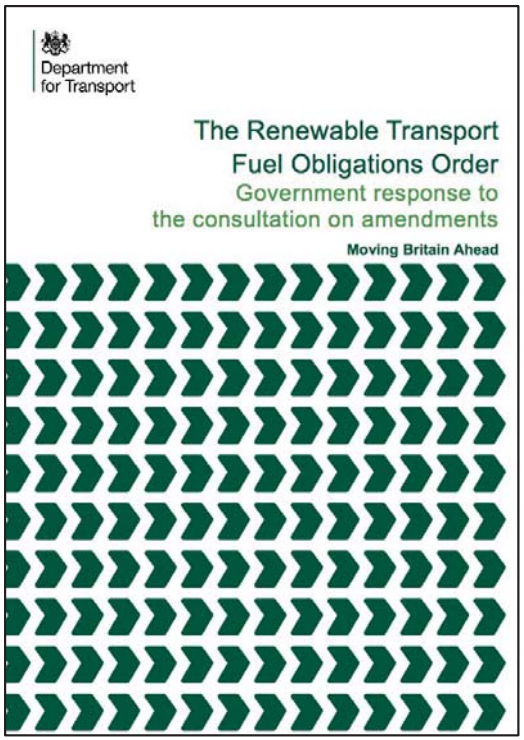
Feedstock & technology analysis of 44 UK companies



Opportunity for SAF – Analysis of 44 UK companies



New Renewable Transport Fuel Obligation now includes development of SAF



- sub-target for aviation (development) fuel set at 0.1% in 2019
- to increase to 2.8% by 2032
- supports waste-based feedstocks
- declining support for crop-based feedstocks

Recent UK Gov investment into SAF

Future Fuels for Freight & Flight (F4C) Competition

Department for Transport

- **Johnson Matthey** (Kerosene, diesel and petrol substitutes)
- **LanzaTech** (Kerosene and diesel substitutes)
- **Kew Projects** (Diesel substitute)
- **Velocys Technologies** (Kerosene and petrol substitutes)

UK has…

- Strong scientific expertise
  (e.g. biotech, chemical engineering, manufacturing, oil & gas)
- Demo & Comm plants
  (e.g. bio-ethanol, bio-butanol, renewable H_2)
- Sources of feedstock
  (e.g. UCO, gases [CO_2, CO], MSW, algae, co-products from food & drink industry & agri)

KTN can help connect you to the right people & expertise

UK Mission to USA – 5 companies subsidised by Innovate UK to attend CAAFI

green fuels

Susteen Technologies
sustainable resources from waste

E4tech
Strategic thinking in sustainable energy

DROCHAID
RESEARCH SERVICES LTD

MECCone

KTN can help connect you

Innovate UK
Knowledge Transfer Network

SUSTAINABLE AVIATION
CLEANER | QUIETER | SMARTER

Department for Transport

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www.SAFSIG.co.uk

#SustainableAviationFuel