Renewable Fuels for Aviation: EU perspective

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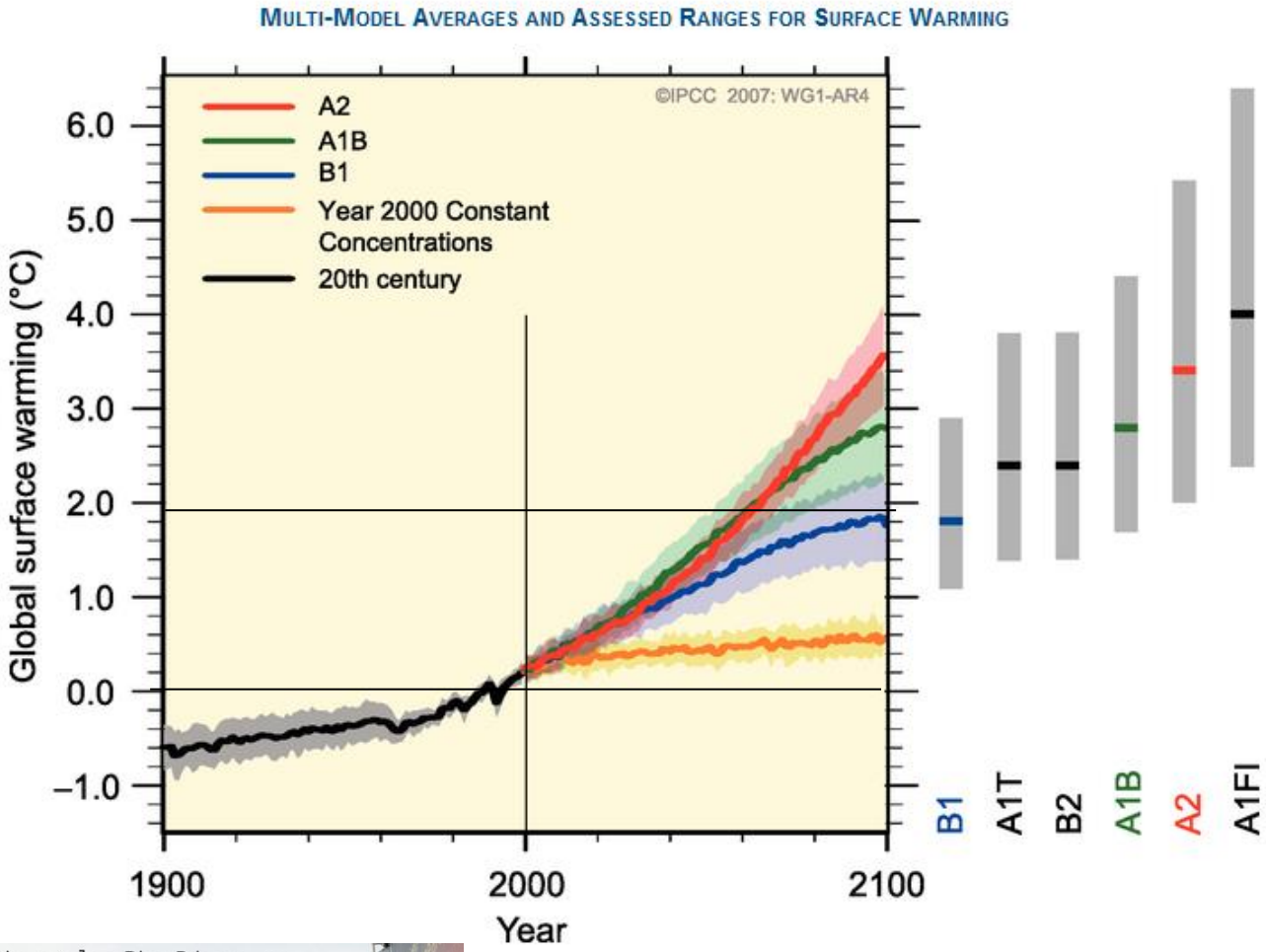
European Commission

CAAFI – Core-JetFuel Cooperation workshop
28 April 2016 – Alexandria - USA

Scenarios



A1 family: Future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, rapid introduction of new and more efficient technologies.

A2 family: Very heterogeneous world. The underlying theme is self-reliance and preservation of local identities.

B1 family: Convergent world with the same global population that peaks in mid-century and declines thereafter but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies

EU Objectives 2020 - 2030 - 2050

	2020	2030	2050
GHG emissions	**-20%** (1 - wrt 1990)	**-40%** (5 - wrt 1990)	**-80 to 95 %**
Transport	*-6% (4 - FQD - wrt 2010)*	-20% (2, wrt 2008)	*-60 % (2*, wrt 2008)*
Share of RE in EU energy consump	**20%** (1) (3)	**27%** (5)**	
Transport	*10% (3 - RED)*		
Improvement in Energy Efficiency	**20%** (1) (6)	**27%** (5)	
	Binding		

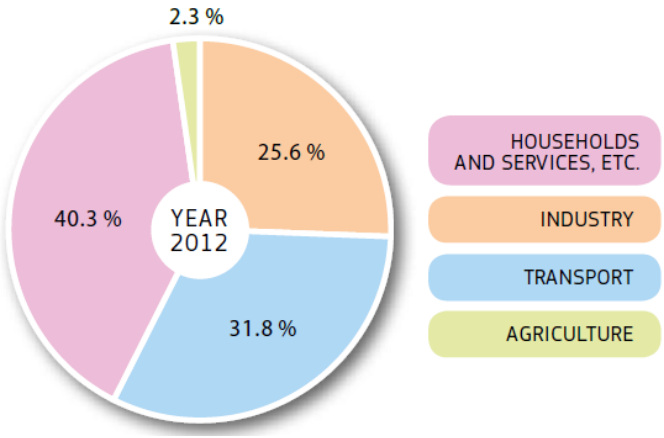
(1) 2020 Climate Energy package, 2007
(2) Transport White paper, 2011 * 40% low carbon sustainable fuels in aviation by 2050
(3) Renewable Energy Directive (RED) , 2009, B, NREAP
(4) Fuel Quality Directive (FQD), 2009, B
(5) 2030 framework for climate and energy policies, 2014, ** binding at EU level only
(6) Energy Efficiency Directive, 2012, B

Each Member State 10%

Transport

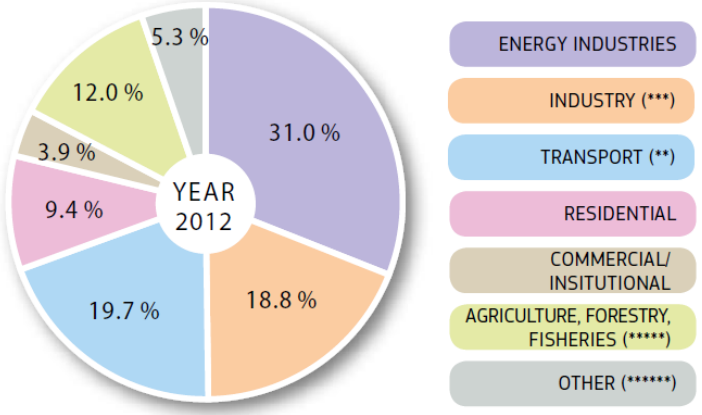
European Commission

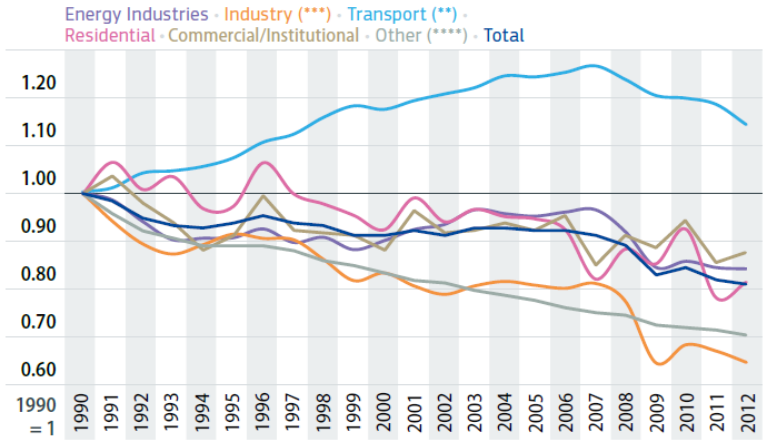
Final Energy Consumption – EU-28
BY SECTOR (Mtoe)



Mostly HC fuel

GHG Emissions (*) by Sector – EU-28
MILLION TONNES CO_2 EQUIVALENT





Notes: (*) Excluding LULUCF (Land Use, Land-Use Change and Forestry) emissions and International Bunkers; (**) Excluding International Bunkers (international traffic departing from the EU); (***) Emissions from Manufacturing and Construction and Industrial Processes; (****) Emissions from Fuel Combustion in Agriculture/Forestry/ Fisheries, Other (not specified elsewhere), Fugitive Emissions from Fuels, Solvent and Other Product Use, Agriculture, Waste, Other.

European Commission

Biofuels in the EU

Final Consumption of Petrol, Diesel and Biofuels for Transport – BY FUEL 2012 (ktoe)

5.3% of final consumption

	FINAL CONSUMPTION OF PETROL AND DIESEL FOR TRANSPORT (*)	Motor Gasoline	Gas Diesel Oil	BIOFUELS	Biogasoline	Biodiesel	Other liquid biofuels (**)
EU-28	272967.2	82368.6	190598.7	14501.0	2851.8	11637.5	11.7
BE	7990.7	1206.5	6784.2	346.0	48.0	298.0	
BG	2152.6	540.2	1612.5	85.9		85.9	
CZ	5148.1	1639.9	3508.2	275.3	56.1	219.2	
DK	3446.3	866.2	2580.1	223.0		223.0	
DE	47450.0	17617.7	29832.3	2912.9	791.8	2113.8	7.3
EE	742.4	256.4	486.0	3.8	3.8		
IE	3437.9	1282.2	2155.7	104.1	47.9	56.2	
EL	4945.9	3097.1	1848.8	123.9		123.9	
ES	25196.8	4777.6	20419.2	2087.3	198.4	1888.9	
FR	39657.6	7628.1	32029.5	2693.5	413.5	2280.0	
HR	1763.2	615.6	1147.6	36.9	1.3	35.7	
IT	30680.4	8769.9	21910.5	1367.9	105.1	1262.9	
CY	682.8	398.9	283.8	15.8		15.8	
LV	853.2	232.1	621.1	21.5	6.4	15.1	
LT	1256.7	231.1	1025.6	60.5	8.4	52.1	
LU	2144.8	358.8	1785.9	48.8	1.3	47.4	0.2
HU	3526.7	1282.6	2244.1	155.1	52.1	103.0	
MT	171.5	77.2	94.3	1.8		1.8	
NL	10530.4	4151.1	6379.3	334.8	124.5	210.3	
AT	6775.9	1607.6	5168.3	478.7	67.5	411.2	
PL	13620.2	3822.2	9798.1	822.9	153.9	669.0	
PT	4969.8	1180.2	3789.6	274.6	2.7	267.8	4.2
RO	4781.4	1331.2	3450.1	217.6	58.9	158.7	
SI	1807.8	525.8	1282.0	50.9	5.1	45.8	
SK	1925.6	554.7	1370.9	90.9	17.8	73.1	
FI	3733.6	1387.5	2346.1	265.8	90.1	175.7	
SE	6539.0	2776.5	3762.5	518.4	205.5	312.9	
UK	37035.9	14153.5	22882.5	882.2	391.7	490.5	

Biofuels Production BY FUEL 2012 (ktoe)

	TOTAL	Biogasoline	Biodiesel	Other liquid biofuels (*)
EU-28	11532.5	2035.9	9187.9	308.7
BE	449.5	155.7	264.6	29.1
BG	7.1		7.1	
CZ	218.6	65.9	152.6	
DK	97.4		97.4	
DE	2976.4	393.7	2492.0	90.7
EE				
IE	24.5		24.5	
EL	124.3		124.3	
ES	638.0	193.4	444.6	
FR	2388.3	422.1	1966.2	
HR	34.7		34.7	
IT	370.8	57.8	253.6	59.4
CY	5.8		5.8	
LV	81.4	1.0	80.4	
LT	107.6	13.3	94.3	
LU				
HU	281.6	152.7	128.9	
MT	2.4		2.4	
NL	1040.2		1040.2	
AT	237.3	70.9	166.4	0.0
PL	677.6	122.4	555.2	0.1
PT	273.0		268.8	4.2
RO	131.2	42.5	88.7	
SI	0.9		0.9	
SK	151.2	51.9	99.3	
FI	273.1		257.3	15.8
SE	634.5	206.4	318.8	109.3
UK	305.0	86.2	218.8	

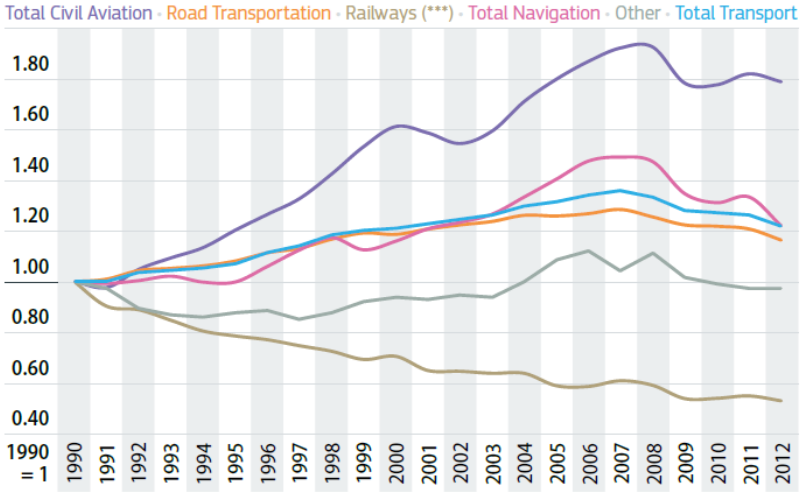
14.5 tons
=
30% of EU aviation fuels

Aviation in Transport

European Commission

GHG Emissions from Transport – EU-28
BY MODE (MILLION TONNES CO_2 EQUIVALENT)

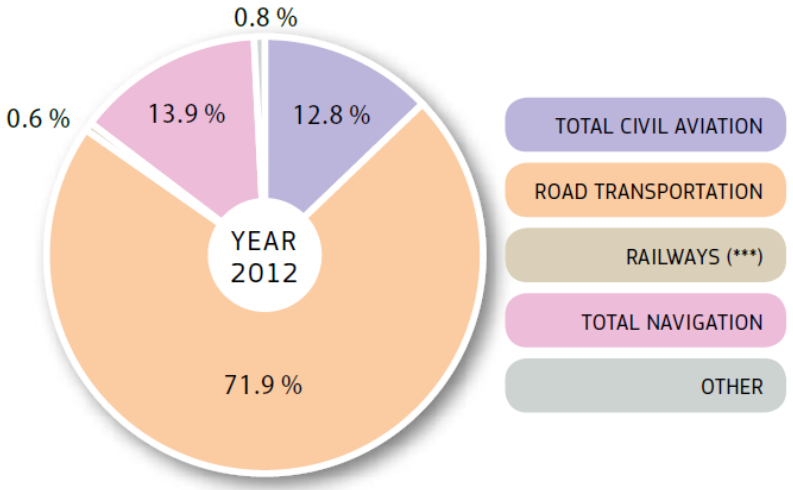
INCLUDING INTERNATIONAL BUNKERS



Notes: (*) Excluding International Bunkers (international traffic departing from the EU); (**) Including International Bunkers but excluding LULUCF; (***) Excluding indirect emissions from electricity consumption; (****) Combustion emissions from all remaining transport activities including pipeline transportation, ground activities in airports and harbours, and off-road activities.

GHG Emissions from Transport – EU-28
BY MODE (SHARE %)

INCLUDING INTERNATIONAL BUNKERS



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Final Energy Consumption
BY SECTOR 2012 (Mtoe)

	ALL SECTORS	INDUSTRY	TRANSPORT	Road	Railways	Air	Domestic navigation	Consumption in pipeline transport, etc	HOUSEHOLDS, SERVICES, ETC.	Households	Agriculture	Services, etc.
EU-28	1 104.5	282.8	351.7	287.5	7.0	49.1	4.4	3.6	470.0	289.2	25.0	155.9
Share	100%	26%	32%	82%	2%	14%	1%	1%	43%	62%	5%	33%

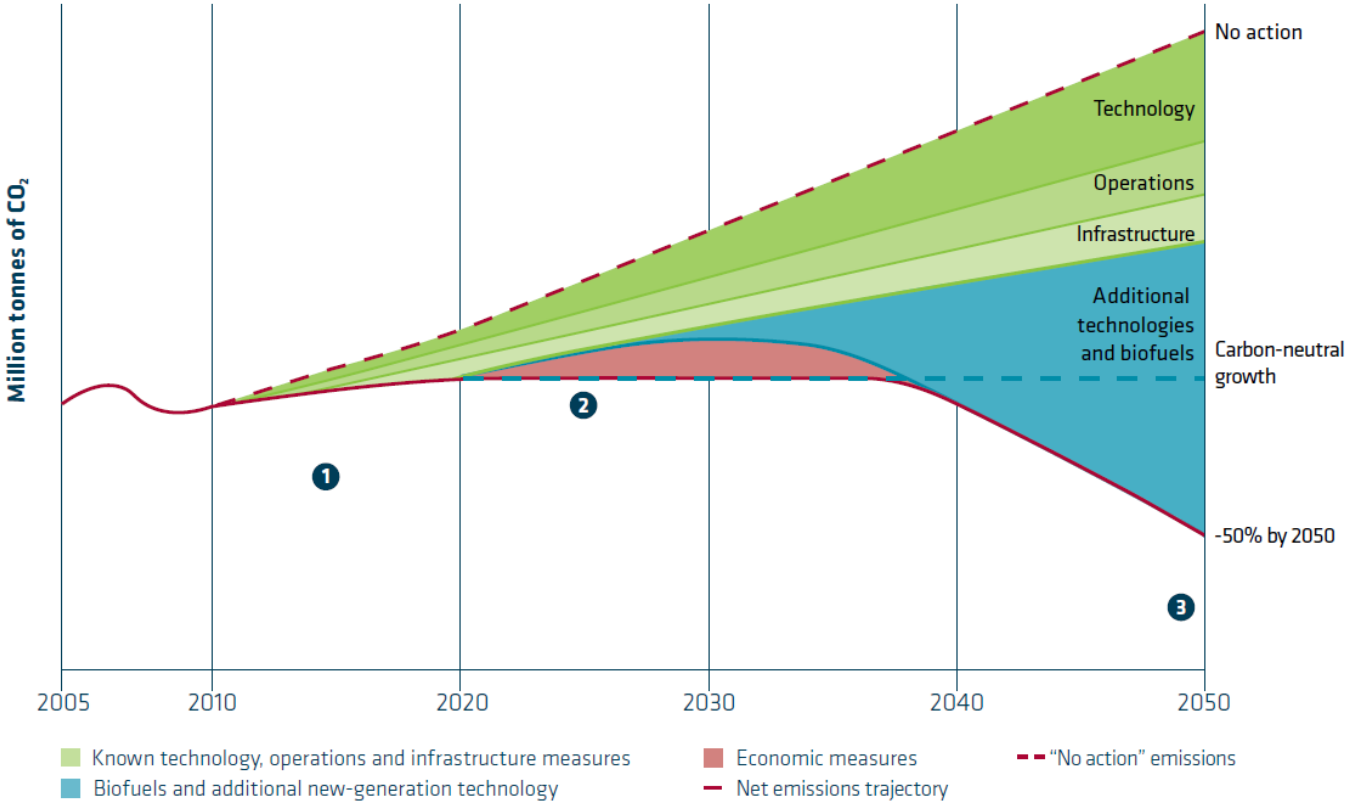
In 2012 EU-28:

- Final energy consumption of the air transport sector was ~50 Mtoe.
- GHG emissions from the aviation sector (incl. international bunkers) represent 12.8% of Transport GHG emission or 2.5% of total emission

European Commission

ATAG AIR TRANSPORT ACTION GROUP

MAPPING OUT THE INDUSTRY COMMITMENTS



1_Improve fleet fuel efficiency by 1.5% per year from now until 2020

2_Stabilise net emissions from 2020 through carbon-neutral growth

3_By 2050, net aviation carbon emissions will be half of what they were in 2005

(Schematic, indicative diagram only)

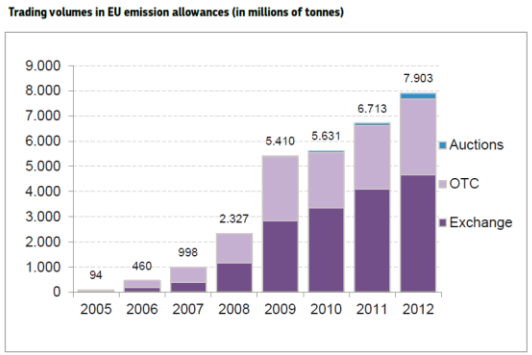
Emission Trading Scheme

- Initiated in 2005 – Cap and trade
- Phase I 2005-2007
- Phase II 2008-2012
- Phase III 2013-2020
- Inclusion of Aviation in ETS since 2012 (Directive 2003/87/EC)

Article 1

Historical aviation emissions for the purposes of paragraphs 1 and 2 of Article 3c of Directive 2003/87/EC are set at 219 476 343 tonnes of CO_2.

- 2014 revision (Regulation 421/2014) intra-european traffic only



EU ETS sector:
11000 power stations in 31 countries + aviation
~45% of GHG emissions
(- 21% wrt 2005)

Non-trading sector
(-10% wrt to 2005)

-20% by 2020 (wrt to 1990)

Phase IV: beyond 2020

The overall number of emission allowances will decline at an annual rate of 2.2% from 2021 onwards, compared to 1.74% currently.

European Commission

2011 Biofuel Flight Path

- Part of the European Industrial Bioenergy Initiative (EIBI) of the EU Set Plan
- 2011-2020
- 2 million tons per year by 2020 (i.e. ~ 4% of current volumes)

2015

Time horizons	Action	Aim/Result
Short-term (next 0-3 years)	Announcement of action at International Paris Air Show	To mobilise all stakeholders including Member States.
	High level workshop with financial institutions to address funding mechanisms.	To agree on a "Biofuel in Aviation Fund".
	> 1,000 tons of Fisher-Tropsch biofuel become available.	Verification of Fisher-Tropsch product quality. Significant volumes of synthetic biofuel become available for flight testing.
	Production of aviation class biofuels in the hydrotreated vegetable oil (HVO) plants from sustainable feedstock	Regular testing and eventually few regular flights with HVO biofuels from sustainable feedstock.
	Secure public and private financial and legislative mechanisms for industrial second generation biofuel plants.	To provide the financial means for investing in first of a kind plants and to permit use of aviation biofuel at economically acceptable conditions.
	Biofuel purchase agreement signed between aviation sector and biofuel producers.	To ensure a market for aviation biofuel production and facilitate investment in industrial 2nd generation biofuel (2G) plants.
	Start construction of the first series of 2G plants.	Plants are operational by 2015-16.
	Identification of refineries & blenders which will take part in the first phase of the action.	Mobilise fuel suppliers and logistics along the supply chain.
Mid-term (4-7 years)	2000 tons of algal oils are becoming available.	First quantities of algal oils are used to produce aviation fuels.
	Supply of 1.0 M tons of hydrotreated sustainable oils and 0.2 tons of synthetic aviation biofuels in the aviation market.	1.2 M tons of biofuels are blended with kerosene.
	Start construction of the second series of 2G plants including algal biofuels and pyrolytic oils from residues.	Operational by 2020.
Long-term (up to 2020)	Supply of an additional 0.8 M tons of aviation biofuels based on synthetic biofuels, pyrolytic oils and algal biofuels.	2.0 M tons of biofuels are blended with kerosene.
	Further supply of biofuels for aviation, biofuels are used in most EU airports.	Commercialisation of aviation biofuels is achieved.

Past and ongoing initiatives at EU level

Coordination

Bio Fuel FP Core Team

Biojetmap
(DG ENER, Tender to synthesize demo flights)

CORE-JetFuel
(DG MOVE/RTD FP7, 1.2 MEur EU funding, 2013-2017, Coordination Action, overview of RTD, RTD roadmap)

Forum AE
(DG RTD - 1.2 MEur EU funding , 2013-2017, Coordination Action, Technical focus, NOx, PM, not BF centric)

Policy

Bio Fuel Flight Path
(DG ENER, towards large scale production in the EU, 2 Mt by 2020)

EuroCAEP
(DG MOVE, ICAO)

ACARE WG3
(Environnent, partial focus on biofuels)

European Biofuels TECHNOLOGY PLATFORM

Research

dream
(DG RTD, 2008-2012- endurance test on a helicopter engine)

Alfa-Bird
(DG RTD, 2008-2012, 6.8 MEur, biofuel characterisation)

Swafea
(DG MOVE, Study on sustainability)

Solar Jet
(DG RTD, 2011-2015, 2.1 MEur, biofuel forom a solar reactor)

SOLAR-JET
Zero-carbon jet fuel from sunlight

Demo

ITAKA
(DG RTD, 10 MEur EU funding 2012-2015, production + flight)

Biorefly
(DG ENER, 13.7 MEur Eu Funding, 2 000 t + flights)

BFSJ
(DG ENER, 2014, 60 months, 27.8 MEur,

Bio-based Industries Consortium
(1.0 bEur Eu Funding + 2.8 bEur from industry, incl. in-kind)

Flights and Production

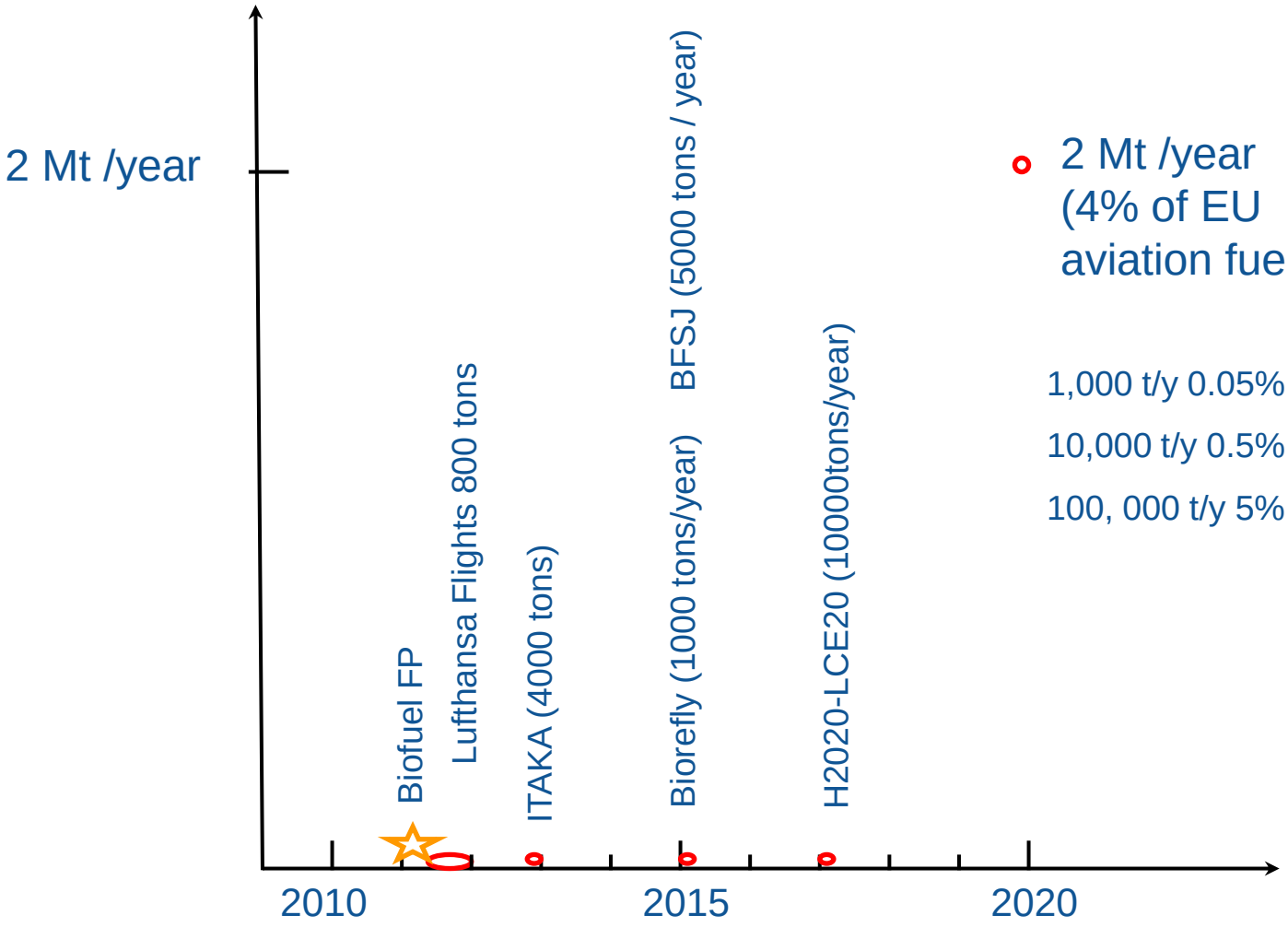
Flights:

- IATA: 1600 flight worldwide using bio-kerosene blends
- Lufthansa: 1189 flights Frankfurt-Hamburg involving 800 tons of biokerosene – July-December 2011

Production (EU)

- Neste (FI): by batches
  - Frankfurt-Hamburg (6 months) 1189 flights Lufthansa 800 tons,
  - Itaka (2012-2015, 9.9 MEur EU, 17.4 MEur total, 4000 tons)
- Biorefly (2000 tons/year, 2nd gen., 2015) BioChemtex (IT)
- BSFJ (4000 tons/year , 2015) Swedish Biofuels

Where are we today ?



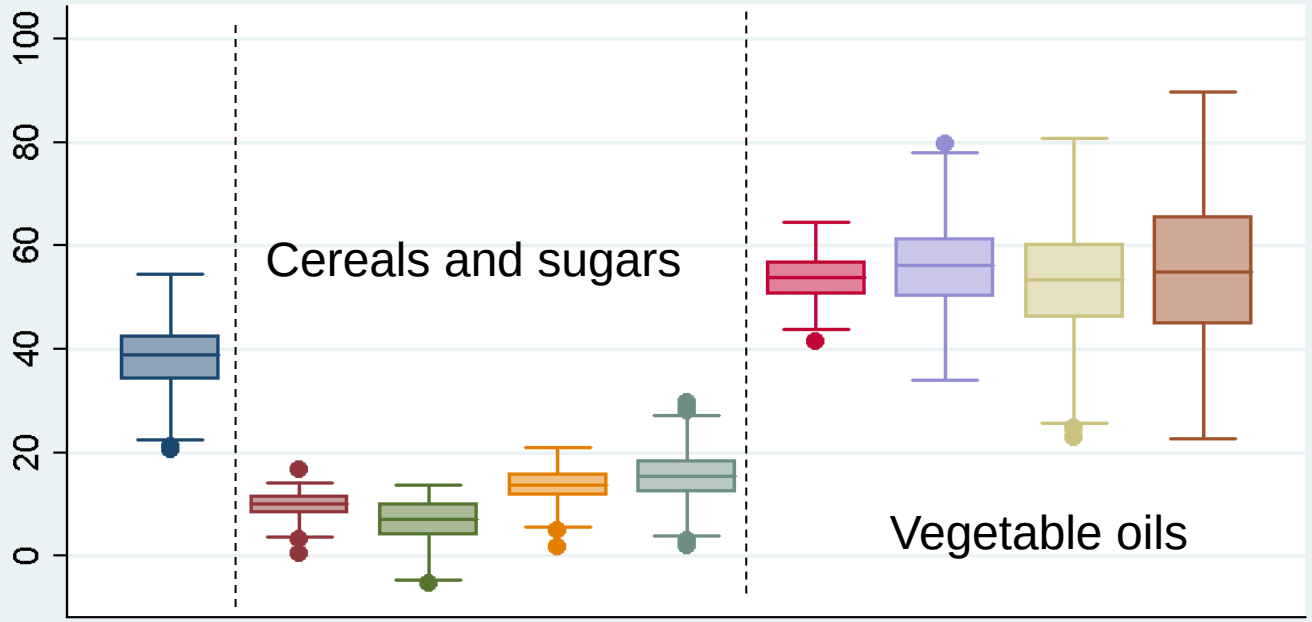
- 2 Mt /year (4% of EU aviation fuels) ?

1,000 t/y 0.05% of the objective

10,000 t/y 0.5% of the objective

100, 000 t/y 5% of the objective

Feedstock specific results (gCO2/MJ)



Source: Figure 18 of IFPRI-report

ILUC Directive

2015/153 amending Fuel Quality Directive (98/70/EC) and the Renewables Energy Directive (2009/28/EC)

- Renewable transport fuels of non-biological origin
- 1st generation biofuels capped to 7%
- Member States to report about Indirect Land Use Change
- Indicative target of 0.5% of advanced biofuels, count double
- Transposition deadline 10/09/2017
- In the case of suppliers of biofuels for use in aviation, Member States may permit such suppliers to choose to become contributors to the reduction obligation provided that those biofuels comply with the sustainability criteria
- Installation starting operation after 5 October 2015 shall produce fuels with at least 60% of GHG savings.

H2020: 2016 & 2017

Energy

LCE-20-2016-2017: Enabling pre-commercial production of advanced aviation fuels

- Pre-commercial plant based on sustainable feedstock (~10,000 tons/year)
- Off-take agreement
- Overall business solution

15 MEur in 2016 , 10 MEur in 2017

Transport

MG-1.1-2016: Reducing energy consumption and environmental impact of aviation

- Development of screening and optimisation tools aiming at quantifying the added value of alternative fuels from the jet fuel as well as development of design tools aiming at assessing the impact of different fuel compositions on engine components and fuel systems.

WP2016-2017: Other Actions

Energy

29. Coordination of renewable fuel stakeholder's strategy in the field of aviation

....

- ✓ An update and renewed approach to the 2011 Biofuel Flight Path is needed ...
- ✓ Support to set-up an organisational framework involving key stakeholders in the field ...
- ✓ covering production, distribution and use of renewable fuels
- ✓ and tackling the different aspects:
- ✓ Research and Innovation, sustainability, industrial production, legal framework (including in Member States) and financing mechanisms.
- ✓ The action will foresee resources to perform studies.

Type of Action: Public Procurement - 1 direct service contract

Indicative timetable: 1st quarter 2016

Indicative budget: EUR 1.20 million from the 2016 budget

Summary

- Biofuel development has been driven by surface transport
- The Renewable Energy Directive and the Fuel Quality Directive yielded important achievements
- ILUC Directive caps 1st gen to 7%, advices 0.5% for 2nd generation
- Unlike road transport, aviation is bound to liquid drop-in fuels on the medium term
- Unlike road transport, aviation is global i.e. EU only solutions are not satisfactory
- The financing of excess costs needs to be solved
- The post 2020 conditions are unclear
- How to be sure that initiaves will ultimately coherent with international context?

What's Next ?

2015

- International: Paris UNFCCC conference

Summer 2016:

- The Commission will propose legislation to achieve the greenhouse gas reduction target.
- Communication on decarbonisation of transport

End of 2016

- Propose for a new Renewable Energy Package including a new policy for sustainable biomass and biofuels

European Commission

Renewable Fuels for Aviation: EU perspective

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