ARTFuels

Support for alternative and renewable liquid & gaseous fuels forum
(policy and market issues)

The EU Alternative and Renewable Transport Fuel Forum and the EU REDII. Focus on Aviation Biofuels: the BIO4A project.

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Keyenergy, 8 Novembre 2018, Rimini

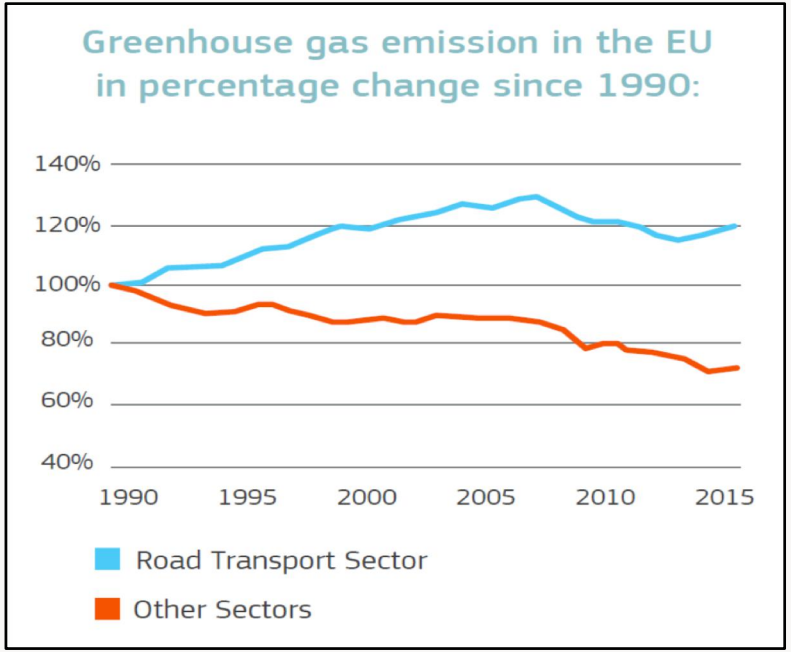
01

Recap on REDII

Sustainable Transport Fuel – the Challenge

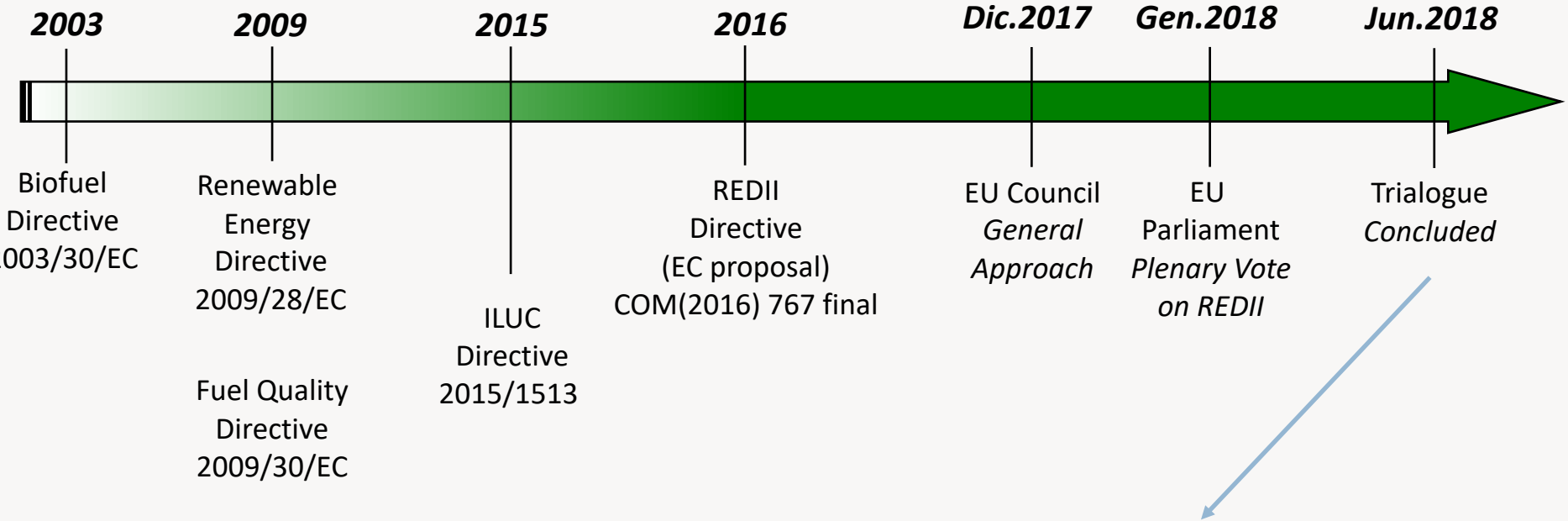
Key figures in EU transport

- 32% of final energy consumption
- Relies on oil for 94% of its energy needs
- 22% of total GHG emissions
- GHG emissions remain > than in 1990



Source: DG Energy

Summary of EU Biofuels Policy developments



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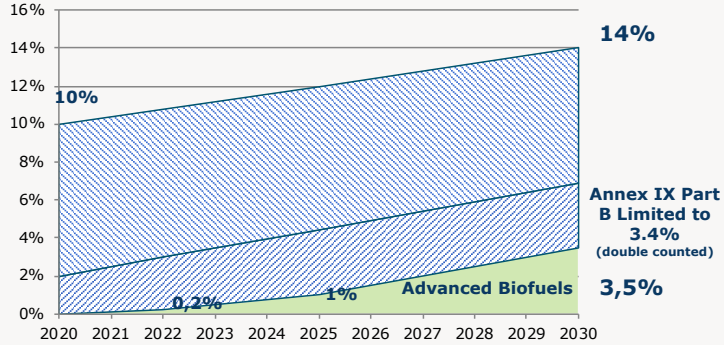
REDII After Trialogue - Key elements

- **14 %** ART fuels, **3.5 %** Advanced (Annex IX-A)
  - ✓ ***0.2% in 2022, 1% in 2025*** *and up to at least* ***3.5% by 2030****.*
- Cap biofuels for **Annex IX Part B** feedstocks to **1.7%** (dc)
- MS **may** double count biofuels and biogas from Annex IX-A feedstocks



- Limit **food-feed crop-based biofuels** to **max 7%**
- **High ILUC impact biofuels**: not exceed 2019 consumption levels, from **31.12.2023** decrease to **0% at 2030 + Low ILUC risk biofuels (no reduction)**
- Include **RFNBO** (**min GHG savings 70% as of 1.1.2021**) and **(Recycled Carbon fuels**, **min GHG threshold defined by DA**)
- **Aviation and Maritime x 1.2,** electrical transport on road (**x4.0**) and rail (**x1.5**)
- **Cover/rye cropping** in Advanced Biofuel definition (Annex IX-A)
- Include **measuring & monitoring soil C**

Annex IX – Part A & B

Part A. Feedstocks for the production of advanced biofuels, the contribution of which towards the target referred to in the first and second subparagraph of Article 25(1) may be considered to be twice their energy content:

(a) Algae if cultivated on land in ponds or photobioreactors.

(b) Biomass fraction of mixed municipal waste, but not separated household waste subject to recycling targets under point (a) of Article 11(2) of Directive 2008/98/EC.

(c) Bio-waste as defined in Article 3(4) of Directive 2008/98/EC from private households subject to separate collection as defined in Article 3(11) of that Directive.

(d) Biomass fraction of industrial waste not fit for use in the food or feed chain, including material from retail and wholesale and the agro-food and fish and aquaculture industry, and excluding feedstocks listed in part B of this Annex.

(e) Straw.

(f) Animal manure and sewage sludge.

(g) Palm oil mill effluent and empty palm fruit bunches.

(h) Tall oil pitch.

(i) Crude glycerine.

(j) Bagasse.

(k) Grape marcs and wine lees.

(l) Nut shells.

(m) Husks.

(n) Cobs cleaned of kernels of corn.

(o) Biomass fraction of wastes and residues from forestry and forest-based industries, i.e. bark, branches, pre-commercial thinnings, leaves, needles, tree tops, saw dust, cutter shavings, black liquor, brown liquor, fibre sludge, lignin and tall oil.

(p) Other non-food cellulosic material as defined in point (q) of the second paragraph of Article 2.

(q) Other ligno-cellulosic material as defined in point (p) of the second paragraph of Article 2 except saw logs and veneer logs.

Part B. Feedstocks for the production of biofuels, the contribution of which towards the target established in Article 25(1) may be limited and may be considered to be twice their energy content:

Part B. Feedstocks for the production of biofuels, the contribution of which towards the target established in Article 25(1) shall be limited and may be considered to be twice their energy content:

(a) Used cooking oil.

(b) Animal fats classified as categories 1 and 2 in accordance with Regulation (EC) No 1069/2009 of the European Parliament and of the Council [1]

Annex IX – Part A, (p) (q)

(p) Other non-food cellulosic material as defined in point (q) of the second paragraph of Article 2.

(q) Other ligno-cellulosic material as defined in point (p) of the second paragraph of Article 2 except saw logs and veneer logs.

Part A

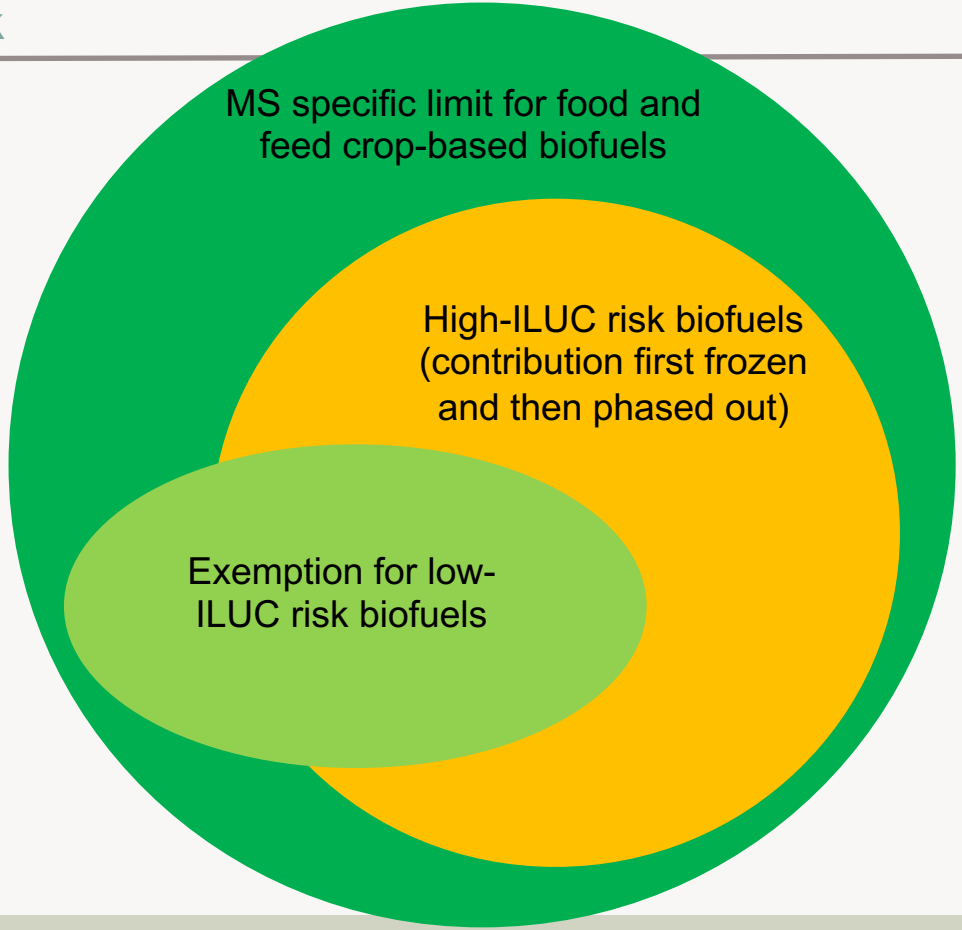
(p) 'ligno-cellulosic material' means material composed of lignin, cellulose and hemicellulose such as biomass sourced from forests, woody energy crops and forest-based industries' residues and wastes;

(q) 'non-food cellulosic material' means feedstocks mainly composed of cellulose and hemicellulose, and having a lower lignin content than ligno-cellulosic material; it includes food and feed crop residues (such as straw, stover, husks and shells), grassy energy crops with a low starch content (such as ryegrass, switchgrass, miscanthus, giant cane), cover crops before and after main crops, ley crops, industrial residues (including from food and feed crops after vegetal oils, sugars, starches and protein have been extracted), and material from biowaste. Ley and cover crops have to be understood as temporary, short-term sown pastures comprising grass-legume mixture with a low starch content to get fodder for livestock and improve soil fertility for obtaining higher yields of arable main crops;

Definition of COVER CROP: a crop planted between main crops to prevent leaching or soilerosion or to provide green manure

Definition of LEY FARMING: the growing of grass or legumes in rotation with grain or tilled crops as a soil conservation measure

The concept


MS specific limit for food and feed crop-based biofuels
High-ILUC risk biofuels (contribution first frozen and then phased out)
Exemption for low-ILUC risk biofuels

Extension of scope to new fuels

- **Renewable fuels of non-biological origin (RFNBO) e.g. renewable hydrogen**
  - ✓ 70% thresholds for minimum GHG emission savings
  - ✓ Rules for determining renewable energy share
  - ✓ Specifics to be set out in delegated acts
- **Recycled carbon fuels (fuels from non-recyclable plastic, fuels from CO from steels mills, coke ovens, etc.)**
  - ✓ Definition ensuring compatibility with WFD
  - ✓ GHG emission savings requirements and methodology to be set out in delegated act
  - ✓ Promotion is optional
  - ✓ Do not count to overall RES target

02

REDII Gaps & weacknesses

Some of the open issues

Art.25

- […] The contribution to the targets set out in Article 3(1) and for the calculation of the numerator (1) from **high indirect land-use change risk food or feed crop-based biofuels, bioliquids and biomass fuels produced from food or feed crops for which a significant expansion of the production area into land with high carbon stock** is observed, shall **not exceed the level of consumption in 2019 in the Member State**, unless they are certified as low indirect land-use change-risk biofuels, bioliquids and biomass fuels pursuant to the following two subparagraphs: **As of 31 December 2023, this limit shall decrease gradually to 0% by 31 December 2030 at the latest**.

- **Q.** : **Are Member States in charge of defining the term "gradually",** i.e. how the limit for high ILUC biofuels will decrease (i.e. the path year by year to 0% at 2030)? In case, is it acceptable that different EU MS pursue the reduction to 0% in different ways (unbalancing the market, until they all reach 2030 and thus 0%)? Or is the Commission that will determine a common path to % at 2030?

Some of the open issues

- **6bis**. The **Commission is empowered to adopt delegated acts** in accordance with Article 32 to amend the list of feedstocks in **parts A and B of Annex IX** in order to **add feedstocks, but not to remove them**. **Feedstocks that can only be processed with advanced technologies shall be added to Annex IX part A while feedstocks that can be processed into biofuels with mature technologies shall be added to Annex IX Part B.**

- **Q.** : **This definition "can only be processed with advanced technologies" is recursive**. This statement in fact says that these new advanced feedstocks must be processed with advanced technologies, while so far only the Feedstock determine the "Advanced" nature of the bio-fuel (or Recycled Carbon Fuel). There thus a need to "**define which technologies are advanced**". Moreover, possible **ambiguous cases can occur**, for instance (just as an example):
  - → *a"new"crop producing non-edible oils, if processed to biodiesel (mature technology) should go under Annex 9 Part B, if instead processed via pyrolysis or gasification (advanced technologies), it would fall under Annex 9 Part A*
  - → *the volume of product reserved to Annex IX Part B is capped to 1.7%. Thus, there is no room for growth of sustainable feedstocks falling under this category*

Some of the open issues

Art.26

- Biomass fuels shall have to fulfil the sustainability and greenhouse gas emissions saving criteria set out in paragraphs 2 to 7 [ ] if used in installations producing electricity, heating and cooling or fuels with a [ ] total rated thermal input equal to or exceeding 20 MW **in case of solid biomass fuels** and with a [ ] total rated thermal input capacity equal to or exceeding [ ] 2 MW **in case of gaseous biomass fuels**. Member States may apply the sustainability and greenhouse gas emission saving criteria to installations with lower fuel capacity.

- **Q**. Bioliquids, as for instance **Intermediate Energy Carriers as Fast Pyrolysis Bio Oil**, are not mentioned here

Some of the open issues

Annex IX

- Annex XI list: (a) Algae if cultivated on land in **ponds** or **photobioreactors**.
- **Q**. Eterotrophic Algae or yeast, fed with sustainable feedstock – as for instance the case of microbial oil from lignocellulosic sugars – are excluded, while they should clearly belong to the Advanced Category

03

AFF Team views on REDII impact

Team views of REDII gaps and impacts on their respective sectors

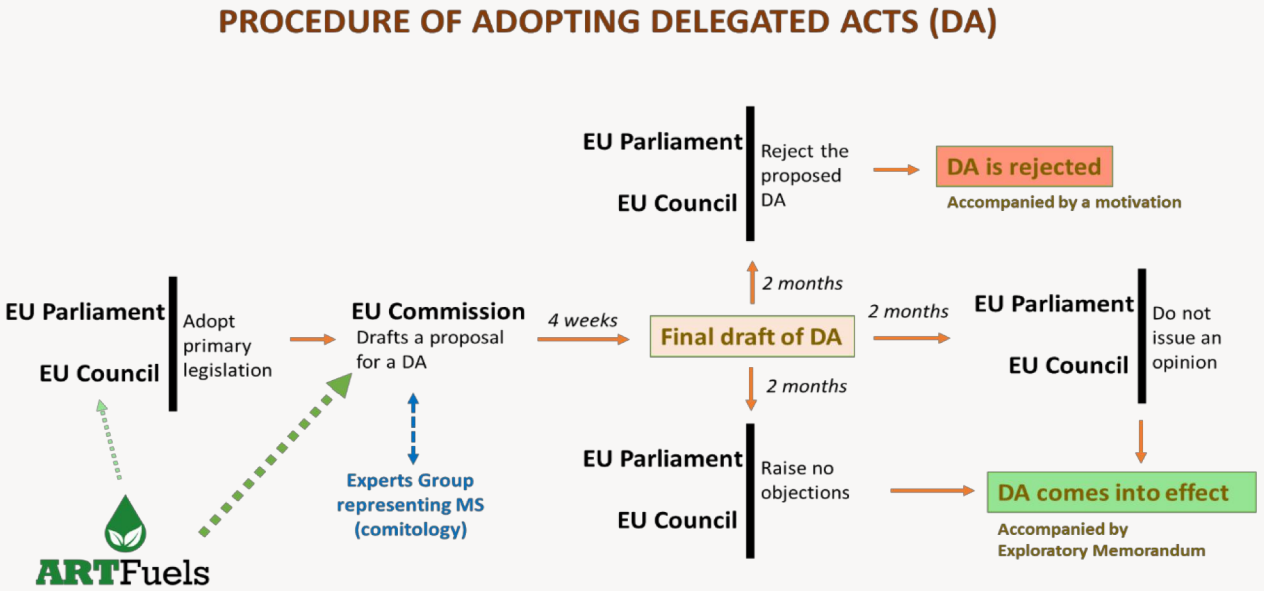
- **GASIFICATION**: Positive judgement, 65% GHG fine, concerns REC.CARBON FUELS
- **PYROLYSIS**: Priority to co-processing (DA5)
- **BIOCHEMICAL**: Positive judgement, targets realistic, compulsory nature & fines, timing
- **LIPID-BASED**: Priority to High/Low-ILUC Def (DA1-DA2) and co-processing (DA5)
- **BIOMETHANE**: Positive judgement, cover crop pending, and amendment to Annex IX-A list
- **POWER-TO-X(RFNBO)**: Large concerns, no level-playing field and tech.neutrality, several burdens. RFNBO formerly (RED) in Annex IX Part A, not anymore in REDII.
- **REC.CARBON FUELS**: Same concerns as PtX. Time for DA will further delay.
- **AVIATION**: Major preoccupation is REDII vs CORSIA
- **PASSENGER CARS**: Tank-to-Wheel (TtW) s Well-to-Wheel (WtW). Without WtW no car manufacturers interest in ART Fuels.
- Other comments from the **MARITIME, HEAVY DUTY** and **ALGAE** and sectors

04

Procedures: DA, IA

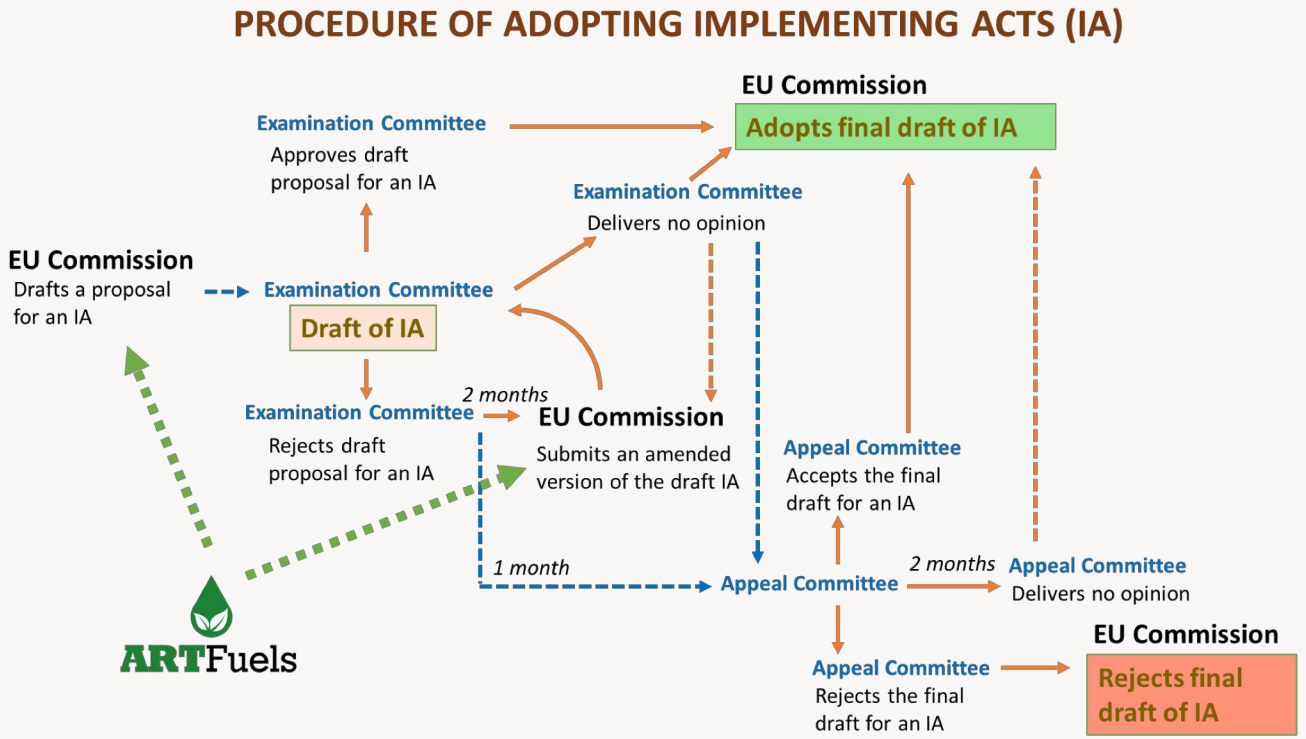
Procedures - Delegated Acts (DA)

EU Parliament and the Council delegate to the Commission (EU Treaty, Art.290) the power to adopt **Delegated Acts** of general application that supplement or amend certain non-essential elements of a legislative act, i.e. Directive, Regulation, or Decision. Delegated Acts are generally measures of a technical nature. This way, the legislator concentrates on policy direction and objectives without entering into overly detailed and often highly technical debates in the process of legislative act promulgation.



Procedures - Implementing Acts (IA)

Some of the Acts require uniform conditions for the implementation and in cases like these, the Commission or, in duly justified specific cases and in cases provided in the Articles 24 and 26 of the European Union Treaty, the EU Council is empowered to adopt Implementing Acts (Article 291)

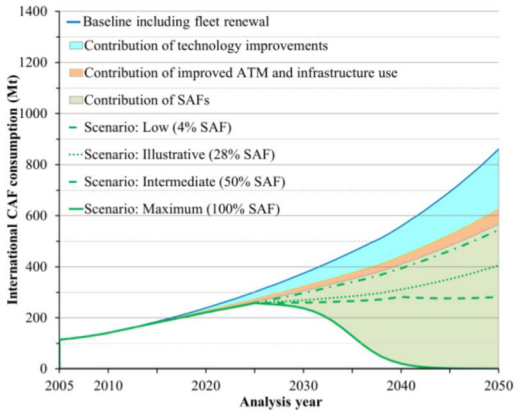


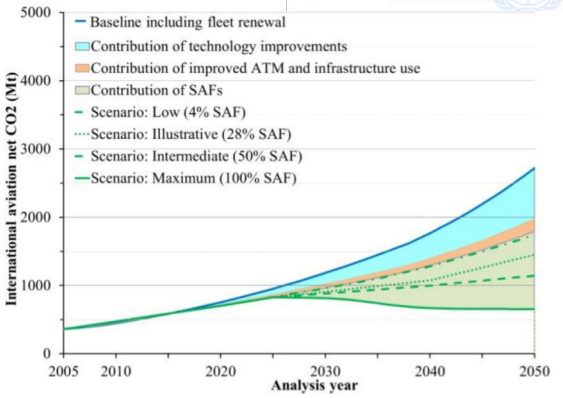
05

Sustainable Aviation Fuels

Sustainable Aviation: ICAO scenarios

- **142** Mt CAF in 2010, **860** Mt by 2050 (**570** Mt by improvements)
- **100% CAF** substitution could theoretically be met by SAF (**MAX** scenario) – **170 new biorefineries to be built annually** from **2020 to 2050** (cost of 15-60 $B/y)
- **MAX** would **cut CO2 emiss by 63%**
- **LOW** scenario: **4% CAF, 20 Mt/y SAF in 2050**
- Short-term, **2025**: **5 Mt/y SAF** for all scenarios
- Ref: **0.9 Mt/y** today off-take agreements

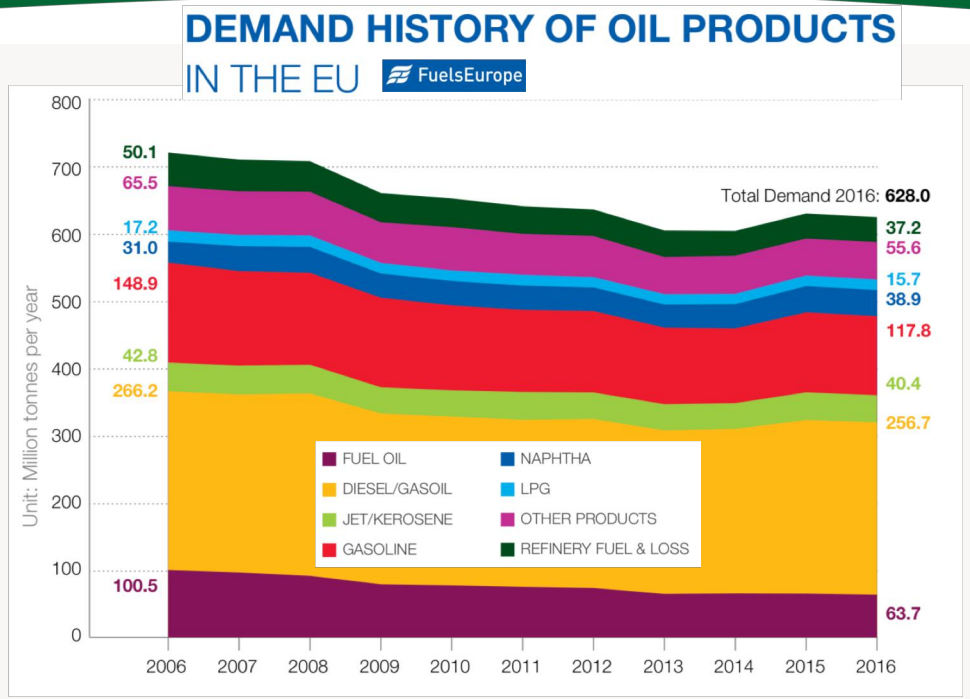


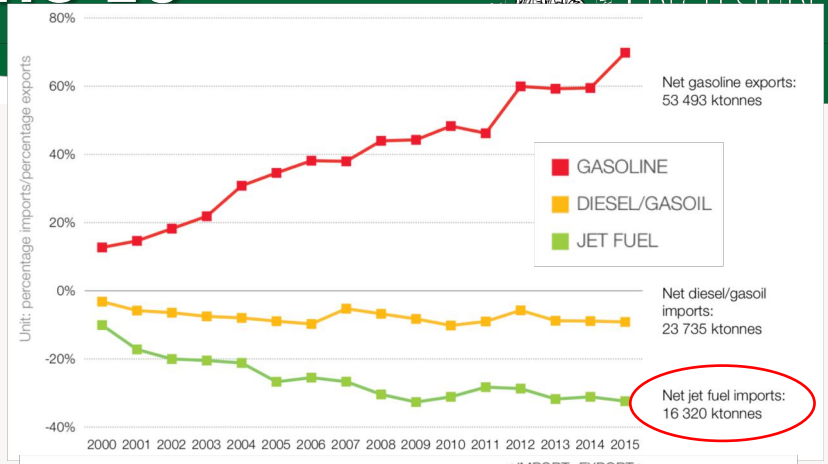


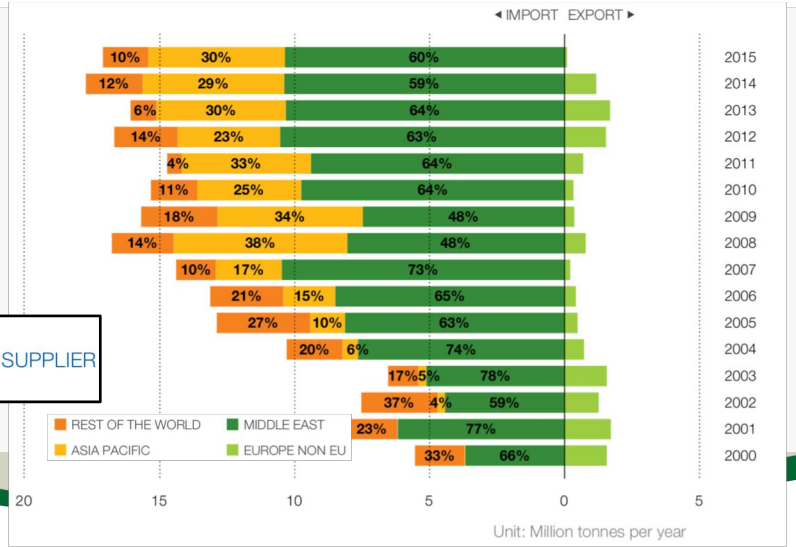
Expected fuel consumption and aircraft CO_2 emissions from international aviation, reflecting aircraft technology, ATM and infrastructure use improvements, and possible substitution with SAFs from 2005 to 2050.

- ✓ ***ICAO** scenario refers to **International Aviation, ≈2/3 global jet demand***
- ✓ ***Today** , global jet-fuel demand **≈ 300 million t/y (≈ 200 for International)***

Refining & Aviation Fuels in the EU







EU JET FUEL TRADING BALANCE

MIDDLE EAST REMAINS MAIN JET FUEL SUPPLIER FOR THE EU

RE·CORD

ASTM certification of new pathways: the unavoidable step towards scale up..

UNIVERSITÀ DEGLI STUDI FIRENZE

Annex	Conversion Process	Abbrev.	Possible Feedstocks	Max Blending Ratio by Volume
1	Fischer-Tropsch hydroprocessed synthesized paraffinic kerosene	FT-SPK	Coal+, natural gas+, biomass	50%
2	Synthesized paraffinic kerosene produced from hydroprocessed esters and fatty acids	HEFA-SPK	Lipids	50%
3	Synthesized iso-paraffins produced from hydroprocessed fermented sugars	SIP-HFS	Biomass used for sugar production	10%
4	Synthesized kerosene with aromatics derived by alkylation of light aromatics from non-petroleum sources	SPK/A	Coal+, natural gas+, biomass	50%
5	Alcohol-to-jet synthetic paraffinic kerosene	ATJ-SPK	Biomass used for starch & sugar production and cellulosic biomass for isobutanol production	30%

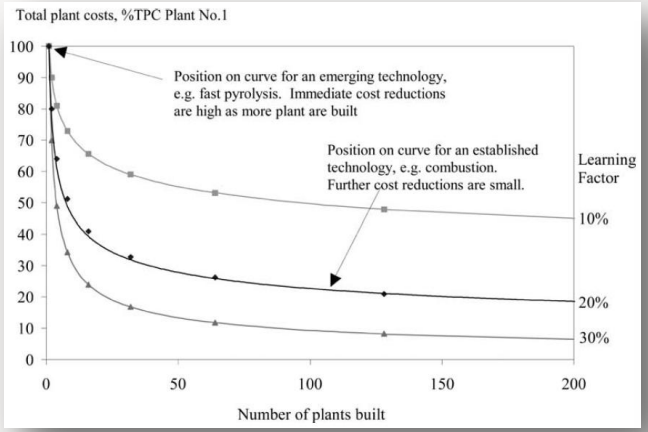
+ Co-processing max 5% v/v Fats and Oils (FFA & FAE)

- ASTM D1655 Standard Specification for Aviation Turbine Fuels
- ASTM D7566 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons;
- ASTM D4054 Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives;

RE·CORD

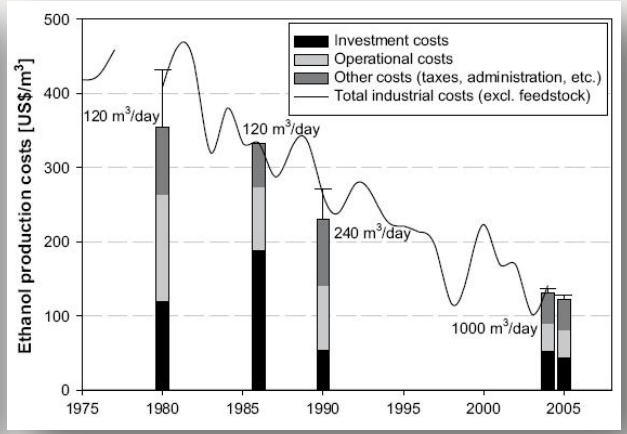
Are shortcuts to innovation possible ?

- True innovation requires time to develop into commercial scale solutions

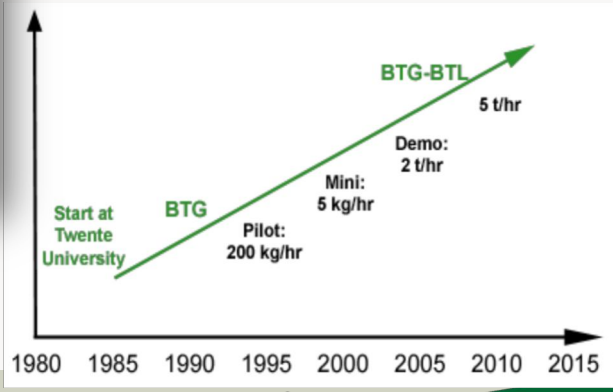


A.A.V.Bridgwater et al, 2004

Cost breakdowns of the industrial ethanol production process excluding feedstock costs (Brasil)



Van den WallBake et al, 2009



Project Acronym: **BIO4A** Project Number: **789562** Call: LCE-20-2016-2017 Topic: Aviation Biofuels

Project title: **Advanced sustainable BIOfuels for Aviation**

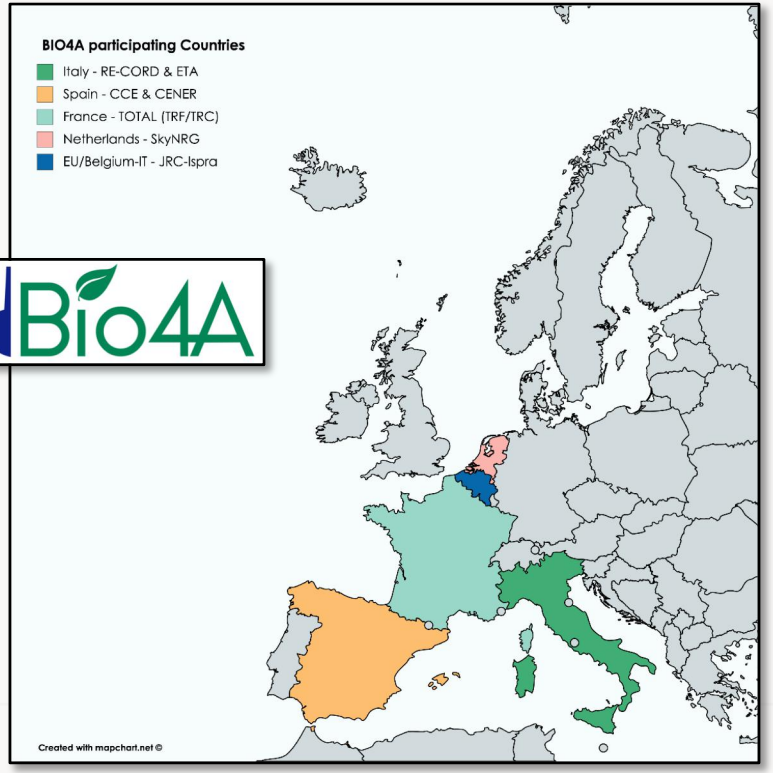
Specific Challenge

Accelerate the deployment of Aviation Biofuels, enabling **commercial production**. Supporting the accomplishment of **pre-commercial plant(s)** for advanced biofuels for aviation based on **sustainable biomass feedstock**.

Technological approach of the Project

Main goals:

1) To bring **HEFA to full commercial scale in new plant using sustainable lipids (e.g. UCO);**
2) To investigate alternative supply of **sustainable feedstocks recovering EU MED marginal land for drought resistant crop production**;
3) To **test the entire chain and logistic at industrial scale**, and **assess environmental performances**.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No *[789562]*

Project Acronym: **BIO4A** Project Number: **789562** Call: LCE-20-2016-2017 Topic: Aviation Biofuels
Project title: **Advanced sustainable BIOfuels for Aviation**

Expected Impact:
Respond to the EU FlightPath objectives for commercial deployment and realisation of aviation biofuels and its target of using **2 million tons** aviation biofuel by 2020.
Favourable energy and GHG balances expected.
Demonstrated industrial concepts should ensure the techno-economic feasibility of the entire value chain.
Significant **social and economic** impact.

Contribution of the Project:
BIO4A will target **the production and use of Sustainable Aviation Fuels (SAF) at large industrial scale from sustainable lipids (e.g. UCO)**.
The **new plant** will be operated for the very first time under this mode.
Potential for **sourcing sustainable lipids from recovered EU-MED marginal land** will be investigated.

Highlights (technological/non-technological):
New Aviation Biofuel plant producing ≥ 5 kt SAF (HEFA-based biojet)
Production and test of SAF in commercial flights in non-segregated mode
Test of marginal land in Spain recovered by biochar/compost addition, scenario analysis
Dedicated Dissemination, Communication and Exploitation action

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No *[789562]*

BIO4A

- ~5 kt SAF (ASTM compliant) from sustainable lipids (e.g. UCO)
- Axens' technology tested for the very first time at industrial scale in TOTAL La Mède Biorefinery (FR)
- SkyNRG distributing the SAF-biojet (non-segregated logistics) to commercial flights
- R&D: dry marginal land EU MED (Camelina, Biochar, Combi) & UCO pretreatment
- Market study, policy interactions
- Environmental and sustainability assessment
- Dissemination,Communication and Exploitation action

WP1 – Feedstock supply and large-scale industrial production of SAF-biojet [TOTAL]
WP2 – R&D Long-Term Strategy for SAF production [RE-CORD]
WP3 – Downstream logistics & Use [SkyNRG]
WP4 – Evaluation [CENER]
WP5 – Market scaling strategy [SkyNRG]
WP6 – Management, dissemination and exploitation [RE-CORD]

The groundbreaking nature of BIO4A – SAF production at industrial scale

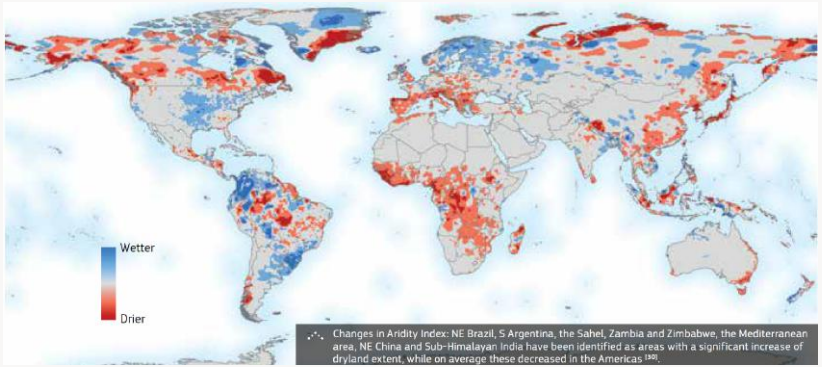
TOTAL
COMMITTED TO BETTER ENERGY

- Increase EU bio-based hydrocarbon production capacity by 500 kt/y of diesel or 300-350 kt/y of SAF-biojet, depending on policy framework in places and markets conditions (WP1)
- Test Axens' HEFA-technology at full industrial scale (Axens Vegan™ process first-ever industrial unit capability to produce SAF)
- SAF storage and despatch facilities to be in place in La Mède before the industrial production milestone of the project, even assuming dematerialization of the production and commercialization along the supply chain (book & claim)
- Policy interaction will be part of the R&D work during WP3 and WP5

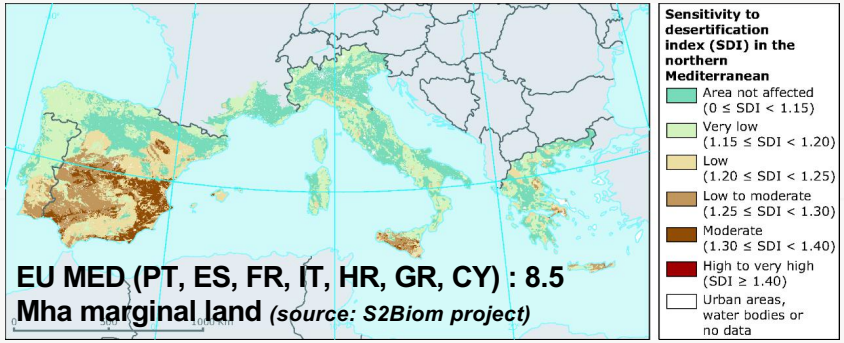
✓ ***Follow-up in 2019 : LC-SC3-RES-22-2019 : "Development of next generation biofuel and alternative renewable fuel technologies for aviation and shipping" & LC-SC3-RES-24-2019 : "Boosting pre-commercial production of advanced aviation biofuels"***

RE·CORD TOTAL SkyNRG CENER etaflorence renewableenergies Camelina Company | España European Commission

The groundbreaking nature of BIO4A: Sustainable lipids for the SAF industry



Source: EC-JRC. World Atlas of Desertification, 3rd Edition. Mapping Land Degradation and Sustainable Land Management Opportunities. 2015. http://wad.jrc.ec.europa.eu



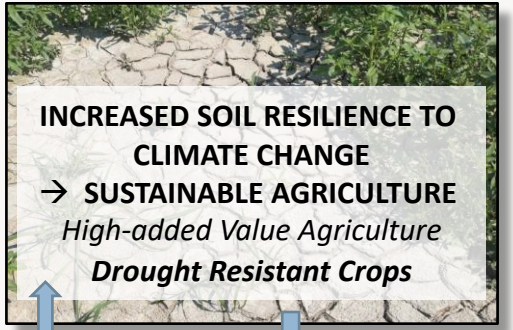
EU MED (PT, ES, FR, IT, HR, GR, CY) : 8.5 Mha marginal land ***(source: S2Biom project)***

Residual biomass (agri-woody)

CARBONIZATION
(Innovative Oxidative Slow Pyrolysis System)

Biochar & Compost (COMBI)

ENERGY



CAMELINA oil

SAF Biojet

06

Conclusions

- **REDII** represents a necessary step towards the deployment of Renewable and Alternative Transport fuels in the next decades
- The impact of REDII on the respective ART Fuel sectors is relevant
- Impacts from Delegated Acts, Implementing Acts, etc is also very relevant, and needs to be examined
- AF will deliver a Strategy that will be based on stakeholders view of REDII, now that it has taken shape

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