Sustainability of Alternative Aviation Biofuel

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Paris Agreement

Nearly 200 nations signed Paris Agreement at COP21 in Dec.12, 2015.

The Agreement sets the goal of limiting the world's rise in average temperature to "well below 2 degrees Celsius above preindustrial levels and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius."

Come into force in Nov.4, 2016

Rapid decarbonisation of all economic sectors is required including aviation.

Why work on aviation?

- Estimates of the current contribution of global aviation to total anthropogenic CO2 emissions are between **2% to 2.5%** (IPCC, 1999, IPCC, 2007, Lee et al., 2009).
- If the aviation sector were a country, it would be the **7th largest emitter** globally.
- **International aviation** accounts for approximately **65%** of total aviation emissions or 1.3% of all anthropogenic CO2 emissions (ICAO, 2016).
- **Aviation emissions are expected to triple by 2050.**
- The fast growth in air traffic and the associated increase in jet fuel consumption mean that by 2050 global aviation could account for **over 22%** of all anthropogenic CO2 emissions (Cames et al., 2015).
- In addition, the sector further contributes to global warming with its non-CO2 emissions, which are estimated to have a radiative forcing effect at least equal to that of its CO2 emissions (Cames et al., 2015).

ICAO and goals

Emissions from domestic aviation are covered by the Paris agreement and thus dealt with by countries on an individual basis.

Since 1997, efforts to address emissions from international aviation have been primarily pursued through the **International Civil Aviation Organization (ICAO),** a specialized agency of the United Nations (UN).

The ICAO has adopted two goals:

- A 2% annual fuel efficiency improvement through 2050;
- Carbon neutral growth from 2020 onwards (CNG2020).

Four Ways to Achieve:

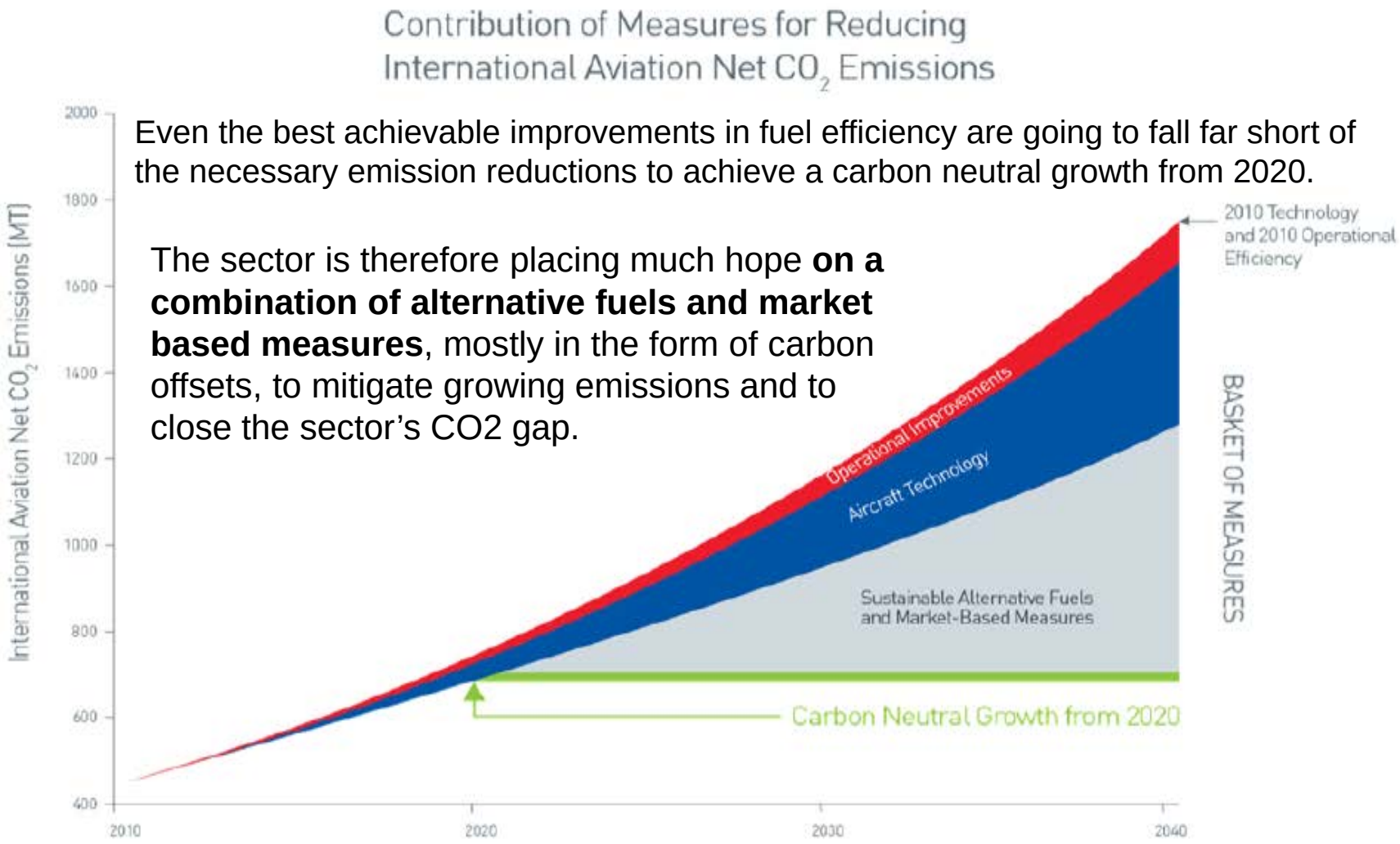
- Aircraft efficiency improvement
- Operational improvement
- Carbon offset
- Sustainable alternative fuels

It is already clear that technical and operational advances available today will not suffice to achieve fuel efficiency improvements at a rate of 2% annually; instead, 1.4% has been deemed a more realistic figure (ICAO, 2016).

Contribution of Measures for Carbon Neutral Growth

Even the best achievable improvements in fuel efficiency are going to fall far short of the necessary emission reductions to achieve a carbon neutral growth from 2020.

The sector is therefore placing much hope **on a combination of alternative fuels and market based measures**, mostly in the form of carbon offsets, to mitigate growing emissions and to close the sector's CO2 gap.



Alternative Fuels

- Alternative aviation fuels, mostly based on biomass, are a relatively new entrant into the discussion on mitigation options available to global aviation.
- The first commercial flight fuelled by biofuels took place in 2011, demonstrating the fast pace of development in the bio jet arena.
- Today, **sustainable bio jet fuels are considered to be integral to the long-term effort of curbing CO2 emissions from the aviation sector.**

A Sustainable Alternative to Fossil Fuels **VS** **Environmental Risks**

The aviation sector must ensure any biofuels used in planes **adhere to the highest sustainability standards, or risk undermining the credibility of its climate mitigation efforts**.

Alternative fuels

In 2016, WWF-UK commissioned the SEI (Stockholm Environment Institute) to assess the potential supply and sustainability characteristics of carbon credits and alternative fuels during the expected first term of the MBM: 2020-2035.

Technology pathways 技术路径：

- Hydro-processed esters and fatty acids （HEFA）,
- Fischer-Tropsch（FT）process
- Direct Sugar to Hydrocarbons （DSHC）
- Pyrolysis

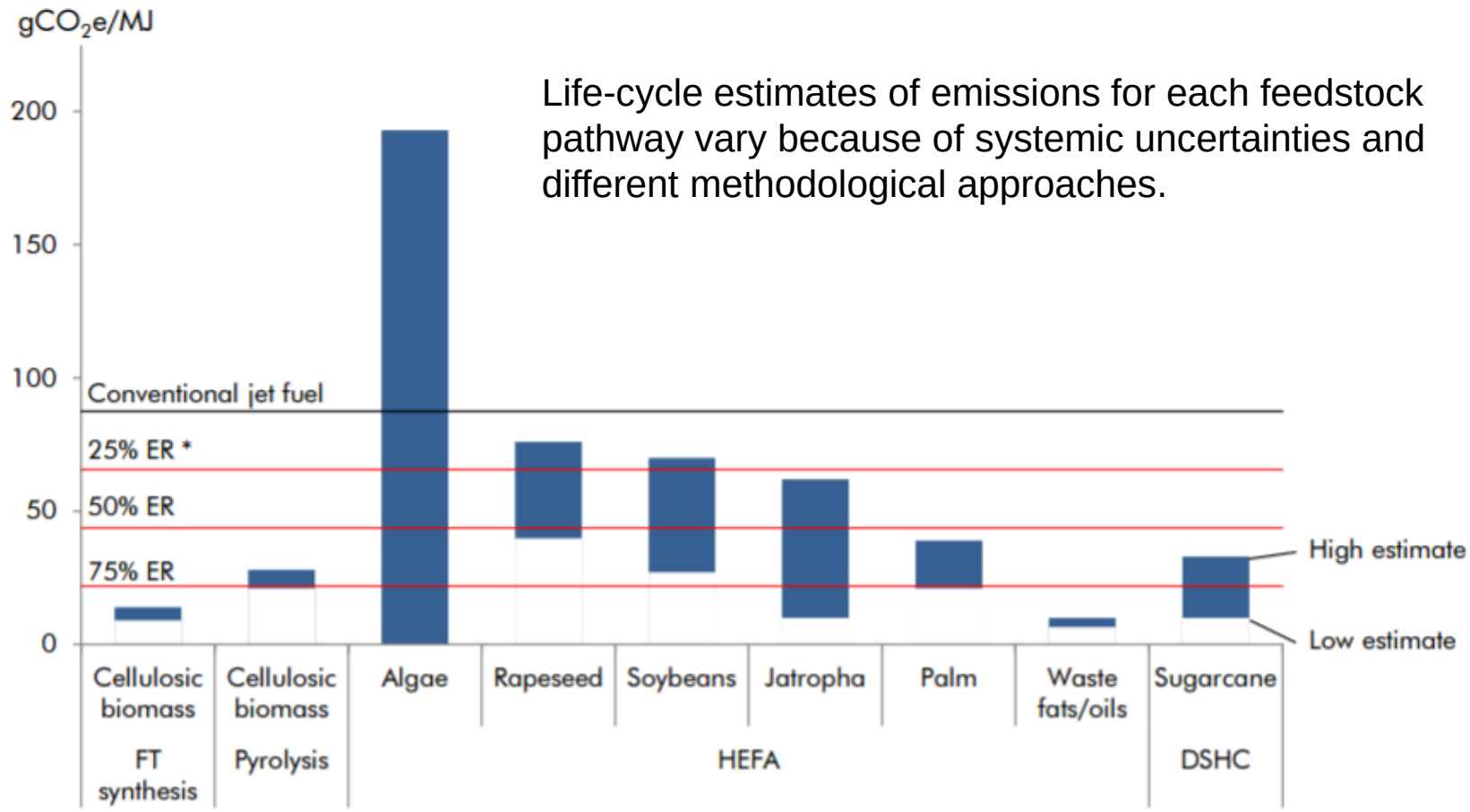
目前，HEFA, FT 和DSHC 已获得在商用航线上使用的许可 。

Common feedstock pathways grouped according to emissions reduction potential: 根据全生命周期的减排潜力，对不同原料和技术的组合进行分类

- ✓ **Upper range** = >50% emissions reduction compared to conventional jet fuel.
- ✓ **Lower range** = <50% emissions reduction compared to conventional jet fuels.

Alternative fuels

Estimated GHG emissions from alternative feedstocks and pathways without considering land use change impacts



Life-cycle estimates of emissions for each feedstock pathway vary because of systemic uncertainties and different methodological approaches.

** ER = emission reductions.*

Alternative fuels

The potential contribution from sustainable alternative fuels with appropriate restrictions on direct and indirect land use change and certification to promote sustainable development is **0.1-0.3 Gt CO2e**, **2-9%** of the CNG2020 goal.

Cumulative emissions reductions from alternative fuels 2020 – 2035 based on total capacity in 2020

UPPER RANGE EMISSIONS REDUCTIONS		LOWER RANGE EMISSIONS REDUCTIONS	
Path	**Illustrative feedstocks**	**Path**	**Illustrative feedstocks**
HEFA	Waste fats and oils	HEFA	Low ILUC risk rapeseed, low-performing algae
FT	Low ILUC risk switchgrass, maize-stover, bagasse, forest wastes or municipal solid waste		
DSHC	Sugarcane with no D/ILUC	DSHC	Sugarcane with minimal D/ILUC
Other	Low ILUC risk switchgrass, maize-stover, bagasse, forest residues, municipal solid waste	Other	Switchgrass with ILUC
Total potential emissions reductions:	0.3 Gt CO_2e	Total potential emissions reductions:	0.1 Gt CO_2e

Alternative fuels

WWF urges airlines to first of all maximize the emissions reduction potential in operational and technical efficiency before then turning to sustainable alternative fuels and carbon credits.

- When sourcing carbon credits, WWF calls on airlines to commit to sourcing carbon credits from activities for which there is both higher confidence in environmental integrity, and certification to promote sustainable development benefits.
- To prove the concept of sustainable low-ILUC biofuels, WWF encourages airlines as a priority to seek certification via the RSB “low ILUC risk” module.

RSB
ROUNDTABLE ON SUSTAINABLE BIOMATERIALS

- **The RSB has been recognised as the best-in-class sustainability, meaning it provides the most comprehensive set of criteria and the most demanding requirements to meet them.**
- **It is also the only standard that has an “indirect land use change module”, albeit still voluntary at this stage.**

Assessing Sustainable Biofuel Production in Sub-Saharan Africa

WWF has estimated the current and future sustainable biofuel potentials for Sub-Saharan Africa in accordance with the RSB principles from land-based energy crops, as these feedstocks are most prone to sustainability risks.

Table 3: Technical potential for biojet from energy crops in Sub-Saharan Africa relative to projected global demand for alternative aviation fuels

SAF demand by global international aviation in 2050	285 Mt/a
SSA technical potential by 2050 from very suitable and suitable land	55 – 60 Mt/a
SSA technical potential by 2050 from very suitable, suitable and moderately suitable land	180 - 185 Mt/a
% global demand that could be met by biofuel from SSA	~20 – 60%

There is a meaningful potential for RSB compliant biojet fuel that can be produced in Sub-Saharan Africa, and hence there is no reason to lower the sustainability bar to include unsustainable alternative fuel in the portfolio of fuel supply options to airlines.

China's biofuel and aviation

- **Three No Principles of biofuel development (2007)**

1. Not to occupy cropland
2. Not consume a large amount of food
3. Not influence the ecological environment

- **Biomass development 13 FYP**

By 2015, the annual output of biodiesel is about 0.8 million tons.

By 2020, the consumption of biosubstance liquid fuel is over 6 million tons.

- **Test Flight with Biofuel**

2011 Air China

2015 Hainan Airlines First passenger flight

2017 Hainan Airlines Beijing - Chicago

Total Turnover of Civil Aviation (2012-2016)


Thank You !