



**ASSEMBLY — 40TH SESSION**

**EXECUTIVE COMMITTEE**

**Agenda Item 17: Environmental Protection – Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)**

**POTENTIAL CONTRIBUTION OF LOWER CARBON AVIATION FUEL TO GHG EMISSIONS REDUCTIONS**

(Presented by Saudi Arabia)

**EXECUTIVE SUMMARY**

This paper presents Saudi Arabia’s view of the potential contribution of lower carbon aviation fuels (LCAF) to GHG emissions reductions under CORSIA. The development and deployment of LCAF require the appropriate policies and incentives framework that encourage the investment on resource management, resource prioritization, and innovative technologies of both upstream and downstream operations. An outlook of the technical analysis is provided to show the carbon intensity heterogeneity and GHG mitigation potential of conventional jet fuel. The paper concluded that the LCAF has the potential to further reduce aviation GHG emissions.

<i>Strategic Objectives:</i>	This working paper relates to Strategic Objective E – Environmental Protection
<i>Financial implications:</i>	None
<i>References:</i>	

**1. INTRODUCTION**

1.1 The ICAO Council, at its 214th Session (June 2018) adopted the First Edition of Annex 16 *Environmental Protection*, Volume IV entitled “*Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*” and some of the “*CORSIA Implementation Elements*” documents. The approved CORSIA package support the use of CORSIA Eligible Fuels (i.e. “CORSIA Sustainable Aviation Fuel (SAF)” and “CORSIA Lower Carbon Aviation Fuel (LCAF)”) to reduce the airlines offsetting requirements.

1.2 Saudi Arabia supports the CORSIA Eligible Fuels definitions which incentivise the existing industry to improve and capitalize on the GHG emissions reduction potential of the technologically advanced petroleum industry.

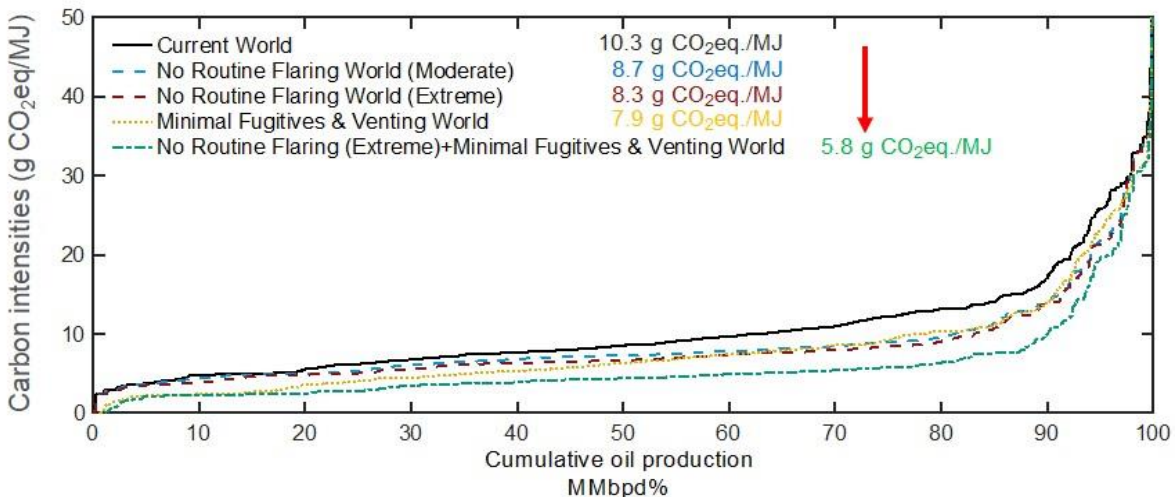
1.3 During the last few years, the undertaken work on aviation fuels by ICAO and its relevant deliberative bodies has focused on developing detailed methodologies for SAF consideration under CORSIA.

1.4 Recently, the work on LCAF under CORSIA has commenced by the Committee on Aviation Environmental Protection (CAEP) and its Fuels Task Group (FTG).

1.5 This paper will describe a preliminary assessment of the potential of emissions reductions from petroleum-based jet fuel through applying the strategies of resource management, resource prioritization, and innovative technologies. This preliminary assessment is extracted from scientific research on the life cycle carbon intensity of petroleum-based fuels by El-Houjeiri *et al.*, 2013; Elgowainy *et al.*, 2014; Malins *et al.*, 2014; Carnegie, 2016; Speth *et al.*, 2016; Abella *et al.*, 2017; Cooney *et al.*, 2017; El-Houjeiri *et al.*, 2017; Masnadi and Brandt, 2017; Wang *et al.*, 2017; Brandt *et al.*, 2018; Masnadi *et al.*, 2018a, Masnadi *et al.*, 2018b, and Meehan *et al.*, 2018. These references are provided in the Appendix.

## 2. CRUDE OIL PRODUCTION CARBON INTENSITY

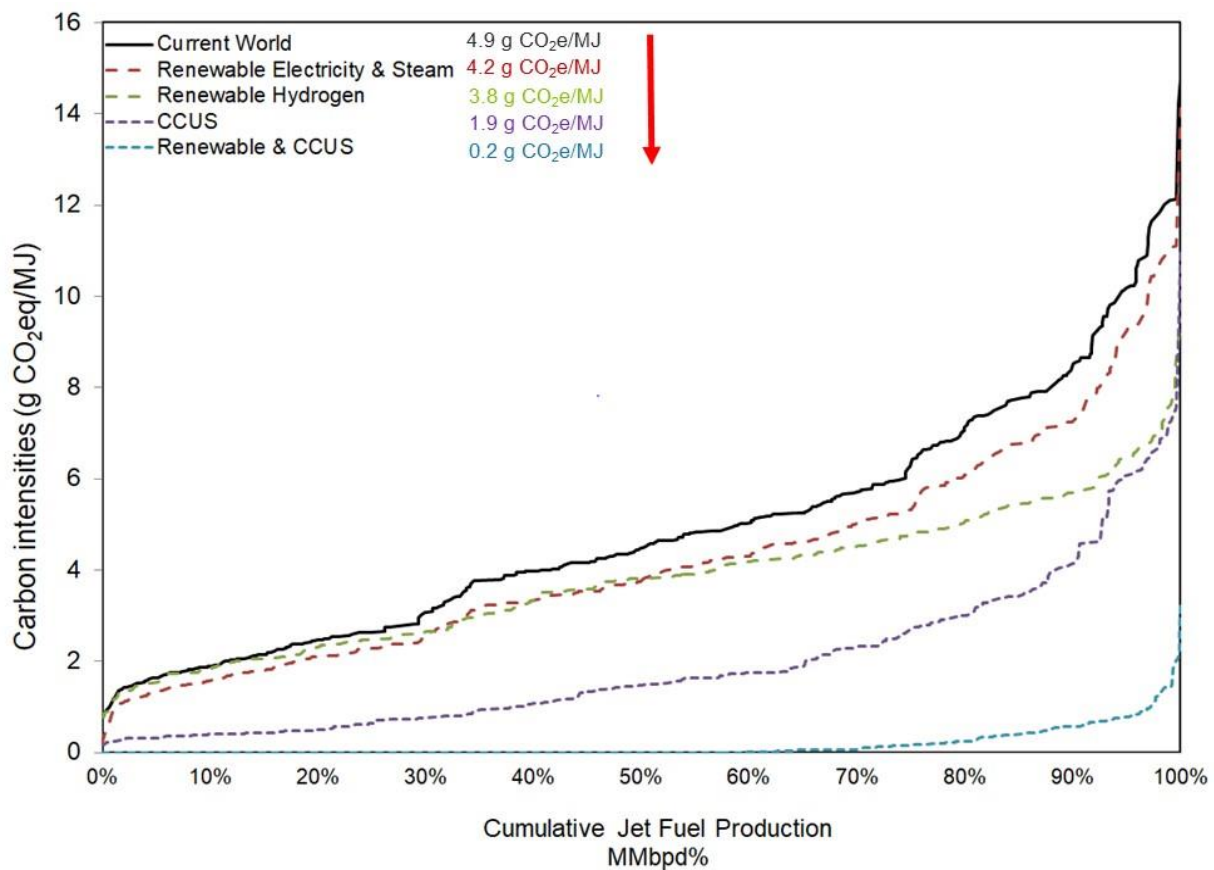
2.1 A recent study published in Science has estimated emissions from 8966 onstream oilfields in 90 countries (Masnadi *et al.*, Science, 361 (6405), 851-853). These oilfields represent ~98% of 2015 global crude oil and condensate production. Figure 1 shows a global field level CI curve for the 8966 fields (sorted cumulatively). This illustrates the CI heterogeneity of global crudes. Fields in the highest 5th percentile emit more than twice as much as the median field. The global volume-weighted-average upstream CI estimate is 10.3 gCO<sub>2</sub> equivalents (CO<sub>2</sub>eq)/megajoule (MJ) crude oil. Flaring (burning) of noneconomical salable gas in oilfields has a considerable influence on the CI. The CI curves of four hypothetical GHG mitigation case studies are shown in Figure 1. The fourth case study which includes both stringent flaring reduction (limited to 20 standard cubic feet of gas per barrel of oil) and minimal fugitive and venting emissions (0.2 gCO<sub>2</sub>eq per megajoule crude oil) reduces the global average to 5.8 g CO<sub>2</sub>eq/MJ and results in ~43% CI reduction. In addition to gas management, the use of solar energy could result in sector wide emissions reductions on the order of ~1.7 gCO<sub>2</sub>eq/MJ (Wang *et al.*, 2017).



**Figure 1: Global field-level upstream carbon intensity supply curve (2015).** From the supplementary information for Masnadi *et al.*, *Science*, 361 (6405), 851-853.

### 3. REFINERY JET FUEL CARBON INTENSITY

3.1 Figure 2 shows a global refinery-level CI curve for jet fuel production from 511 refineries (sorted cumulatively). This illustrates the CI heterogeneity of global jet fuel production on a refinery gate-to-gate basis. The global volume-weighted-average refinery jet fuel CI estimate is 4.9 gCO<sub>2</sub>eq/MJ jet fuel. The major factor that drives the variation of refinery jet fuel CI is the volume composition of the product blend stocks. Jet fuels made from straight run kerosene have low CI, whereas those with higher fractions of hydrocracker kerosene and hydrotreater kerosene in the blending pool have significantly higher CI. Similar to the upstream analysis we analyzed four hypothetical GHG mitigation scenarios. The results show that renewable-powered carbon capture, utilisation, and sequestration (CCUS) applied to atmospheric and vacuum towers reduces the global average to 1.9 gCO<sub>2</sub>eq/MJ and results in ~61% CI reduction. The methodologies that will be developed for the incorporation of LCAF under CORSIA should be sophisticated enough to capture the level of granularity needed to recognize the wide variability of refinery jet fuel CI between different supplying regions. This is a result of wide variation in refinery configurations and technology.



**Figure 2: Global refinery-level jet fuel carbon intensity supply curve (2017).** Source: Aramco Research Center – Detroit, MI, United States.

#### 4. **CONCLUSION**

4.1 The implementation of LCAF recognizes the heterogeneity of petroleum-based aviation fuels and rewards improved production practices with clear incentives for the lowest carbon intensity producers.

4.2 LCAF has the potential to further reduce aviation GHG emissions.

#### 5. **NEXT STEP**

5.1 Develop detailed LCA methodologies for the consideration of lower carbon aviation fuel (LCAF) under CORSIA.

5.2 Build a high-resolution petroleum LCA tool for the measurement of conventional jet fuel life cycle emissions.

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## APPENDIX

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