Global ASBU Environmental Benefits Assessment – To 2025

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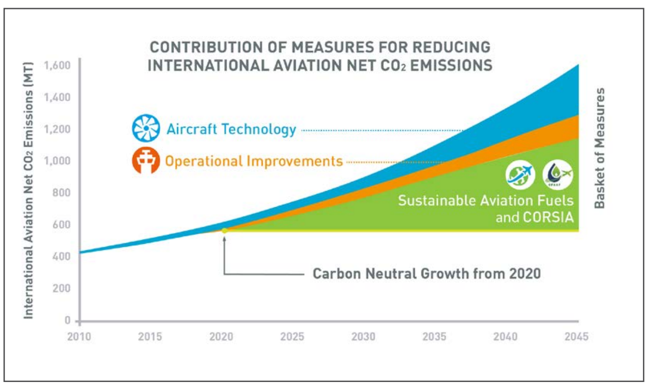
INTRODUCTION

ICAO has developed a comprehensive approach to achieving carbon neutral growth from the year 2020 onward. It involves the implementation of a "basket of measures" comprised of: technical, operational, and infrastructure enhancements; sustainable alternative fuels; a CO_2 standard for aircraft; and the development of a global market-based measure (CORSIA).

FIGURE 1: ICAO Global Environmental Trends on CO_2 Emissions and Contribution of Measures for Reducing International Aviation Net CO_2 Emissions



The CO_2 savings derived from the operational wedge of the basket of measures (See Figure 1) are expected to come from more efficient aircraft operations, and from the implementation of new technologies, concepts and procedures developed under the auspices of the regional air traffic management (ATM) improvement programs such as SESAR (Europe), NextGen (US) and CARATS (Japan). These programs are aligned at the ICAO level under the Aviation System Block Upgrades (ASBU) framework that is detailed in the Global Air Navigation Plan (GANP), ICAO Doc. 9750. The ASBU framework, adopted at the Twelfth Air Navigation Conference in 2012, was developed to reflect and build consensus around the series of technologies, procedures, and operational concepts needed to meet future capacity and ATM challenges. This strategy aims to ensure global interoperability by harmonizing regional air traffic management improvement programs by laying out a roadmap for the implementation of a series of essential ATM operational concepts which ensure that safety is maintained while future capacity, efficiency, and environmental benefits are maximized.

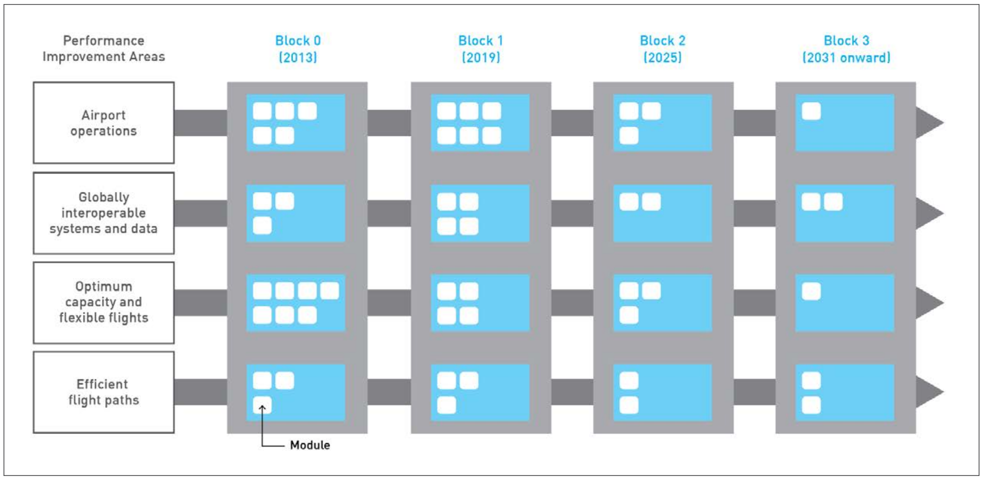
With air traffic growth forecast to increase by 4.3%[1] per year (Compound Annual Growth Rate (CAGR)) for the next 20 years, the ASBU framework is expected to deliver global ATM operations that improve safety and capacity, all while reducing the amount of greenhouse gases on a per flight basis.

ASBU ANALYSIS

The ASBU framework consists of a set of operational concepts or improvements, divided into four performance improvement areas, that are expected to come on-line, or be deployed, in a series of timeframes or Blocks, out to the year 2030 and beyond[2]. As shown in Figure 2 ASBU Block 0 is from 2013 to 2019, Block 1 is from 2019 to 2025, and Block 2 is from 2025 to 2030.

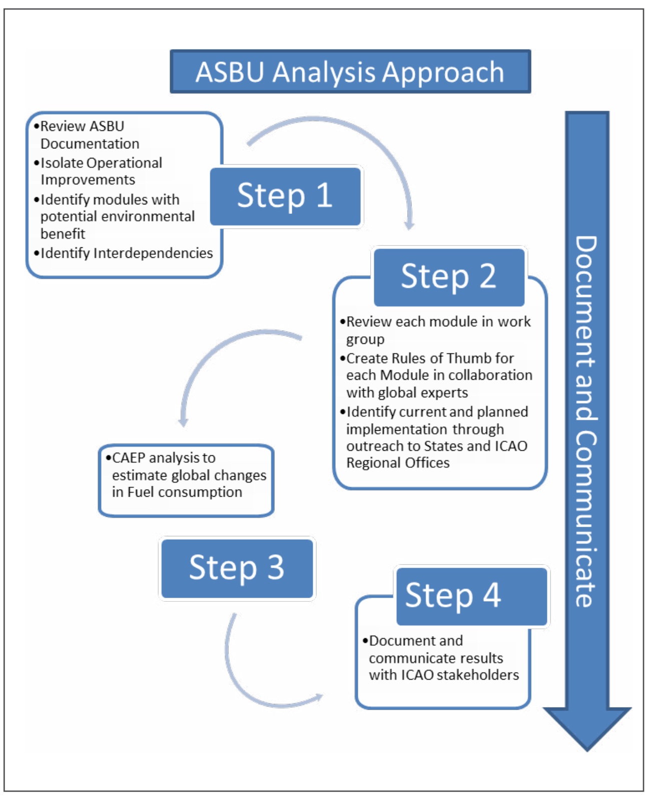
1 https://www.icao.int/sustainability/Documents/LTF_Charts-Results_2018edition.pdf
2 For more information see https://www.icao.int/sustainability/pages/asbu-framework.aspx. Note that the ASBU framework is currently being updated with a new structure to be endorsed at the 40th ICAO Assembly (October 2019).

FIGURE 2: The ICAO ASBU framework (2016)



In 2016, the ICAO Committee on Aviation Environmental Protection (CAEP) reported that the estimated global fuel and CO_2 emissions savings from the implementation of the operational concepts detailed in ASBU Block 0 between 2013 and 2018[3] would be between 2.5 – 4.9Mt in fuel saved and between 7.8 – 15.4Mt in reduced CO_2 emissions. As Block 0 ends in 2019, the 39th Session of the ICAO Assembly requested CAEP to look at the expected fuel and emissions saving benefits of ASBU Block 1 (2019-2025). CAEP subsequently undertook a 3-year analysis of the expected environmental benefits following the planned implementation of Block 1 out to 2025. This analysis concluded that many of the ASBU modules have the potential to reduce the adverse environmental impacts of aviation, and that quantifying these benefits can further support the facilitation and adoption of ASBU globally.

FIGURE 3: ASBU Analysis Approach



CAEP followed the same approach as the previous ASBU B0 analysis, namely, in line with the environmental assessment approach outlined in the recently published ICAO Doc 10031, *Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes*. Figure 3 presents the ASBU analysis approach.

The first step involved the screening of each ASBU module within Block 1 (B1) for potential environmental benefits. At this stage, CAEP concluded that the B1 elements or operational improvements build upon those identified in Block 0, and that the benefits accrue together and should not be separated. Therefore, CAEP decided to undertake a combined Block 0/1 environmental benefits assessment.

The second step was to identify a Rule of Thumb (RoT) fuel saving for a generic implementation of any of the concepts, elements or operational improvements for which potential fuel and emissions savings had been identified.

3 Block 0 was previously defined from 2013-2018.

TABLE 1: Block 0/1 modules, potential environmental benefits and rules of thumb.

B0 / B1 Module[4]	Environmental benefits in OI (Y/N)	Number of RoT(s) defined	B0 / B1 Module[4]	Environmental benefits in OI (Y/N)	Number of RoT(s) defined
ACAS	N		NOPS	Y	*****
ACDM	Y	***	OPFL	N	
AMET	Y	***	RATS	Y	*
APTA	Y	********	RPAS	N	
ASEP	Y	**	RSEQ	Y	***
ASUR	Y	*	SNET	N	
CCO	Y	**	SURF	Y	***
CDO	Y	***	SWIM	N	
DATM	N		TBO	Y	**
FICE	Y	*	WAKE	Y	********
FRTO	Y	******			

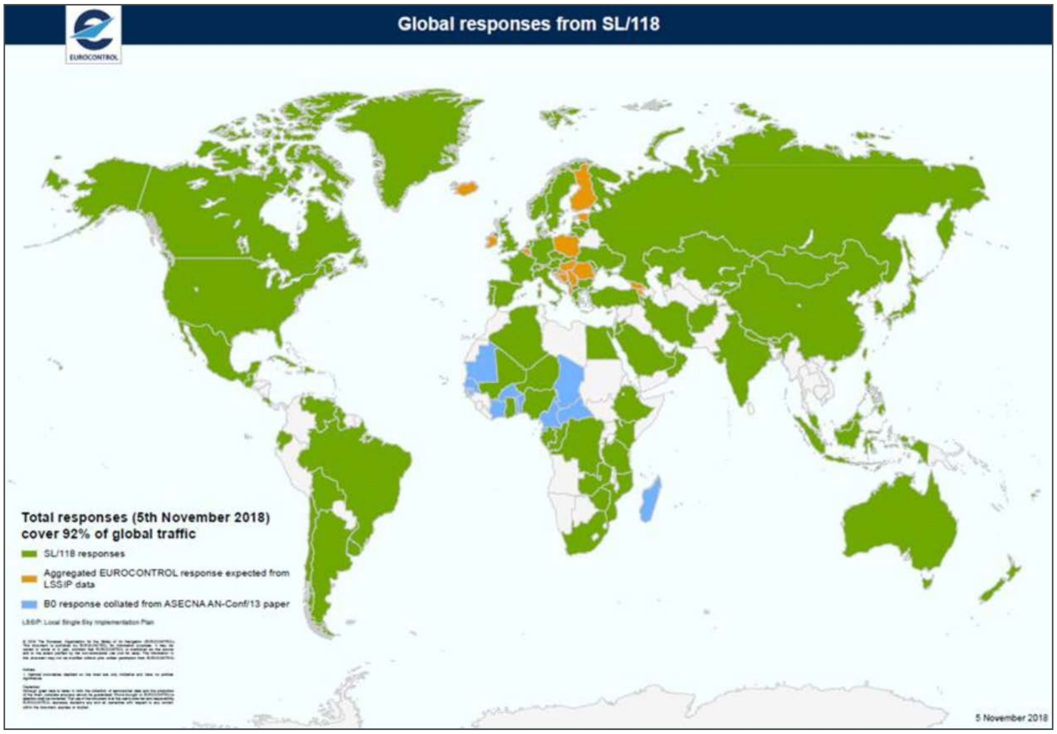
To create a RoT, operational experts gathered data from pre- and post- implementation assessments and used information from studies and trials, combined with their expert judgement to create and agree on the fuel saving benefit attributed to a generic implementation of each operational improvement. The RoT creation process also took into account any interdependencies among the different modules with the objective to follow a conservative approach to avoid any double counting of benefits. For existing Block 0 RoTs, these were reviewed and updated where necessary taking into account the latest information available. In total, CAEP created 51 Rules of Thumb for 15 of the Block 0 / 1 modules (see Table 1).

ASBU IMPLEMENTATION AND RESULTS

To identify the current and planned implementation status of all the Block 0/1 operational improvements for which rules of thumb had been created, a State Letter was sent out to all ICAO States in late 2017. Over the following 10 months, ICAO received more than 100 responses from States detailing their current and future plans for ASBU implementation. In Figure 4, green areas indicate a direct response to the State Letter, orange areas indicate aggregated regional implementation data provided by EUROCONTROL, and blue areas indicate responses from the States of ASECNA (Agency for Air Navigation Safety in Africa and Madagascar) in the form of a Block 0 implementation report to the ICAO's 13th Air Navigation Conference.

4 ACAS-ACAS improvements; ACDM-Airport CDM; AMET-Meteorological information supporting enhanced operational efficiency; APTA-Approach procedures including vertical guidance; ASEP-Air Traffic Situational awareness; ASUR-ADS-B satellite based and ground based surveillance; CCO-Continuous Climb Operations and PBN SIDs; CDO-Continuous Descent Operations and PBN STARs; DATM-Digital Air Traffic Management; FICE-Increased efficiency through ground - ground integration; FRTO-En route Flexible Use of Airspace and Flexible routes; NOPS-Air Traffic Flow Management; OPFL-In-Trail Flight Procedures; RATS-Remote Air Traffic Services; RPAS-Remotely Piloted Aircraft System; RSEQ-AMAN / DMAN; SNET-Ground based safety nets; SURF-A-SMGCS, ASDE-X; SWIM-System Wide Information Management; TBO-Data link en-route; WAKE-Wake vortex.

FIGURE 4: Global ASBU implementation responses



While the 2016 CAEP study on the environmental benefits of the planned implementation of Block 0 compared 2018 ASBU implementation to 2013, the 2019 B0/1 study used 2015 as a reference case because the CAEP modelling team used a new 2015 traffic forecast. Therefore the results of the 2019 B0/1 analysis compared 2015 and 2025 fuel burn data, and are thus likely to be slightly conservative because they do not take into account the increase of the benefits derived from additional Operational Improvements that were implemented between 2013 and 2015.

Depending on how States phased the implementation of the ASBU Block 0/1 modules between 2015 and 2025, potential fuel burn savings were estimated to range between 106 - 204kg per flight. This corresponds to between 5.2 - 10.1Mt in possible global annual fuel savings (16.6 - 32.0Mt in global CO_2 savings) in 2025 resulting from planned ASBU Block 0 / 1 implementations since 2015. In addition, traffic growth will also contribute by increasing the pool of potential recipients of the environmental benefits from modules implemented before the end of 2013. Overall, it is estimated that an increase in total fuel / CO_2 savings of 1.5 - 2.9% in 2025 relative to the 2015 fuel savings can to be attributed to Block 0/1 implementation.

The implementation of some of the ASBU Block 0/1 modules will lead to better predictability within the global air traffic system as well as overall efficiency improvements. Therefore, the amount of fuel loaded onto aircraft that is required to 'carry fuel' can also be reduced by the amount of the estimated benefit. As explained in ICAO Doc 10013 - *Operational Opportunities to Minimize Fuel Use and Reduce Emissions*, this can result in an additional 2.5-4.5% savings relative to the reduction described above due to the reduced weight of the aircraft. In this analysis, the reduction in fuel load was estimated to reduce fuel burn by a further 4-10kg per flight, resulting in a total average fuel saving of 110 – 215kg per flight globally. Overall, therefore, a total annual fuel saving of 5.4 – 10.7Mt in 2025 (17.2 - 33.7Mt in CO_2 savings) can be attributed to ASBU Block 0 / 1 implementation since 2015, which corresponds to global fuel and CO_2 savings of between 1.6 – 3.0% in 2025 compared with the 2015 fuel savings. These fuel savings correspond to yearly monetary savings of up to €5.6 billion, or $6.4 billion[5].

5 Based on IATA fuel price 24/01/19.

FIGURE 5: Estimated regional fuel savings in 2025 (compared with 2015) from global ASBU B0/1 implementation

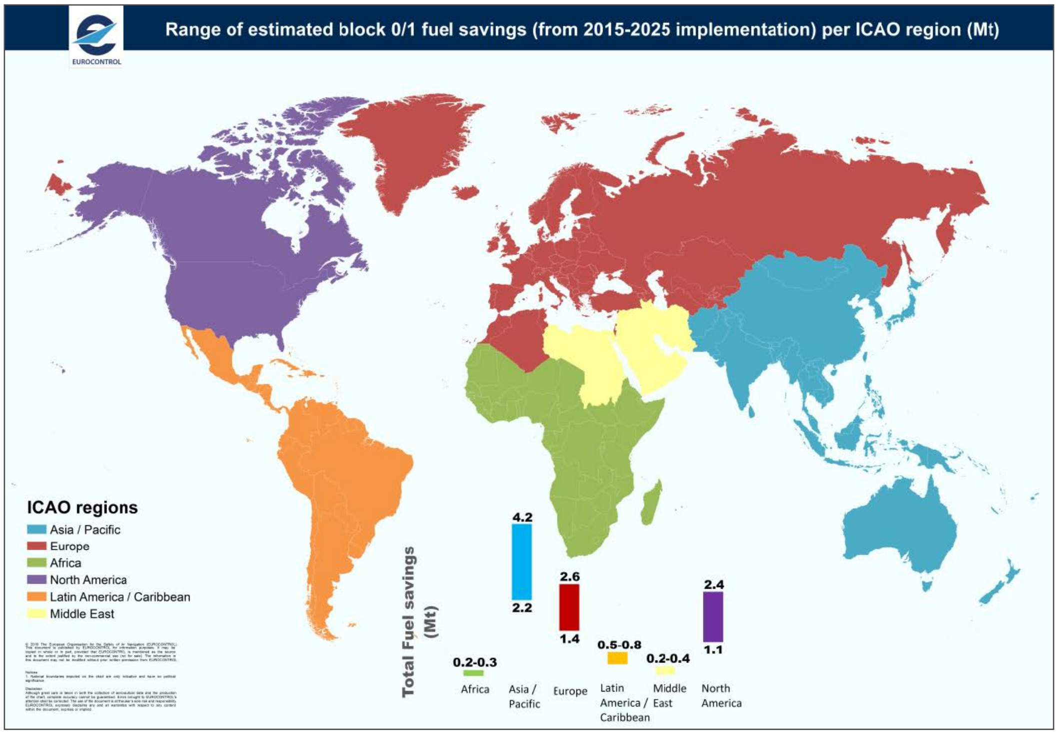
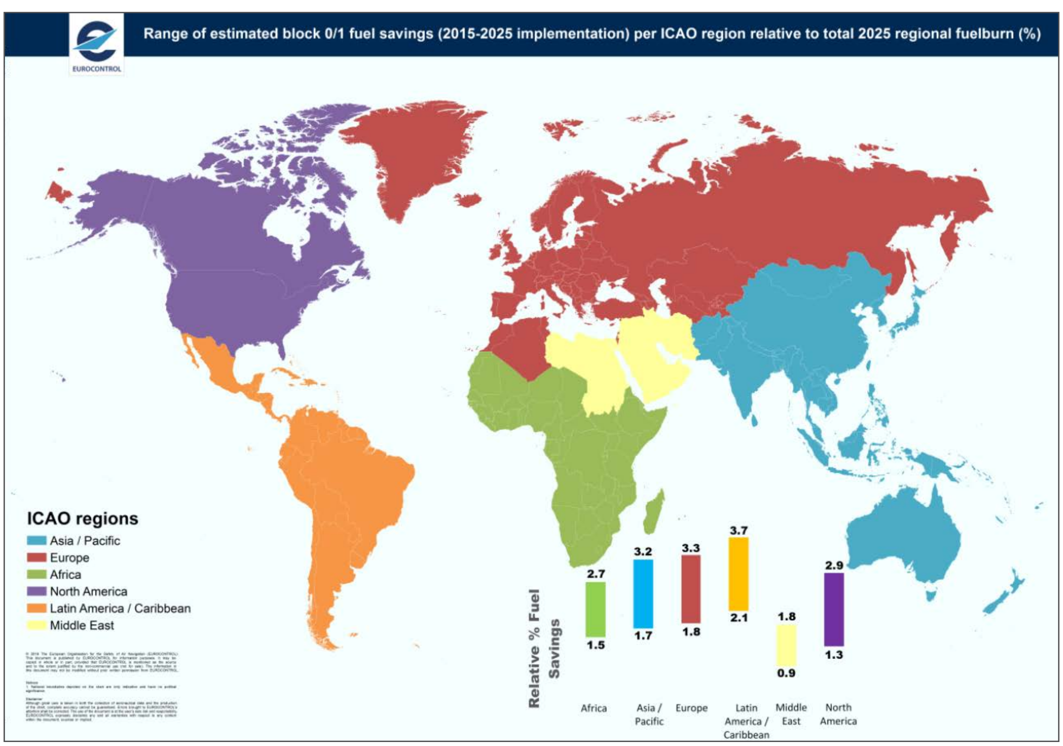


FIGURE 6: Estimated percentage fuel savings in 2025 (compared with 2015) from global ASBU B0/1 implementation relative to total 2015 regional fuel burn



Breaking down the results to the ICAO regional level it can be seen in Figure 5 that there is considerable variance in absolute fuel and CO_2 savings per region.

However, when the estimated fuel and CO_2 savings relative to the total fuel burn per region are compared (Figure 6), with the possible exception of the Middle East region, the total percentage of savings available is similar for all regions. This emphasizes how the ASBU framework supports the ICAO philosophy of 'no country left behind' where the main goal is to ensure globally harmonized implementation so that all States have access to the significant socio-economic benefits of safe, reliable, and efficient air transport.

Even though regional efficiency levels, fuel burn levels, and absolute savings may differ between regions, the picture that emerges from the study emphasizes certain key messages:

- Four ASBU modules (CDO, ASUR, TBO and CCO) together provide close to 60% of the higher range of fuel and CO_2 savings in 2025 compared with 2015.
- A further 6 ASBU modules (RSEQ, ACDM, APTA, FRTO, AMET and NOPS) together provide an additional 37% of the higher range of CO_2 savings in 2025 compared with 2015.
- Two ASBU modules (CDO and CCO) provide two of the top 5 ranked savings in each ICAO region.
- Six ASBU modules (CDO, CCO, ACDM, APTA, ASUR and TBO) provide one of the top 5 ranked savings in three or more ICAO regions.

Therefore, from the environmental and fuel / CO_2-savings perspective, those ASBU elements that provide the higher ranges of global savings should be the focus of ICAO for the development and implementation of deployment programs.

Traffic growth will also contribute to the level of benefits in 2025 by increasing the pool of potential recipients of the fuel and emissions savings provided by certain modules implemented before the baseline. Therefore, in addition to providing an assessment of the environmental benefits of the ASBU modules implemented between 2015 and 2025, this analysis also estimated the global benefits of the planned implementation of all ASBU B0 / B1 modules by 2025, regardless of their date of implementation. Such figures are likely to represent the amount of CO_2 savings that make up the operational wedge of the ICAO basket of measures to reduce CO_2 (See Figure 6 above). It should also be noted that although the ASBU framework was first developed in 2012, many of the operational improvements contained within the ASBU Block 0 modules were existing concepts that had already provided substantial environmental benefits prior to 2015. The fuel saving benefits from Block 0/1 operational improvement implementations prior to 2015 are estimated to range between 57-92kg per flight.

Therefore, in total, the fuel saving benefits that could be attributed to the operational improvements defined in the Block 0/1 modules that will be implemented by the end of 2025 are equivalent to between 167-307kg of fuel per global aircraft movement in 2025. Additional savings can also be obtained as a result of traffic growth between 2015 and 2025 which increased the pool of potential recipients

FIGURE 7: Range of ASBU Block 0/1 per-flight Fuel Savings by 2025

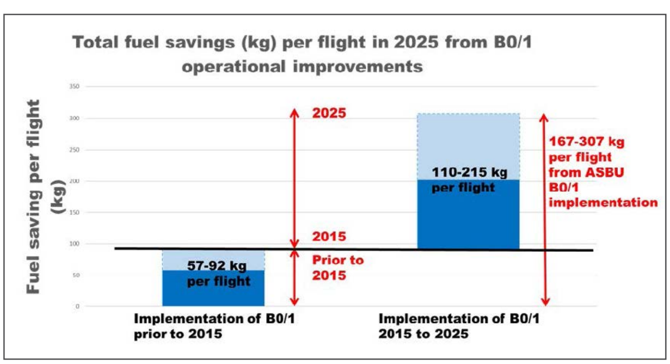
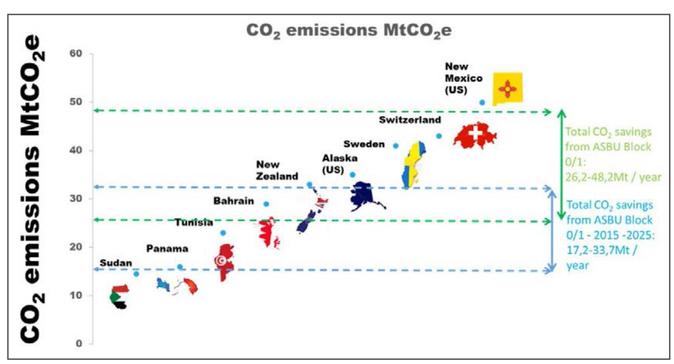


FIGURE 8: Estimated CO_2 savings from planned ASBU B0/1 implementation in 2025 compared with Country and Selected US State emissions



of the environmental benefits from modules implemented before the end of 2015. The total savings are therefore equivalent to avoiding the consumption of 8.3 - 15.2Mt of fuel (which would have generated 26 - 48Mt CO_2) or 2.4 – 4.3% of total global fuel burn in 2025, taking into account the benefits from both module implementation and the increased traffic between 2015 and 2025. These results are summarized in Figure 7.

To put these results into perspective, Figure 8 shows the range of estimated Block 0/1 CO_2 savings when 2025 savings are compared with those of 2015, regardless of implementation date. Also shown are results comparisons from the planned implementation of ASBU B0/1 for national yearly CO_2 emissions of some countries and selected US States.

CONCLUSION

In light of the above discussion, it can be seen that while the operational wedge of the ICAO basket of measures to reduce CO_2 is perhaps the smallest wedge in the basket (See Figure 1), it has the potential to provide annual CO_2 savings of up to approximately 48 million tons. In addition, this wedge represents potential annual fuel cost savings to airlines worth up to \$5-9.2 billion (€4.4-8.1 billion).

The ASBU framework provides the concepts, initiatives and operational improvements which ensure that safety is maintained, while future capacity, efficiency, and environmental benefits are maximized. While such concepts may be robustly implemented in those areas of the world where ATM optimization is an immediate concern, it is the interoperability of the framework that ensures that operational solutions are available to all, and able to be implemented if and when the operational need for a solution arises.

In addition, although fuel and CO_2 savings vary among regions which have differing traffic numbers, levels of airspace complexity, and availability of specialist system support; on the whole, it is the same modules and operational improvements that provide the vast majority of the fuel / CO_2 savings. As the focus increases on mitigating aviation-related CO_2 emissions, ICAO's priority needs to be on implementation programs that can be rapidly deployed, especially for those operational improvements that have been demonstrated to reduce fuel burn and CO_2 emissions.