Supporting
European
Aviation

EUROCONTROL

Operational Improvements / Fuel and emissions savings

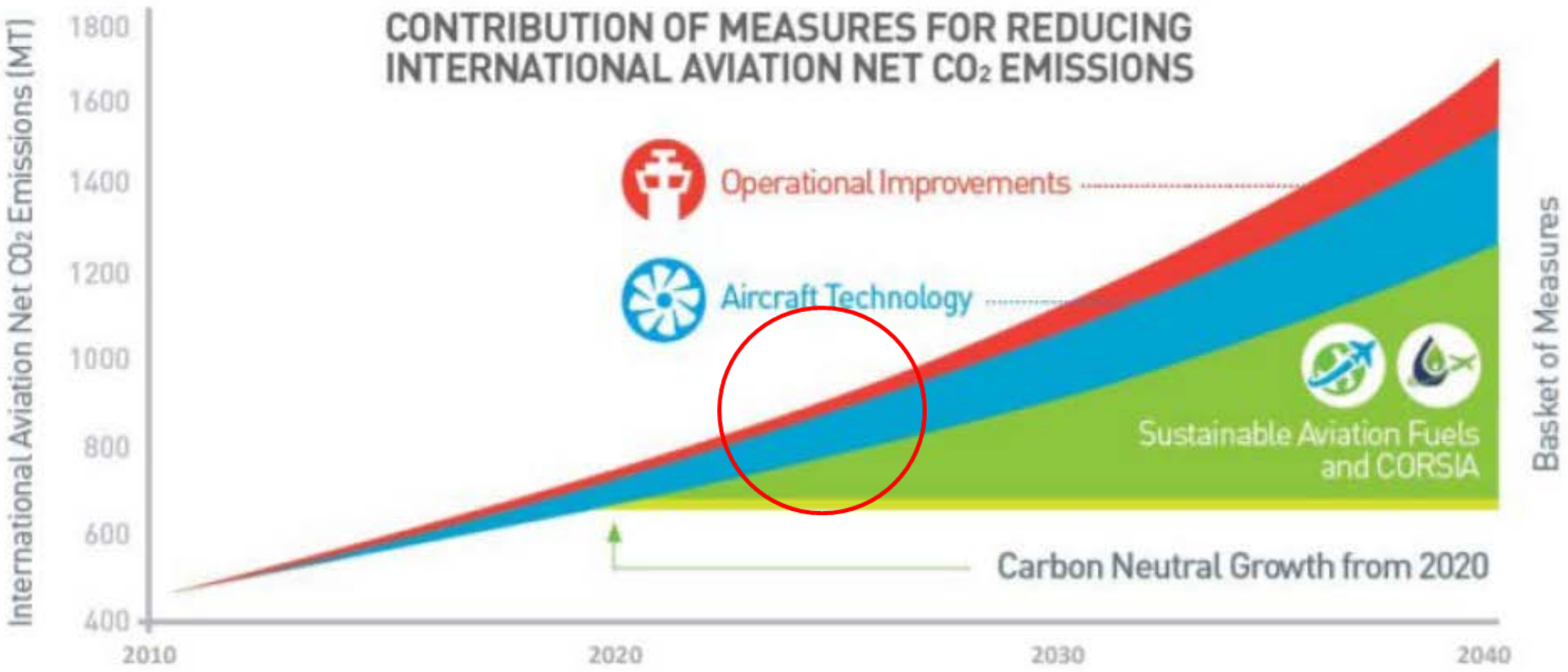
ICAO EUR ENV TF/2

David Brain
EUROCONTROL
9th October 2019

FOUNDING MEMBER SESAR JOINT UNDERTAKING

NETWORK MANAGER

ICAO basket of measures to reduce CO_2

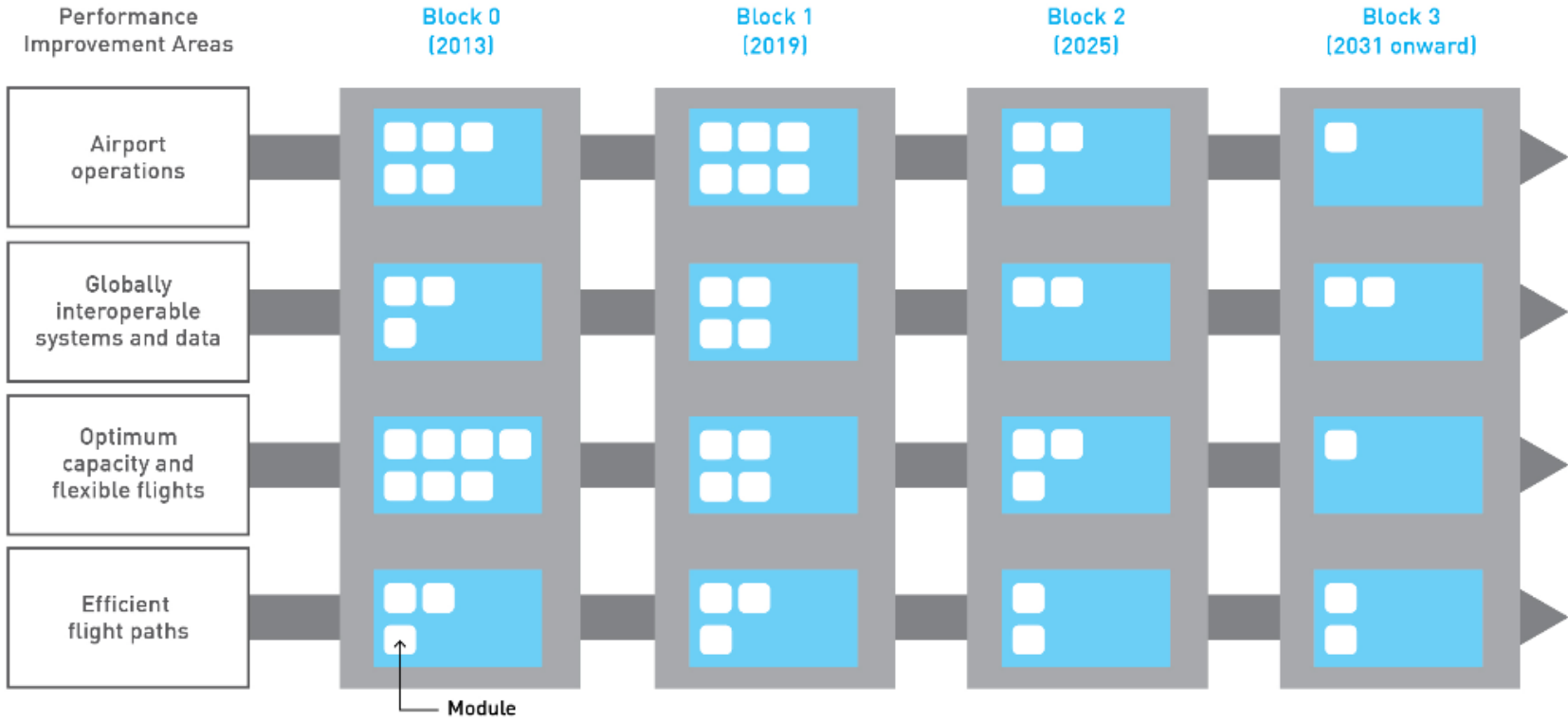


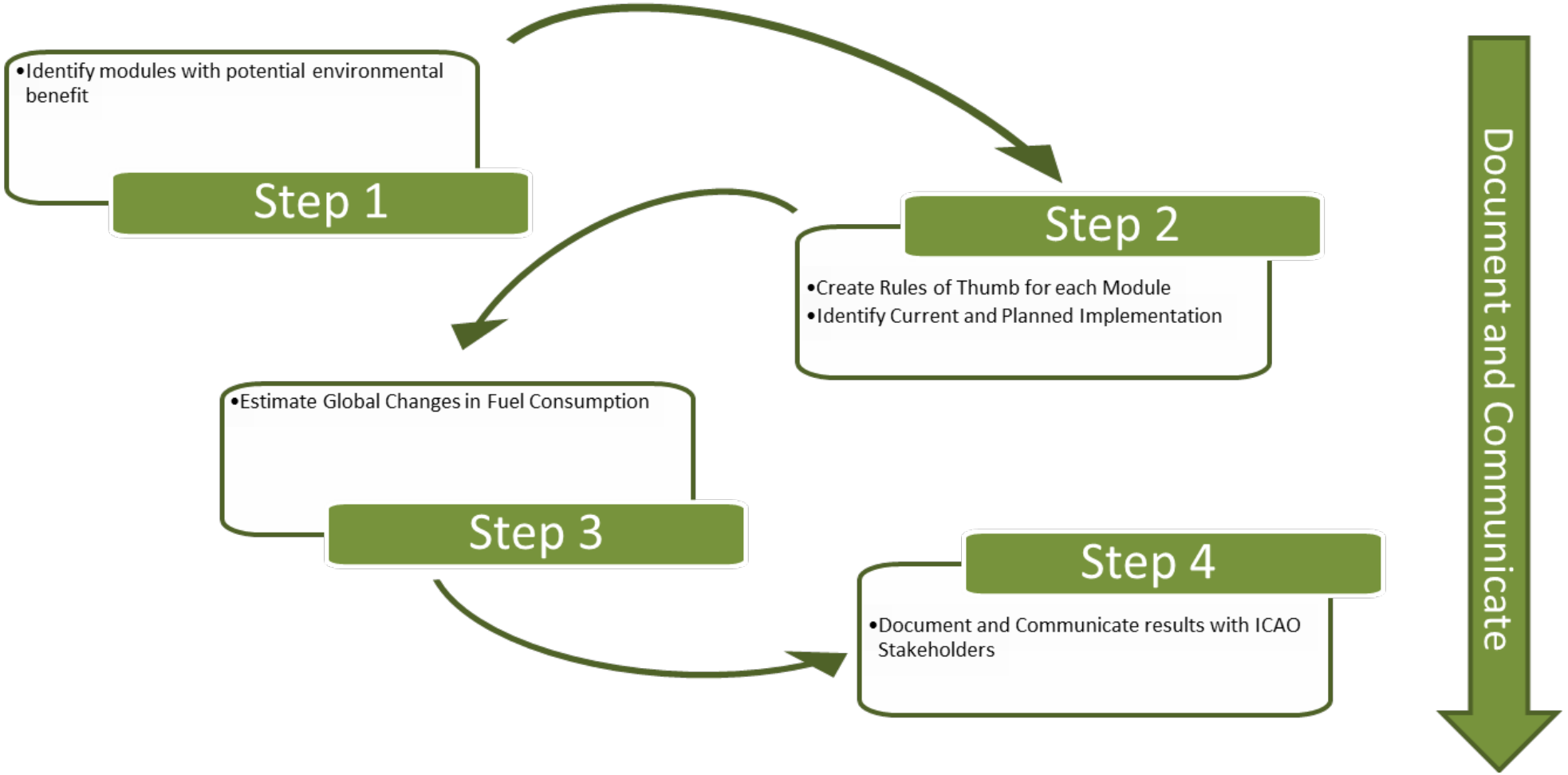
In 2019, ICAO-CAEP undertook a global environmental benefits assessment to identify the fuel / CO_2 emissions savings from the implementation of ASBU Blocks 0/1 out to 2025

ICAO initiated the Aviation System Block Upgrade (ASBU) initiative as a programmatic framework that:

- Develops a set of Air Traffic Management (ATM) solutions or upgrades
- Takes advantage of current equipage
- Establishes a transition plan, and
- Enables global interoperability

Outlined in *ICAO Global Air Navigation Plan (Doc. 9750)*





Aligns with approach outline in ICAO Doc 10031, *Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes*

- 53 rules of thumb (RoT) were developed for ASBU B0 / B1 generic implementations

AC Class	High Ave Kg Saved per taxi min Taxi-out	Low Ave Kg Saved per taxi min Taxi-in**	Fleet %
RJ	7	4.9	6,0
SA	14,4	10.1	71,0
Small TA	20,5	14,4	12,9
Med TA	34	23,8	8,8
Large TA	70	49	1,3
Composite	17,2 High	12,0 Low	

AC Class	kg/sec	Low kg/arr	High kg/arr	Low kg/dep	High kg/dep
RJ	0,51	2,2	4,8	7,1	16,4
SA	0,68	2,9	6,4	9,4	21,9
Small TA	1,11	4,8	10,5	15,4	35,7
Med TA	1,57	6,8	14,9	21,7	50,5
Large TA	2,47	10,7	23,4	34,2	79,4
Composite	0,829	3,6	7,8	11,5	26,7

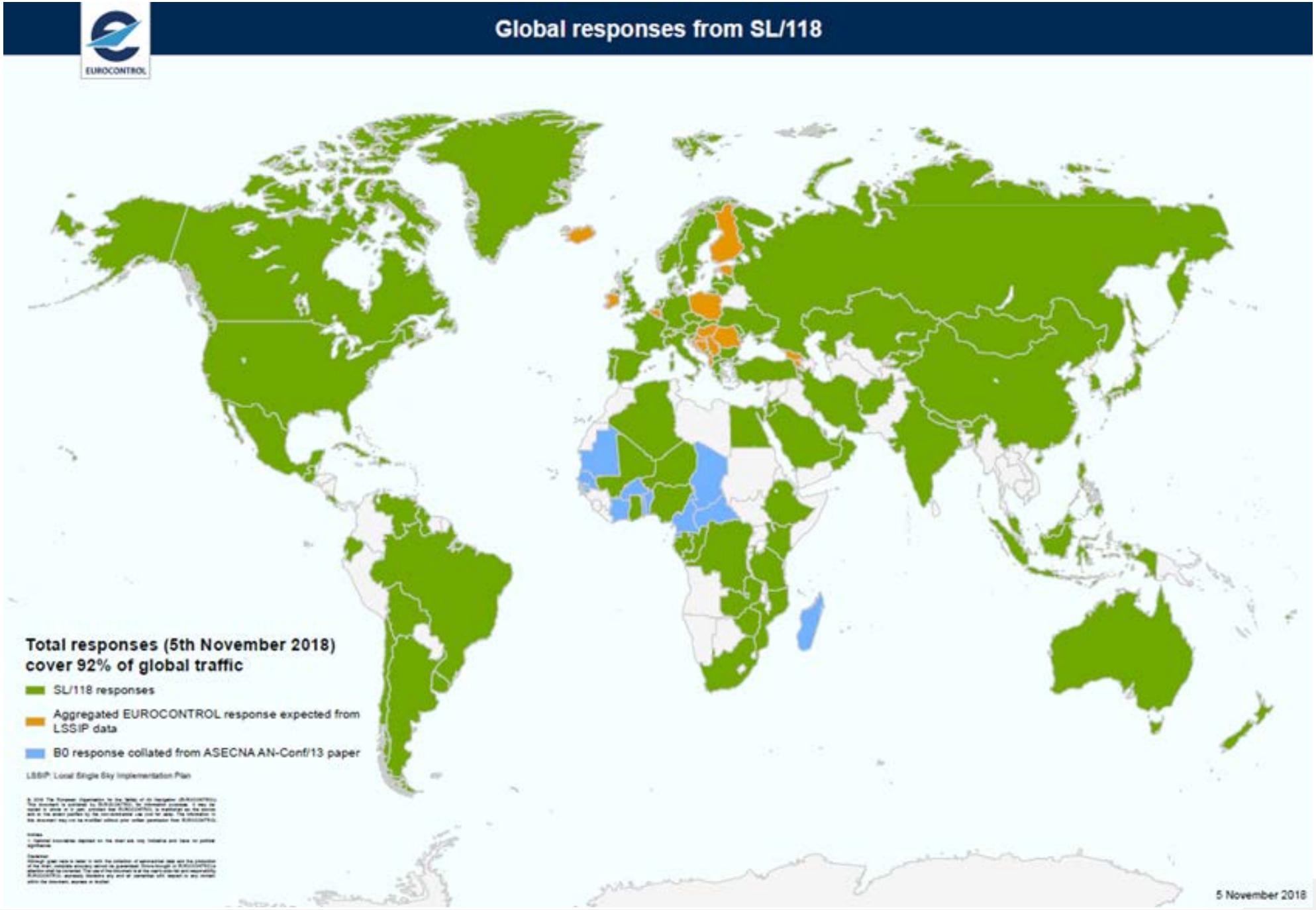
AC Class	Ave Kg Saved per flight	Modified Fleet %
SA	21,0	74,0
Small TA	89,3	13,4

RJ	900-1220	4030	1832	30,53	0,509	1832	31	0,51	6,0%
SA	900-1220	5815	2643	44,05	0,734	2460	41,0	0,68	71,0%
SA	1900	5357	2435	40,58	0,676				
SA	4000-5500	5060	2300	38,33	0,639				
Small WB-1 B57/67-A33/34	900-1220	8580	3900	65,00	1,083	4009	66,8	1,11	12,9%
Small WB-1 B57/67-A33/34	1900	7883	3583	59,72	0,995				
Small WB-2 B57/67/87-A33/34	4000-5500	9995	4543	75,72	1,262				
Medium WB B777-A340/350	4000-5500	11865	5393	89,88	1,498	5642	94,0	1,57	8,8%
Medium WB B777-A340/350	9000-14000	12960	5891	98,18	1,636				
Large WB 747/A380	4000-5500	17279	7854	130,90	2,182	8887	148,1	2,47	1,3%
Large WB 747/A380	9000-14000	21824	9920	165,33	2,756				
						2986	49,8	0,829	100%

Fuel Savings (kgs) per Flight from R
Setting Enabled by Performance E

Aircraft Class >>>	Savings (kgs)	Distance Savings (NM)
Range:		
RoT low	11-95	1-5
RoT high	40-187	17-27

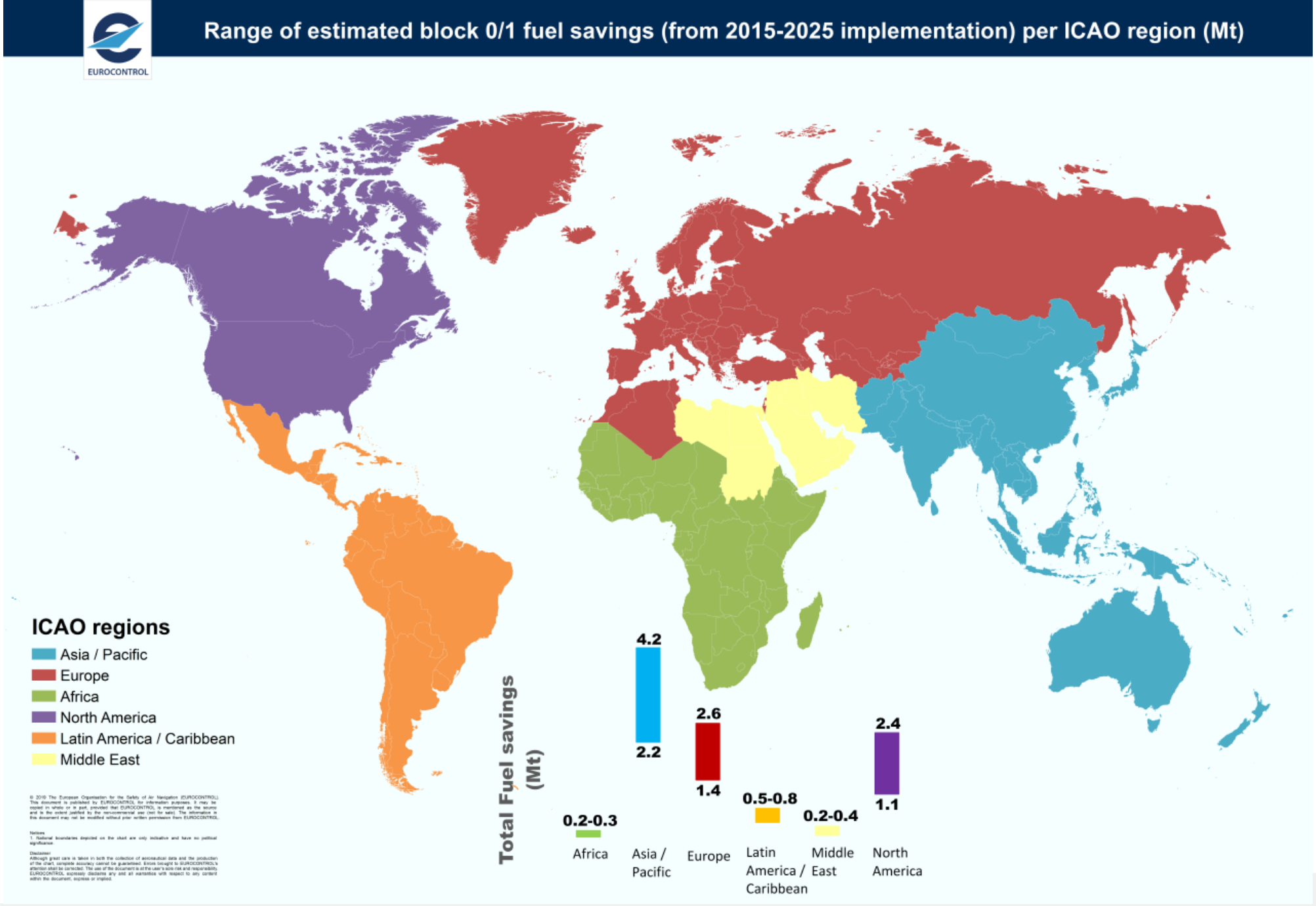
Global responses from SL/118



- Global annual fuel burn savings from ASBU Block 0/1 elements
- 5.4-10.7Mt fuel burn or 17.2-33.7Mt CO_2

ICAO Region	Fuel savings (Mt)	Fuel / CO_2 savings (%)	CO_2 savings (Mt)	Cost savings ($billion)*	Cost savings (€billion)
Africa	0.2-0.3	1.5-2.7	0.5-1.0	0.1 – 0.2	0.1 – 0.2
Asia/Pacific	2.2-4.2	1.7-3.2	6.9-13.3	1.3 – 2.5	1.2 – 2.2
Europe	1.4-2.6	1.8-3.3	4.4-8.2	0.8 – 1.5	0.7 – 1.4
Latin America/Caribbean	0.5-0.8	2.1-3.7	1.5-2.6	0.3 – 0.5	0.2 – 0.4
Middle East	0.2-0.4	0.9-1.8	0.7-1.4	0.1 – 0.3	0.1 – 0.2
North America	1.1-2.4	1.3-2.9	3.5-7.6	0.7 – 1.5	0.6 – 1.3
Global	**5.4-10.7**	**1.6-3.0**	**17.2-33.7**	**3.3 – 6.4**	**2.9 – 5.6**

Range of estimated block 0/1 fuel savings (from 2015-2025 implementation) per ICAO region (Mt)



Notes
1. National boundaries depicted on the chart are only indicative and have no political significance.

Disclaimer
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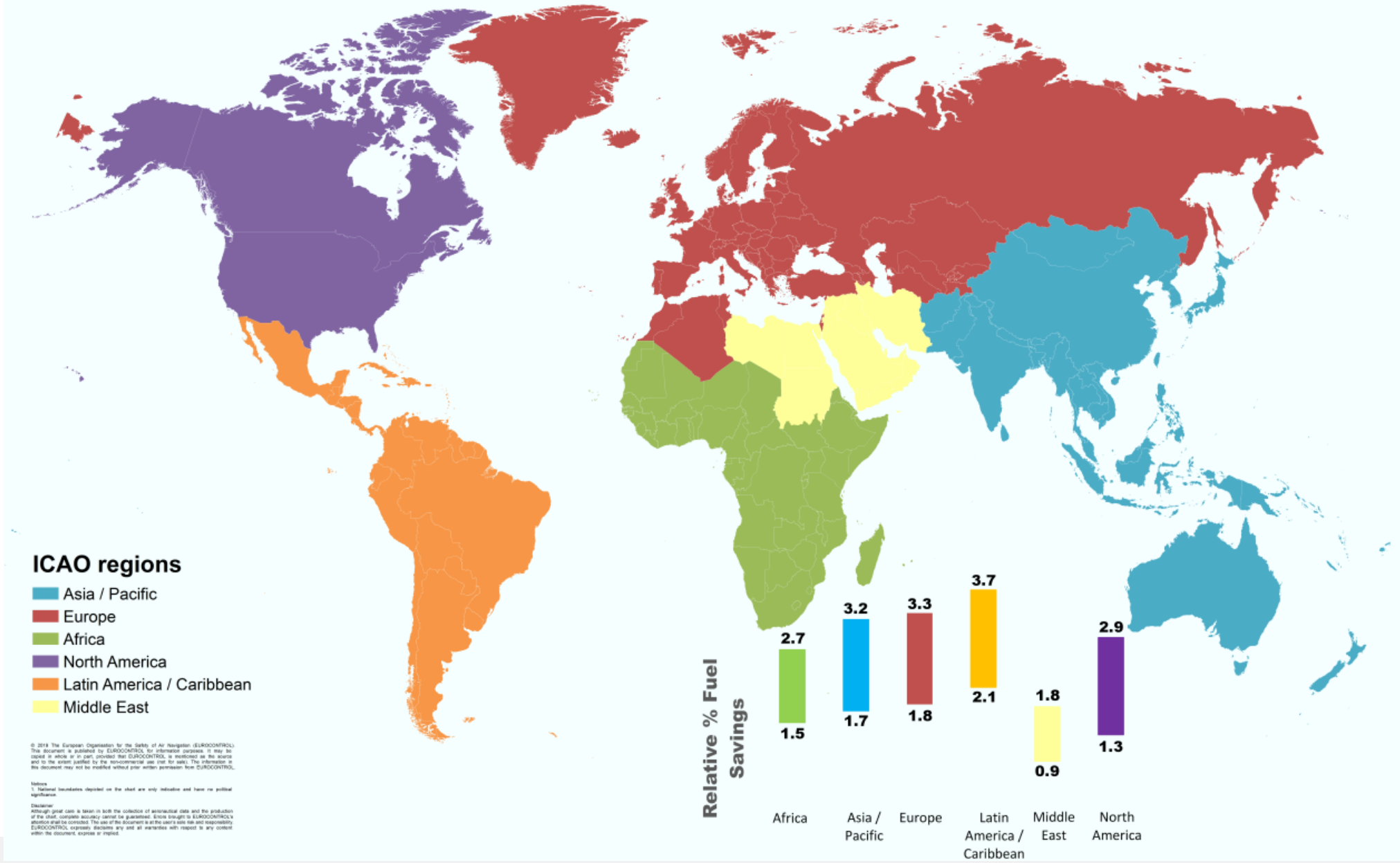
Range of estimated block 0/1 fuel savings (2015-2025 implementation) per ICAO region relative to total 2025 regional fuelburn (%)



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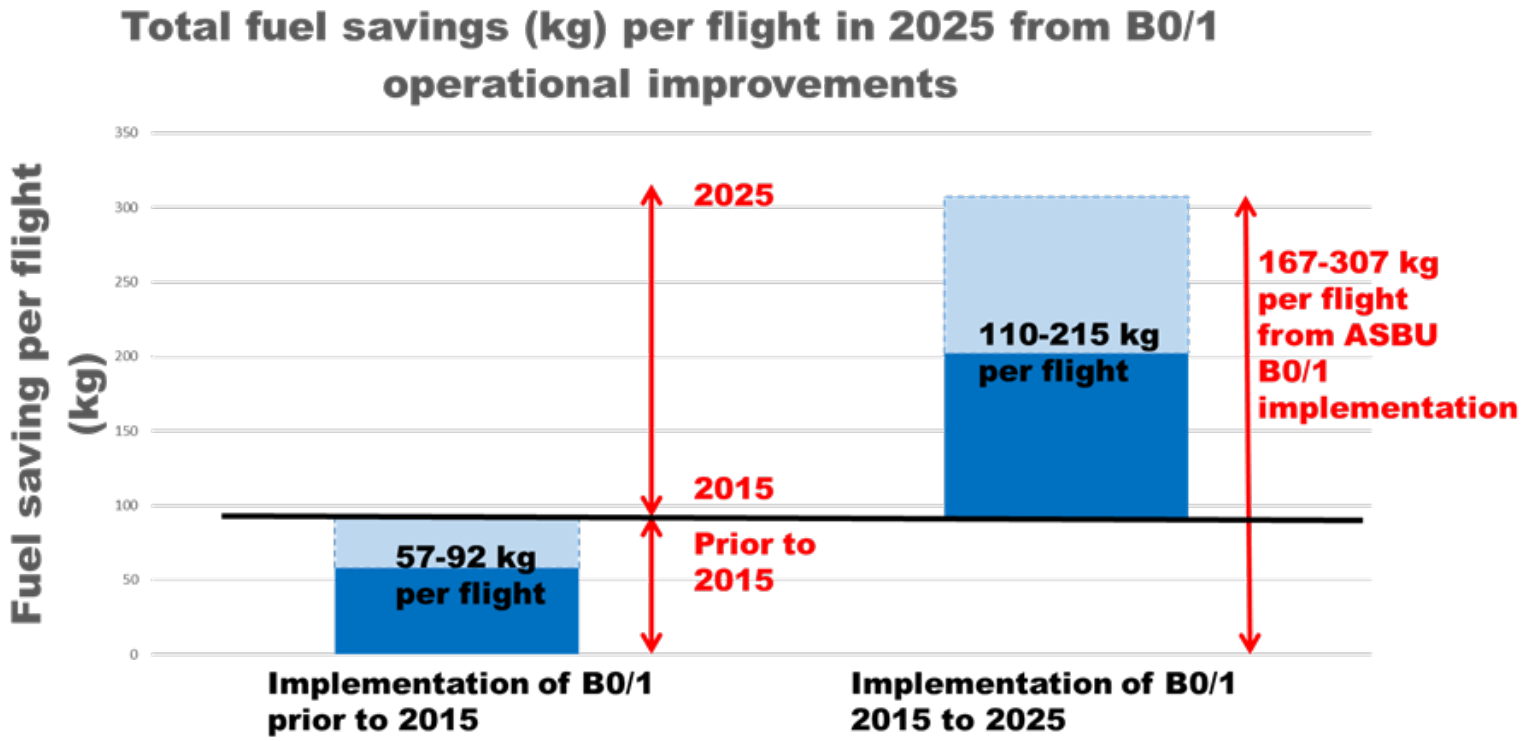
- ASBU B0 / B1 modules implemented prior to 2015: 57-92kg fuel per flight (180-289 kg CO_2)

- The implementation of ASBU is estimated to provide a total annual global fuel savings in 2025 of between 167-307kg per flight (528-970kg CO_2)



ASBU analysis – key findings in Europe

4 ASBU modules (CDO, ASUR, TBO and CCO) provide close to 60% of the higher range of fuel and CO_2 savings;

CDO – Continuous Descent Operations
ASUR – Space-based ADS-B surveillance
TBO – Trajectory-Based Operations
CCO – Continuous Climb Operations

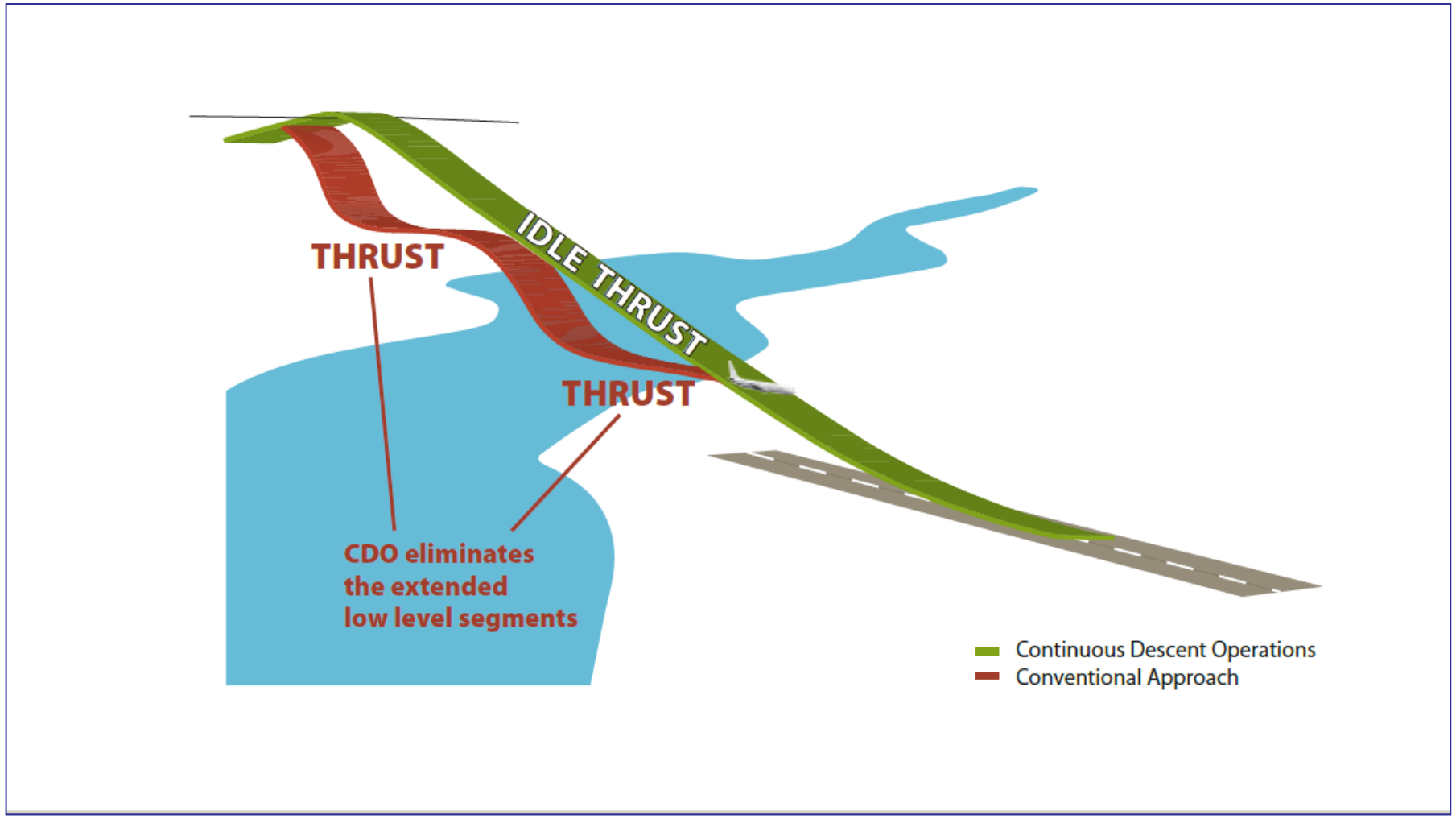
ASBU analysis – key findings in Europe

A further 6 ASBU modules (RSEQ, ACDM, APTA, FRTO, AMET and NOPS) provide an additional 37% of savings;

RSEQ – Runway sequencing (AMAN / DMAN)
ACDM – Airport Collaborative Decision Making
APTA – Performance Based Navigation
FRTO – Free Route Airspace / FUA
AMET - enhanced MET information
NOPS – Air Traffic Flow Management

Low hanging fruit?

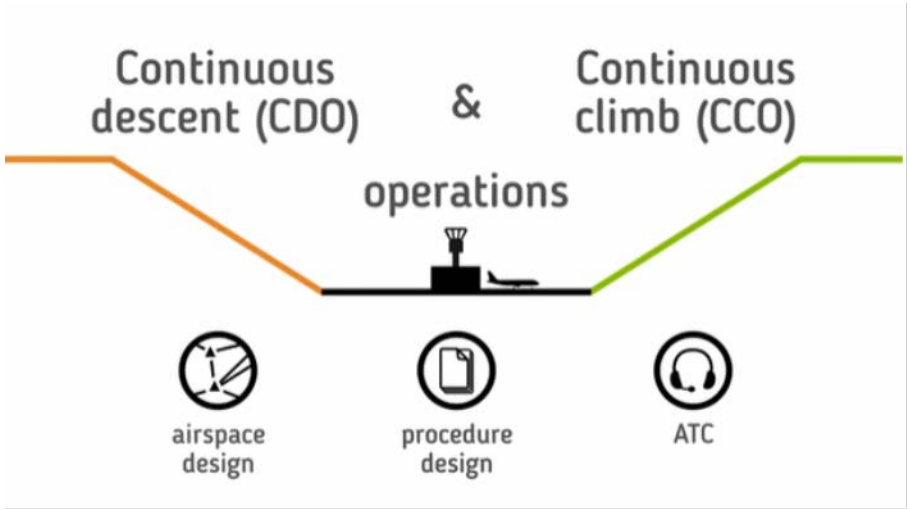
CDO? – The concept



The European CCO / CDO Task Force is working on 1 key deliverable + resources = the CCO / CDO Tool Kit:

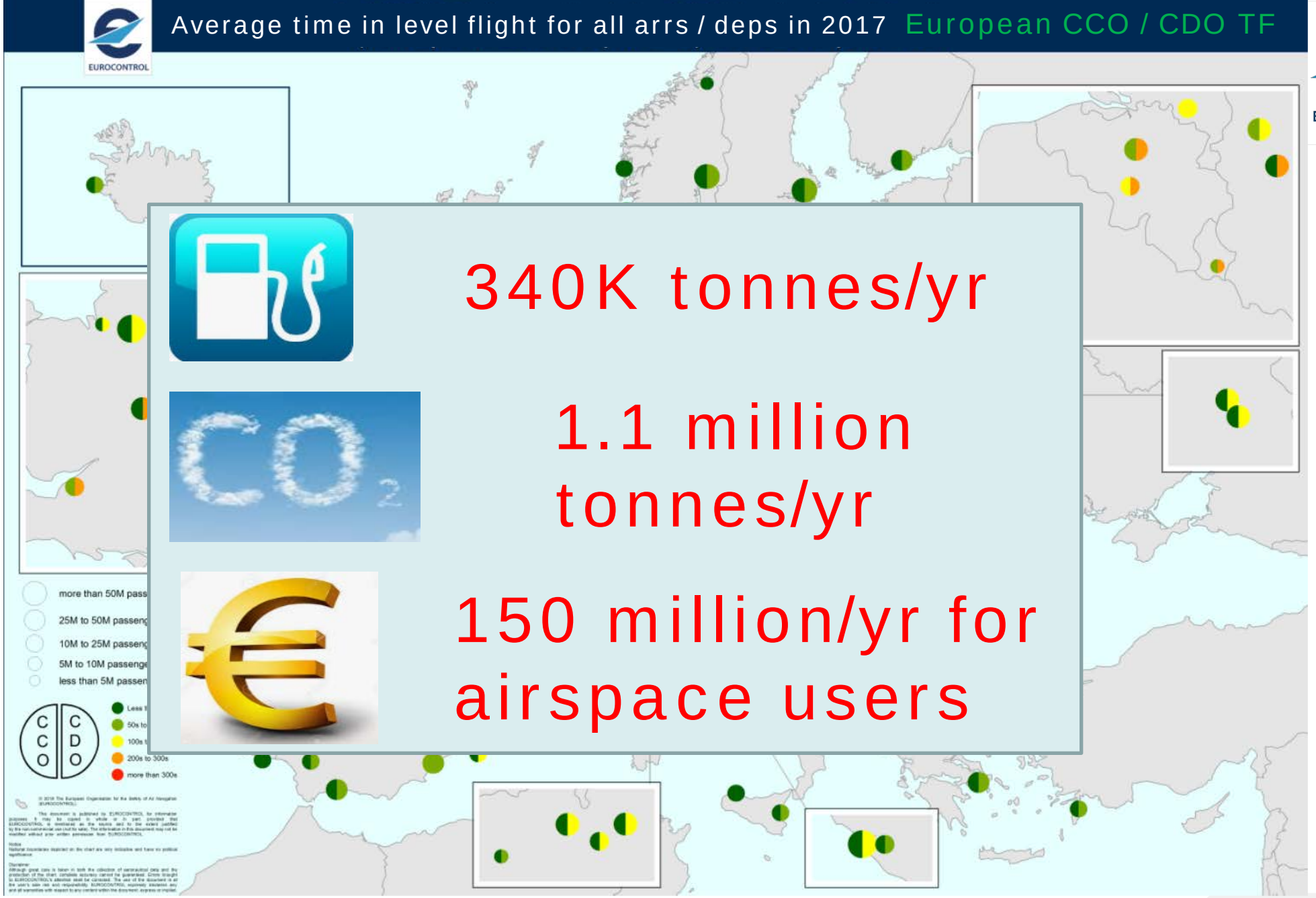
NEW!!

+



European CCO / CDO Action Plan - high level actions and principles to optimise CDO, detailed information on barriers / mitigations and interdependencies

CCO / CDO resources, guidance material and performance data

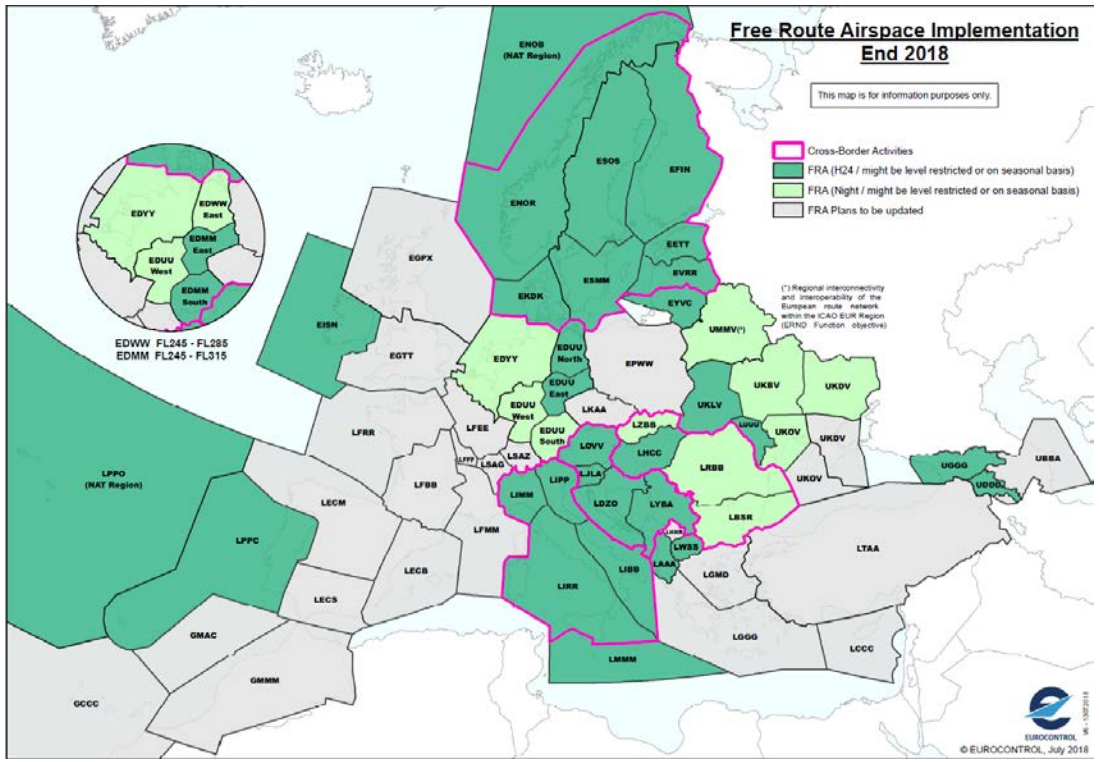

340K tonnes/yr
1.1 million tonnes/yr
150 million/yr for airspace users
more than 50M pass
25M to 50M passeng
10M to 25M passeng
5M to 10M passenge
less than 5M passen
200s to 300s
more than 300s

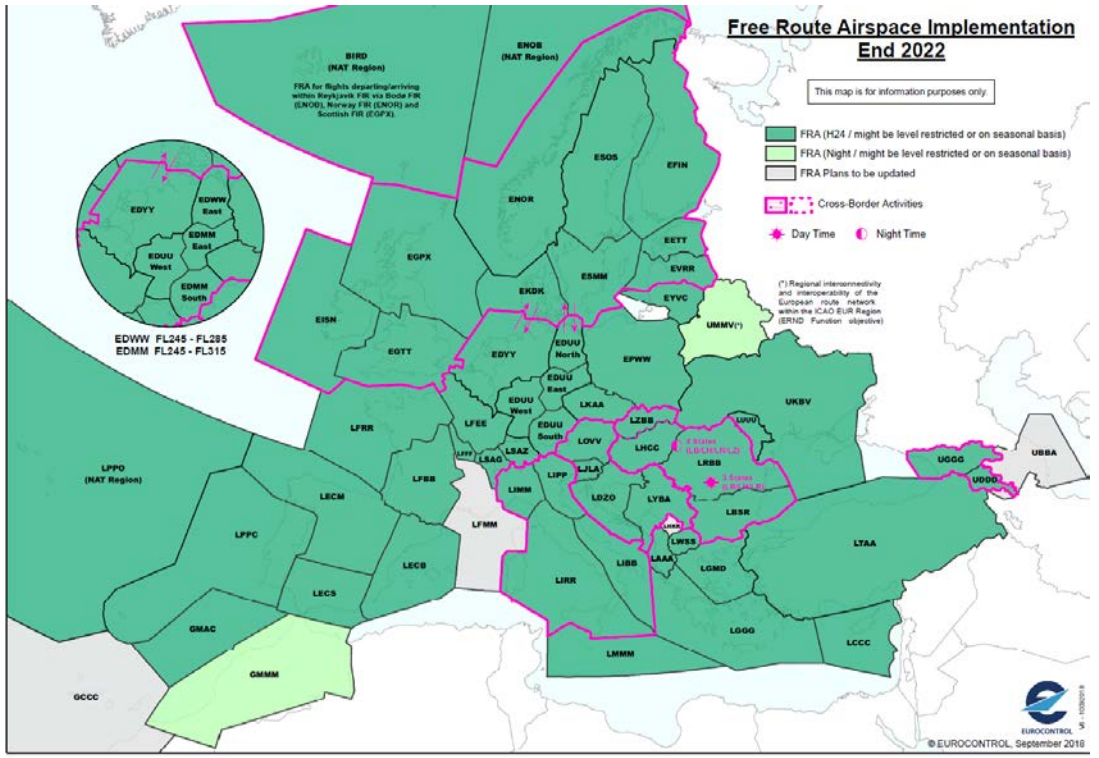
European CCO / CDO TF

- Harmonised definitions and parameters for measurement -
- Performance tables
- ATCO refresher training
- Harmonised AIP content and structure
- Update ERNIP document (airspace design manual)
- Promotion of airlines best practices
- https://www.eurocontrol.int/concept/continuous-climb-and-descent-operations
- cdo@eurocontrol.int


Colored By Altitude
Color Legend
0 to 2,000 Feet
2,000 to 5,000 Feet
5,000 to 10,000 Feet
10,000 to 18,000 Feet
18,000 to 40,000 Feet
40,000 Feet & Above

Free route airspace Europe

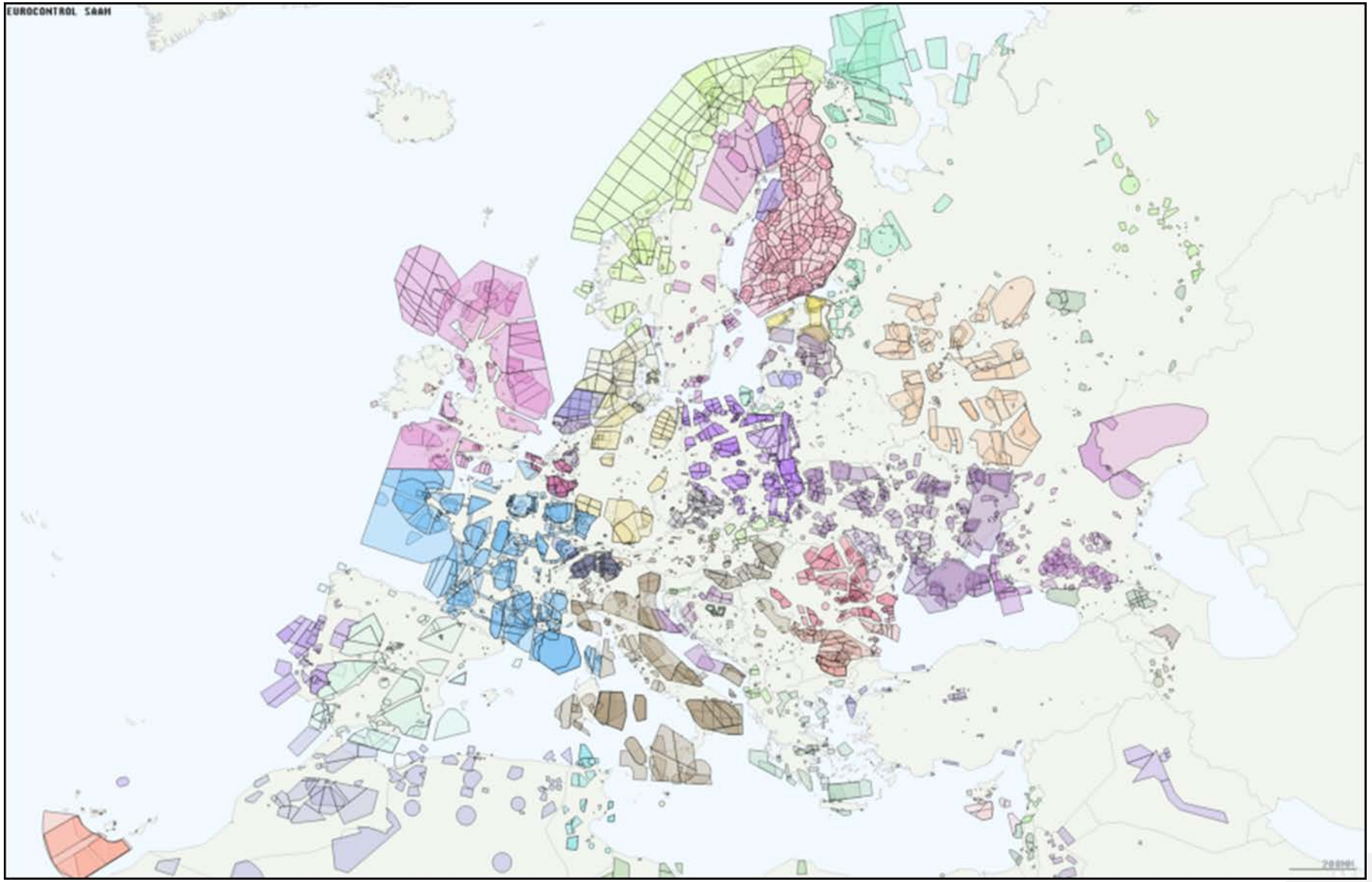




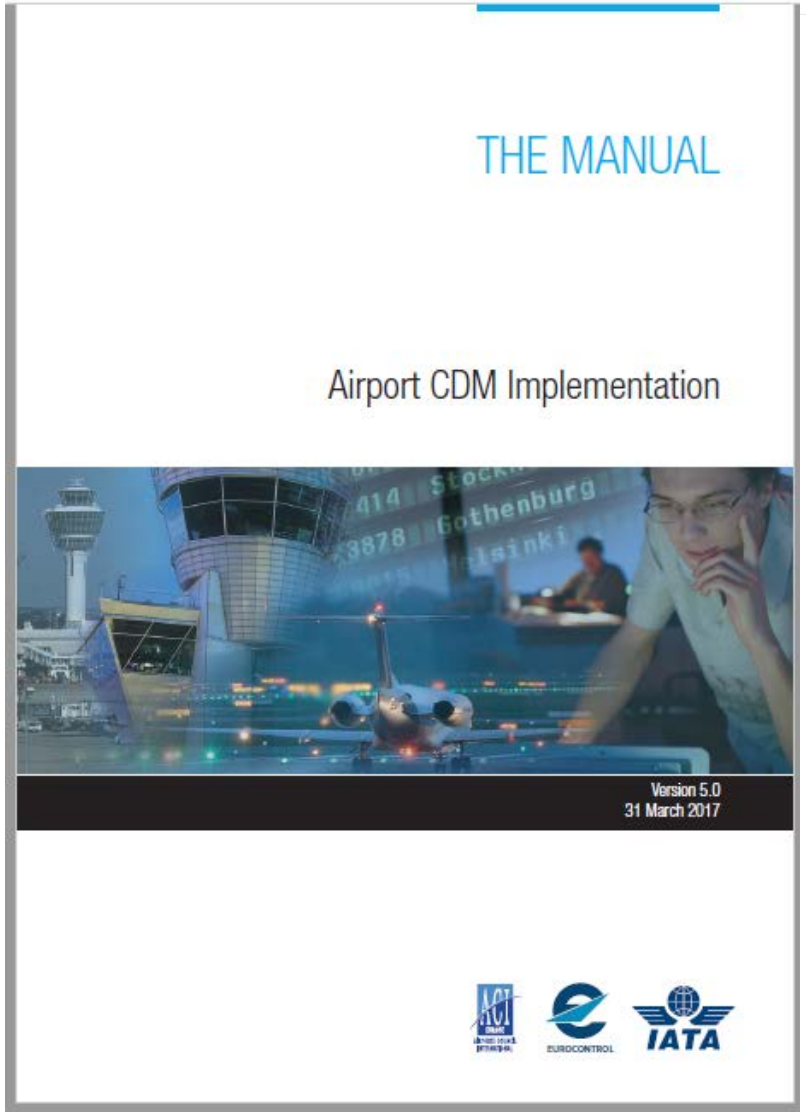
- Free route can save up to 2/3% total fuel burn depending upon current airspace inefficiency

FUA – Civil Perspective

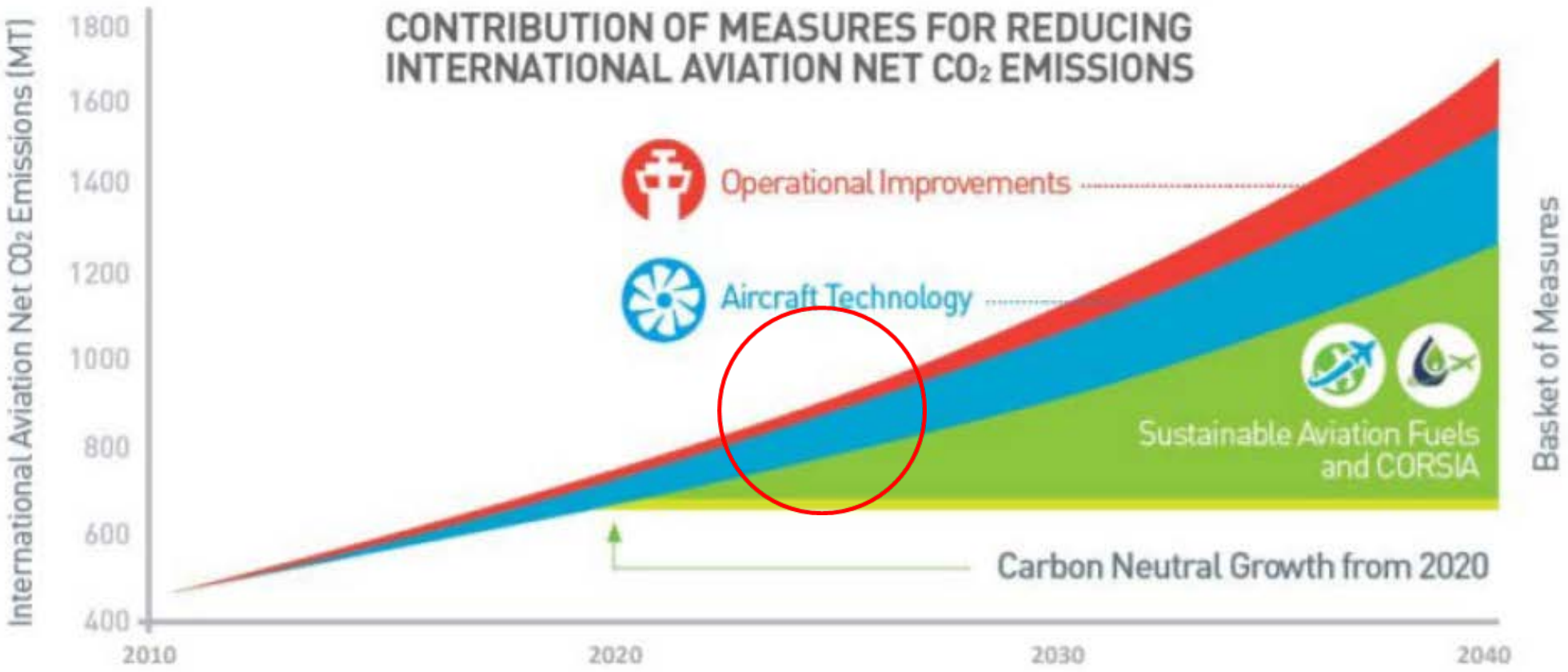
2018



Airport Collaborative Decision Making – A-CDM



ICAO basket of measures to reduce CO_2



Doc. 9988

Category	*Sub-category*	*Measure (References)*	*Rule of thumb*	*Example*
Improved air traffic management and infrastructure use *(continued)*	More efficient ATM planning, ground operations, terminal operations, en-route operations, airspace design and usage, aircraft air navigation capabilities *(continued)*	Measures to improve fuel efficient departure and approach procedures: *CCO* (CAEP/10 Report 2016)	Use IFSET or FS = 90-150 kg (0.09-0.15 tonnes) of fuel * number of CCOs	A State averages 2,000,000 flights per year. Currently, 50 of its airports offer CCO which accounts for approximately 200,000 departure movements. Expert judgement estimates that CCO is performed by 80% of the departures, a total of 160,000 departure movements. The annual fuel savings can be estimated as: — 0.09* 160,000 = 14,400 tonnes of fuel saved (low end of range) — 0.15 * 160,000 = 24,000 tonnes of fuel saved (high end of range)
		Measures to improve fuel efficient departure and approach procedures: *PBN SID* (CAEP/10 Report 2016)	Use IFSET or FS = 0 kg to 30 kg of fuel (0 to .03 tonnes) * number of departure movements on PBN SID	A State averages 1,000,000 flights per year. Currently, 50 of its airports have implemented PBN SID which is estimated to be used by 200,000 departure movements. Expert judgement is that 100% of these departures fly the PBN SID. The annual fuel savings can be estimated as: — 0.0 * 200,000 = 0 tonnes of fuel saved (low end of range) — 0.03 * 200,000 = 6,000 tonnes of fuel saved (high end of range)
		Measures to improve collaborative decision making: *A-CDM (non-U.S. version)*	Use IFSET or FS = time savings (1 to 3 min) * number of movements	An airport with an average of 100,000 movements (both departures and arrivals) annually is implementing A-CDM. On average, aircraft at the airport burn 12 kg (0.012 tonnes) per minute during taxi. The benefit of A-CDM (non-U.S. version) is achieved during the total taxi phase (taxi-in and taxi-out). The annual fuel savings can be estimated as: — 1* 0.012 * 100,000 = 1,200 tonnes fuel saved (low end of range) — 3 * 0.012 * 100,000 = 3,600 tonnes of fuel saved (high end of range)
		Measures to improve collaborative decision making: *A-CDM (U.S. version)*	Use IFSET or FS = time savings (1 to 2 min) * number of departure movements	An airport with an average of 50,000 departure movements annually is implementing A-CDM. On average, aircraft at the airport burn 12 kg (0.012 tonnes) per minute during taxi. The benefit of A-CDM (U.S. version) is achieved only during the taxi-out phase. The annual fuel savings can be estimated as: — 1 * 0.012 * 50,000 = 600 tonnes fuel saved (low end of range) — 2 * 0.012 * 50,000 = 1,200 tonnes fuel saved (high end of range)

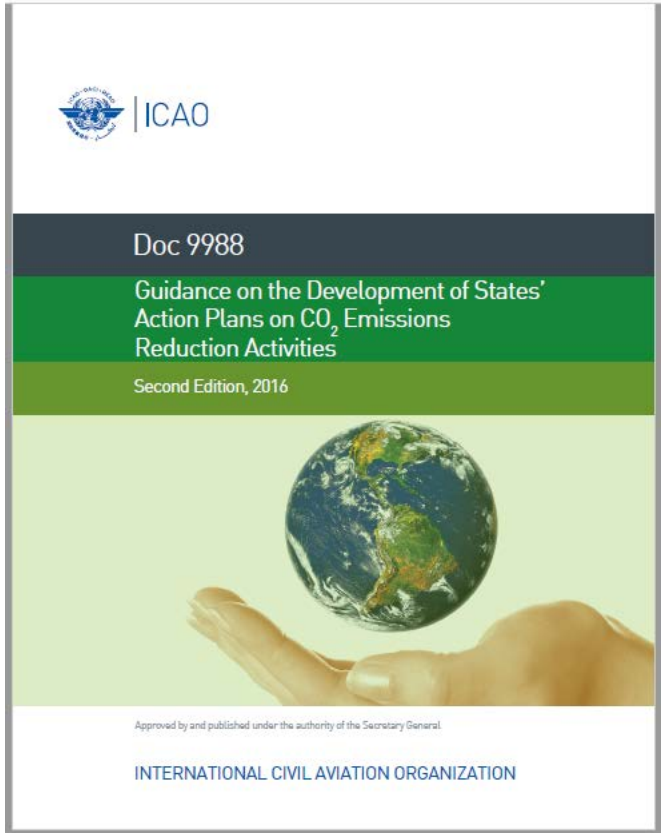


Table C2: Rules of thumb for estimating expected results by measure

Спасибо! / Thank you

david.brain@eurocontrol.int