



ICAO

ENVIRONMENT

ICAO Regional Seminar on CORSIA

Session 2: CORSIA MRV System: Monitoring of CO₂ Emissions

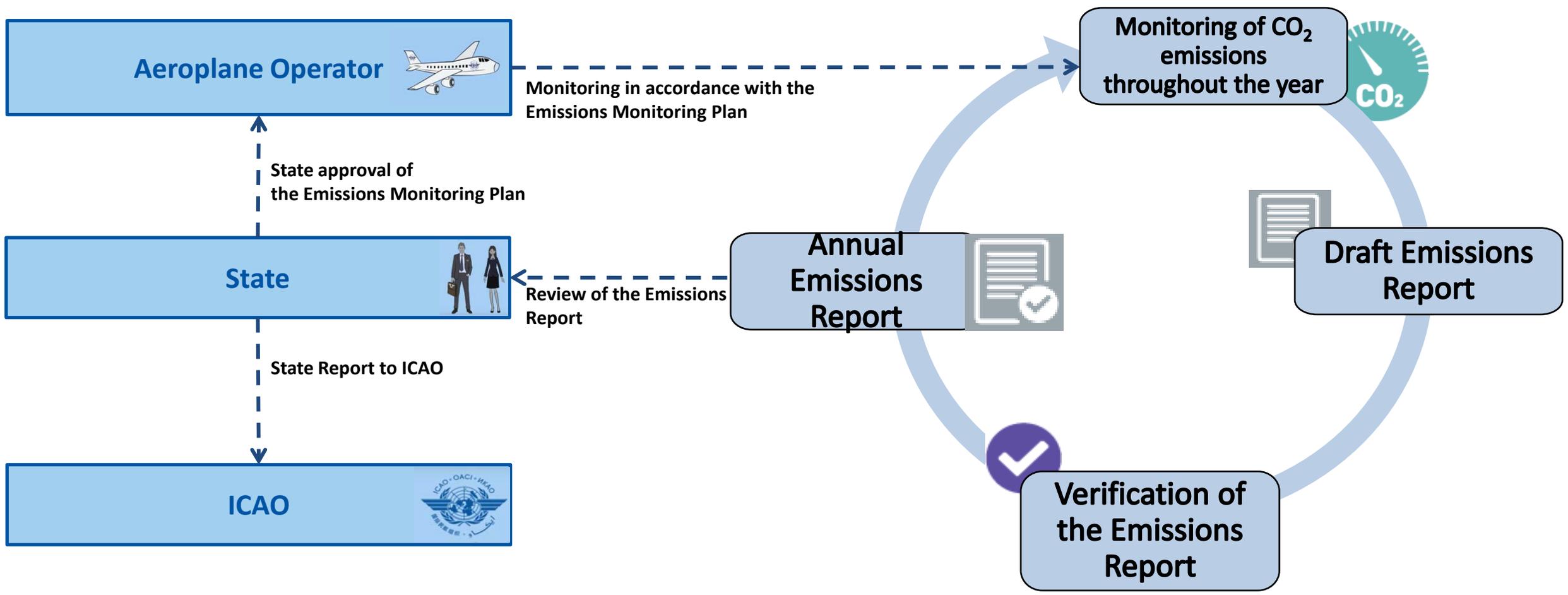
ICAO Secretariat



Monitoring, Reporting and Verification (MRV) of CO₂ Emissions

- A monitoring, reporting and verification (MRV) system is a key component of CORSIA implementation
 - Implementation of the MRV system from 1 January 2019 for all international flights is essential to establish CORSIA's baseline (2019-2020)
 - Purpose of MRV is to collect information on international aviation CO₂ emissions on an annual basis and compare emissions against the baseline emissions
- Components of the MRV system:
 - **Monitoring** of fuel use on each flight and calculation of CO₂ emissions
 - **Reporting** of CO₂ emissions information between aeroplane operators, States and ICAO
 - **Verification** of reported emissions data to ensure completeness and to avoid misstatements

Monitoring, Reporting and Verification (MRV) of CO₂ Emissions – Annual MRV Cycle



Monitoring, Reporting and Verification (MRV) of CO₂ Emissions

- Monitoring, reporting and verification of aeroplane operator's annual CO₂ emissions – draft Annex 16, Volume IV, Chapter 2

2.1 Applicability of MRV Requirements

2.2 Monitoring of CO₂ Emissions

2.3 Reporting of CO₂ Emissions

2.4 Verification of CO₂ Emissions

2.5 Data Gaps

2.6 Error Correction to Emissions Reports

A-17

CHAPTER 2. — MONITORING, REPORTING AND VERIFICATION (MRV) OF AEROPLANE OPERATOR ANNUAL CO₂ EMISSIONS

2.1 Applicability of MRV requirements

Note. — See also Chapter 1 for administration requirements of the State and aeroplane operator.

2.1.1 The Standards and Recommended Practices of this Chapter shall be applicable to an aeroplane operator that produces annual CO₂ emissions greater than 10 000 tonnes from the operation of an aeroplane(s) with a maximum certificated take-off mass greater than 5 700 kg conducting international flights, as defined in 1.1.2, on or after 1 January 2019, with the exception of humanitarian, medical and firefighting flights.

2.1.2 **Recommendation.** — *When considering whether a flight is international or domestic, an aeroplane operator and a State should use, for the purpose of this Volume, the ICAO Manual on Location Indicators (Doc 7910) which contains a list of aerodromes and the attributes of the State they are attributed to. Further guidance material is also provided in the Environmental Technical Manual (Doc 9834) of Volume IV. Procedures for demonstrating compliance with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).*

2.1.3 The Standards and Recommended Practices of this Chapter shall not be applicable to international flights, as defined in 1.1.2, preceding or following humanitarian, medical or firefighting flight provided such flights were conducted with the same aeroplane, and were required to accomplish the related humanitarian, medical or firefighting activities or to reposition hereafter the aeroplane for its next activity. The aeroplane operator shall provide supporting evidence of such activities to the verification body or, upon request, to the State.

2.1.4 The Standards and Recommended Practices of this Chapter shall be applicable to a new entrant aeroplane operator from the year after it meets the requirements in 2.1.1 and 2.1.3.

2.1.5 **Recommendation.** — *If the aeroplane operator is close to the threshold of annual CO₂ emissions, as defined in 2.1.1 and 2.1.3, from international flights, as defined in 1.1.2, it should consider engaging with the State to which it is attributed for guidance. Likewise, the State should carry out oversight of the aeroplane operators attributed to it, and engage with any that it considers may be close to or above the threshold. The aeroplane operator with annual CO₂ emissions below the threshold may choose to voluntarily engage with the State to which it is attributed.*

Note. — See Attachment B Figure B-1 for a process flowchart on the determination of the applicability of Chapter 2 to international flights, as defined in 1.1.2.

- Monitoring, reporting and verification of aeroplane operator's annual CO₂ emissions – draft Annex 16, Volume IV, Chapter 2

2.1 Applicability of MRV Requirements

2.2 Monitoring of CO₂ Emissions

Covered in this session

2.3 Reporting of CO₂ Emissions

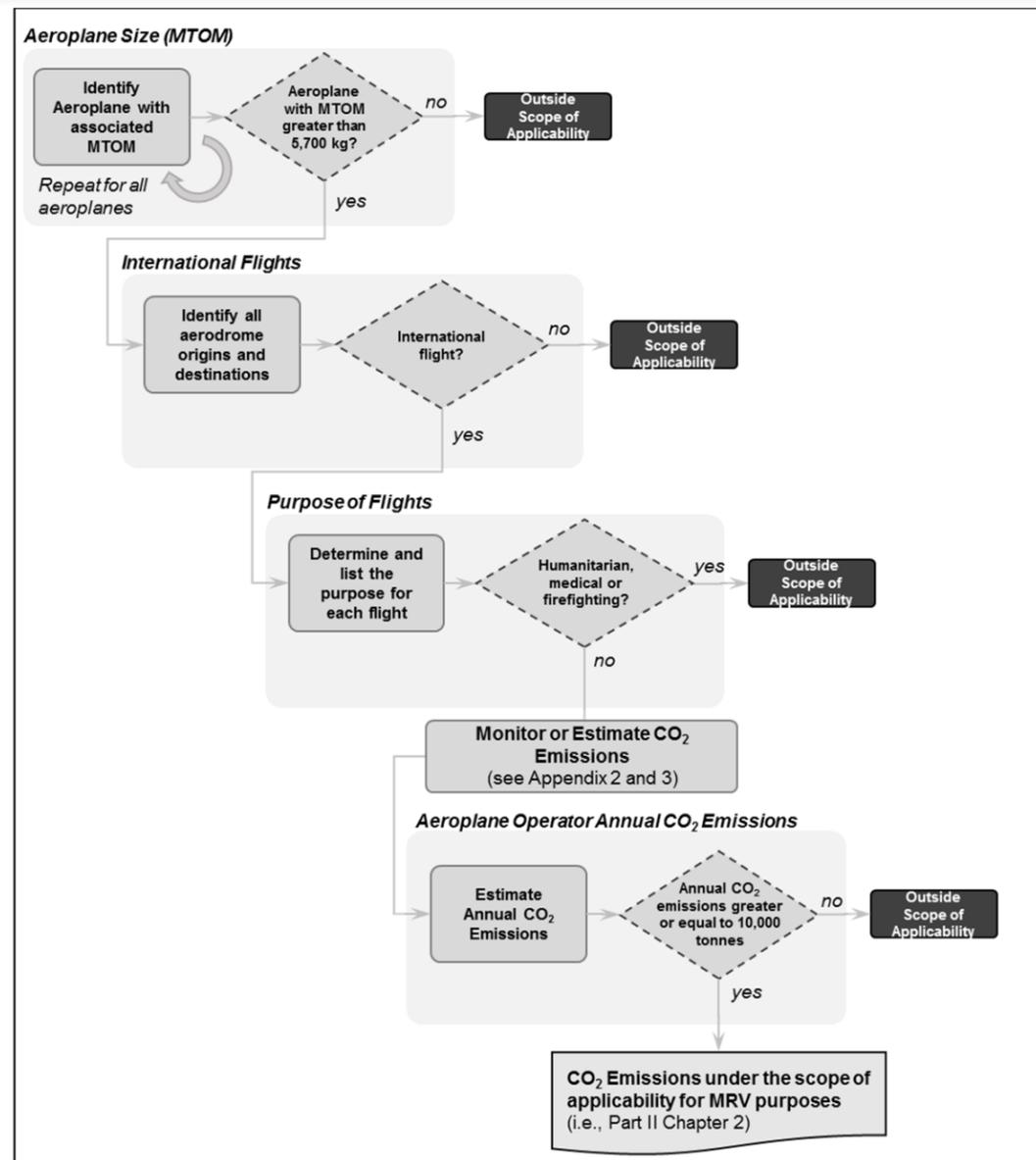
2.4 Verification of CO₂ Emissions

2.5 Data Gaps

2.6 Error Correction to Emissions Reports

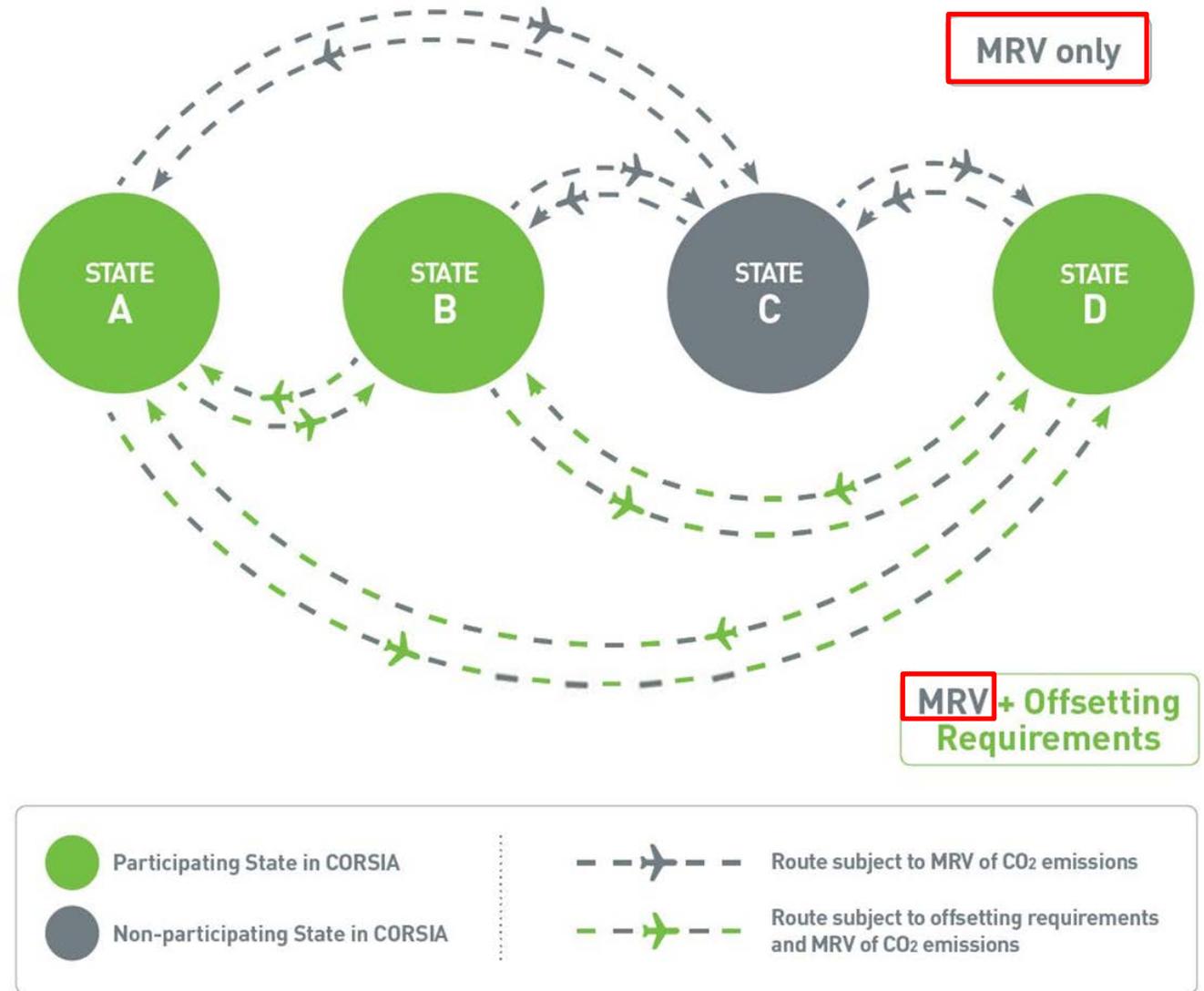
Covered in session #3

- From the use of an aeroplane with a maximum certificated take-off mass of greater than 5,700 kg
- Conducting international operations on or after 1 January 2019
- With the exception of humanitarian, medical and firefighting operations
- An operator that produces annual CO₂ emissions greater than 10,000 tonnes



Applicability of Monitoring Requirements

- All aeroplane operators conducting international flights are required to monitor, report and verify CO₂ emissions from these flights every year starting on 1 January 2019
- Requirement for the MRV of CO₂ emissions is independent from participation in CORSIA offsetting





Monitoring of CO₂ Emissions – Emissions Monitoring Plan

Monitoring of CO₂ Emissions – Emissions Monitoring Plan

- An Emissions Monitoring Plan (EMP) is a collaborative tool between the State and the aeroplane operator. The EMP:
 - Identifies the most appropriate means and methods for CO₂ emissions monitoring on an operator-specific basis; and
 - Facilitates the reporting of required information to the State.
- An aeroplane operator shall submit an EMP to the State to which it is attributed for approval.
- The State and aeroplane operator should maintain clear and open communication during the development and review of an EMP.

Developing an Emissions Monitoring Plan

1 PREPARATION AND SUBMISSION

An aeroplane operator submits an Emissions Monitoring Plan for review and consultation by the State to which it is attributed.

- **Recommended timeframe:** submit by 30 September 2018.
- **Mandatory timeframe:** submit by 28 February 2019.

2 REVIEW AND APPROVAL

The State reviews and approves the Emissions Monitoring Plan.

- **Recommended timeframe:** approve by 30 November 2018.
- **Mandatory timeframe:** approve by 30 April 2019.

Note: If the aeroplane operator's Emissions Monitoring Plan is not fully aligned with the Emissions Monitoring Plan requirements in the CORSIA SARPs, the State shall collaborate with the aeroplane operator to resolve the outstanding issues.

3 REVISIONS AND UPDATES

An aeroplane operator resubmits the Emissions Monitoring Plan for review and approval by the State if a material change is made to the information contained within the Emissions Monitoring Plan.

For example, a change to the information that would affect:

- The status or eligibility for an option under the emissions monitoring requirements;
- The approach to monitoring; or
- The State's oversight (e.g., change in corporate name / address).

- EMP contents are included in the draft Annex 16, Volume IV, Appendix 4

- The main components of an EMP are:

- | |
|--|
| 1. Aeroplane operator identification |
| 2. Fleet and operations data |
| 3. Methods and means of calculating emissions from international flights |
| 4. Data management, data flow and control |

CORSIA EMISSIONS MONITORING PLAN (EMP)

CONTENTS

- 1 [EMP-Versions](#)
- 2 [Identification](#)
- 3 [Fleet and Operations Data](#)
- 4 [Fuel Use Monitoring Methods](#)
 - 4.1 [Method A](#)
 - 4.2 [Method B](#)
 - 4.3 [Block-On/Block-Off](#)
 - 4.4 [Fuel Uplift](#)
 - 4.5 [Fuel Allocation with Block Hour](#)
 - 4.6 [CORSIA CO₂ Estimation and Reporting Tool \(CERT\)](#)
- 5 [Data Management](#)

Template Information

Template provided by:	
Version (publication date):	

EMP Contents

1. Aeroplane operator identification

2. Fleet and operations data

3. Methods and means of calculating emissions from international flights

4. Data management, data flow and control

AIR OPERATOR CERTIFICATE		
1	STATE OF THE OPERATOR ²	1
ISSUING AUTHORITY ³		
AOC #: Expiry date ⁵ :	OPERATOR NAME ⁶ Dba trading name ⁷ : Operator address: Telephone ⁸ : Fax: Email:	OPERATIONAL POINTS OF CONTACT ⁹ Contact details, at which operational management can be contacted without undue delay, are listed in _____ ¹¹ .
This certificate certifies that _____ ¹² is authorized to perform commercial air operations, as defined in the attached operations specifications, in accordance with the operations manual and the _____ ¹³ .		
Date of issue ¹⁴ :	Name and signature ¹⁵ : Title:	

Notes—

1. For use of the State of the Operator.
2. Replace by the name of the State of the Operator.
3. Replace by the identification of the issuing authority of the State of the Operator.
4. Unique AOC number, as issued by the State of the Operator.
5. Date after which the AOC ceases to be valid (dd-mm-yyyy).
6. Replace by the operator's registered name.
7. Operator's trading name, if different. Insert "dba" before the trading name (for "doing business as").

ANNEX 6—PART I

APP 6-1

10/11/16



- Name of the operator
- Information for attributing the operator to a State:
 - ICAO Designator;
 - Air operator certificate; or
 - Place of juridical registration
- Operator's ownership structure, including parent-subsiary relationships
- Contact information, including operator's CORSIA Focal Point
- Description of the operator's activities

EMP – 2. Fleet and Operations Data

EMP Contents

1. Aeroplane operator identification
2. Fleet and operations data
3. Methods and means of calculating emissions from international flights
4. Data management, data flow and control



Fleet declaration			
No	ICAO type designator	Fuel type	Number of aeroplanes
1	A320	Jet-A	10
2	B737	Jet-A	10
3	E190	Jet-A	15
4	BCS3	Jet-A	15
5
6

- Information on the operator's aeroplane types and types of fuel
- Flight attribution to the operator
- Procedures to track changes in the fleet
- List of State pairs operated at the time of the EMP submission
- Procedures to identify international flights and exempted flights

- ICAO Designator
- Registration mark
- Emissions monitoring plan code
- Aircraft owner

EMP – 3. Emissions Monitoring Options

EMP Contents

1. Aeroplane operator identification
2. Fleet and operations data
3. Methods and means of calculating emissions from international flights
4. Data management, data flow and control

*$CO_2 \text{ Emissions} = \text{Mass of fuel} * \text{Fuel Conversion Factor of given fuel type}$*



- An aeroplane operator shall monitor and record its fuel use from international flights in accordance with an eligible monitoring method
- Monitoring method shall be approved by the State as a part of aeroplane operator's Emissions Monitoring Plan
- The aeroplane operator shall use the same eligible monitoring method for the entire compliance period



EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)

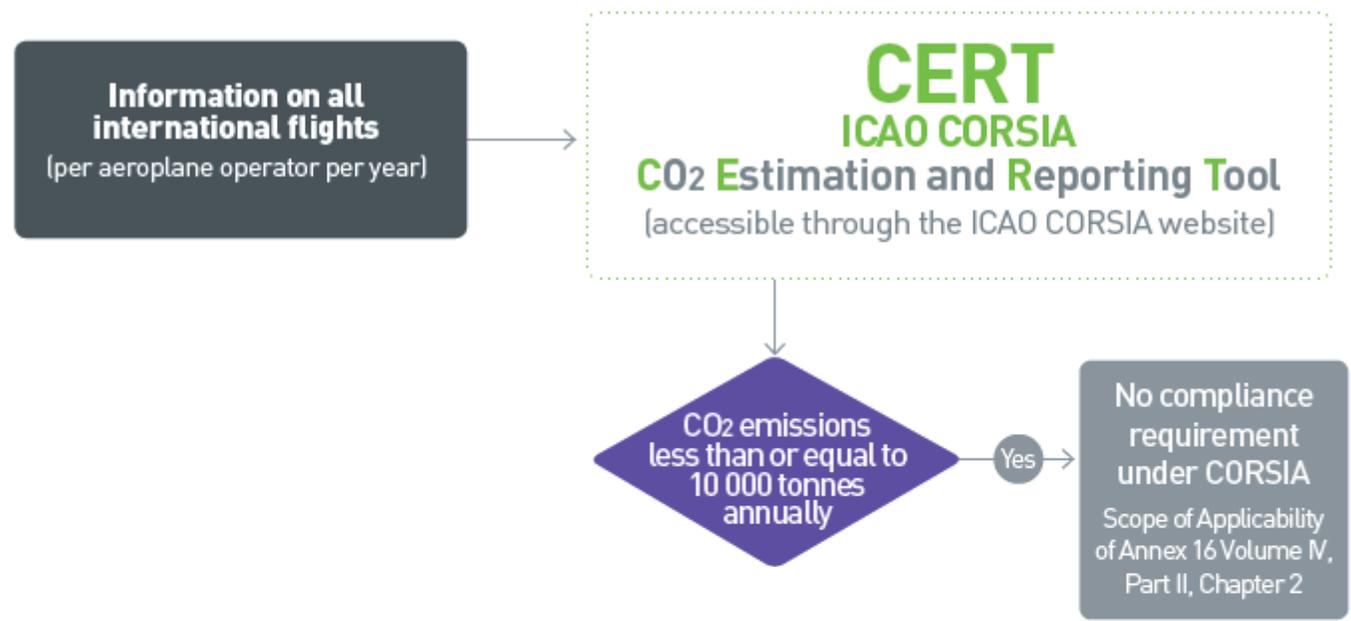
**Information on all
international flights**
(per aeroplane operator per year)



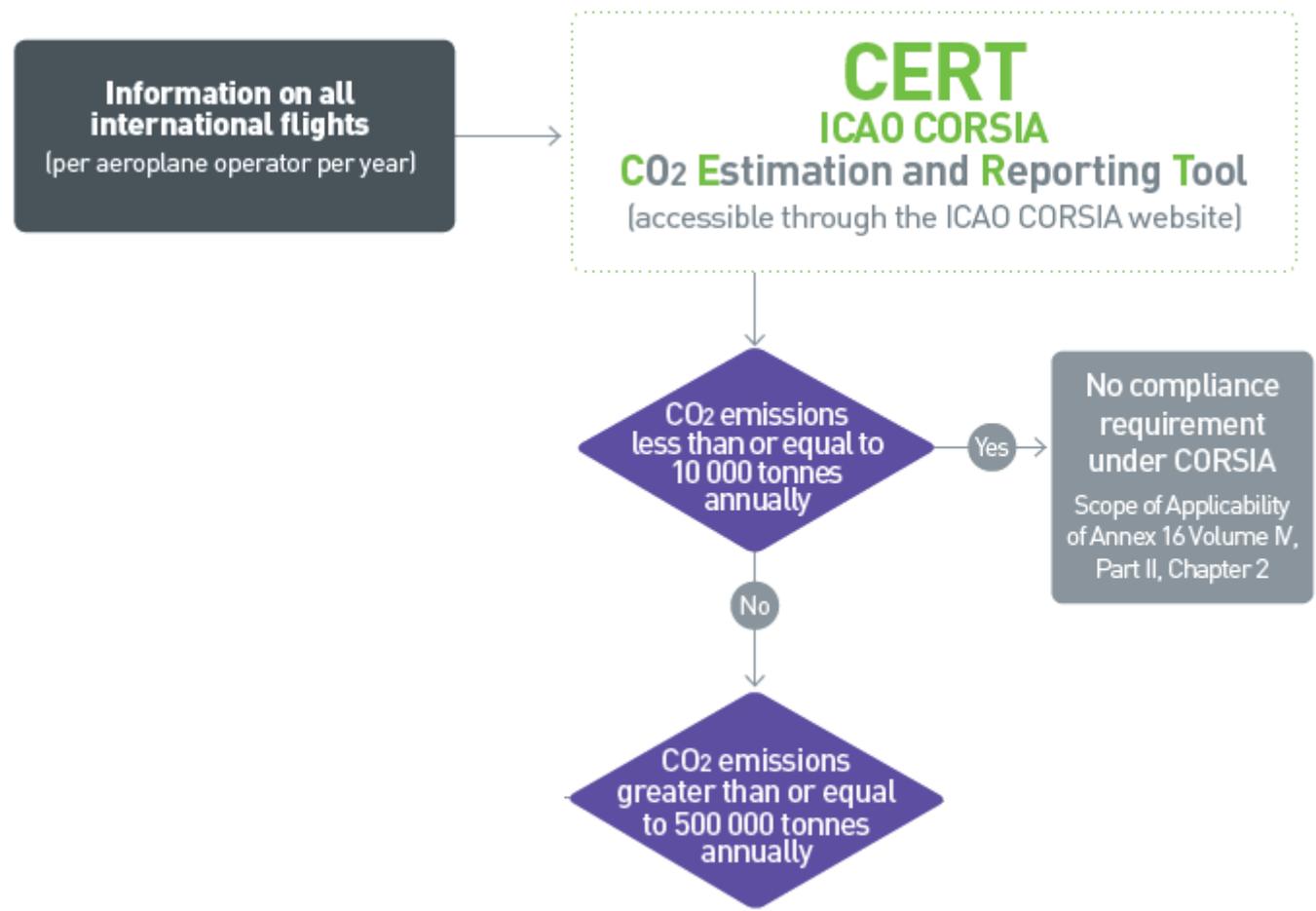
EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)



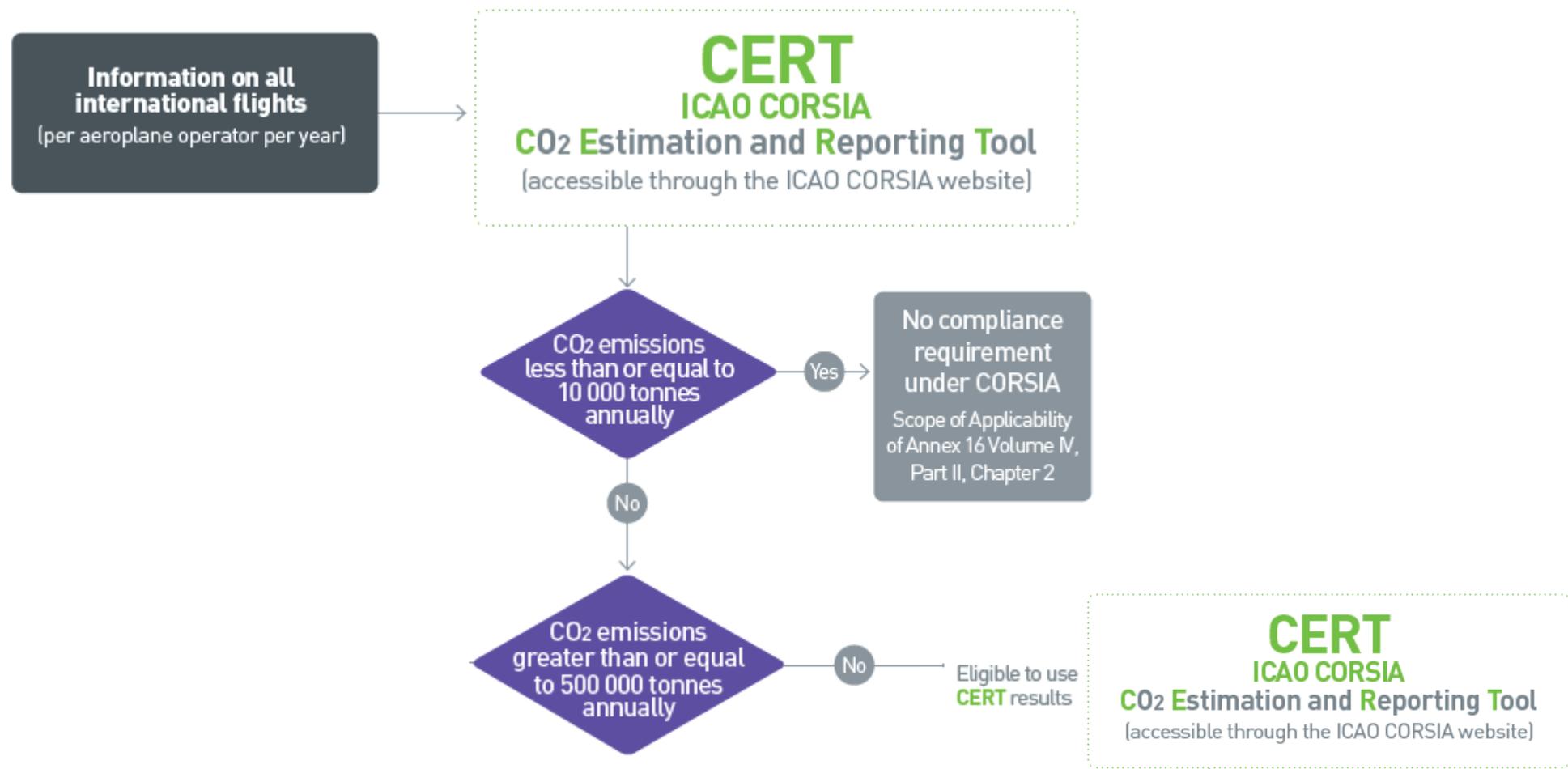
EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)



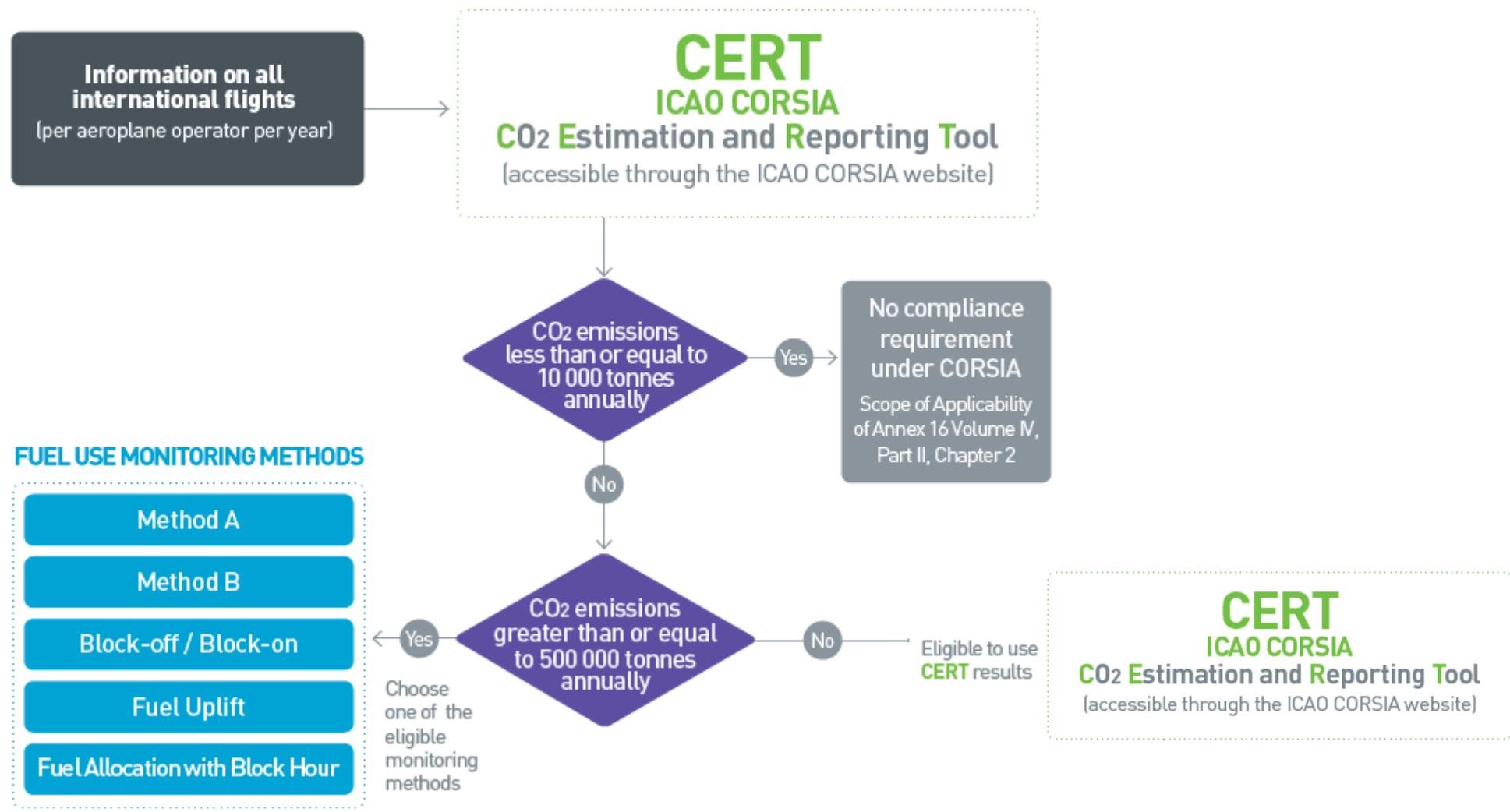
EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)



EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)

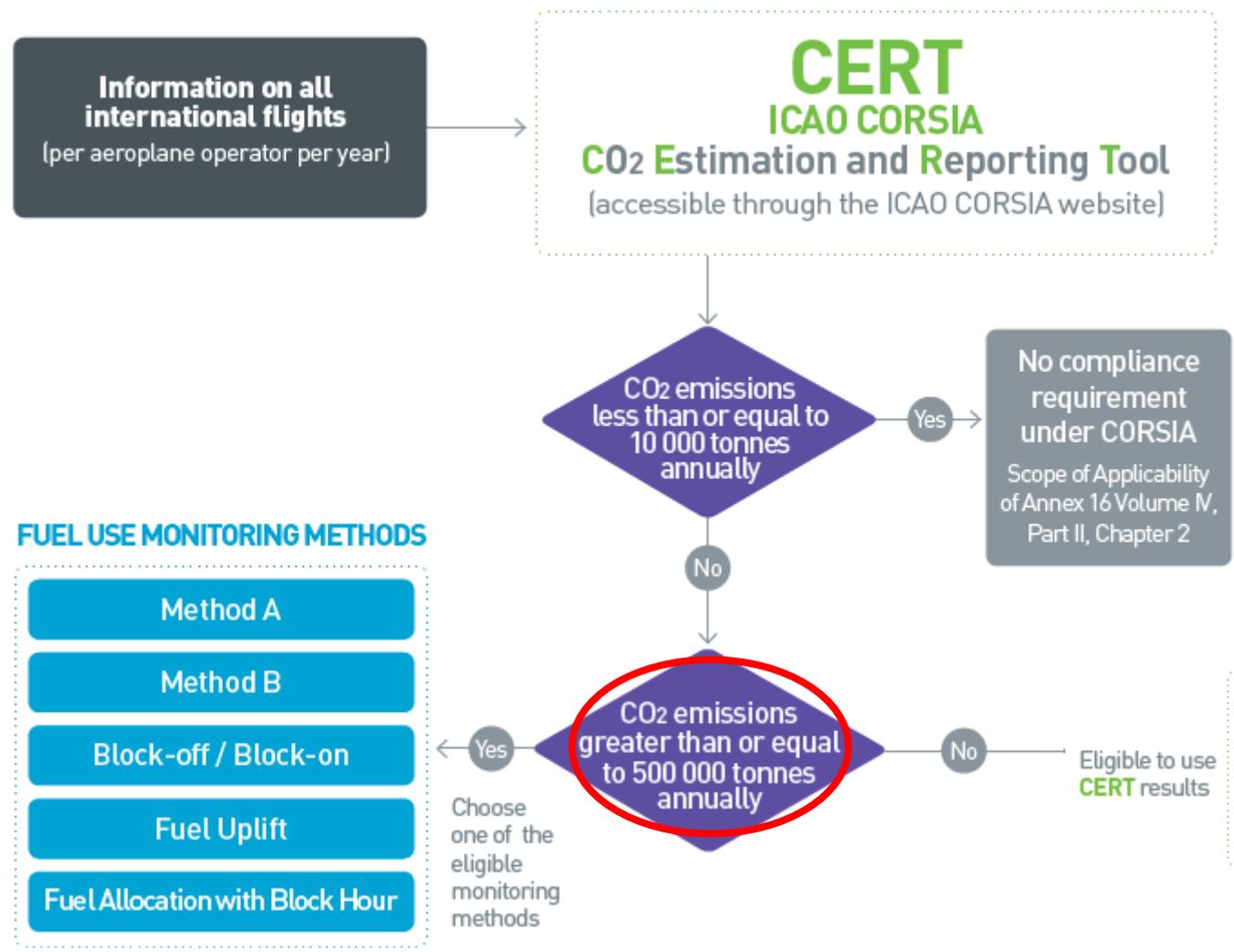


EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)





EMP – 3. Emissions Monitoring Options (Decision Tree for 2019 & 2020)



If the aeroplane operator's annual CO₂ emissions increase above the threshold of 500 000 tonnes during year 2019, the State can permit the aeroplane operator to continue to use the already chosen monitoring method chosen during 2020.

CERT
ICAO CORSIA
CO₂ Estimation and Reporting Tool
(accessible through the ICAO CORSIA website)

EMP – 3. Emissions Monitoring Options

ICAO CORSIA CO₂ Estimation and Reporting Tool (CERT)

CERT

ICAO CORSIA

CO₂ Estimation and Reporting Tool

(accessible through the ICAO CORSIA website)

- CORSIA CERT is an ICAO tool to help aeroplane operators estimate and report their international aviation emissions (draft Annex 16, Volume IV, Appendix 3)

- All operators can use the ICAO CORSIA CERT for a preliminary CO₂ assessment
- Eligible operators can use the ICAO CORSIA CERT for:
 - Estimating CO₂ emissions;
 - Populating the Emissions Monitoring Plan and Emissions Report templates; and
 - Filling CO₂ emissions data gaps.
- Expected release of the ICAO CORSIA CERT is in July 2018

Practical demonstration of the ICAO CORSIA CERT: later in this session

EMP – 3. Emissions Monitoring Options (5 Monitoring Methods)

FUEL USE MONITORING METHODS

Method A

Method B

Block-off / Block-on

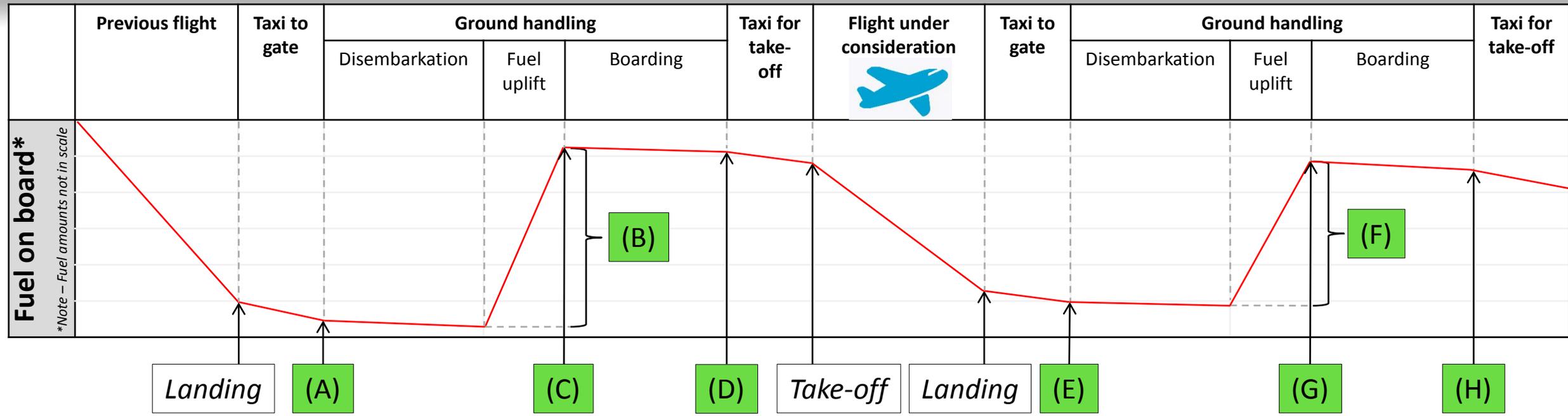
Fuel Uplift

Fuel Allocation with Block Hour

- Those operators that are not eligible to use ICAO CORSIA CERT, have five Fuel Use Monitoring Methods to choose from
- An operator shall choose one of the five methods
- Methods represent the most accurate established practices, and are equivalent; there is no hierarchy for selecting a method
- Each method uses different fuel measurement points. Specifications of the methods are included in the draft Annex 16, Volume IV, Appendix 2.



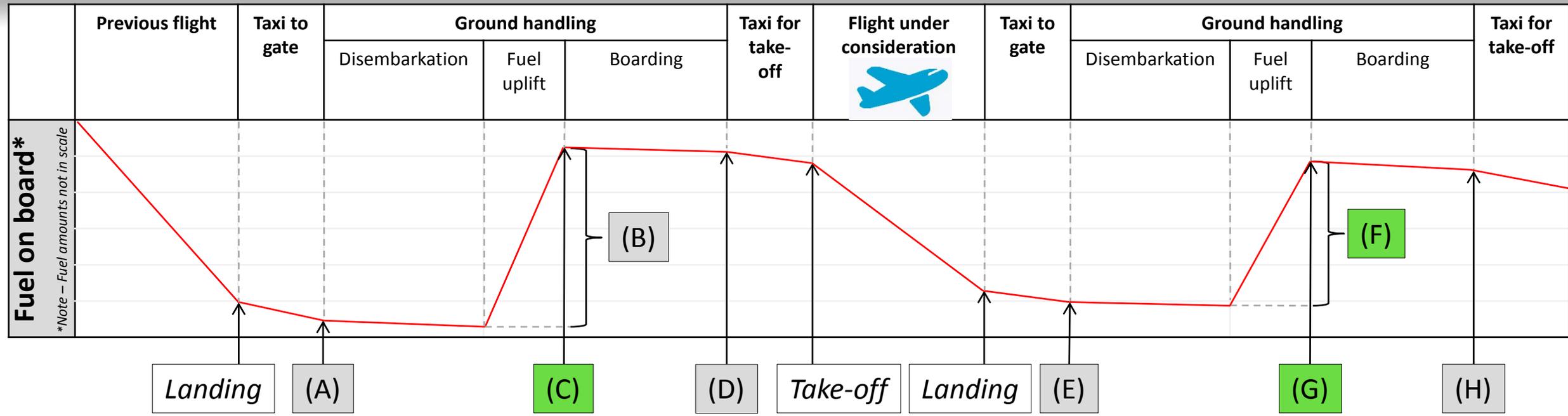
EMP – 3. Emissions Monitoring Options (Fuel Measurement Points)



Fuel Measurement Points		Definition of the measurement point
Before the flight under consideration	After the flight under consideration	
(A) Block-on	(E) Block-on	<i>The time when an aeroplane finally stops at the end of the flight</i>
(B) Fuel uplift	(F) Fuel uplift	<i>Measurement of fuel provided by the fuel supplier, as documented in the fuel delivery notes or invoices for each flight (in litre)</i>
(C) Fuel in tanks after fuel uplift	(G) Fuel in tanks after fuel uplift	<i>Amount of fuel contained in aeroplane tanks once fuel uplifts for the flight under consideration are complete (in tonnes)</i>
(D) Block-off	(H) Block-off	<i>The time when an aeroplane first moves for the purpose of taking off</i>



EMP – 3. Emissions Monitoring Options (5 Monitoring Methods – Method A)



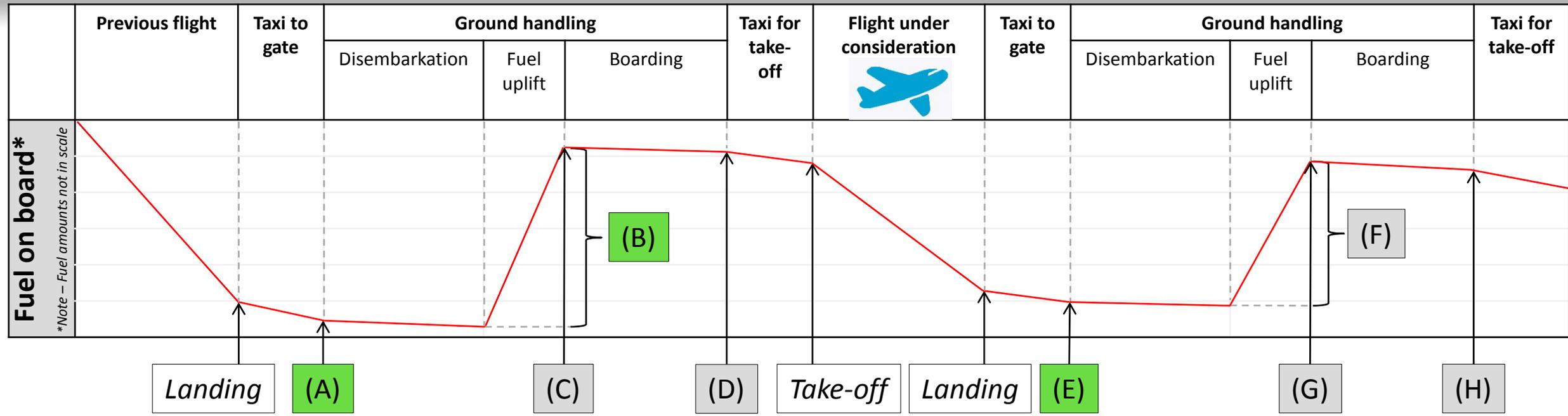
Fuel Measurement Points	
Before the flight under consideration	After the flight under consideration
(A) Fuel at block-on	(E) Fuel at block-on
(B) Fuel uplift	(F) Fuel uplift
(C) Fuel in tanks after fuel uplift	(G) Fuel in tanks after fuel uplift
(D) Fuel at block-off	(H) Fuel at block-off
Fuel Use Monitoring Method: METHOD A	
Fuel consumed = C-G+F	

FUEL USE MONITORING METHODS

- Method A
- Method B
- Block-off / Block-on
- Fuel Uplift
- Fuel Allocation with Block Hour



EMP – 3. Emissions Monitoring Options (5 Monitoring Methods – Method B)



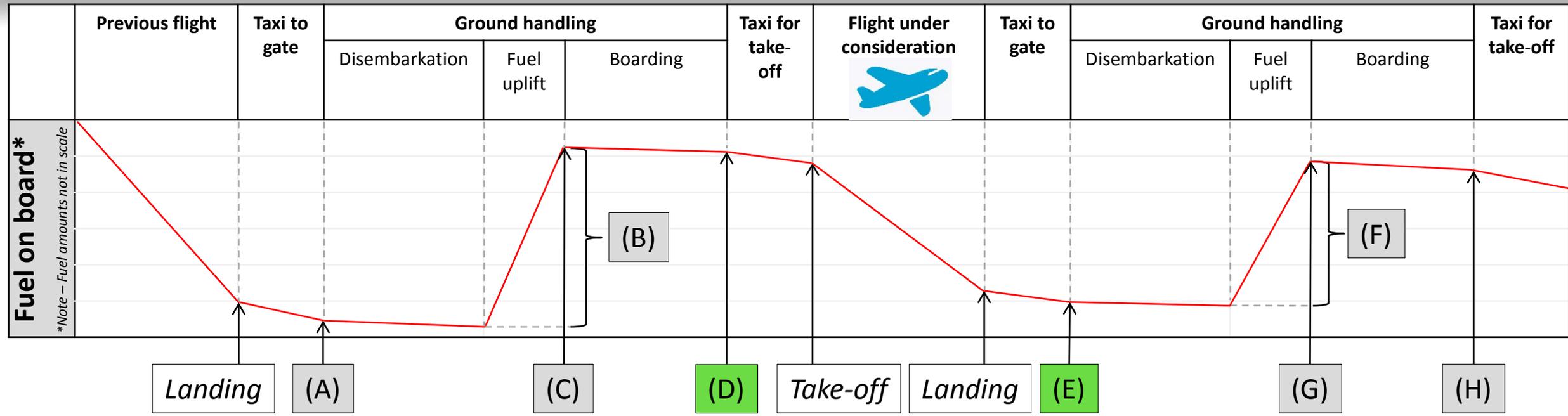
Fuel Measurement Points	
Before the flight under consideration	After the flight under consideration
(A) Fuel at block-on	(E) Fuel at block-on
(B) Fuel uplift	(F) Fuel uplift
(C) Fuel in tanks after fuel uplift	(G) Fuel in tanks after fuel uplift
(D) Fuel at block-off	(H) Fuel at block-off
Fuel Use Monitoring Method: METHOD B	
Fuel consumed = A-E+B	

FUEL USE MONITORING METHODS

- Method A
- Method B**
- Block-off / Block-on
- Fuel Uplift
- Fuel Allocation with Block Hour



EMP – 3. Emissions Monitoring Options (5 Monitoring Methods – Block-off / Block-on)



Fuel on board*
*Note – Fuel amounts not in scale

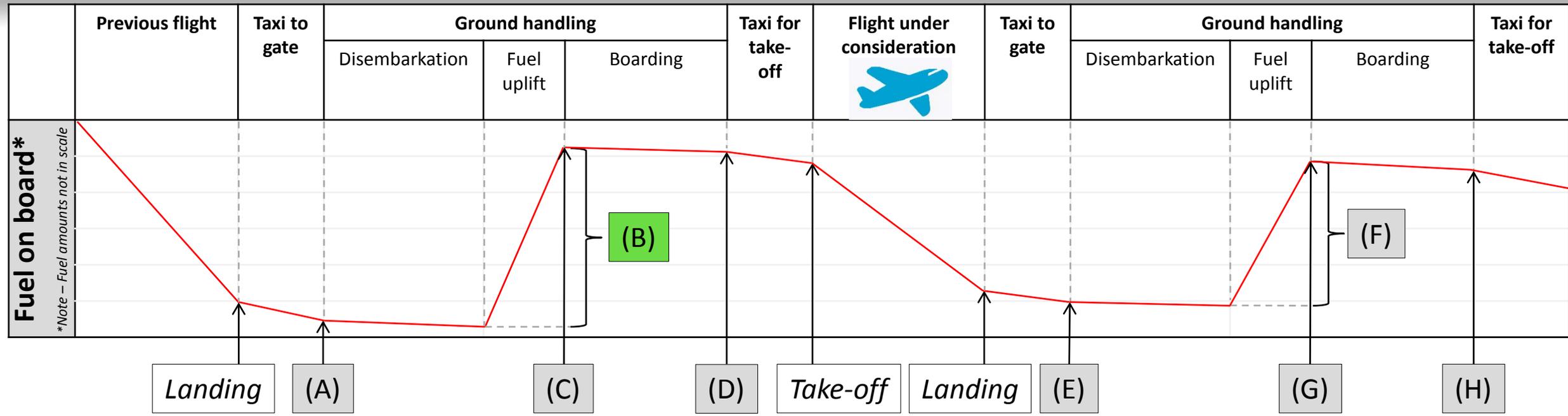
Fuel Measurement Points	
Before the flight under consideration	After the flight under consideration
(A) Fuel at block-on	(E) Fuel at block-on
(B) Fuel uplift	(F) Fuel uplift
(C) Fuel in tanks after fuel uplift	(G) Fuel in tanks after fuel uplift
(D) Fuel at block-off	(H) Fuel at block-off
Fuel Use Monitoring Method: Block-off / Block-on	
Fuel consumed = D-E	

FUEL USE MONITORING METHODS

- Method A
- Method B
- Block-off / Block-on**
- Fuel Uplift
- Fuel Allocation with Block Hour



EMP – 3. Emissions Monitoring Options (5 Monitoring Methods – Fuel Uplift)



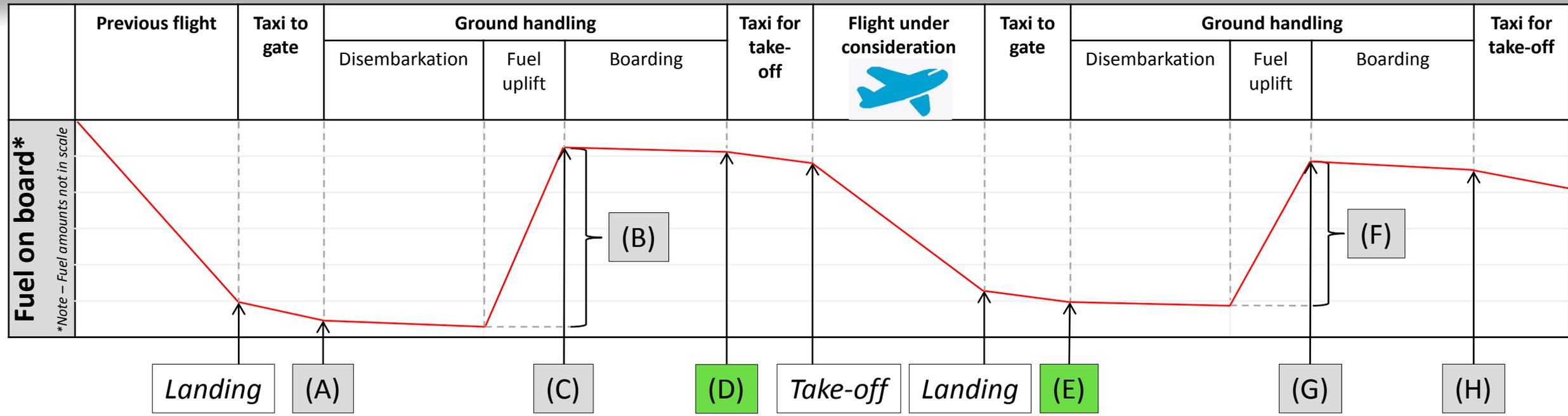
Fuel Measurement Points	
Before the flight under consideration	After the flight under consideration
(A) Fuel at block-on	(E) Fuel at block-on
(B) Fuel uplift	(F) Fuel uplift
(C) Fuel in tanks after fuel uplift	(G) Fuel in tanks after fuel uplift
(D) Fuel at block-off	(H) Fuel at block-off
Fuel Use Monitoring Method: Fuel Uplift	
Fuel consumed = B	

FUEL USE MONITORING METHODS

- Method A
- Method B
- Block-off / Block-on
- Fuel Uplift**
- Fuel Allocation with Block Hour



EMP – 3. Emissions Monitoring Options (5 Monitoring Methods – Block Hour)



Fuel Measurement Points	
Before the flight under consideration	After the flight under consideration
(A) Fuel at block-on	(E) Block-on time
(B) Fuel uplift	(F) Fuel uplift
(C) Fuel in tanks after fuel uplift	(G) Fuel in tanks after fuel uplift
(D) Block-off time	(H) Fuel at block-off
Fuel Use Monitoring Method: Fuel Allocation with Block Hour	
Fuel consumed = Block hour * Average fuel burn ratio	

FUEL USE MONITORING METHODS

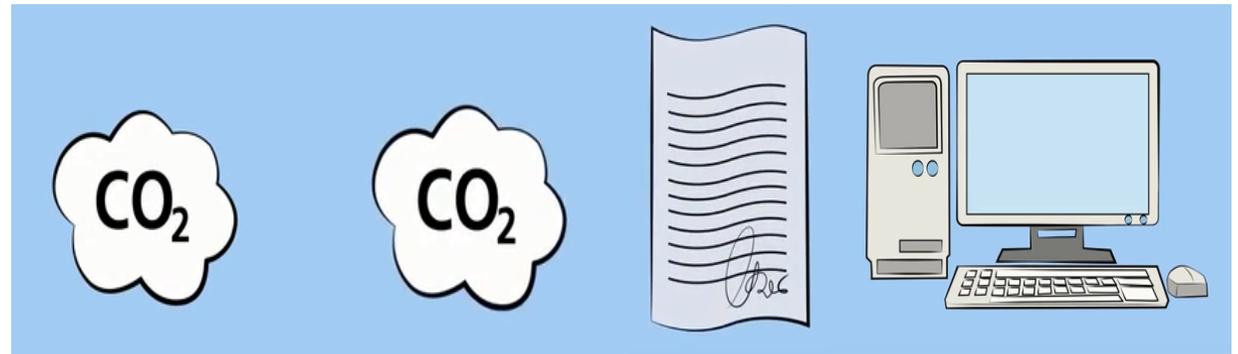
- Method A
- Method B
- Block-off / Block-on
- Fuel Uplift
- Fuel Allocation with Block Hour

EMP – 3. Emissions Monitoring Options (Fuel Density)

- If the amount of fuel is determined in units of volume, an aeroplane operator shall apply a fuel density value to calculate fuel mass
 - This is the case in, e.g., when fuel uplift is measured in volume
- The operator shall record the fuel density that is used for operational and safety reasons
 - Density is usually recorded e.g., in an operational, flight or technical log
 - Fuel density value may be:
 - An actual fuel density value; or
 - A standard value of 0.8 kg per litre
- The operator shall detail the procedure for informing the use of fuel density in the EMP, along with a reference to the relevant documentation

EMP Contents

1. Aeroplane operator identification
2. Fleet and operations data
3. Methods and means of calculating emissions from international flights
4. Data management, data flow and control



- Aeroplane operator’s internal roles, responsibilities and procedures on data management, and related risks
- Procedures to handle possible data gaps and errors
- Documentation and record keeping plan
- Procedures for communicating the changes in the EMP to the State



Monitoring of CO₂ Emissions – Review of the Emissions Monitoring Plan

- The State and aeroplane operator should maintain clear and open communication during the development and review of an EMP
 - The State shall engage with the aeroplane operator to resolve any outstanding issues in the EMP
- The State shall review and approve aeroplane operator's Emissions Monitoring Plan
- Guidance material on Emissions Monitoring Plans will be included in the Environmental Technical Manual (ETM) Volume IV

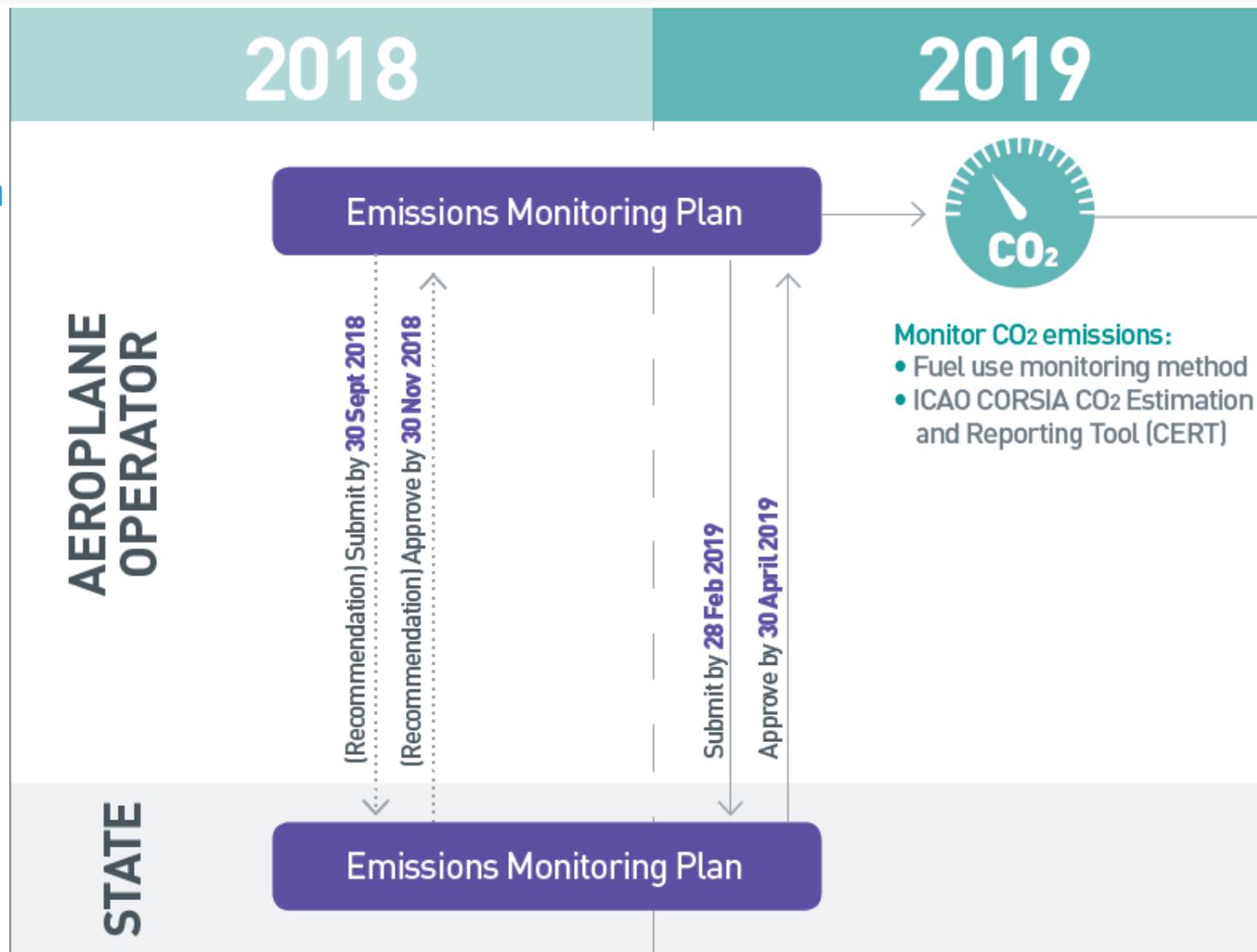
Table 3-2. Emissions Monitoring Plan Checklist

Emissions Monitoring Plan Provision	Checklist for State Review	Material Change or Notice of Change
I. Aeroplane Operator Identification		
Identification of Aeroplane Operator with legal responsibility.	Subject to review and approval by the State; reviewer to review and confirm document(s).	Can be material – If legal entity or means to identify legal entity changes; resubmit and subject to re-approval.
Name and address.	Subject to review and approval by the State; reviewer to review and confirm document(s).	Can be material – If changes to name and/or address are due to a change in the legal entity or means for the State to identify legal entity changes; resubmit and subject to re-approval.
Identifying information for attributing the Aeroplane Operator to a State: either unique ICAO Designator (or Designators) used in the call sign for Air Traffic Control purposes; copy of the Air Operator Certificate; or place of juridical registration.	Subject to review and approval by the State; reviewer to review and confirm document(s).	A change in the identifying information would be material; resubmit and subject to re-approval.
Details of ownership structure relative to any other Aeroplane Operators with international flights, including identification of whether the Aeroplane Operator is a parent company, a subsidiary and/or has a parent and/or subsidiaries.	Information Provided? Check "Yes" or "No".	Not material unless a change in corporate structure changed which entity is the Aeroplane Operator subject to requirements from Annex 16 Volume IV – Changes that do not affect which entity is the Aeroplane Operator would be handled as simple notice to the authority in the annual Emissions Report.

DRAFT

Development of an Emissions Monitoring Plan – Recap of Actions and Dates

- **Recommendation:**
 - By 30 September 2018: an aeroplane operator to submit an EMP for approval
 - By 30 November 2018: State to approve the EMP
- **Mandatory submission on an EMP by 28 February 2019. Approval by 30 April 2019.**
- **New entrants to submit an EMP to their State within three months of falling under the applicability of MRV requirements**



- If an aeroplane operator does not have an approved EMP as of 1 January 2019:
 - The operator shall monitor CO₂ emissions in accordance with the EMP that it will submit, or has already submitted, to the State.
- If an aeroplane operator does not have sufficient information to use a Fuel Use Monitoring Method:
 - The State can approve the use of the ICAO CORSIA CERT for a period lasting no later than 30 June 2019.

- The aeroplane operator shall resubmit the Emissions Monitoring Plan to the State for approval if “a material change” is made to the Plan
- A material change would affect e.g.:
 - The status or eligibility for an option under the emissions monitoring requirements; or
 - Operator’s approach to monitoring.
- The aeroplane operator shall also inform the State of changes that would affect the State’s oversight, even if the changes do not fall within the definition of a material change, e.g.:
 - Change in corporate name / address.



Calculation of CO₂ Emissions and Monitoring of Sustainable Aviation Fuels

- After an aeroplane operator has monitored its fuel use in accordance with an approved EMP, it shall calculate the CO₂ emissions from the fuel burn
- ICAO CORSIA CERT automatically estimates the CO₂ emissions for aeroplane operators who have been approved to use the CERT
- An operator using a Fuel Use Monitoring Method shall determine the CO₂ emissions by using the following equation:

$$CO_2 \text{ Emissions} = \text{Mass of fuel} * \text{Fuel Conversion Factor of given fuel type}$$

Fuel Use

Calculate CO₂ emissions

Fuel Conversion Factor

= 3.16 kg CO₂/kg fuel (Jet-A fuel)

and

= 3.10 kg CO₂/kg fuel (AvGas or Jet-B fuel)

**Monitored and reported
CO₂ emissions from
international flights**

Note – For the purpose of calculating CO₂ emissions the mass of fuel used includes conventional aviation fuel and sustainable aviation fuel

- Information on CO₂ emissions will be reported as a part of an aeroplane operator's Emissions Report

Covered in session #3

- Purchasing and blending records will form the basis for monitoring of the use of Sustainable Aviation Fuels (SAF)
- For the purpose of calculating the CO₂ emissions, the mass of fuel used includes conventional aviation fuel and sustainable aviation fuel
- The emissions reductions from the use of SAF are calculated as part of the CO₂ offsetting requirements



Covered in sessions
#3 and #5

Timeline – 2018 and 2019

Timeline	Responsible Party	Activity
30 September 2018	Operator	Submit Emissions Monitoring Plan to State of attribution <i>(recommended)</i>
30 November 2018	State	Approve Emissions Monitoring Plans of operators attributed to the State <i>(recommended)</i>
30 November 2018	State	Submit to ICAO a list of operators attributed to the State
31 December 2018	ICAO	Make available the ICAO document entitled “CORSA Aeroplane Operator to State Attributions”
1 January to 31 December 2019	Operator	Monitor 2019 CO₂ emissions from international flights
28 February 2019	Operator	Submit Emissions Monitoring Plan to State of attribution
30 April 2019	State	Approve Emissions Monitoring Plans of operators attributed to the State
30 April 2019	State	Submit to ICAO: <ul style="list-style-type: none"> - List of operators attributed to the State - List of verification bodies accredited in the State
31 May 2019	ICAO	Make available the ICAO document entitled “CORSA Aeroplane Operator to State Attributions”

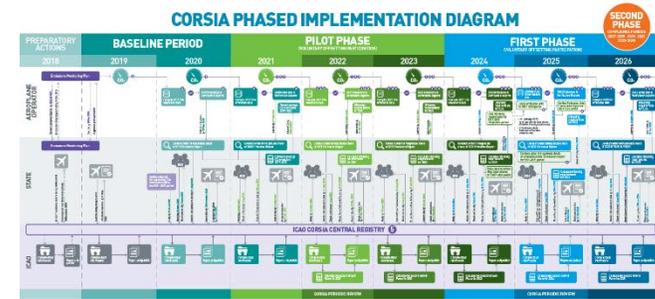


Questions?



Small Group Exercise 1

CORSIA Emissions Monitoring Plan



For more information, please visit our website: <http://www.icao.int/env>