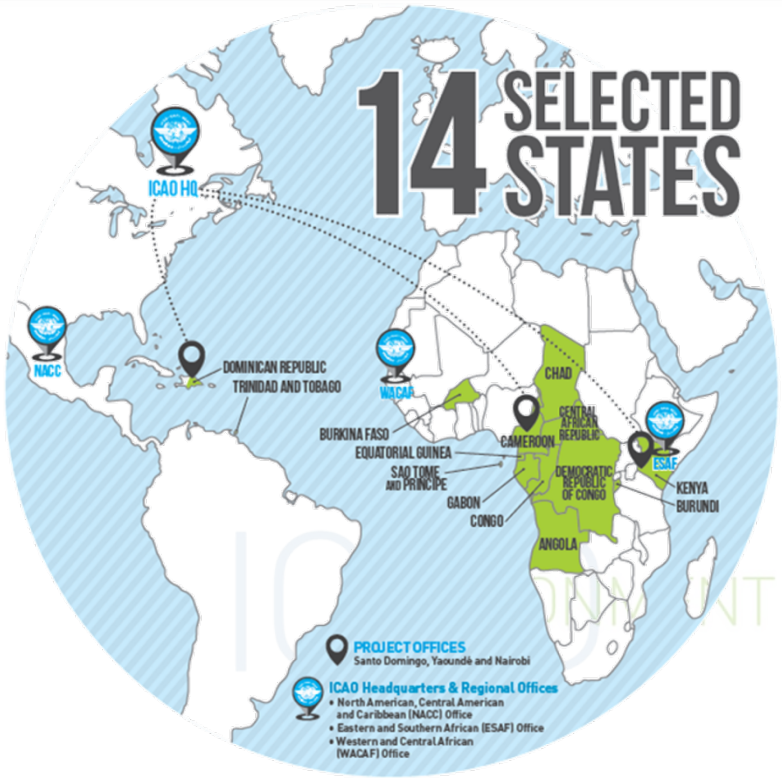
ICAO CAPACITY BUILDING SEMINAR ON LOW EMISSIONS AVIATION MEASURES

Supporting SIDS and their aviation stakeholders in selecting measures for the State Action Plan

Neil Dickson, Chief, Environmental Standards Section, ICAO

CAPACITY BUILDING FOR CO_2 MITIGATION FROM INTERNATIONAL AVIATION



Background

- A State Action Plan comprises 5 elements:
  1. Contact information of the Focal Point
  2. Baseline
  3. **Mitigation Measures**
  4. Expected Results
  5. Assistance needs (if any)

- The selection of Mitigation Measures can be challenging
  - Cost associated?
  - CO_2 abated?

- To facilitate the selection, ICAO has developed a Marginal Abatement Cost (MAC) Curve

Selection of mitigation measures

Top-down approach

Decide upon an environmental objective to be reached from the implementation of measures

Identify and prioritize measures

Aggregate expected results of measures selected

Meets intended objective?

Bottom-up approach

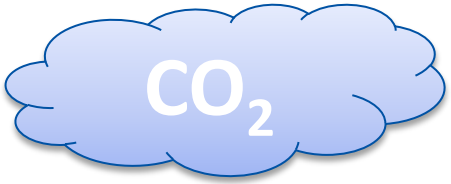
Identify and prioritize measures

Aggregate expected results of measures selected

Prioritization of mitigation measures

- The prioritization of mitigation measures consists to rank the selected mitigation measures based on criteria, such as
  - Emissions reductions;
  - Economic feasibility;
- **Example** (for economic feasibility):

Specific Budget

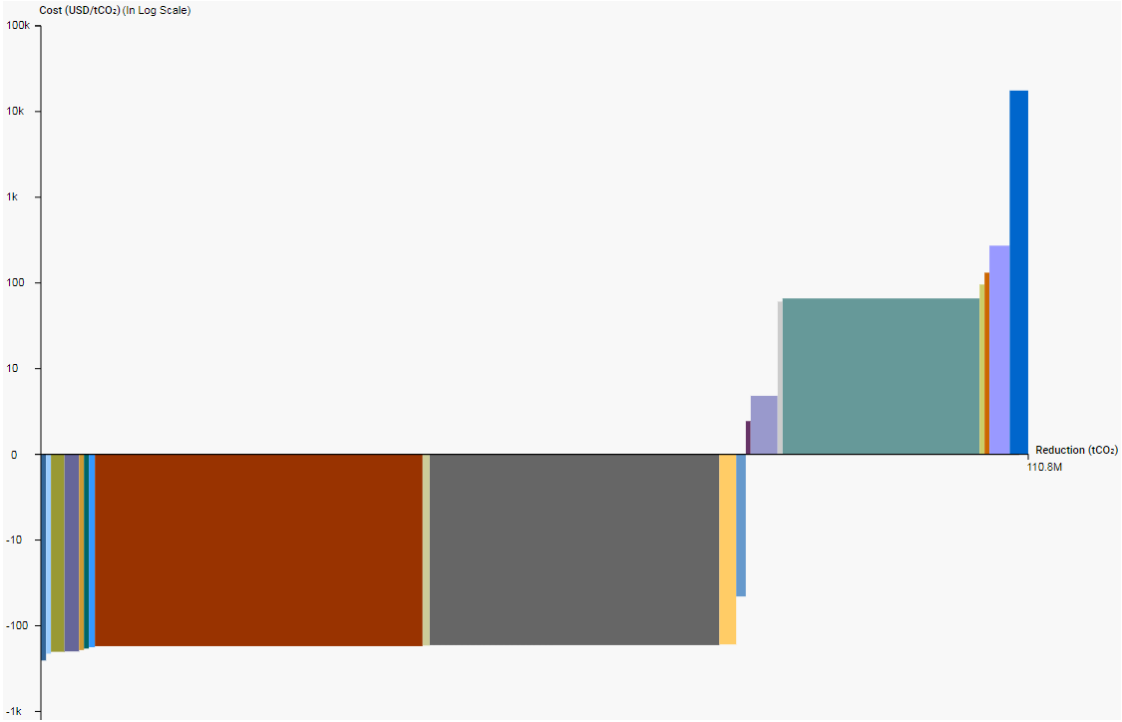


Maximize the CO_2 reduction

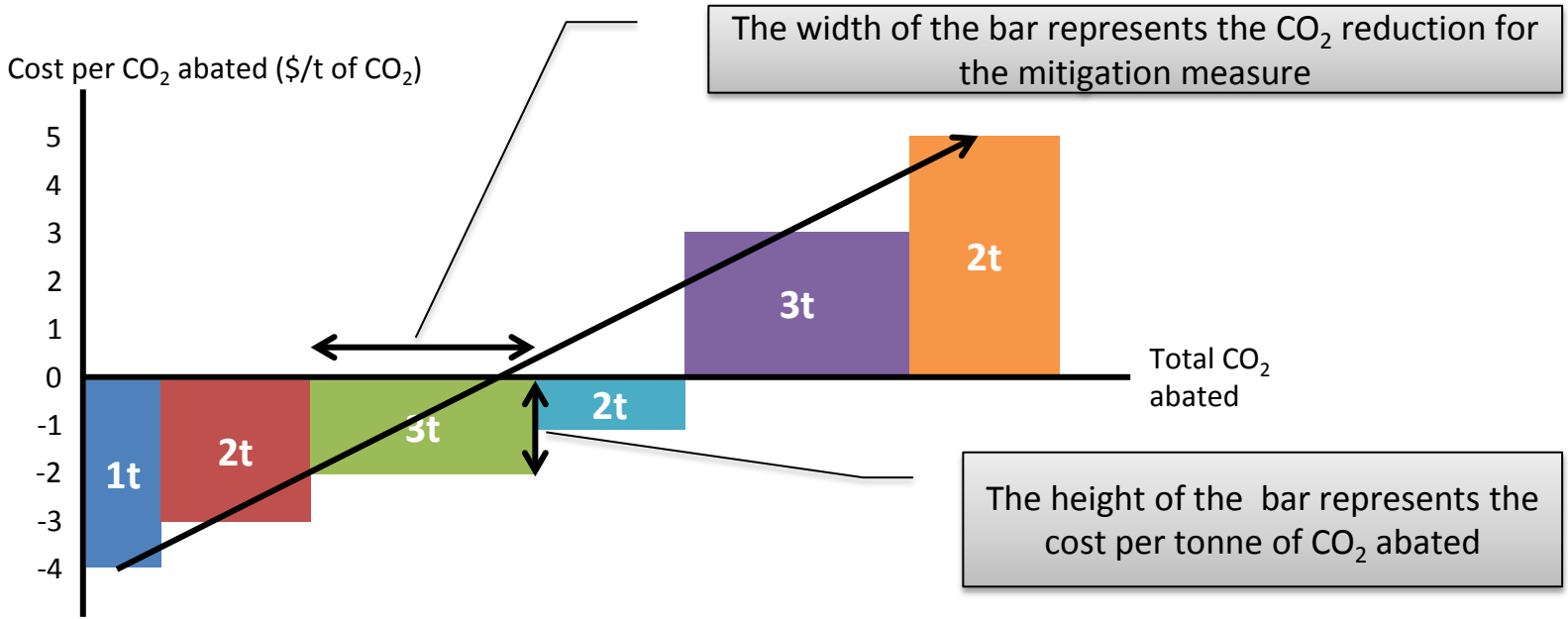
Function and Representation of a MAC curve

Function: A MAC curve helps to select and prioritize mitigation measures.

Representation: - - - - - - - - ->

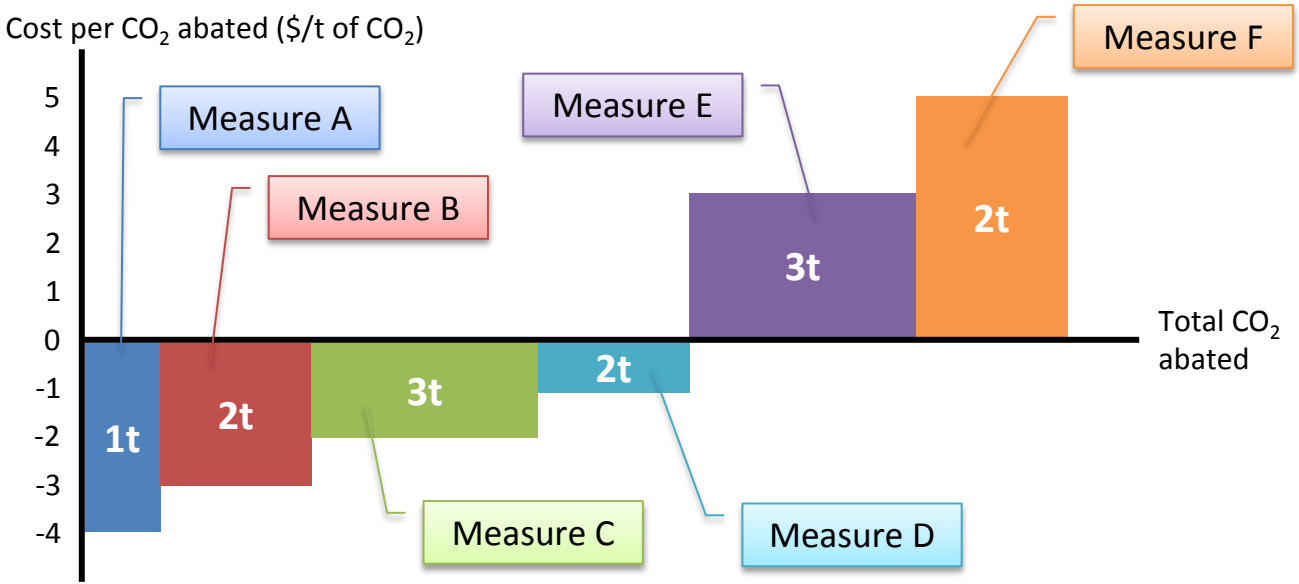


How to read a MAC curve?



How to use a MAC curve – Example

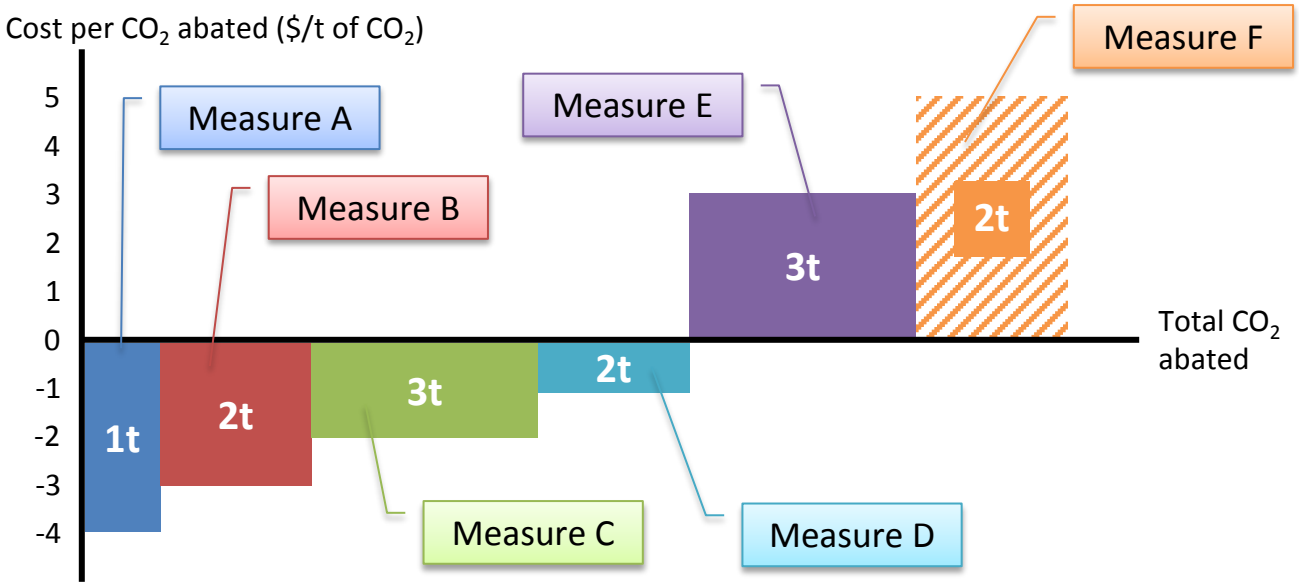
Scenario	Maximize the CO_2 abated by setting the total cost at 0$ or lower



#	Cost per tonne ($/t)	CO_2 abated (tonne)	Total cost ($)
A	-4	1	-4
B	-3	2	-6
C	-2	3	-6
D	-1	2	-2
E	3	3	9
F	5	2	10
Total		**13**	**1**

How to use a MAC curve – Example

Scenario	Maximize the CO_2 abated by setting the total cost at 0$ or lower



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E	3	3	9
~~F~~	~~5~~	~~2~~	~~10~~
Total		13 --> 11	1 --> -9

CASE STUDY

Recommendations for

Small Islands Developing States

and

Developing States

Case Study: Parameters

In order to calibrate the model (based on 34 countries), statistics on **Airport** and **Aircraft** need to be provided.

- 34 Countries located in Latin America/Caribbean and Asia-Pacific:
  - **13** SIDS
  - **21** Developing States
- Airports:
  - Small (<25k arrivals): **45.06%**
  - Medium (25k-100k arrivals): **49.59%**
  - Large (>100k arrivals): **5.35%**
- Aircraft:
  - TP/RJ (Turboprop/Regional Jet): **29.87%**
  - NB (Narrow-body): **59.83%**
  - WB (Wide-body): **10.30%**
- Aircraft age:
  - 0-10 years: **81.09%**
  - 10-20 years: **8.20%**
  - +20 years: **10.71%**

Case Study: Approach used

- **Step 1:**

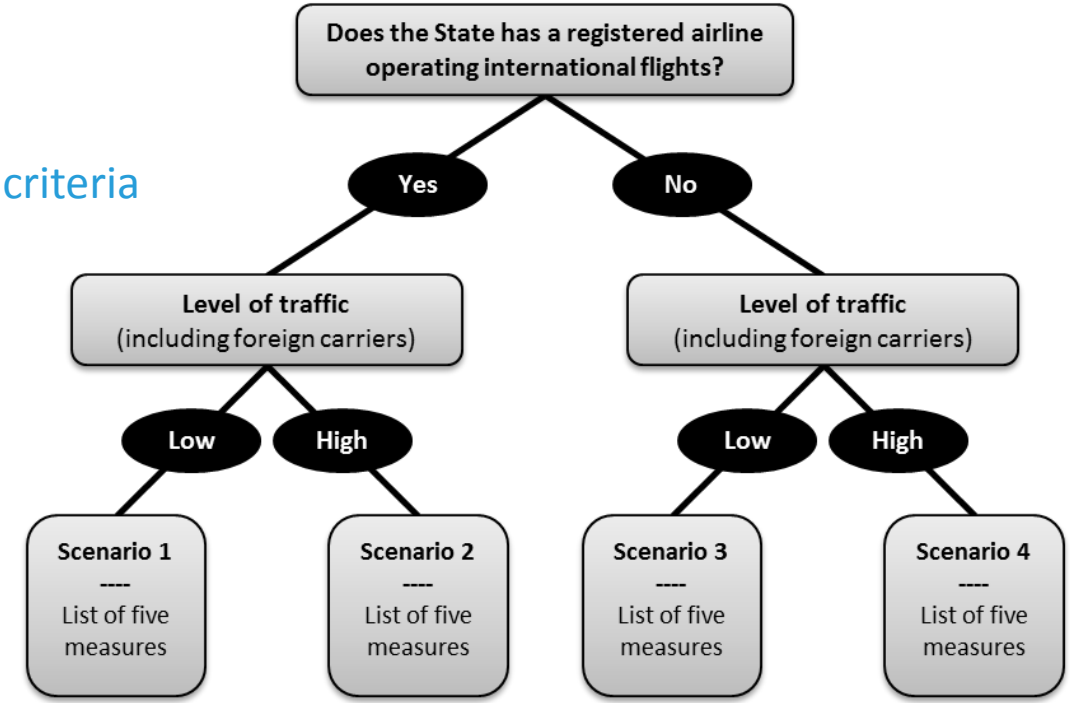
  Set the objective:

  "Get the maximum of CO_2 abated with a maximum cost of 0$ and with a maximum of 5 mitigation measures"

Case Study: Approach used

- **Step 2:**

  Elaborate 4 scenarios based on 2 criteria



Case Study: Approach used

- **Step 3:**

  Select 5 mitigation measures by taking into consideration the 2 criteria for each scenario

  Process:

  - **(a)** Sort the 20 mitigation measures from the highest to the lowest potential CO_2 abated
  - **(b)** Select the top 5 mitigation measures respecting both criteria
  - **(c)** Sum the cost for the 5 mitigation measures with a limit of 0$

Case Study: Approach used

(a) Sort the 20 mitigation measures from the highest to the lowest potential CO_2 abated

Measure	CO_2 Reduction
Measure 19	900
Measure 3	800
Measure 2	750
….	…
Measure 1	500
Measure 20	100

Case Study: Approach used

(b) Select the top 5 mitigation measures respecting both criteria

Measure	CO_2 Reduction	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Measure 19	900			Yes	
Measure 3	800			**No**	
Measure 2	750				

Measure 3:
Minimizing weight

Measure 19:
Introduce continuous climb and descent operations

Scenario 3

Criteria:

1. Does the State has a registered airline operating international flights? **No**
2. Level of traffic: **Low**

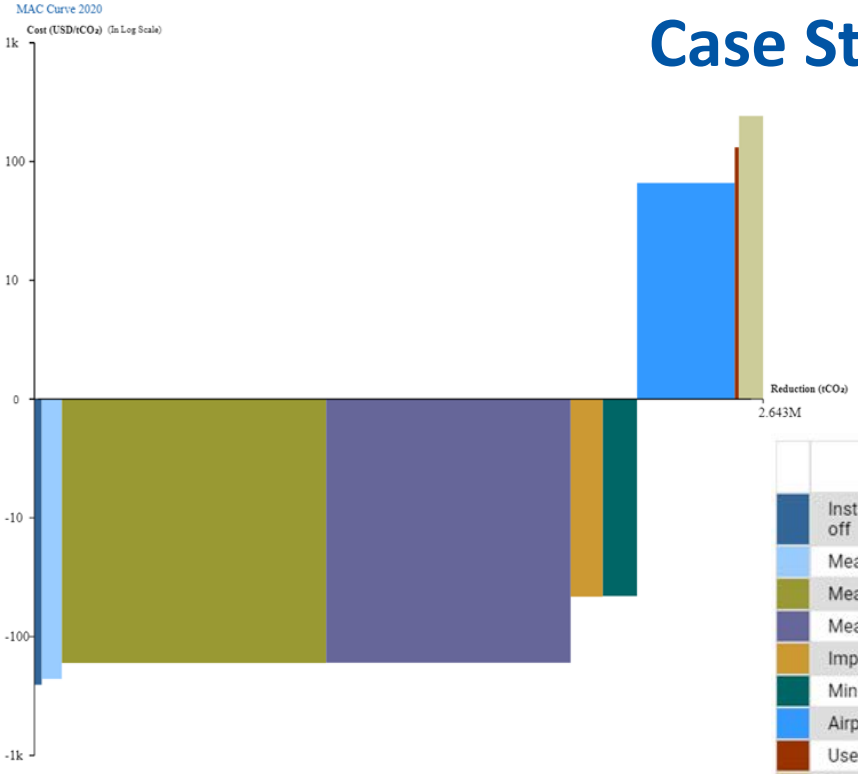
(c) Sum the cost for the 5 mitigation measures with a limit of 0$

Measure	CO_2 Reduction (t)	Cost ($/t of CO_2)	Total Cost ($)	Respect criteria?
A	10,000	-100	-1,000,000	Yes
B	8,000	-200	-1,600,000	Yes
C	7,000	-500	-3,500,000	No
D	6,000	10,000	60,000,000	Yes
E	5,000	-500	-2,500,000	Yes
F	4,000	-500	-2,000,000	Yes
G	1,000	1000	1,000,000	Yes
TOTAL			**52,900,000**	

(c) Sum the cost for the 5 mitigation measures with a limit of 0$

Measure	CO_2 Reduction (t)	Cost ($/t of CO_2)	Total Cost ($)	Respect criteria?
A	10,000	-100	-1,000,000	Yes
B	8,000	-200	-1,600,000	Yes
C	7,000	-500	-3,500,000	No
~~D~~	~~6,000~~	~~10,000~~	~~60,000,000~~	~~Yes~~
E	5,000	-500	-2,500,000	Yes
F	4,000	-500	-2,000,000	Yes
G	1,000	1000	1,000,000	Yes
TOTAL			**-6,100,000**	

Case Study: Results



For the 4 scenario created, a total of 9 different mitigation measures have been highlighted

Measure	Cost (USD/tCO₂)	Reduction (tCO₂)
Installation of fixed electrical ground power and pre-conditioned air to allow APU switch-off	-254	26,082.11
Measures to improve collaborative decision making (A-CDM)	-226	73,208.66
Measures to increase fuel efficiency of departure and approach procedures	-166	964,285.04
Measures to introduce CCO and CDO	-165	892,351.94
Improve fuel efficiency through modifications	-46	117,192.07
Minimizing weight	-45	124,516.26
Airport infrastructure (runways, taxiways, highspeed turnoffs)	65	356,258.60
Use cleaner alternative sources of power generation	131	1,133.23
Development of biofuels	241	87,716.49

Case Study: Results

S1	Does States have a national airline? Level of traffic	Yes Low
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	
3.	Minimizing weight	
4.	Improve fuel efficiency through modifications	
5.	Development of sustainable aviation fuels	

S2	Does States have a national airline? Level of traffic	Yes High
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	
3.	Airport infrastructure (runways, taxiways, highspeed turnoffs)	
4.	Minimizing weight	
5.	Improve fuel efficiency through modifications	

Case Study: Results

S3	Does States have a national airline? Level of traffic	No Low
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	
3.	Development of sustainable aviation fuels	
4.	Installation of fixed electrical ground power and pre-conditioned air to allow APU switch-off	
5.	Use cleaner alternative sources of power generation	

S4	Does States have a national airline? Level of traffic	No High
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	
3.	Airport infrastructure (runways, taxiways, highspeed turnoffs)	
4.	Development of sustainable aviation fuels	
5.	Measures to improve collaborative decision making (A-CDM)	

Case Study: Conclusion

- The two mitigation measures with the highest potential in term of CO_2 abated are present in the four scenario.

S1	Does States have a national airline? Level of traffic	Yes Low
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	

S2	Does States have a national airline? Level of traffic	Yes High
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	

S3	Does States have a national airline? Level of traffic	No Low
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	

S4	Does States have a national airline? Level of traffic	No High
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	

Case Study: Conclusion

- In the case where the State has **no national airlines** and with a **low level of traffic** (scenario 3), the **installation of fixed electrical ground power and pre-conditioned air units** augmented by **photovoltaic panels** represents an excellent opportunity to consider in the case of developing States and SIDS

S3	Does States have a national airline? Level of traffic	No Low
1.	Measures to increase fuel efficiency of departure and approach procedures	
2.	Measures to introduce CCO and CDO	
3.	Development of biofuels	
4.	Installation of fixed electrical ground power and pre-conditioned air to allow APU switch-off	
5.	Use cleaner alternative sources of power generation	

For more information on this project, please visit ICAO's website:

https://www.icao.int/environmental-protection/Pages/ICAO_UNDP.aspx

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THANK YOU