



THAILAND'S ACTION PLAN to Reduce Aviation Emission The first step of CAAT to deal with Climate Change

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• THE CIVIL AVIATION AUTHORITY OF THAILAND (CAAT)

- o Environmental Protection & the Responsible Function
- o Climate Change Implementation Elements

• STATES'ACTION PLAN DEVELOPMENT

- o Baseline Emission
- o Mitigation Measure
- o Exercise/EBT Demonstration
- THAILAND'S ACTION PLAN TO REDUCE AVIATION EMISSION
- CHALLENGES ON CLIMATE CHANGES





- Mr. Pasavi RATCHAPONGSIRIKUL
- Head of Aviation Environment Division/CAAT
- THAILAND's CORSIA Focal point
- Educational Background
 - M.Sc. Environmental Engineering & Management (AIT) (Environmental Toxicology Technology and Management)
 - M.Sc. Technology of Environmental management (Mahidol University)
- Background & Skills
 - ✓ QA/QC auditor QMS, EMS, OHSAS, EHS
 - ✓ Aviation Fuel Management
 - ✓ Emission Trading
 - Environment

















The Civil Aviation Authority of Thailand (CAAT)

- Direct to Minister of Transport
- The Civil Aviation Authority

REGULATOR

Enforce laws on air navigation, aviation liability, and other relevant laws

- Promote and develop the network of air transport system, aviation industry, and civil aviation
- Prescribe, regulate, and audit implementation of civil aviation
- Cooperate and liase with relevant domestic and international civil aviation organizations as well as organizations related to relevant conventions and agreements
- Etc.









Aviation Environment Division (Est on 2016)



- 1. Develop **standards and Regulations**
- 2. Enhance aviation industry to become more efficient and environmentally friendly
- 3. To develop and monitor the implementation of aviation greenhouse gas emissions reduction
- 4. To develop aviation greenhouse gas (GHG) **emissions** inventory **database**
- 5. To develop **Aviation Environmental Database**
- 6. To **monitor** the standards $\underline{-(SURVEILLANCE)} \rightarrow$ Reduce environmental Impact
- 7. To advise and support the related organizations which are involved in aviation environmental management plan

Aviation Environment Division

Pasavi R. Division Head

C. Inter

•Aviation&Climate Change,GHG management-CORSIA, Auditor (EMS, QMS)



Phichittra C Specialist

 Environmental Engineer,
 Wastewater Treatment, Energy and Bioenergy



Surocha P Specialist

 Noise Pollution Expert Environmental Impact Assessment Expert.



Kantinan W Jr. Specialist

•Aviation technology /Airside operation expert.





Aviation Environment Division/ CAAT

- Started from "ZERO"
- Newly established function/Division
- Newly recruited staffs
- Tons of work coming from everywhere
 - Complaints of environmental problems caused by airport
 - Other Environmental issues for airlines and airport
 - Climate change became very HOT ISSUE for Aviation
 - **CORSIA** preparation for THAILAND
- Very Challenging for newly established function with 4 people





Climate Change Policies Affecting Aviation

CLIMATE CHANGE in AVIATION SECTOR

- ICAO Aspirational goal and CARBON NEUTRAL GROWTH 2020
- UNFCCC is trying to reduce GHG emission in order to keep global temperature rise this century well below 2 degrees Celsius (Paris Agreement)
 - National Policies
 - Aviation Sector is included









Action Plan



 States' Action Plan to Reduce GHG Emission is "The First Mission" in Environment Area
 <u>TARGET</u>: to be submitted by 2018
 Only one year (2017) to develop the Action Plan (AP)
 Only 4 people, staff of the division

The other environmental issues also have to be concerned

"WE NEED SUPPORT"



European Union Delegation (EUD)





THAILAND-EUROPEAN UNION Policy Dialogues Support Facility

(1) trade and investment;

(2) higher education and science and technology including health;

(3) environment, climate change, energy and

natural resources sustainable management, and;

(4) good governance and human rights; besides, to enhance public awareness.





- The SUPPORT in Environmental and Climate Change area has been introduced to Aviation Sector via DCA (2013)
- Capacity building was given to Thai Airlines and DCA
 - Carbon offsetting , MRV system..etc



$2017 \rightarrow CAAT$

- In 2017, CAAT continued PDSF project by requesting for Aviation and Climate Change support in the 3 topics
 - POLICY / Action Plan
 - MRV systems / framework
 - Aviation Emission Database
- Then CAAT's work program/package started in 2017 with States Action Plan development





10/10/2018



Thailand has submitted the 1st Action Plan since 2013 (Thai DCA)

• The 1st mission of our division since CAAT established







- ICAO Doc 9988 : Guidance on Development of States' Action Plan on CO₂ Emissions Reduction Activities
- Available in ICAO's portal



https://www.icao.int/environmentalprotection/Documents/GuidanceMaterial_DevelopmentActionPlans.pdf



- 1. Contact Information for the State Action Plan Focal Point
- 2. Baseline Scenario (without action) including fuel consumption, CO2 emissions, and RTK
- 3. Selected Measures to mitigate CO₂ emissions
- 4. Expected Results (estimated impact of selected mitigation measures on the baseline scenario) including fuel consumption, CO2 emissions, and RTK
- 5. Assistance Needs (if needed)



- Someone to work
 - ✓ Team (Authority)
- Someone to provide data and information
 - Airplane operators ,Air Navigation Service
 Provider, Airport Operators
- Someone to advise
 - ✓ Experts or technical supporters
- Someone to approve your work
 - ✓ Committee or working group





Routine process on mitigation measures implementation



- CO2 emission comes from fuel consumption
- Aviation fuel consumption Aviation Emission
- How to collect fuel consumption data?
 - ICAO FORM M



- Template : ICAO FORM M
- Parameter
 - Fuel consumption
 - Available Tonne Kilometer (ATK)
 - Revenue Tonne Kilometer (RTK)
- Operation type (Flights)
 - International (Schedule)
 - International (non Schedule)
 - Total (Service , International)

 Airplane operator has to submit FORM M to CAAT annually

ICAO FORM M



The Civil Aviation Authority of Thailand

INTERNATIONAL CIVIL AVIATION ORGANIZATION AIR TRANSPORT REPORTING FORM FUEL CONSUMPTION AND TRAFFIC - INTERNATIONAL AND TOTAL SERVICES, COMMERCIAL AIR CARRIERS

Contact person:	
Tel:	
Fax:	
E-mail:	

State:	
Air carrier:	
Year ended:	

Aircraft in fleet by I	type	International scheduled services		International non-scheduled services (excluding on-demand flights)			iternational total (scheduled and non-schedulei excluding on-demand flights)			Total services (international and domestic, scheduled and non-scheduled, excluding on-demand flight			percent	
Manufacturer, Model and Series	Version code 1/	Fuel consumed (tonnes)	Tonne- kilometres performed (thousands)	Tonne- kilometres available (thousands)	Fuel consumed (tonnes)	Tonne- kilometres performed (thousands)	Tonne- kilometres available (thousands)	Fuel consumed (tonnes)	Tonne- kilometres performed (thousands)	Tonne- kilometres available (thousands)	Fuel consumed (tonnes)	Tonne- kilometres performed (thousands)	Tonne- kilometres available (thousands)	of biofuels (total services)
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CAAT's FORM M (modified)

- Aircraft operators have to submit to CAAT on yearly basis through "STATISTIC" database
- CAAT will conduct magnitude check and then send through ICAO
- Parameters to report includes:
 - Fuel consumption (uplift)
 - ATK, RTK
 - By Aircraft type and Sector

CAAT's Challenges on data collection

- We had data 2011-2013 (The previous action plan)
- The 2014 data was missing
- CAAT tried to collect 2015-2016 data set from big 5 airlines
- However, data fixation was needed to fulfil the completeness principle
- With Support from EU, data fixation was done by GHG expert (Mr. Predrag Novosel)

Data Fixation on Thailand's International fuel data





CAAT's Challenges on Data collection

- The ¾ of aircraft operators in Thailand had not experienced on FORM M reporting
- Training sessions were organized and given to aircraft operators since 2017
- CAAT "Statistic" Database was developed to facilitate data collection
- CAAT " EDMS" Database was developed since 2017 for CO2 emission reporting purpose
- In 2016, only **5 airlines** reported and submitted form M
- In 2017 , **7 airlines** submitted form M to CAAT
- In 2018 about **10 airlines** submitted form M to CAAT



Thailand's Reporting system on EMISSION data





From "Data collection" Process

- We could have FORM M form THE AIRLINES
- Total aviation <u>FUEL CONSUMPTION</u> of the State
- Total <u>ATK</u> and <u>RTK</u> of the State
- Then ...Ready for "DATA PROCESSING"



DATA Processing




Data Processing

- Manual Calculation : DOC9988
- <u>TOOL</u> : Environmental Benefit Tool "**EBT**" of ICAO

□ The 3 CURVEs needed to be presented in the action plan

- 1. Statistic (Real data)
- 2. Baseline (Forecasted emission without mitigation measures)
- 3. Forecasted emission with mitigation measures





Input data

- Fuel consumption (past to present)
- ATK& RTK (past to present)
- Mitigation measures

Output data

- Baseline emission (+forecasted emission without measures)
- Forecasted emission with measures
- Growth



EBT'S OUTPUT BASELINE CURVE

Fuel consumption





Determine Mitigation Measures



Fuel consumption



Year



- The measures implemented and proposed by the stakeholders or determined by State
- ICAO DOC 9988 as guideline to calculate emission reduction
- Report in the ICAO's Template (DOC9988)
 - Modification can be made
- EBT can also be used to calculate emission reduction

Basket of Measures (7 categories) to reduce CO2 emission

(ref: ICAO)

- 1. Aircraft-related Technology Development
- 2. Alternative Fuels
- 3. Improvement of Air Traffic management and Infrastructure Use
- 4. More Efficient Operations
- 5. Economics / Market-Based Measures
- 6. Regulatory measures / Other
- 7. Airport Improvement



THAILAND's Aviation CO2 Reduction (Mitigation) Measures

OLD MEASURE (2013)

• The 11 measures Proposed by Airlines, Air Navigation Service Provide and Airport Operator

NEW MEASURE (2018)

- The 8 measures Proposed by Airlines, Air Navigation Service Provide and Airport Operator
- Short Term , Medium Term, Long Term



- How could CAAT obtain these information & Data?
 - Almost complete within 6 months





- We went to the operators' offices as host of the meetings
 - Thai Airways ,Thai Air Asia, ThaiSmile airways AEROTHAI, Airport of Thailand (AOT),...etc
- The meetings are for
 - Sharing Information
 - Making closer relationship
 - Supporting each other
 - Starting cooperation



"TO LET THEM KNOW OUR ROLES and RESPONSIBILITIES"

"TO SHOW THEM CAAT IS SUPPORTING THEM"

"TO DEMOSTRATE COOPERATION between REGULATOR and OPERATORs"

it is not that we are in the opposite side .. anymore



CAAT started with the measures proposed in 2013 (Old Action Plan)

- ➤ Walked to the Stakeholder "as friends"
- Interviewed and updated how progress of the measures
- > Asked if they have new measures to propose
- > Explained how to use the template
- ≻ Told them about "follow up" plan
- > KEEP GOOD RELATIONSHIP



THAILAND's Mitigation Measures

	Measure no.	Titles	stakeholders involved
	1	Modification of B777 aircrafts-B777 performance improvement program	Thai Airways Int, Boeing company
	2	Purchase of new aircraft/Buy new Airbus A320-200 NEO	Thai AirAsia Company Limited
	3	Measures to improve ground operations/Gate Hold Procedure	AEROTHAI, Airlines operating at Suvarnabhumi Airport
	4	Measures to improve flexible use of civil-military airspace, the use of optimum routings (Parallel Route)	AEROTHAI
	5	Retune (NEW)flight planning system	Thai Airways International
	6	Reduce Portable Water Quantity in Aircraft	Bangkok Airways, Thai Airways
	7	Aircraft and Engine wash	Thai Airways International
	8	One Engine Taxi in	Bangkok Airways
	9	Best practices in operations	Thai AirAsia, GE Aviation Company, AOT, AEROTHAI
	10	The air temperature is set at 25°C	AOT
	11	LIGHTING SYSTEM CONTROL at DMK	AOT

.2013 MEASURES

×	Measure no.	Titles	stakeholders involved
URES •	1	Continuous Decent Operation	Aerothai ,AOT, DOA, Bangkok Airways, Nok Air, Thai Air Asia, Thai Smile, Thai Airways International, Thai Lion Air
JEAS	2	Purchase of new Airbus A350	Thai Airways International
018 N	3	Reduced Flap landing	Air Asia Group, Bangkok Airways, Lion Air and Nok Air
.2	4	Electronic Flight Bag (EFB)	Bangkok Airways
	5	Seat Retrofit	Bangkok Airways
	6	Construction of new runway at Suvarnabhumi airport	AOT
	7	Airport Collaboration Decision making(airport CDM)	AOT, AEROTHAI
	8	CORSIA	CAAT, Airline Operators



- Significant Parameters for mitigation measure template
 - ✓ INDICATOR
 - ✓ BENEFIT in terms of CO2 Emission Reduction
 - Quality Control and Quality Assurance



Significant Parameters for the Measure

INDICATORs for the measure

- To indicate the effectiveness of the measures
- To help in "FOLLOW UP"
 - Quantity of CO2 reduced
 - Number of operation
 - Percentage of "RES" (Renewable Energy Sources) into the energy balance

• Example : Continuous Decent Operation (CDO)

Continuous descent approach (CDA) is a method by which aircraft approach airports prior to landing. It is designed to reduce fuel consumption and noise compared to other conventional descents. Instead of approaching an airport in a stairstep fashion, throttling down and requesting permission to descend to each new (lower) altitude, CDA allows for a smooth, constant-angle descent to landing.





- Measure : Continuous Decent Operation (CDO)
- The objective : to reduce aircraft noise, fuel burn and emissions by means of a continuous descent, so as to intercept the approach glidepath at an appropriate altitude for the distance to touchdown
- Benefit: Fuel saved per time of operation by aircraft type
- Indicator : Number of Operations
- Challenge : Monitoring-Reporting <u>System</u> or <u>Procedure</u> need to be SET



BENEFIT in terms of CO2 Emission Reduction Example : CDO

- <u>Number of CDO operation X fuel saved per time by AC type X EF</u>
- Fuel saved \rightarrow Estimation by guideline, EBT
- EF = Emission Factor (3.16 TON CO2/Ton Fuel)*
 - ref : ICAO for International aviation



Quality Control and Quality Assurance Example : CDO

- To ensure the data obtained or to report is reliable
- Method of collect or record data ???
- > Who will control data???
- > Who will verify data???

Exercise : Calculation of emission reduction from the measure applied

- EX1: An airline has 5 aircraft that are used, on average, 2,700 hours per year. The airline intends to reduce weight by 20 kg (0.02 tonnes) on all 5 of these aircraft
- Measure information
 - Category: More efficient operations/Best practices in operations / Minimizing weight Narrow Body Aircraft
- Role of Thumb :

Fuel Saved = weight reduction * flight time * 3.35%

(Tonnes)

(Hours per year)



• The annual fuel savings can be estimated as:

= 5 * 0.02 * 2,700 * 0.0335 = 9.0 tonnes fuel saved per year



FORM M

FOR STATE

- Communicate to the airline operator
- Capacity building/ training
- Set the system
- Collect REPORT and submit to ICAO

FOR AIRLINE OPERATOR

- Fuel consumption
 - Collect Fuel uplift data each flight every light
 - Record and keep record
 - REPORT in form M
 - Submit the State



State A has complied international aviation data of 2017 where the result is:

- Annual fuel consumption of 2017 is 270,000 Tons
- Annual RTK of 2017 is 750,000

Mitigation measures implemented by State A

Category: More efficient Operation

- Minimizing weight
- 2020-2030
- Large Single Aisle Jet
- Number of Ac per year=30
- Avg flt time per AC= 4000 hr
- Weight reduction/AC =50 kg
- % Implementation=20

Generate baseline through 2030 by using EBT

Generate forecasted CO2 emission curve with mitigation measures applied



THAILAND'S ACTION PLAN 2018

Thailand's Action Plan to Reduce Aviation Emission 2018



4.3 TREND IN AIR TRAFFIC STATISTICAL DATA AND GHG ESTIMATION

The data and figures contributed to the above analysis are to be soperately developed and clarified in their own systems, parameters, and limits in the following tables:



5.2 UPDATES ON MITIGATION MEASURES CITED IN THE 2013 ACTION PLAN 5.2.1 OVERVIEW

The basistic of measurue designed, solutions, and selende under mailand's basedured to the mailand's basedured selende under mailand's basedured b

It shall be pomied out that most of the quoted previous mitigation measures cannot be answered in terms GHG and Coorrecting strategies and the strategies of controlling strategies and the strategies of controlling strategies and the strategies of controlling strategies and the strategies of and strategies and strategies of and strategies and strategies and and DAC had none of procedure in place travialisherholders. The procedure has since been downormental and climate impacts of the measures expanded to the strategies of the measures expanded in the previous version of the Action Plan cannot be aendmant.

To demonstrate the development, officacy and follow up of each measure started under DCA in 2011, CAAT optied to use the same Action Plan measure templete submitted by DCA to ICAO in 2013,

THAILAND EU-PDSF project , Dr. Monica BONFANTI (Team leader)

Table 3: Fuel burn, RTK, fuel consumption efficiency (FB/RTK) and CO2 emissions during 2010 -2018

	Fue	si Burn (FB)	RTK Thousand (Tonnosxium)	FB/RTK		CO ₂ Emissio
Year	(LITRE)	Tannes		LITRE/RTK	NO/R1K	Ternis
_	IAJ	(8)	(C)	(D) = [A]/[C]	(E) = [B][1,000]/[C]	[F] = [B] × 3.1
2010	3,440,992,343	2,752,794	7,574,912	0.4543	0.3634	8,671,300
2011	3,582,037,382	2,865,630	8,511,965	0.4208	0.3367	9,026,733
2012	3,575,544,966	2,860,436	8,765,787	0.4079	0.3263	9,010,375
2013	3,456,980,863	2,765,585	9,685,980	0.3569	0.2855	8,711,592
2014	3,251,262,249	2,601,010	9,424,065	0.3450	0.2760	8,193,181
2015	3,792,499,121	3,033,999	10,034,051	0.3780	0.3024	9,557,098
2016	3,636,640,352	2,909,312	10,822,393	0.3360	0.2688	9,164,334

Source: M Form submitted by actions and GAAT calculation using no. of Hights (GA) from almost operators, somildering ADC's nationalities

Table 3 presents historical statistical data and emission inventory for 2010-2016, used to forecast air transport activities in the baseline scenario.

"These mariteen, were out evaluable as the M forms and the values (tave been established uningsacrought methods

Despite lacking the appropriate data collection and verification procedures in the park, it should be emphasized that, scenshy, the purchase of imore advanced and bigger aincrafts to replace dated models (measure n. 28 as well as the implementation or trave efficient ATM planning, porund and terminal operations, and the increasing efficiency level in infrastructure web have already produced the list holicolated in evel in a infrastructure and services by 392,764 tornes; count from 2015's 9,557,098 tornes to 2016's 9,148-34 tornes.

Therefore, even with the lack of data to establish how the indicators of these massures have changed from the reference scenario, the graphic on GHG emissions from 2010 until 2016 (/igue 7) demonstrates the inst impacts after the introduction in terms of CO2 emissions reduction.







Figure 6: Fuel consumed (tonnes) and fuel consumption efficiency (litre/RTK) during 2010 -2016



Figure 9: Forecast of CO₂ emissions by Thai airlines in international flights (in mega tonnes) 2017-2030



Figure 7: Greenhouse gas emission during 2010 - 2016

EMISSION DATA THAILAND'S INTERNATIONAL AVIATION

Fuel consumption, CO2 Emission, Fuel Efficiency Emission with measures

THAILAND's Emission Data







- Purchase of new aircrafts
- Retrofitting and upgrade improvements on existing aircraft
- Retune Flight planning system
- Aircraft Wash and Engine Wash
- Single Engine Taxiing
- Weight Reduction
- Etc.



- Thai Airways International
- Optimize aircraft maintenance
- Aircraft wash can reduce friction and improve fuel efficiency which result in 0.4% fuel consumption reduction





- Thai airways for A350 and B787
- Thai Air Asia for A320 NEO
- Thai Lion Air for B737 max





- Bangkok Airways
- Airbus One Engine Taxi
- By procedure
- With record





- Thai Airways Int. and Bangkok Airways
- Reduce potable water as per water Loading Matrix
- Water uplift as follow by the number of passenger onboard
- Quantity of potable water variation direct with flight hours







- Airport Collaboration Decision Making (A-CDM)
- Parallel route
- Construct New Runway (AOT/BKK)
- Etc.

Airport Collaboration Decision Making (A-CDM)



- Airport CDM (A-CDM) is about partners
 working together and making decisions
 based on more accurate and higher quality
 information, where every bit of
 information has the exact same meaning
 for every partner involved. More efficient
 use of resources, and improved event
 punctuality as well as predictability are the
 target results
- COMMUNICATION-DECISION OPERATION
- Start date: 2018
- Stakeholders: Airport of Thailand and AEROTHAI





- Suvarnabhumi
 International Airport
- Runway no.3 and no.4





- "SUSTAINABLE" Alternative Fuels
- Long term measure
- Research and Development
- In the future



THAILAND's Biofuel flight



- Thai Airways had demonstration flight and commercial flight powered by BIOFUEL derived from used cooking oil
- DECEMBER 2011


How CAAT manage the Action Plan(AP)?

- The action plan has to be approved by the committee
- The committee comprises DG of CAAT, airline operators, ANSP, Airport operators..etc.
- Data will be updated every year with approval from the committee
- AP has to be updated every 3 years



CHALLENGES





NO DATA

NEVER BEEN COLLECTED

LOW QUALITY

UNMANAGED DATA

13/10/2018



Problem	NO DATA
Cause	NEVER BEEN COLLECTED
Root Cause	DON'T KNOW HOW /WHY to COLLECT
	Not realize how important of data







Not realize in the data quality





PPORT $\overline{(\mathbf{z})}$ NORKING CLOSELY



Managing data collection and reporting

- CAAT started with TRAINING/WORKSHOP on ICAO FORM (by focusing form M-fuel consumption) in March 2017
- Created and Shared FORM A, C, M instruction (TH)
- Developed DATABASE to facilitate data reporting for the airlines and managing for CAAT
- Kept communication and monitoring closely with support ready to be provided
 - Call, Consult, Visit, Meeting.....
- The 7 (big) Airlines can report properly and submitted in June 2017



FORM M-ICAO : VERIFICATION RESULT



VERIFIED



SET THE STRUCTURE, DATA FLOW w/ Channels

Data collecting flow process (Ad hoc /yr2017)



12/10/2018



- Data is very important
- Working with data --- Database is a powerful tool
- This work would be less difficult if airlines know how to→ Capability building/ training
- Mitigation measures and indicators



THANK YOU for your kind attention

Your safety is our mission.

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10/10/2018