Thailand's Action Plan

to Reduce Aviation Emission 2018

CAAT
สำนักงานการบินพลเรือนแห่งประเทศไทย
The Civil Aviation Authority of Thailand

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01 Introduction

Thailand's aviation sector has registered deep changes during the last years, especially after the submission of the first Action Plan by the Department of Civil Aviation (DCA) in 2013. The most important change is the creation of a real authority in charge of regulating the sector as an independent body. This new entity has significant effect to the former existing structure incorporated within the Ministry.

CAAT, as Thailand's aviation sector authority, is fully committed to and involved in the fight against climate change. It is working towards resource efficiency; a greener and sustainable transport modal system as framed into the Ministry of Transport's set of priorities. CAAT, as well as its stakeholders, have been determined and driven by a strong wind of change especially in terms of introducing consistent environmental, climate considerations and tools in a sector primarily regarded and ruled by business and market principles.

This is exactly the spirit CAAT introduced into the update of the old mitigation measures submitted by DCA into 2013 Action plan. It is incorporated, in a more incisive way, into the new mitigation measure structure and logical framework as the tools to provide a roadmap of where CAAT is headed and what goals shall be reached by 2030, and create the hypothesis on which these expected results are based.

Through training and capacity building process, CAAT has been working diligently to support different sector operators facing the big challenge of using ad hoc indicators and baselines to monitor the trends in the sector.

Being well aware of the potentialities connected with the creation and reinforcement of partnerships at both regional and international levels, CAAT is simultaneously moving forward to gain regional and international cooperation and support. To achieve this, dedicated medium- and long-term mitigation measures are in the process of being developed and implemented.

Since its establishment, CAAT has followed a clear green and sustainable path of administration and operation. Even though the targeted results might not be clearly apparent or achieved within a short period of time, as the intermediate rules and procedures are still being executed, CAAT knows exactly where it is heading; which steps shall be taken next; and how important it is for the local aviation industry to have a regulatory system with guaranteed transparency and good governance.

This action plan is, therefore, aimed to demonstrate the framework developed by CAAT in collaboration and cooperation with all sector stakeholders with the goal of meeting the international criteria set by ICAO.

02
Objective

As stated in ICAO's proposal on a global MBM scheme, Member States are requested to address CO_2 emissions from international aviation by ensuring progress on aircraft technology, operational improvements, and sustainable fuels is reflected in State Action Plans. Thailand recognizes the importance of preparing, updating and submitting to ICAO an updated State Action Plan on emissions reductions as a pivotal step towards achieving the global collective goals agreed at the 38th Session of the ICAO Assembly in 2013.

The main objective of this updated Action Plan is to show in details how Thailand's aviation sector has worked towards the aforementioned goals since 2013, and its future outcome predictions. This Action Plan identifies the country's new structures and actors involving and cooperating in the effort to reach ICAO's medium-term Global Aspirational Goal of improving fuel efficiency and stabilizing the international aviation's global CO_2 admissions at 2020 levels, which is the existing reference scenario (i.e. baseline) for each new short-term mitigation measures.

Problems and challenges arising during the course of action are also described to demonstrate that even if the way has been already paved, the real and tangible results will be achieved only after a minimum of a 10-year period of hard work and cooperation between all involved parties: governmental, public and private organizations.

Climate indicators and approaches are stated in the dedicated part on basket of mitigation measures as the tools for all sector stakeholders to take appropriate actions following ICAO's strong commitments towards environmental protection and the national policy on sustainable transport of 2016. The new short-, medium-, and long-term mitigation measures are organized into the following 6 categories of measures suggested by ICAO below:

1) Aircraft-related Technology Development

a. Aircraft minimum fuel efficiency standards
b. Aggressive aircraft fuel efficiency standards, setting standards for the future
c. Purchase of new aircrafts
d. Retrofitting and upgrade improvements on existing aircrafts
e. Optimizing improvements in aircraft produced in the near to mid-term
f. Avionics
g. Adoption of revolutionary new designs in aircraft/engines

2) Alternative Fuels

a. Development of biofuels
b. Development of other fuels with lower lifecycle CO_2 emissions
c. Standards/requirements for alternative fuel use

3) Improved Air Traffic Management and Infrastructure Use

a. More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), en-route operations, airspace design and usage, aircraft capabilities
b. More efficient use and planning of airport capacities
c. Installation of airport infrastructure such as Fixed Electrical Ground Power and Pre-Conditioned Air to allow aircraft APU switch-off
d. Construction of additional runways and taxiways if used solely to relieve traffic congestion
e. Collaborative research endeavors

4) More Efficient Operations

a. Best practices in operations
b. Optimized aircraft maintenance (including jet engine cleaning/washing)
c. Selecting aircraft best suited to mission

5) Economic / Market-Based Measures

a. Voluntary inclusion of aviation sector in emissions trading scheme
b. Incorporation of emissions from international aviation into regional or national emissions trading schemes, in accordance with relevant international instruments
c. Establishment of a multilateral emissions trading scheme for aviation which allows trading permits with other sectors, in accordance with relevant international instruments
d. Establishment of a framework for linking existing emissions trading schemes and providing for their extension to international aviation, in accordance with relevant international instruments
e. Emissions charges or modulation of landing/take-off (LTO) charges, in accordance with relevant international instruments
f. Positive economic stimulation by regulator: research programs, special consideration and government programs/legislation and accelerated depreciation of aircraft
g. Accredited offset schemes
h. Explore extension of CDM
i. Taxation of aviation fuel, in accordance with relevant international instruments

6) Regulatory Measures / Other

a. Airport movement caps / slot management
b. Enhancing weather forecasting services
c. Requiring transparent carbon reporting
d. Conferences / workshops

03
Sector Information

3.1 AVIATION SECTOR: CONTACT AND BACKGROUND INFORMATION

3.1.1 SUMMARY

Aviation sector in Thailand has started as early as 1910s. Thai government saw the potential of the aviation in the military first and then extended its capacity to civil use shortly after. Thailand has deposited the instrument of ratification to the Chicago convention since 1947. Once becoming a contracting state, Thailand adopt several measures proposed by ICAO including the concern on climate change.

From September 2013 when the first Action Plan was submitted to ICAO, the aviation sector of Thailand has made significant strides. A new Independent Entity, the Civil Aviation Authority of Thailand (CAAT), in charge of regulating the sector, was created in October 2015 through the Emergency Decree B.E. 2558. The structure, the organization chart and the role have been settled and with a decision of government. Aviation Environment Division was created to focus on:

"Developing Environmental Policy for Thailand's aviation industry, Collecting, Monitoring and Verifying emissions data in aviation sector and Developing and updating State Action Plan on Emission Reduction (APER)."

CAAT is the Regulator of the aviation sector and is in charge of updating the existing sectoral policy, mitigation measures inherited by the previous competent body (Department of Civil Aviation – DCA.) While progressively developing its structure, competence, duties and powers, CAAT is managing the existing situation of lack of data, lack of control and verification, especially the lack of GHG, fuel burnt, RTK data and related benefits of the mitigation measures at the end of their implementation period.

In order to counter this deficiency, CAAT has introduced a new phase characterized by transparency, accuracy of data, making goals more SMART (Specific, Measurable, Achievable, Realistic and Time-bound.) This is done by introducing KPIs, breaking them down into discrete objectives or benchmarks, linking goals to existing measures/programs or policy, monitoring/verification of the sector trends and data with dedicated QA/QC procedures. This is to ensure continuity and sustainability.

CAAT also has an advantage over the DCA. A dedicate environment division has gathered the personnel from the industry. This make process of implementation of all the above aspects possible. The new division has planned and programmed workplan with objectives and targets established with regards to priorities and obligations for all involved stakeholders. It is now possible to deliver the action plan with new realistic mitigation measures, with controlled and verified data despite the shortage of time available.

3.1.2 CONTACT INFORMATION

Name of the Authority	Civil Aviation Authority of Thailand (CAAT)
Point of Contact	Chula Sukmanop, Director General
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City	Bangkok
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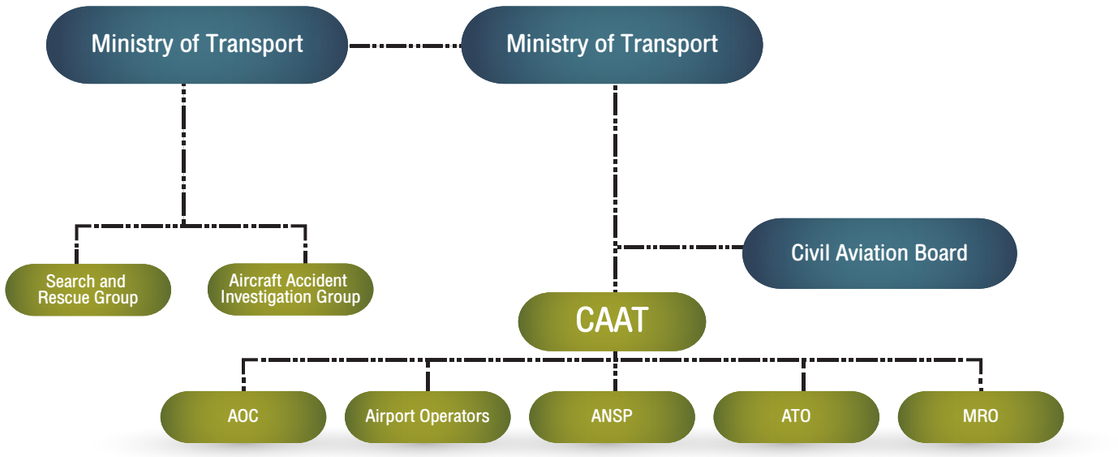
3.1.3 HISTORICAL OVERVIEW OF THAILAND'S AVIATION SYSTEM

Aviation in Thailand began in B.E. 2453 from the need to have aircraft to use for defending the nation. After that the Ministry of Defence realized that aviation was not necessary an activity specific to military missions alone; therefore, it started the Postal Airline to assist the Post and Telegraph Department with its services. Further, The Ministry of Defence arranged to have aircraft transported medications, physicians, and nurses to deal with epidemic in rural areas. This led to the beginning of civil aviation in Thailand. As air transport was becoming more efficient and starting to play a more important role commercially, the Ministry of Defence then transferred this mission to be in the care of the Ministry of Transport up until today. At the international level, Thailand became a party to the Convention on International Civil Aviation or the Chicago Convention as of the 4th of April B.E. 2490 (A.D. 1947). Thailand has also been housing the International Civil Aviation Organization (ICAO) Asia and Pacific Office since B.E. 2498. Thailand and ICAO have been cooperating and supporting several projects.

3.1.4 CAAT[1] POSITION WITHIN THE GOVERNMENTAL FRAMEWORK

The previous strategies and master plans[2] designated by Thailand's Ministry of Transport, as well as the new 20-year plan Thailand's Transport Development Strategy, refers to each sub sector agency/Authority as the subject in charge of drafting sector regulations, dedicated policies and plans. CAAT has been placed under the Ministry of Transport. CAAT's role is to regulate all the aviation sectors including Aircraft Operators, Airport Operators, Air Navigation Services Provider, Training Organizations, and Maintenance Organizations.



CAAT and Thailand's civil aviation industry operates within a legislative and regulatory framework established at national level. There are two national regulations that provide roles and responsibilities for CAAT. They are:

- The Civil Aviation of Thailand Emergency Decree, B.E. 2558
- Air Navigation Act B.E. 2497

There are other supporting regulations that provide detail processes for the operators to comply with the law. These are Ministerial Regulations, Regulation of Civil Aviation Board, Notification of Civil Aviation Authority of Thailand, and Notification of Department of Civil Aviation.

Within the above-mentioned legal background in existence, CAAT is working to update and implement sector regulations as per international standards as well as drafting aviation policies aimed at increasing transparency in the sector and supporting the plan to reduce GHG emissions and increase fuel efficiency.

[1] Cfr. AOC: air operator certificate; ANSP: air navigation service provider; ATO: approved training organization; MRO: maintenance, repair and operations

[2] In 2013, the government launched an ambitious 7-year national transport development strategy to rehabilitate, modernize, and expand the country's transport infrastructure to enhance competitiveness (via reduced logistics costs), increase resilience to climate change and natural disasters, and promote more inclusive development.

3.1.5 CIVIL AVIATION AUTHORITY STRUCTURE: COMPETENCE AND ROLE

The Civil Aviation of Thailand Emergency Decree, B.E. 2558, established the Civil Aviation Authority of Thailand (hereinafter CAAT, The Authority, the Regulator) and transferred to this entity all the competence previously belonging to the Department of Civil Aviation. CAAT also adds the economic aspect of the operators within in its role.

Since 2016, CAAT has inspected the annual audited financial records of all Thai airlines and operators. This is a positive step as it will guarantee that airlines focus on financial management and ensuring that their financial position is sound and stable.

In terms of policy and legal framework, CAAT is drafting regulations allowing it to exercise its powers and to give rights and real legal status. CAAT is planning to develop and influent the framework for the next three years. In the meantime, CAAT will fill in the positions to meet the target.

CAAT is currently working on the recognition of the Aviation Environment Division to increase a number of dedicated staff in the field of environmental protection and climate change.

The Authority is a State agency acting as an independent body. It is a legal entity endowed with rights and duties. Among its duties, the followings have a pivotal importance for the purposes of this document:

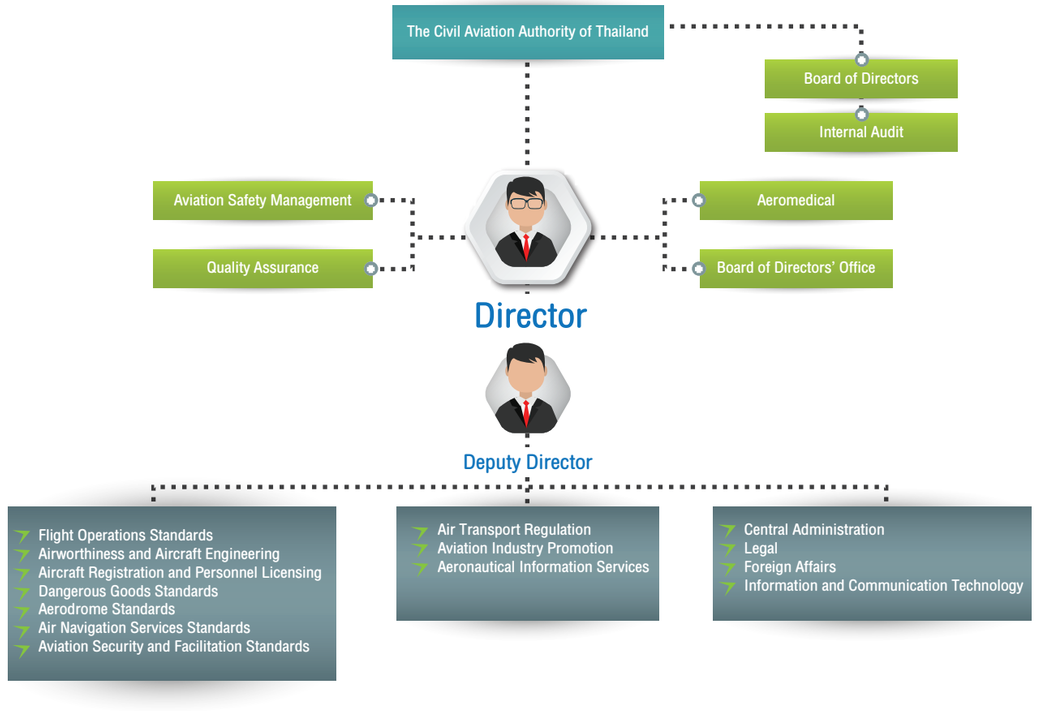
"to regulate, oversee, control, promote and develop civil aviation business in the aspects of safety, environmental protection, security, air transport facilitation, air transport economy and other issues related to civil aviation to comply with international laws and standards".

Therefore, the Authority has to be regarded as the national body in charge of regulating the civil aviation sector. It has the following structure of management:

Under the Aerodrome Standards Department (AGA), the Aviation Environment Division (EV) was created. The dedicated environmental and climate change experts have been employed.

The main objectives of the new division are the followings:

- To study and analyze national and international standards, regulations and give suggestions for measures and legislation concerning aviation environment to comply with international standards;
- To encourage environmental standard development to comply with Thailand and international laws in order to improve aviation's energy savings and environmental friendly;
- To Establish Action Plan for air Transportation emissions following the commitment with ICAO;
- To establish Aviation emissions database;
- To establish environmental database on noise pollution, land and water, air quality, hazardous waste etc. caused by aviation activities;
- To monitor and inspect aviation industry in order to reduce environmental impact;
- To encourage and support functions concerning aviation environment management.



For the time being, the Division is composed of 5 experts, three in charge of climate and two in charge of environment. CAAT is in the process of recruiting new staff dedicated only to these aspects and the Authority's voluntary position towards supporting ICAO's aspirational goals. The capacity building phase has recently started.

An aviation emissions database has been established to demonstrate:

- Accuracy of data and trends in the sector: exhibiting CAAT's role and powers as the new Regulator of the aviation sector

- The environmental effectiveness of the instrument: its demonstrated effect on emissions reductions and the benefits that stem from a continuous and systematic update of the system

- The economic benefits: the cost-effectiveness of the instrument, its effect on economic growth, and the potential for demonstrating the need, the uptake and development of low-carbon technology

In addition, CAAT is drafting its MRV system for the aviation sector as requested by ICAO, in order to be ready for its enforcement by January 2019. This system is an additional guarantee of data accuracy in the sector. It will help the country continuously monitor and improve its intended contribution to environment protection[3] and other related actions as defined in the national, sectoral policies and strategies.

The objectives of the MRV and, in particular, of the sub-sectoral one is to measure, to monitor through reporting processes, and to verify the measures/actions as well as the progress towards the fixed targets. The system identifies a set of particular rules as to what, how, who, when, and for what the data shall be handled.

According to ICAO's Resolution A39-3 the member states shall:
- Develop standards and recommended practices;
- Develop guidance materials for the implementation of the MRV system

"All ICAO Member States (having aircraft operator operating internationally) have to implement MRV by 1 January 2019[4] …to develop necessary arrangements for the implementation of the MRV in accordance with SARPs…"

CAAT has made a lot of progress in setting up the system. The guidelines for MRV are in place and the related systems are in the phase of being formed. It will be completed by the fixed deadline, at around the same time as the training of the staff of stakeholders dedicated to aviation sector.

[3]The intended contributions in terms of targets can be both quantitative and qualitative
[4] This data stands for a pivotal one for the country as it is required to collect CO2 emission data from 2012 because of CORSIA's sectoral baseline as the average emission from 2019 and 2020.

To further strengthen Thailand position towards its voluntary commitment to ICAO aspiration goal, the Minister of Transport, during the plenary session of the 39th Assembly of ICAO – 28 September 2016, stated the followings:

"Civil aviation is playing a crucial part in the economic and social development of Thailand ….."

"For the medium – term to long – term sustainability plan, the newly established CAAT would enhance its overall safety oversight capacity….."the newly civil aviation act is now also being drafted using ICAO model primary legislation with provision to allow speedy legislative process of ICAO SARPs adoption…."

"In order to support the global efforts in reduction of emissions from international air transport, Thailand encourages all Member States the GMBMs where Thailand is fully committed to join on the basis of voluntary participation for its pilot phase in 2021…."

The Ministry of Transport has included aviation among its priorities in its administrative strategies for the next 20 years. This will not have a strong implication at the international level as emissions from domestic aviation is addressed under the UNFCCC and calculated as part of the national GHG inventory, included in the national totals as a possible additional part of the NDC[5].

[5] Thailand reiterates that the Paris Agreement is an important milestone for global community towards addressing climate change. The Agreement reflects the delicate balance which was achieved in Paris during COP 21.
Thailand remains committed to the global efforts against climate change and the implementation of the Paris Agreement. The government will continue to accord high priority to climate issue and to ensure successful implementation of our nationally determined contribution (NDC). On 23 May 2017, the Cabinet has approved the Thailand's Nationally Determined Contribution Roadmap on Mitigation 2021 – 2030 which contains concrete guidelines and measures in order to achieve our NDC target.
The Royal Thai Government will continue to work with all countries and other stakeholders to tackle the threat of climate change, in the promotion of sustainable development and efforts to eradicate poverty.

Powers of the Aviation Regulator

The Aviation Regulator (hereinafter the Regulator) shall have the following powers:

a) issue and adopt binding decisions on aviation undertakings. The Regulator shall be entitled to engage scientists and specialists to advice its staff in drafting procedures, providing technical support in the aviation sector, especially in those areas linked to energy (EE, RE, ES, EC), sustainable transport, environment and climate change. The Regulator shall be banned in engaging subjects falling within possible conflict of interests as well as not respecting independence criterion;

b) contribute to ensuring high standards of public service in compliance with ICAO standards and the protection of clients;

c) carry out investigations in the functioning of aviation sector in terms of procedures on tariffs setting, methodologies, proportionality and non-discriminatory criteria, and to decide upon and impose any necessary and proportionate measures to promote and ensure transparency and good governance in the sector;

d) require any information from entities operating in the related sectors relevant for the fulfilment of its tasks;

e) impose effective, proportionate and dissuasive penalties on aviation undertakings not complying with its rules/policy and regulations or any relevant legally binding decisions of the regulatory authority or to propose to a competent court to impose such penalties.

f) dispute settlement;

CAAT is working on realizing all these powers and is transforming the structure of the Authority into a mature Sector Regulator with a newly consolidated Environment Department, an upgrade from a mere Division.

CAAT, through EV, is controlling and verifying all data received from airlines, especially the group of data related to fuel consumption. Its own verification procedures, which is currently being drafted, will be approved and shared with sector stakeholders by the beginning of 2018.

3.1.6 STAKEHOLDERS IN THE AVIATION SECTOR Stakeholders under CAAT are the followings (As of March 2017):

Operators	Number
Aircraft Operators	42 (16 Commercial, 24 Charter, 2 Cargo)
Repair Station	255 (35 Local, 220 Foreign)
Commercial Airport	38 (11 International, 27 Domestic)
Personnel	594 PPL, 2251 CPL, 2437 ATPL
Training Organization	9 (8 Flight School, 1 Maintenance)

In more details:

AIRLINES
COMMERCIAL AIRLINES

AIRLINE	ICAO	IATA	CALL SIGN
1) Thai Airways International	THA	TG	THAI
2) Thai AirAsia	AIQ	FD	THAI ASIA
3) Nok Air	NOK	DD	NOK AIR
4) Thai Lion Mentari	TLM	SL	MENTARI
5) Orient Thai Airlines	OEA	OX	ORIENT THAI
6) Bangkok airways	BKP	PG	BANGKOK AIR
7) Thai Smile Airways	THD	WE	THAI SMILE
8) Thai AirAsia X	TAX	XJ	EXPRESS WING
9) NewGen Airways	VGO	E3	VIRGO
10) NokScoot	NCT	XW	BIG BIRD
11) Jet Asia Airways	JAA	JF	JET ASIA
12) Siam Air	RBR		SIAM AIR
13) Thai Vietjet Air	TVJ	VZ	THAIVIET JET
14) Asia Atlantic Airlines	AAQ	HB	ASIA ATLANTIC
15) Skyview Airways	RCT	RK	GREEN SKY
16) Sabaidee Airways		VZ	

CHARTER AIRLINES

AIRLINE	ICAO	IATA	CALL SIGN
1) Thai Aviation Service	TSL		
2) United Offshore Aviation			
3) Kan Air	KND	K8	KANNITHI AIR
4) SFS aviation	SIC		
5) MJets	MIN		
6) Flying media			
7) Siam land flying			
8) Thai Flying service	TFT		Thai Flying
9) Advance Aviation	AAX		Advance Aviation
10) AC Aviation (Bangkok Jets)	ACJ		Sinojet
11) Air inter transport (Budget Lines)	BGN	BN	Skybuddy
12) Advance Aviation Jet	AJV		Lee Jet
13) Minebea Aviation			
14) Heliluck Aviation			
15) HS Aviation	HSN	HP	Jaguar
16) Bangkok Helicopter Services	BHD		Bangkok Dusit
17) Rabbit Wings Airways			
18) AAS	SPY		
19) VIP JETS			
20) RPS System	GBJ		Global Jet
21) Thai Sky Adventure			
22) Royalskyways			
23) Siam Airnet			
24) Sriracha Aviation			

[6] PRIVATE JET SERVICE

CHARTER AIRLINES

AIRLINE	ICAO	IATA	CALL SIGN
1) K-Mile Air	KMI	8K	KAY-MILE AIR
2) Thai Express Air	TXZ	EX	Thai express Air

SOME DETAILS OF THE MAIN AIRLINES OPERATING IN THAILAND

The table below shows the ranking of the 10 largest airlines in terms of number of passengers per year

NAME OF AIRLINE	NATIONALITY	NUMBER OF PASSENGERS PER YEAR	AIRLINE TYPE
1) Thai AirAsia	Thailand	25,610,116	Low cost
2) Thai Airways International	Thailand	21,162,746	Legacy
3) Nok Air	Thailand	15,339,604	Low cost
4) Thai Lion Air	Thailand	14,255,752	Low cost
5) Bangkok Airways	Thailand	9,502,249	Legacy
6) Thai Smile Airways	Thailand	7,957,979	Low cost
7) Emirates	United Arab Emirates	2,383,919	Legacy
8) AirAsia	Malaysia	1,898,966	Low cost
9) Cathay Pacific Airways	Hong Kong (sar) China	1,755,215	Legacy
10) China Southern Airlines	China	1,681,057	Legacy

Source: CAAT Database and Air Transport Statistic information from International Institute for Trade and Development (Public Organization), 2016

EXISTANCE OF LOW COST COMPANIES

Impact on international and domestic market in 2014

INTERNATIONAL MARKET IN 2014

LEGACY AIRLINES

Airlines	Number of Passengers	Percentage
Thai Airways International	13,294,860	62.98%
Bangkok Airways	1,053,853	4.99%

SHARE ON THE MARKET Total = 67.97%

LOW COST AIRLINES

Airlines	Number of Passengers	Percentage
Thai Air Asia	4,414,815	20.91%
Thai Smile	1,027,394	4.87%
Nok air	208,985	0.99%
Orient Thai Airlines	726,528	3.44%
Thai Air Asia X	258,033	1.22%
Thai Lion Air	72,578	0.34%
City Airways	52,557	0.25%

SHARE ON THE MARKET Total = 32.02%

DOMESTIC MARKET IN 2014

LEGACY AIRLINES

Airlines	Number of Passengers	Percentage
Thai Airways International	7,232,511	19.67%
Bangkok Airways	4,749,131	12.92%

SHARE ON THE MARKET Total = 32.59%

LOW COST AIRLINES

Airlines	Number of Passengers	Percentage
Thai Air Asia	10,712,359	29.13%
Thai Smile	662,401	1.80%
Happy air	5,909	0.02%
Nok air	9,871,269	26.85%
Orient Thai Airlines	103,019	0.28%
Thai Air Asia X	103,019	0.28%
Thai Lion Air	3,329,880	9.06%

SHARE ON THE MARKET Total = 67.42%

Source: Adapted from “Annual Traffic Report”, Airports of Thailand Public Company Limited, 2014

Impact on international and domestic market in 2015

INTERNATIONAL MARKET IN 2015

LEGACY AIRLINES

Airlines	Number of Passengers	Percentage
Thai Airways International	14,530,935	62.62%
Bangkok Airways	1,154,486	4.97%

SHARE ON THE MARKET Total = 67.59%

LOW COST COMPANIES

Airlines	Number of Passengers	Percentage
Thai Air Asia	5,067,005	21.83%
Thai Air Asia X	834,280	3.60%
Orient Thai Airlines	996,327	4.29%
Nok Air	397,942	1.71%
Siam Air Transport	225,272	0.97%

SHARE ON THE MARKET Total = 32.4%

DOMESTIC MARKET IN 2015

LEGACY AIRLINES

Airlines	Number of Passengers	Percentage
Thai Airways International	6,043,491	13.09%
Bangkok Airways	5,151,714	11.16%

SHARE ON THE MARKET Total = 24.25%

LOW COST COMPANIES

Airlines	Number of Passengers	Percentage
Thai Smile	3,921,390	8.49%
Thai Flying Services	2,869	0.01%
Thai Air Asia (Transit only)	13,017,370	28.19%
Nok Air	10,724,368	23.23%
Thai Lion Airlines	7,140,857	15.47%
Orient Thai Airlines	86,567	0.19%
Skyview Airways	84,906	0.18%

SHARE ON THE MARKET Total = 75.76%

Source: Adapted from “Annual Traffic Report”, Airports of Thailand Public Company Limited, 2015

COMMERCIAL AIRPORTS

AIRPORTS WITH INTERNATIONAL ROUTES

AIRPORT	CITY SERVED	ICAO	IATA	OPERATOR
1) Phuket International Airport	Phuket	VTSP	HKT	AOT
2) Suvarnabhumi Airport	Bangkok	VTBS	BKK	AOT
3) Chiang Mai International Airport	Chiang Mai and Lamphun	VTCC	CNX	AOT
4) Don Mueang International Airport	Bangkok and Nonthaburi	VTBD	DMK	AOT
5) Hat Yai International Airport	Hat Yai, Songkhla	VTSS	HDY	AOT
6) Mae Fah Luang Chiang Rai International Airport	Chiang Rai	VTCT	CEI	AOT
7) Samui Airport	Ko Samui	VTSM	USM	Bangkok Airways
8) Trat Airport	Trat	VTBO	TDX	Bangkok Airways
9) Buriram Airport	Buriram	VTUO	BFV	DOA
10) Nakhon Ratchasima Airport	Nakhon Ratchasima (Khorat)	VTUQ	NAK	DOA
11) Narathiwat Airport	Narathiwat	VTSC	NAW	DOA
12) Phitsanulok Airport	Phitsanulok	VTPP	PHS	DOA
13) Ranong Airport	Ranong	VTSR	UNN	DOA
14) Surat Thani Airport	Surat Thani	VTSB	URT	DOA
15) Chumphon Airport	Chumphon (Pathio, Pathiu)	VTSE	CJM	DOA
16) Hua Hin Airport	Hua Hin, Prachuap Khiri Khan	VTPH	HHQ	DOA
17) Krabi Airport	Krabi	VTSG	KBV	DOA
18) Mae Sot	Tak	VTPM	MAQ	DOA
19) U-Tapao International Airport	Rayong/ Pattaya	VTBU	UTP	Royal Thai Navy

Source: CAAT Database, 2016

AIRPORT WITH DOMESTIC ROUTES

AIRPORT	CITY SERVED	ICAO	IATA	OPERATOR
1) Sukhothai Airport	Sukhothai	VTPO	THS	Bangkok Airways
2) Khon Kaen Airport	Khon Kaen	VTUK	KKC	DOA
3) Pattani Airport	Pattani	VTSK	PAN	DOA
4) Phetchabun Airport	Phetchabun	VTPB	PHY	DOA
5) Phrae Airport	Phrae	VTCP	PRH	DOA
6) Roi Et Airport	Roi Et	VTUV	ROI	DOA
7) Sakon Nakhon Airport	Sakon Nakhon	VTUI	SNO	DOA
8) Tak Airport	Tak	VTPT	TKT	DOA
9) Trang Airport	Trang	VTST	TST	DOA
10) Ubon Ratchathani Airport	Ubon Ratchathani	VTUU	UBP	DOA
11) Udon Thani Airport	Udon Thani	VTUD	UTH	DOA
12) Lampang Airport	Lampang	VTCL	LPT	DOA
13) Loei Airport	Loei	VTUL	LOE	DOA
14) Mae Hong Son Airport	Mae Hong Son	VTCH	HGN	DOA
15) Mae Sariang Airport	Mae Hong Son	VTCS		DOA
16) Nakhon Phanom Airport	Nakhon Phanom	VTUW	KOP	DOA
17) Nakhon Si Thammarat Airport	Nakhon Si Thammarat	VTSF	NST	DOA
18) Nan Nakhon Airport	Nan	VTCN	NNT	DOA
19) Pai Airport	Pai, Mae Hong Son	VTCI	PYY	DOA

Source: CAAT Database, 2016

OTHER AIRPORTS[7]

AIRPORT	CITY SERVED	ICAO	IATA	OPERATOR
1) Pattaya Airpark	Pattaya	VTBF		
2) Phi Phi Island Airport	Phi Phi Island, Krabi		PHZ	
3) Phuket Airpark	Phuket	VTSW		
4) Photharam Airport	Photharam, Ratchaburi	VTPR		
5) Ban Thi Airport (Lanna Airfield)	Chiang Mai	VTCM		
6) Rob Muang Airport	Roi Et	VTUR		
7) Bhumibol Dam Airport Bhumibol Dam Airport)	Tak, Bhumibol Dam	VTPY		
8) Uttaradit Airport	Uttaradit	VTPU	UTR	
9) Watthana Nakhon Airport	Watthana Nakhon, Sa Kaeo	VTBW		
10) Old Chiang Rai Airport	Chiang Rai	VTCR		
11) Nakhon Ratchasima Airport	Nakhon Ratchasima (Khorat)	VTUQ	NAK	DOA
12) Pattani Airport	Pattani	VTSK	PAN	DOA
13) Phetchabun Airport	Phetchabun	VTPB	PHY	DOA
14) Surin Airport	Surin	VTUJ	PXR	DOA
15) Tak Airport	Tak	VTPT	TKT	DOA
16) Mae Sariang Airport	Mae Sariang, Mae Hong Son	VTCS		DOA
17) Nok Airfield	Chiang Mai	VTCY		Nok Aviation Flying Club
18) Khorat Air Force Base	Nakhon Ratchasima (Khorat)	VTUN		Royal Thai Air Force
19) Takhli Air Force Base	Nakhon Sawan	VTPI	TKH	Royal Thai Air Force
20) Prachuap Khiri Khan Air Force Base-Wing	Prachuap Khiri Khan	VTBP		Royal Thai Air Force Royal Thai Air Force
21) Kamphaeng Saen Airport	Nakhon Pathom	VTBK	KDT	Royal Thai Air Force
22) Khok Kathiam Air Force Base	Lopburi	VTBL	KKM	Royal Thai Army
23) Cha Eian Airport	Nakhon Si Thammarat	VTSN	NST	Royal Thai Navy
24) Chanthaburi Airstrip	Chanthaburi	VTBC		Sahaphatana Holding Co
26) Lamphun Airport	Lamphun	VTCO		Thai Flying Club
27) Bang Phra Airport	Chonburi	VTBT	QHI	

Source: CAAT Database, 2016

3.2 TRENDS OF THE AVIATION SECTOR IN THAILAND: PROBLEMS AND CHALLENGES

3.2.1 BACKGROUND SITUATION

As per Intergovernmental Panel on Climate Change (IPCC), aviation (domestic and international) accounts for approximately 2% of the global CO_2 emissions produced by human activity, and international aviation is responsible for approximately 1.3% of the global CO_2 emissions. It is undeniable that technological progresses have been registered heavily in the aviation sector. Aircraft is 80% more fuel efficient per passenger km than in the 1960s. However, forecasts clearly demonstrate that aviation emissions are growing and in the coming decades they are supposed to grow at higher rate. The energy demand of aviation will grow 3–5 % per year over the coming decades as populations and economic activity increase. For example, India's aviation sector is expected to become the third largest worldwide by 2020 and the largest by 2030 (FICCI-KPMG 2016).

About 3.6 billion people[8] travel by plane each year, covering over 5,000 billion passengers-kilometres per year. That number is approximately one third the number of passenger-kilometres made by passenger cars today. CO_2 from aviation sector is accountable for 2–3 % of the total global energy-related CO_2 emissions. This portion is expected to grow over the coming decades as the aviation sector grows. Tickets become cheaper and people can afford more trips. When expressed in terms of passenger-kilometres, planes use slightly more energy than an average passenger car because they carry significantly more passengers in a single trip and move at faster speeds.

Almost all energy use originates from fossil fuels. Therefore, global CO_2 emissions in aviation will play a key role in meeting the international climate targets set forth in the 2015 Paris Agreement, even though the document does not specifically mention aviation emissions.

Many airlines, aircraft manufacturers and industry associations have committed to voluntary, aspirational targets that would collectively achieve carbon-neutral growth by 2020 and a 50 % reduction in GHG emissions by 2050 (relative to 2005 levels)[9].

[7] commercial airports without scheduled services, military airports, and airports and airstrips for general aviation
[8] Cfr. IRENA REPORT 2017
[9] Cfr. IRENA REPORT 2017

the Assembly, WP A39, session 55, based on CAEP, international aviation fuel consumption is estimated to grow between 2.8 to 3.9 times by 2040 compared to the 2010 levels.

In the past, Thailand's aviation industry was affected by various factors such as the world economy and political instability. Although numbers of passengers and cargo dropped over some periods, the aviation industry in Thailand has continued to grow afterwards.

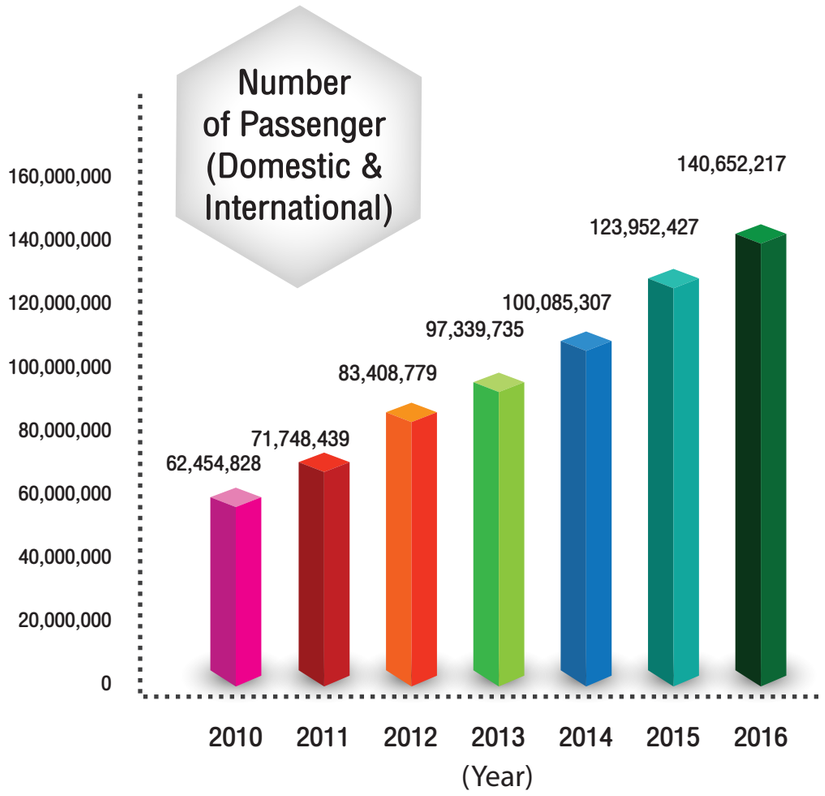


Figure 1: Number of passengers, from 2010 to 2016

Source: CAAT Database, 2017

Figure 1 illustrates statistics of passengers (domestic and international) from 2010 to 2016. In 2010, there were 62,454,828 passengers; while in 2016 this number is more than doubled, registering an increase of 78,197,389. The number of passenger stalled between 2013 and 2014; there were only 2,745,572 more passengers in 2014 than those of 2013. This figure is, however, impressive in itself considering the economic growth at the time was very weak globally and beyond the crisis level for developed countries, emerging market and developing countries.

This positive trend is a clear sign of a strong and growing sector which has not been deeply affected by the worldwide financial crisis and political uncertainty due to social and geopolitical instability across the world.

The number of international passengers rose back to 50,214,322 in 2014 but this number reflects the dominant worldwide feeling of fear linked to geopolitical tensions. Nevertheless, this minus (–) 4,696,143 in 2014 did not cause any real decline for the sector as the negative trend in international aviation was compensated by the increase in the domestic sector, and the balance at the end of 2014 was still a positive one. Moreover, this slight decline in the international sector was compensated by the increase in the number of domestic passengers registering a value in the plus, compared to 2013 by the end of the year.

In addition, in 2015 the value turnaround represents the strong potentiality linked to this growing sector recording a + 11,452,441 in 2015 and a + 8,914,062 in 2016 compared to 2015 value. (figure 2)

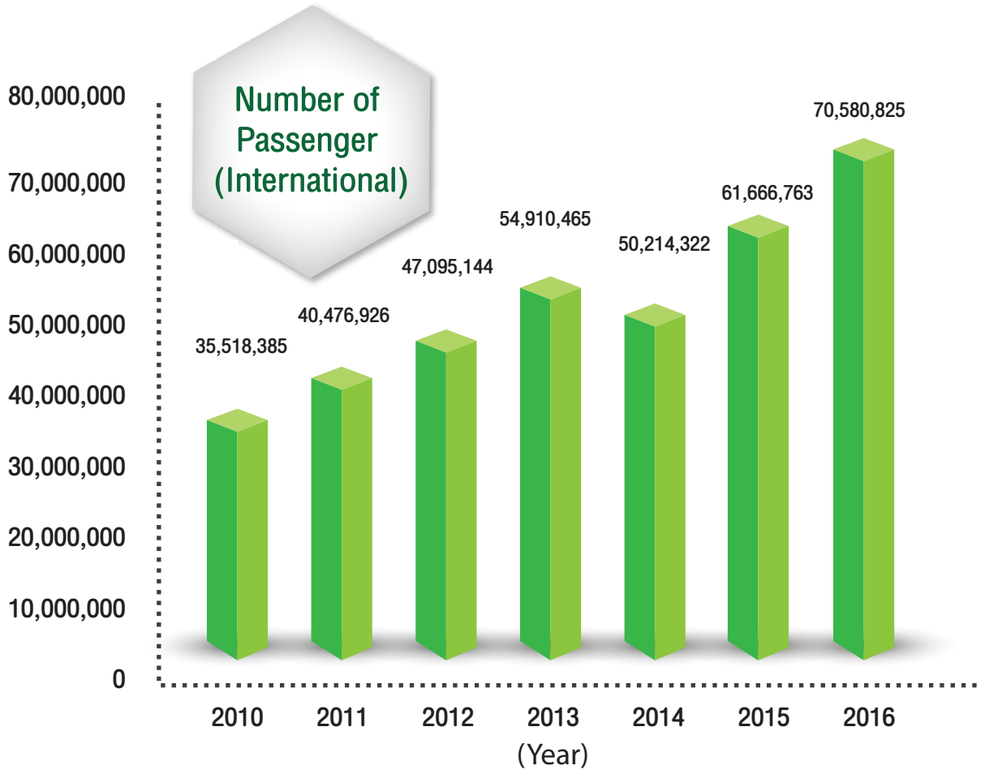


Figure 2: Number of passengers (international), from 2010-2016

Source: CAAT Database, 2017

Table 1: Number of flights for air cargo operated from 2010-2016

YEAR	2010	2011	2012	2013	2014	2015	2016
Inter schedule	10,601	11,899	11,622	9,756	9,624	8,693	8,756
Inter non-schedule	401	238	409	118	248	164	349
TOTAL	11,002	12,137	12,031	9,874	9,872	8,857	9,105
Domestic schedule	No Freighter Aircraft operate domestically						
Domestic non-schedule							
TOTAL	N/A						

Source: "Annual Traffic Report" Airports of Thailand Public Company Limited, 2009-2016

It is clear from Table 1 that the cargo sector had been affected more heavily from the worldwide crisis in comparison to the previous values of number of passengers. The flow of passengers has never shown a real decrease for both domestic and international sectors, the same cannot be said for the air cargo sector. The number of flights decreased from 11,002 in 2010 to 9,105 in 2016, which is 1,897 in 6 years. Nevertheless, there was a recovery sign from 2015 to 2016.

Table 2: Number of passengers and number of air cargos operated from 2010-2016

B.E.	A.D.	Number of passenger (Dom & Int)	Number of passenger (Int)	Numbers of Air Cargo (Int)
2553	2010	62,454,828	35,518,385	11,002
2554	2011	71,748,439	40,476,926	12,137
2555	2012	83,408,779	47,095,144	12,031
2556	2013	97,339,735	54,910,465	9,874
2557	2014	100,085,307	50,214,322	9,872
2558	2015	123,952,427	61,666,763	8,857
2559	2016	140,652,217	70,580,825	9,105

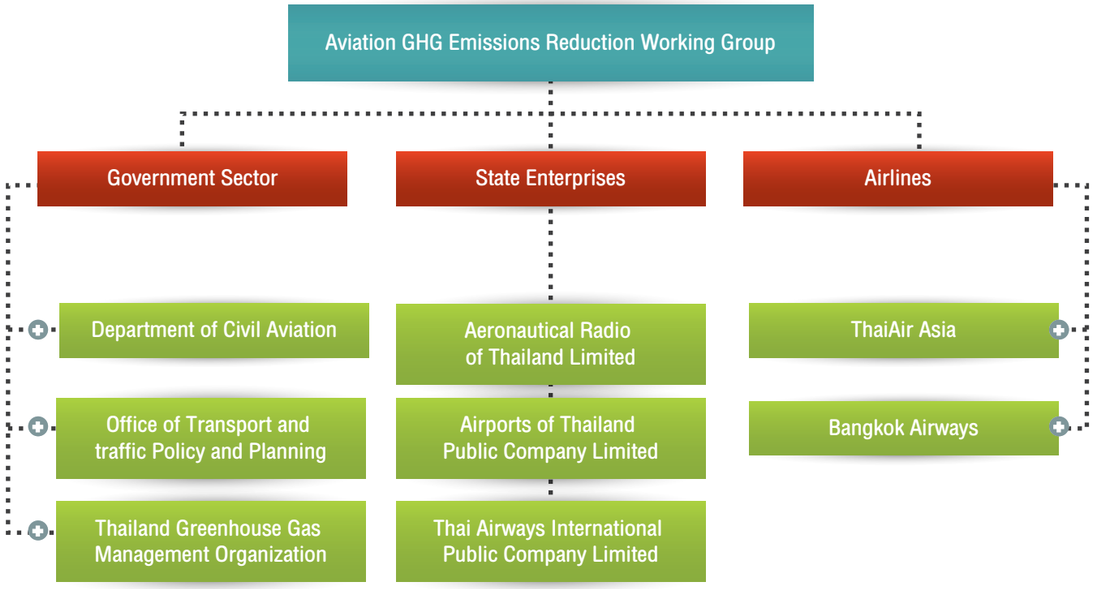
Source: “Annual Traffic Report” Airports of Thailand Public Company Limited, 2009-2016

3.2.2 PROBLEMS

In respect of emissions reduction in the aviation sector, the roles and responsibilities of DCA were fixed as a consequence of the Resolution A37-19 adopted by ICAO’s 37th Assembly in 2010. This was an important step towards a sustainable air transport future and made international aviation the first sector with global aspirational goals of improving annual fuel efficiency by 2 percent and stabilizing its global CO_2 emissions at 2020 levels.

The Assembly consequently encouraged action plans by States and other parties involved to limit or reduce international aviation emissions.

In order to support ICAO’s ongoing efforts to address international aviation’s contribution to climate change, Aviation GHG Emissions Reduction Working Group (AGERWG) was established in 2011 to develop Thailand’s Action Plan on Emissions Reduction (APER). The Working Group was headed by DCA and included representatives from the Office of Transport and Traffic Policy and Planning (OTP), the Thailand Greenhouse Gas Management (TGO), the Aeronautical Radio of Thailand Limited (AEROTHAI), the Airports of Thailand Public Company Limited (AOT), Thai Airways International Public Company Limited (Thai Airways), Thai AirAsia Co., Ltd. and Bangkok Airways Co., Ltd. The template below clarifies the working group composition as well as the status of each involved stakeholder.



In line with the broad international consensus, the Working Group set a target of average annual improvements in aviation fuel efficiency of at least 2 percent per year until 2020 from a 2005 baseline, measured in litres of fuel per Revenue Tonne Kilometres (RTK). The Working Group tracked statistics and developed a model to calculate RTK, fuel consumption and forecasted RTK. Moreover, the Working Group adopted the basket of measures provided by ICAO to be regarded and considered as guidelines for sectoral stakeholders, pointing out the importance of developing voluntary measures such as aircraft-related technology development, improved air traffic management and infrastructure use, more efficient operations and similar.

The MBMs were drafted considering principles and requirements as per Chicago Convention[10] and UNFCCC[11] . However, due to the problems mentioned in the previous part of the text and after the official establishment of CAAT, the aviation emissions reduction working group (AERWG) was not restructured. Therefore, in order to fill in these gaps, to avoid overlapping of same fora discussing on the same topics and to develop a real coordinated approach to the sector, CAAT has intensified its cooperation inside the existing subcommittee under PM framework and in particular with the one on Climate Change and Policy and Planning integration, working group on mitigation planning, sector Energy and Transport. Below the structure[12] as developed under MNRE, ONEP.

[10] IMF, World Economic Outlook-WE0- legacies, clouds, uncertainties, October 2014' "Largely due to weaker-than-expected global activity in the first half of 2014, the growth forecast for the world economy has been revised downward to 3.3 percent for this year, 0.4 percentage point lower than in the April 2014 World Economic Outlook (WEO). The global growth projection for 2015 was lowered to 3.8 percent. Downside risks have increased since the spring. Short- term risks include a worsening of geopolitical tensions and a reversal of recent risk spread and volatility compression in financial markets. Medium-term risks include stagnation and low potential growth in advanced economies and a decline in potential growth in emerging markets."

[11] the principles of non-discrimination and equal and fair opportunities

[12] Principle of common but differentiated responsibilities and respective capabilities

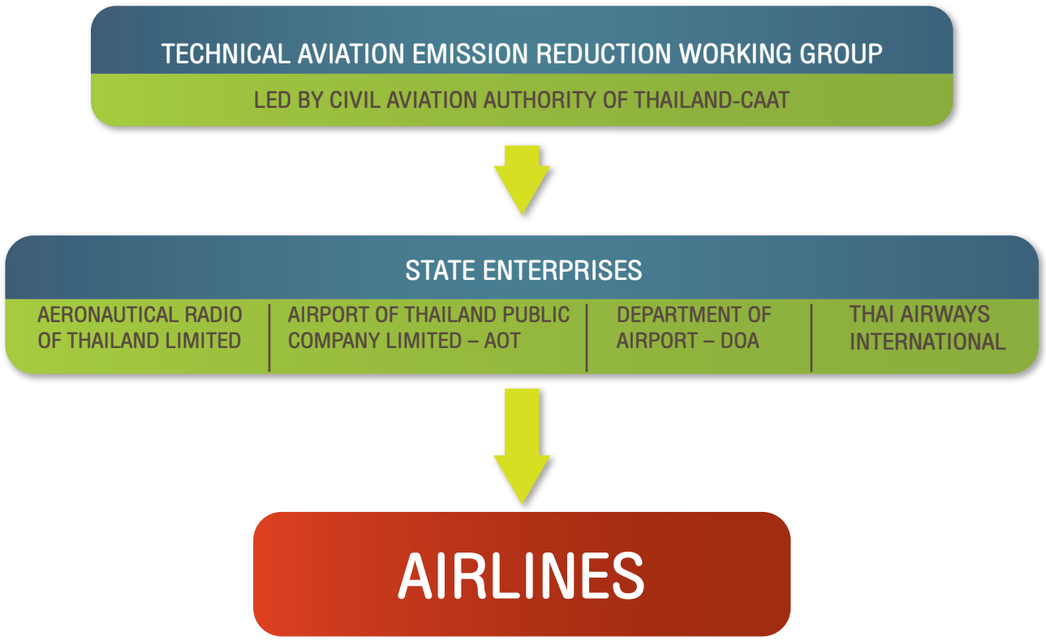


Figure 4: new structure of technical aviation emissions reduction working group, CAAT

3.2.3 CHALLENGES

With multiple present and future tasks, it faces, CAAT is well aware that they are manageable through real cooperation and daily interaction between the private and public interests. The Authority expects to lead the growth of the aviation industry and guide it with sustainability concepts and Thai culture.

In particular, the following challenges will be overcome:

- Reviewing and improving the level and the quality of the existing measures to ensure success;

- Outlining the means and tools to measure success and failure;

- Solving disputes between sector stakeholders' daily business practice according to Thailand's environmental and climate change obligations towards ICAO and UNFCCC;

- Supporting the aviation industry's efforts required to achieve the greatest enhancement in terms of GHG emissions reduction and efficiency increase;

- Encouraging a new operating culture that is efficient and environmental-friendly for stakeholders, finding the best measures for both fuel efficiency and safety;

- Organizing sessions to educate and raise awareness, at both private and public levels, to emphasize the importance of maintaining environmental friendliness in daily business practice.

04
Baseline And Expected Results

4.1 INTRODUCTION

The construction of a baseline scenario[13] is required in analyses and prospective studies aiming at comparing different possible future situations. Many criteria have to be taken into account to build such scenarios, from socio-economical to environmental aspects. Each assessment builds its own baseline scenario, not really based on a strict common methodology but rather on similar key components to respect.

IMPORTANCE OF A RELIABLE BASE LINE: For the purpose of GHG emissions reduction assessment, a project, a measure, or a policy, has to demonstrate how it reduces emissions compared to a baseline. The basic steps to developing a baseline and demonstrating this comparison are the followings: establishing a variety of potential scenario options; characterizing one of these options as the most likely (i.e. the baseline); and proving that the project itself is not the most likely scenario (i.e. demonstrating additionality). The baseline provides the basis for determining whether GHG emissions from a project are lower or greater than the emissions in the absence of that project. It is thus crucial to build a credible baseline scenario in order to avoid a misleading idea of the real mitigation impact of a project/measure.

EXISTING SITUATION: GHG emissions from domestic aviation have never been calculated as per methodologies suggested by IPCCC guidelines and they have never been included in the analysis of the transport sector.

Existing GHG emissions from international aviation were calculated using aggregated methodology as per ICAO, but due to various aforementioned problems, most of the data were not complete and accurate. Therefore, data on fuel consumption were extrapolated from ICAO M-Form submitted by most airlines.

CAAT realizes how pivotal its role is to systemically review and analyze all the existing records to achieve a truthful GHG data assessment, and to create a reliable aviation's emissions database. Baseline have been constructed to define a starting point and forecast projects through accurate and verified data. This will allow assessing existing situations and the impacts of the suggested mitigation measures introduced in the sector to support ICAO's aspirational goals.

[13] Scenario building consists of defining a set of possible alternatives that could reasonably happen from a starting point to a final point, occurring in the future.

4.2 RATIONALE OF EXISTING DATA

A) RTK calculation

- Passengers carried x Flight Distance x 100kg/1000 = Passenger tonne/km -PTKM-
- Freight tonne carried x Flight Distance = Freight tonne/km -FTKM-
- Mail tonne carried x Flight Distance = Mail tonne/km -MTKM-

B) CO_2 calculation

- Amount of fuel burn x emission factors

4.3 TREND IN AIR TRAFFIC STATISTICAL DATA AND GHG ESTIMATION

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

Table 3: Fuel burn, RTK, fuel consumption efficiency (FB/RTK) and CO_2 emissions during 2010 –2016

Year	Fuel Burn (FB)		RTK	FB/RTK		CO_2 Emission
	(LITRE)	Tonnes	thousand (Tonnes×km)	LITRE/RTK	kg/RTK	Tonnes
	[A]	[B]	[C]	[D] = [A]/[C]	[E] = [B][1,000]/[C]	[F] = [B] x 3.16
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	8,766,787	0.4079	0.3263	9,010,375
2013	3,456,980,863	2,765,585	9,686,980	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 airlines and CAAT calculation using no. of flights (D/A) from airport operators, considering AOC's nationalities

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

[14] These numbers were not available in the M forms and the values have been established usingsurrogate methods.

Revenue Tonne Kilometres is considered a part of the routine statistics compiled by air carriers in Thailand and air carrier reports are the main source of traffic data and RTK.

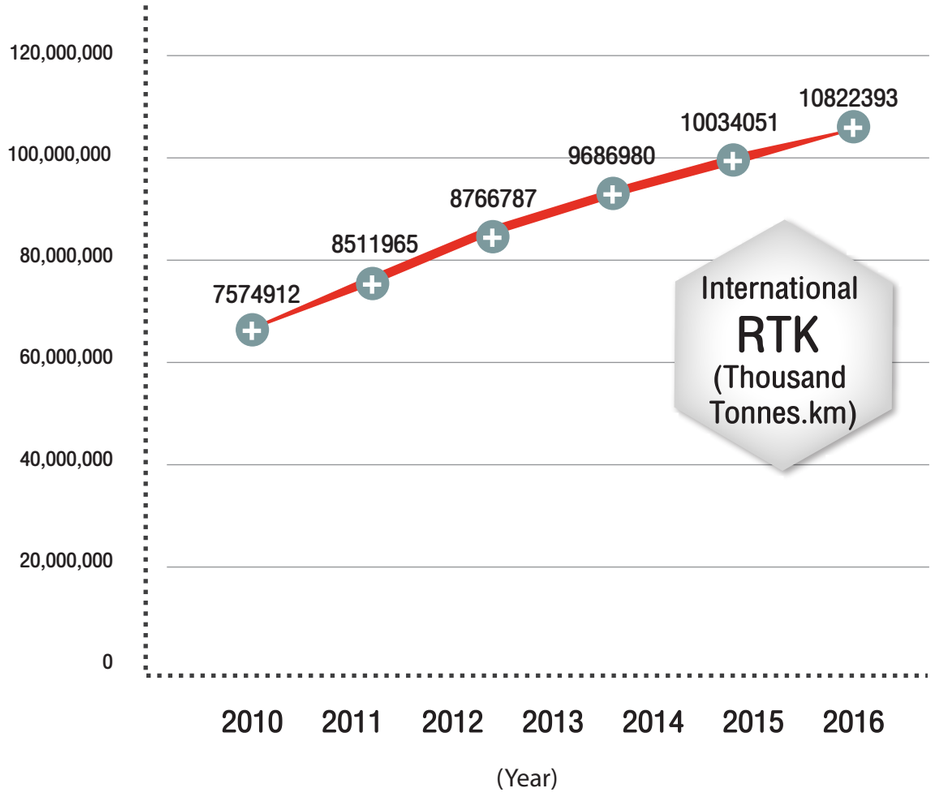


Figure 5: International Revenue Tonne Kilometres (RTK) during 2012 – 2016

The constant growth of RTK reflects an intense increase in international air traffic during the 2010 - 2016 period. It should be noted that worldwide economic recession and political instability affecting the country at the time may have been a factor in the decrease of RTK in 2014.

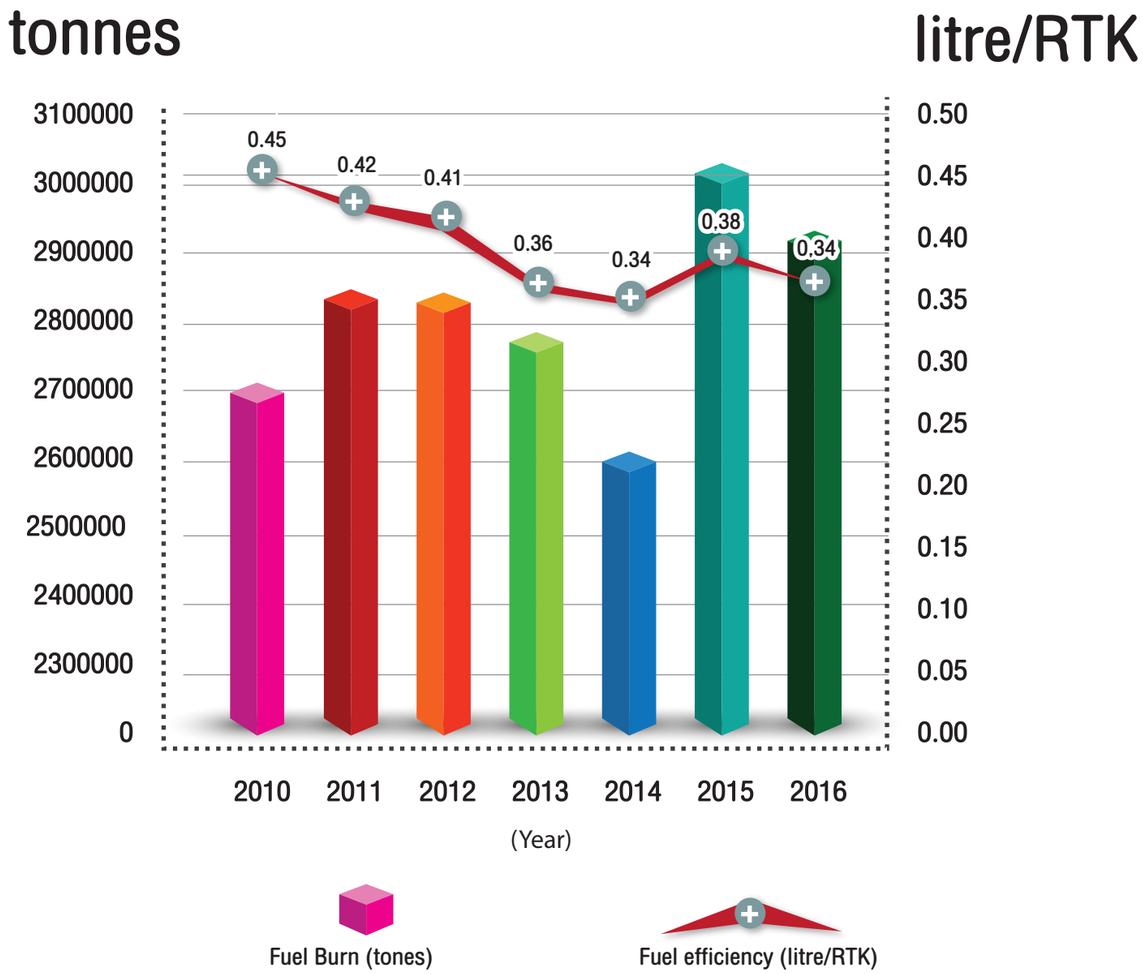


Figure 6: Fuel consumed (tonnes) and fuel consumption efficiency (litre/RTK) during 2010 -2016

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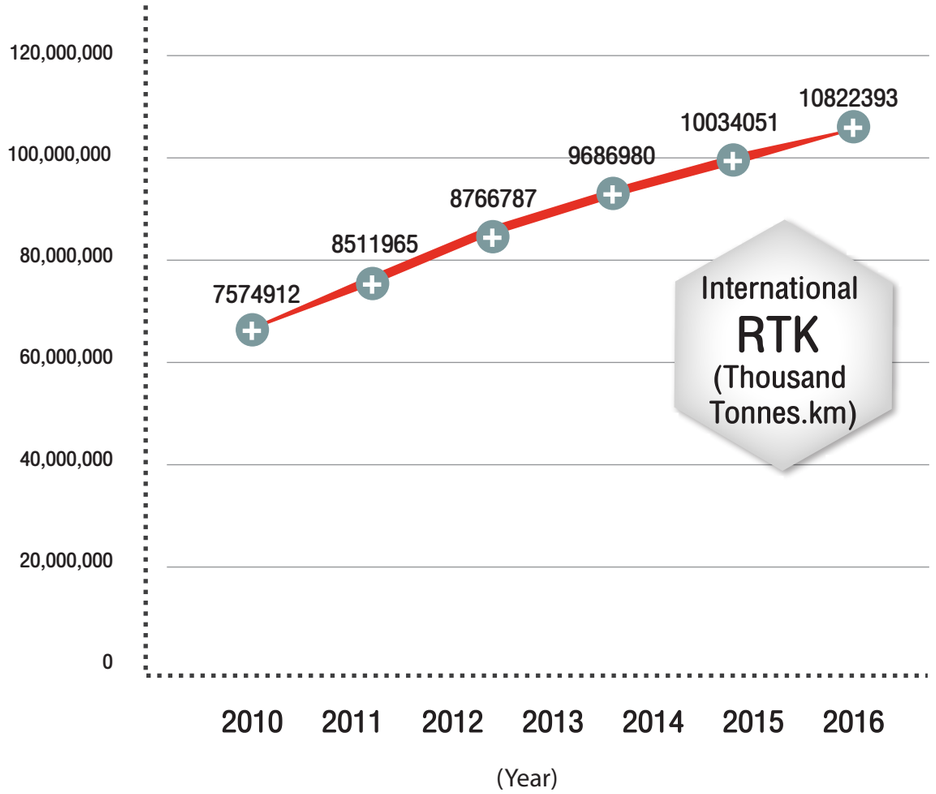

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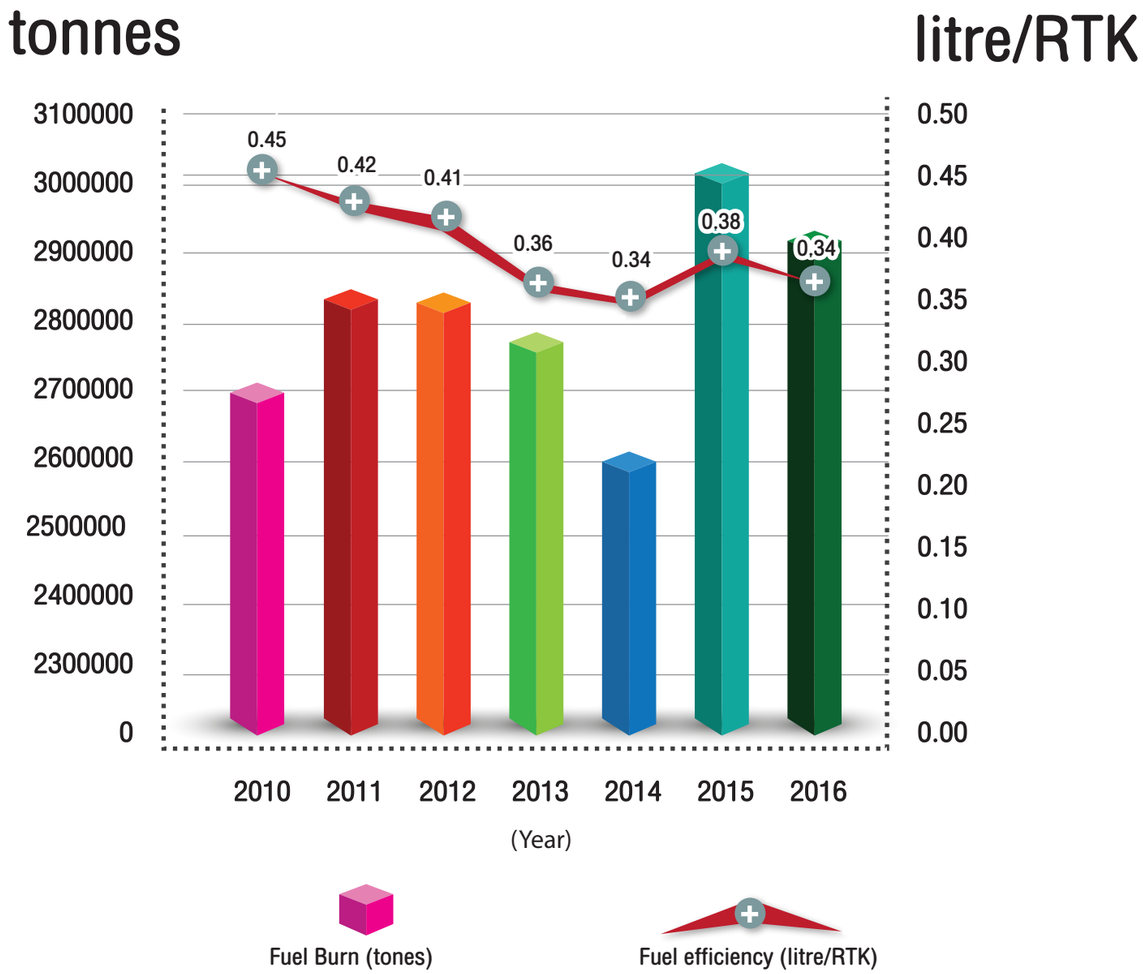

Figure 6: Fuel consumed (tonnes) and fuel consumption efficiency (litre/RTK) during 2010 -2016

Figure 6 shows the evolution of the fuel consumption in the international operations of airlines in Thailand from 2010 to 2016. The vertical bars represent the annual fuel consumptions for these operations, while the points on the horizontal ones indicate the fuel efficiency by RTK per year.

The calculation of the fuel efficiency is based upon the fuel consumption per weight transported (paying passengers and cargo) and distance flown.

Comparing 2016's figures to those of 2010, airlines in Thailand have improved their fuel efficiency by 25 percent, meaning a plus (+) 4.2 percent towards the average annual improvement, while the fuel consumption increased by 5.8% in 2016. This result can be partially considered as the logical consequences of policies adopted by some international airlines to opt for new generation of aircrafts. For example, Thai Airways decided to buy Boeing 787 and Airbus A380 to be able to transport a higher number of passengers per flight in comparison to the previous models, and therefore capable of reducing emissions, increasing efficiency in terms of fuel burn and fuel consumption, and producing stronger effects and benefits for the whole aviation sector.

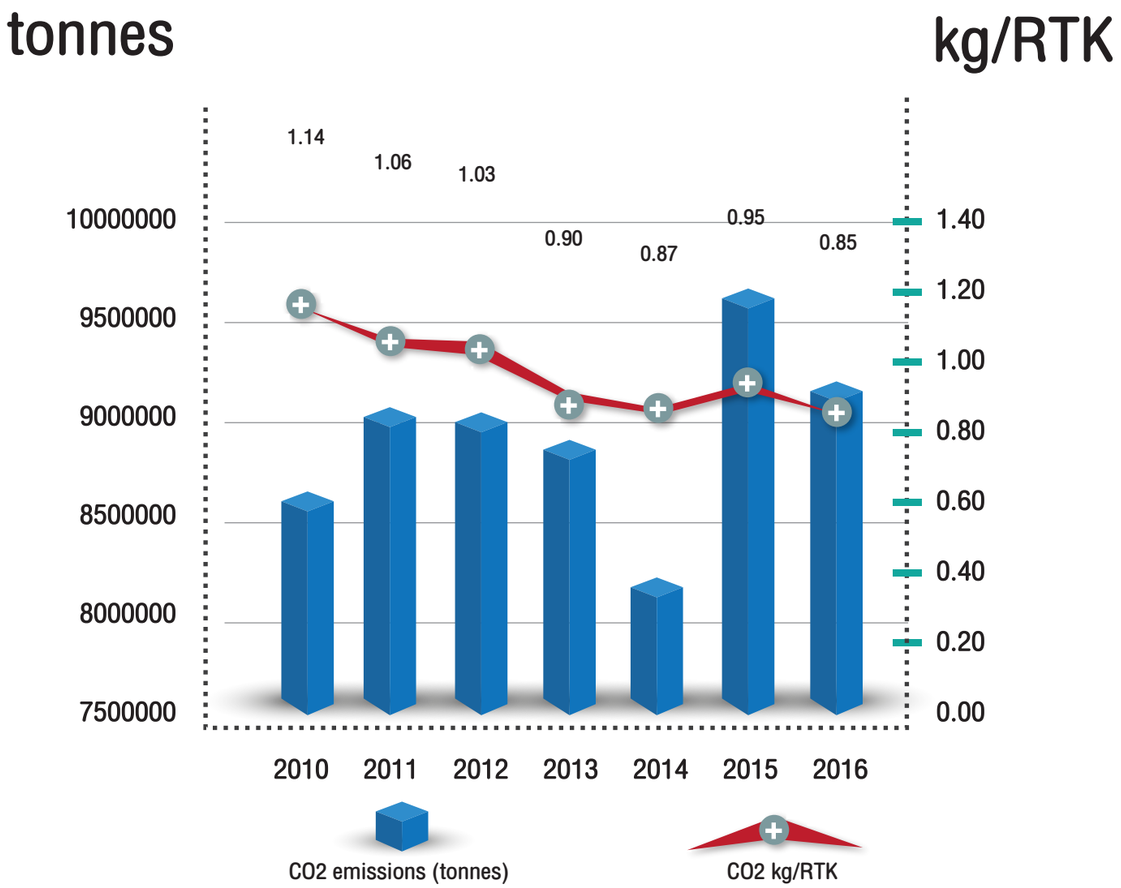

Figure 7: Greenhouse gas emission during 2010 – 2016

Figure 7 presents the GHG emissions trend for Thailand's international aviation industry during the period of 2010 to 2016. The calculation of GHG emissions intensity is based upon the emissions per kilometre flown and per total tonnes of passengers, freight, and mail transported.

From the figure above, it emerges that from 2010 to 2016 a relevant increase of emissions volume up to 5.7% was registered and, at the same time, a reduction in terms of emissions intensity equal to 25.4% was featured.

4.4 BASELINE DEFINITION

Baseline plays a pivotal role in each country's GHG emissions reduction efforts as the baseline scenario can point out how GHG emissions are likely to develop over time under certain given conditions. It shows, in terms of their efforts, where the sector is and will be in a certain number of years.

A dedicated system is set up using a baseline scenario to compare and verify the competence of the measures, giving the Authority an opportunity to make necessary adjustments to resolve the complications.

4.4.1 DEFINITION OF DOMESTIC AND INTERNATIONAL AVIATION

The traffic and fuel consumption data of a flight can be different depending on its flight stage.

According to ICAO, a flight stage is defined as the operation of an aircraft from take-off to its next landing. A flight is classified as international or domestic based on the following definitions:

International: A flight stage with one or both terminals in the territory of a State, other than the State in which the air carrier has its principal place of business.

Domestic: A flight stage not classifiable as international. Domestic flight stages include all flight stages flown between points within the domestic boundaries of a State by an air carrier whose principal place of business is in that State.

Flight stages between a State and territories belonging to it, as well as any flight stages between two such territories, are classified as domestic.

The Action Plan presents information concerning fuel consumption, GHG emissions and other relevant statistical data on international operations, as requested by ICAO.

4.4.2 METHODOLOGY

The amount of CO_2 emitted during the combustion of fuels is calculated by multiplying the amount of fuel burned by the appropriate emission factor. In order to estimate the CO_2 emissions resulting from the combustion of jet fuel, the emission factor of the ICAO Carbon Emissions Calculator methodology (3.160 kg CO_2/kg fuel) was used.

Emissions generated by the largest carriers were calculated using the aggregated methodology; for airlines not reporting through M-form, the disaggregated one was considered. (See para. 4.3 Estimation of completeness and time series.)

BASELINE as a result of Total Revenue Tonne Kilometre (Total RTK) is the total tonnes of passengers, freight, and mail carried (revenue load) multiplied by distance flown.

FORMULAS LEADING TO BASELINE:

Passengers carried x Flight Distancex100kg/1000 = Passenger tonne/km -PTKM-

Freight tonne carried x Flight Distance = Freight tonne/km -FTKM-

Mail tonnes carried x Flight Distance = Mail tonne/km -MTKM-

The Rate of Efficiency is an indicator of the efficiency of fuel usage per each tonne of revenue load carried (passengers, freight and mail).

Formula used:

$$\text{Fuel effciency} = \frac{\text{Volume of fuel}}{\text{RTK}}$$

4.5 QUALITY OF DATA

The quality of aviation sector data is affected mainly by two issues:

A) LACK OF COMPLETENESS

B) TIME SERIES CONSISTENCY

From 2010 to 2016, the available data of Thai aviation sector were not sufficiently comprehensive or accurate. The main reason for some of the airlines[15] was lack of experience in handling and submitting the proper M-Form (The form is used by ICAO Member States to report fuel consumption and traffic statistics). To work around these issues, the following approaches were used:

FIRST: To cover the data gaps from 2010 to 2012, general assumptions were made based on the adjusted fuel consumption numbers of the years 2014 to 2016. Specifically, the average increase of fuel consumption registered each year from 2014 to 2016 was used as a parameter to calculate the average fuel consumption of airlines not reporting[16] through M-Form, using the following formula:

[Average increased % of fuel consumption for carriers without M-Form / Fuel consumption per each of the carriers with M-Form, as estimated by DCA, per year * 100] + Fuel consumption per each of the carriers with M-Form, as estimated by DCA, per year

[15] There were 10 airlines that did not submit, or submit M-Form incorrectly.
[16] Some airlines did not report at all; some only partially; and some submitted forms did not conform to the guidelines.

New data deriving from the adopted formula amending DCA previous assessment point out that the increase of fuel consumption of the carriers without M-Form is at approximately 5.7%. Therefore, the average contribution of the carriers without M-Form represents 5.4% of the total value of fuel consumption from 2014 to 2016 (Table 4)

Table 4: Contribution to fuel consumption of Thai carriers without M-Form, in percentage of the total value of fuel consumption in 2010 – 2016

Year	Contribution (%)
2010	5.40
2011	5.40
2012	5.40
2013	5.40
2014	5.58
2015	5.70
2016	4.90

SOURCE: CAAT database, 2017

SECOND: For 2013, no data were available and the surrogate method given in the Chapter 5 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories was used.

THIRD: For 2014 to 2016, missing data were calculated using ICAO Carbon Emissions Calculator and CAAT database as parameters:

- The annual information for flight stages extrapolated from CAAT's database, updated starting from 2014, and

- The distance flown (approximation by great circle distance)

In addition, the amount of fuel consumption each year can be calculated using ICAO Carbon Emissions Calculator Version 2.6 (2016).[17] This value shall be added to the annual fuel consumption as provided in M-Form submitted by sector stakeholders.

Therefore, through the implementation and the combination of the aforementioned approaches at aggregated and disaggregated levels, CO_2 estimations and the missing data of 2010 to 2016 were made complete. This procedure offers the framework for future operations where necessary data do not exist.

[17] According to APER website

B) TIME SERIES CONSISTENCY

It should be noted that in 2013, Thai Airways and Bangkok Airways, the two largest airlines of Thailand, lost massive data during a database migration, resulting in significant data gaps on that year. Due to this fact, in most of the companies' official documents submitted to the Authority prior to this action plan, the 2013 data were listed as N/A. This lack of information made the flow of data assessment difficult. However, Thai Airways, as Thailand's largest airline operator, periodically reports its emission data (fuel burn, RTK and ATK) to Thailand Greenhouse Gases Organization (TGO), these data were used for emission estimation of 2013.

In order to calculate the missing statistical data for 2013 and ensure time series consistency of the historical aviation data, the value corresponding to Thai airways' share in Thailand's overall aviation fuel consumption and other statistics from the 2014 to 2016 were used.

The applied calculation method is based on the surrogate technique specified in Chapter 5 of the 2006 IPCC Guidelines. The results show that this share remains at a constant level with the largest deviation of 4% for this period, indicating that this approach can be used to calculate missing statistical data (fuel burn, RTK, FB/RTK).

To verify the results emerging from the surrogate techniques as per IPCC Guidelines, the figures were cross-checked against available statistical indicators from the year 2014 (i.e. kg fuel burn per passenger). Ultimately, the additional analysis demonstrated a reasonable margin of accuracy.

[18] The CAAT database currently does not collect Revenue passenger-kilometers (RPK) statistics needed to develop indicators by passenger kilometers.
[19] The IPCC 2006 guidelines recommends comparison between results obtained with higher tier methods and fuel based method as the main QC procedure.

4.6 MONITORING/QUALITY CONTROL OF ESTIMATED EMISSIONS

ICAO Doc 9988 recommends that fuel consumption data shall be monitored using some of the existing quality control (QC) procedures.

To carry out QC procedures, C-Form (Traffic by flight stage - TFS) submitted by Bangkok Airways for the year 2016 as well as data on the total number of flight stages of different types of aircraft provided by Thai Airways were utilized. Along with the flight stage data, the accurate flight distances between the airport pair are also provided by Thai airways.

This data enables the calculation of CO2/fuel consumption using the ICAO Carbon Emissions Calculator and cross-checking the obtained figures with the fuel consumption data of the M-form . Comparing the results, differences of around 10 % are registered between the results obtained using the ICAO calculator and the fuel consumed from M-form.

These deviations are not absolutely unexpected, considering the fact that the ICAO calculator accounts the amount of fuel burn during the flight, while the M-form shows the value of the fuel uplift. CAAT will pay close attention to establishing a methodology for obtaining better quality data within the MRV system, as this is a major prerequisite for allowing CORSIA working.

4.7 FORECAST SCENARIOS IN THE ABSENCE OF MITIGATION MEASURES

The baseline for CO_2 emissions in international aviation represents the evolution of the fuel consumption and traffic from international aviation up to 2030 in the absence of mitigation measures (business as usual scenario). In case of Thailand, this was calculated using Method B (with available data from six years) as described in ICAO Doc 9988 and modelling with the Environmental Benefits Tool (EBT) provided by ICAO.

Prior to performing time series analysis, the best-fit trend line model types (i.e. linear, logarithmic, exponential, etc.) must be determined. Out of the available options, the logarithmic model appears to be the most suitable to the existing national context. After testing the models, the resulting correlation coefficient of annual fuel efficiency improvement -AFEI- proved that with linear model, the AFEI was 9.7 percent; with exponential model, the AFEI was around 4.53 percent; while with logarithmic model, it was 1.35%, indicating that the logarithmic default line can produce more realistic numbers than the others.

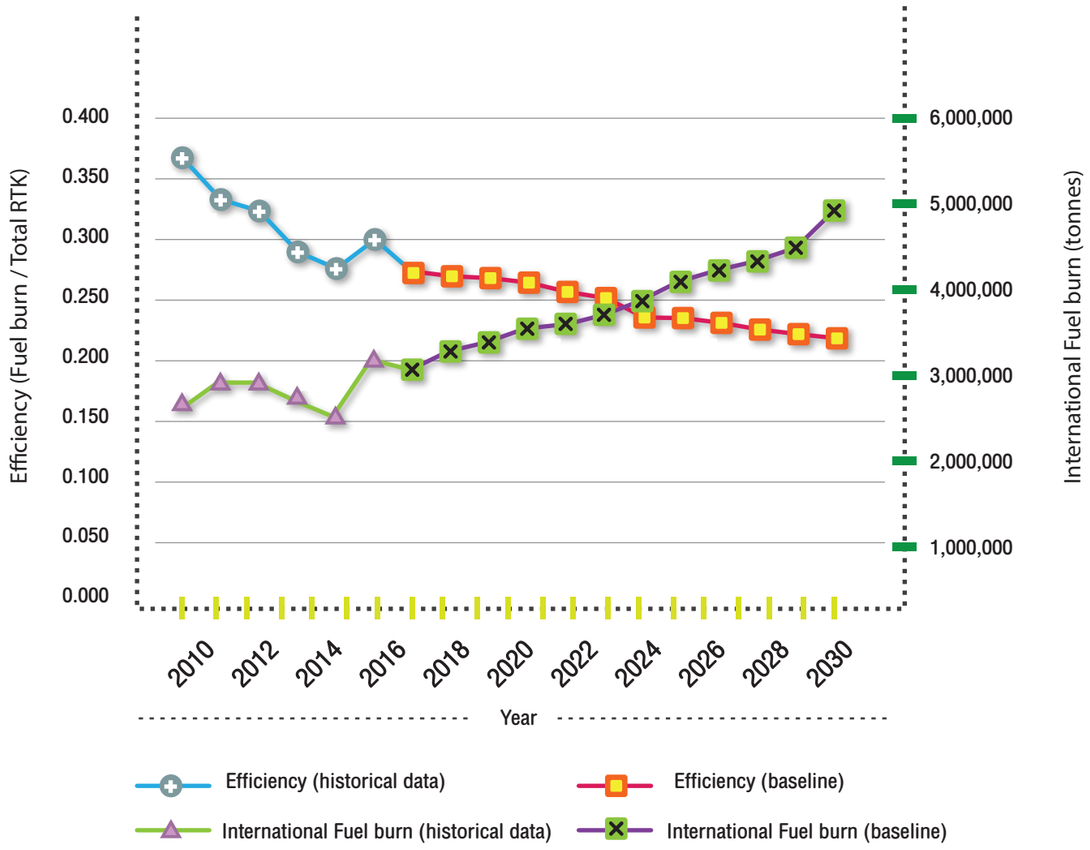

Figure 8: Historical trend and Forecast of consumption growth of jet fuel and fuel efficiency among the airlines with international flights (in tonnes) 2010–2030 of Thailand

The graphic shows increasing values registered in terms of Efficiency from 2010 to 2030.

Data from 2010 - 2016 in terms of RTK and international Fuel Burn are incorporated into the forecasting model as the explanatory variables to calculate the consumption growth and efficiency of 2017 to 2030.

Table 5: Thailand's forecast growth in RTK, Fuel efficiency and Fuel burn from 2017 to 2030

Year	International RTK (Thousand)	International Fuel Burn (Tonnes)	Efficiency (Fuel Burn/RTK)
2017	11,485,805.69	3,075,666.82	0.268
2018	12,189,885.58	3,196,457.18	0.262
2019	12,937,125.57	3,328,082.41	0.257
2020	13,730,171.36	3,470,344.93	0.253
2021	14,571,830.87	3,623,249.09	0.249
2022	15,465,084.10	3,786,944.12	0.245
2023	16,413,093.76	3,961,689.39	0.241
2024	17,419,216.40	4,147,832.60	0.238
2025	18,487,014.37	4,345,795.84	0.235
2026	19,620,268.35	4,556,066.59	0.232
2027	20,822,990.80	4,779,192.14	0.230
2028	22,099,440.13	5,015,776.04	0.227
2029	23,454,135.81	5,266,476.34	0.225
2030	24,891,874.34	5,532,004.82	0.222

The tool used to calculate these numbers - ICAO's Environmental Benefits Tool (EBT) - shows that RTK value is estimated to grow at a rate of 6.13% per year from 2017 - 2030 considering historical trends and numbers from 2010 - 2016.

Fuel efficiency increase is estimated to be around 0.249 in 2021 (after 5 years). Therefore plus 0.114 in comparison with the last value in 2010, after 10 years 0.232, and + 0.131 in comparison to 2010 and + 0.141 in 2030.

Fuel burn is estimated to be around 3.62Mt in 2021, 4.55Mt in 2026 and 5.53Mt in 2030. Related data were integrated into the calculation to forecast CO2 emissions levels of the same period.

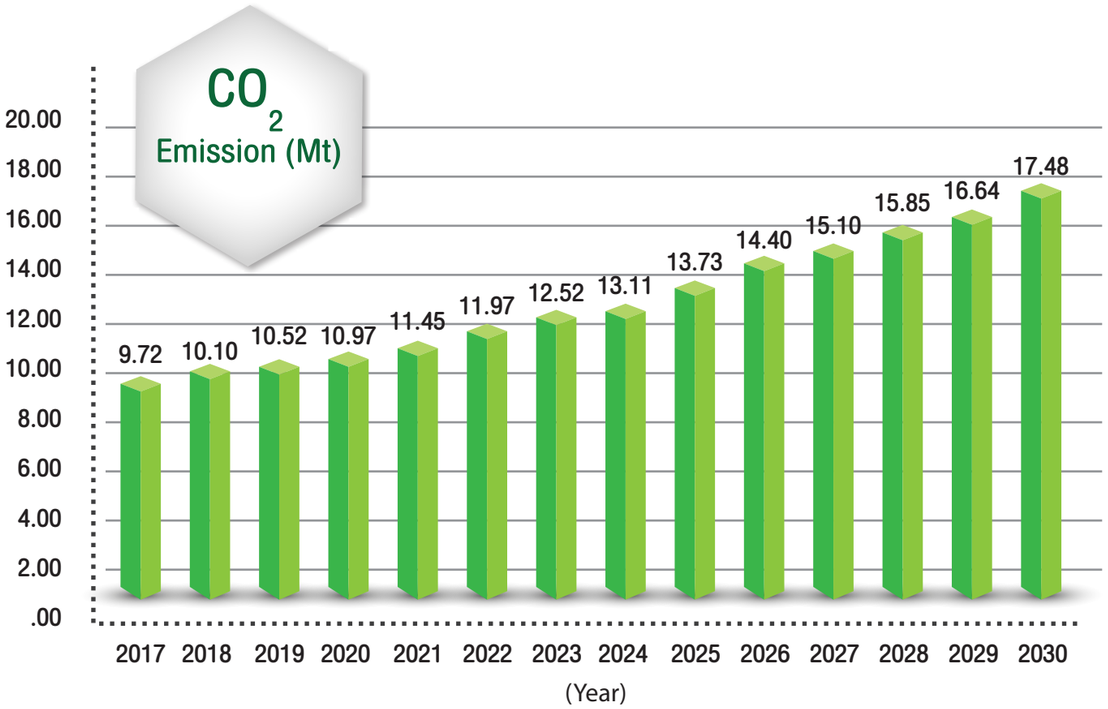

Figure 9: Forecast of CO_2 emissions by Thai airlines in international flights (in mega tonnes) 2017–2030

As it emerges from the graphic above, in the absence of mitigation measures, CO_2 emissions from international aviation will grow from 9,719kt CO_2 in 2017 to 17,481 ktCO_2 in 2030, which represents an increase of 79.9% in thirteen years.

4.8 SCENARIO WITH MEASURES: EXPECTED RESULTS

Thailand is working hard to develop new mitigation measures to fulfil its voluntary commitment in supporting ICAO's fight against the negative effects of climate change. New measures are set and detailed in chapter 5, but in general terms, the expected long-term results linked to their introduction and implementation are the followings:

Total energy demand will continue to rise between 2030 and 2050, whilst energy efficiency increases. CO_2 emissions will drop and the reduction will be connected to a combination of a greater efficiency and an increased use of biofuels (estimated to supply just under 30 % of total aviation energy demand)

Efficiency gains will come from improved fuel efficiency in new aircrafts from aircraft modifications to airport restructuring, and from optimised navigational systems as well as other measures.

Mitigation measures by technological means could potentially slow the rate at which aviation RF (radiative forcing) increases. Other measures including market-based and regulatory measures are usually preferred and in this class of measures, the primary contender is emissions trading, which in the case of aviation is largely seeking to reduce CO_2 emissions under a 'cap and trade' scheme.

However, achieving a significant longer-term reduction of emissions will require airlines to use fuels that are renewable and sustainable, such as biofuels developed for jet aircraft. Although sustainable and clean alternative propulsion technologies are in development, such as electric- or solar-powered aircraft and the use of cryogenic hydrogen, these options[20] are unlikely to be ready for commercial use until well after 2050.

[20] Cfr. IRENA, 2017: So far, 23 airlines have conducted 2 500 commercial and demonstration flights using biofuels. But today less than 0.05 % of the total jet fuel demand is met with biofuels…. As of early 2016, targets for bio jet production are more aspirational than legislative, with the US FAA suggesting that 3.8 billion litres of bio jet could be produced by 2018, and the US Air Force hoping to have 50 % of its fuel replaced by alternative fuels by 2016 (another 3.8 billion litres.)

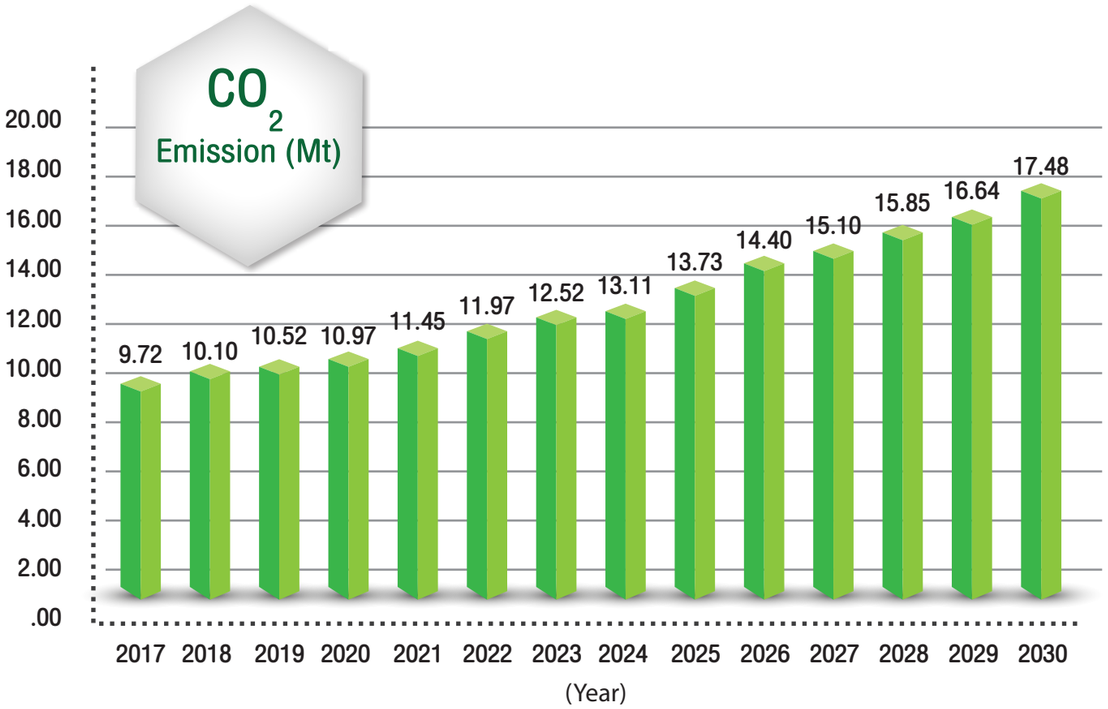

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Table 6: Expected results of annual fuel saving after the introduction of new short-term mitigation measures

Year	Annual Fuel Burn before implementation of mitigation actions(Tonnes)	Annual Fuel Burn after implementation of mitigation actions (Tonnes)	Annual Fuel Saving (Tonnes)	Change in Fuel Saving (%)
2017	3,075,666.82	3,075,666.82	0.00	0.00
2018	3,196,457.18	3,196,457.18	0.00	0.00
2019	3,328,082.41	3,328,082.41	0.00	0.00
2020	3,470,344.93	3,470,344.93	0.00	0.00
2021	3,623,249.09	3,623,249.09	0.00	0.00
2022	3,786,944.12	3,786,944.12	0.00	0.00
2023	3,961,689.39	3,952,484.39	9,205.00	-0.23
2024	4,147,832.60	4,138,203.60	9,629.00	-0.23
2025	4,345,795.84	4,335,713.84	10,082.00	-0.23
2026	4,556,066.59	4,545,501.59	10,565.00	-0.23
2027	4,779,192.14	4,768,117.14	11,075.00	-0.23
2028	5,015,776.04	5,004,157.04	11,619.00	-0.23
2029	5,266,476.34	5,254,892.34	11,584.00	-0.23
2030	5,532,004.82	5,519,200.82	12,804.00	-0.23

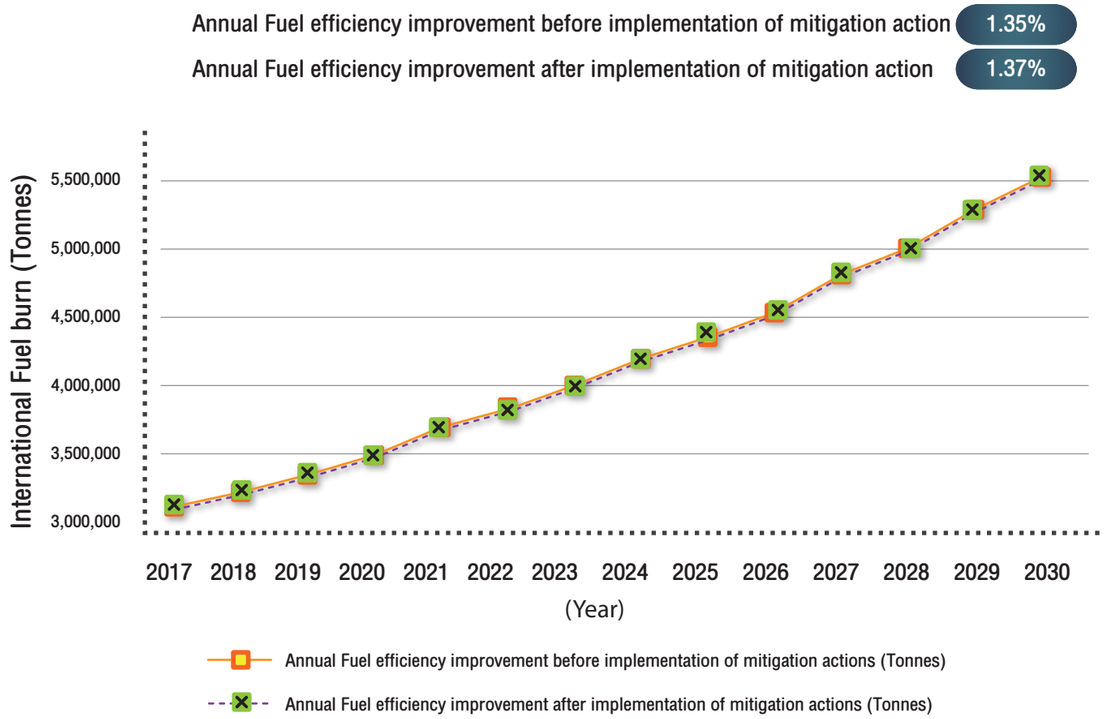


Figure 9: Projected fuel burn curves: without mitigation action 1.35%, with mitigation action 1.37%

Table 7: Expected results of annual CO_2 saving after the introduction of new short-term mitigation measures

Year	Annual CO_2 before implementation of mitigation actions (Tonnes)	Annual CO_2 after implementation of mitigation actions (Tonnes)	Annual CO_2 saving (Tonnes)	Change in Fuel saving (%)
2017	9,719,107.15	9,719,107.15	0.00	0.00
2018	10,100,804.70	10,100,804.70	0.00	0.00
2019	10,516,740.40	10,516,740.40	0.00	0.00
2020	10,966,289.98	10,966,289.98	0.00	0.00
2021	11,449,467.14	11,449,467.14	0.00	0.00
2022	11,966,743.43	11,966,743.43	0.00	0.00
2023	12,518,938.49	12,489,850.69	29,087.80	-0.23
2024	13,107,151.03	13,076,723.39	30,427.64	-0.23
2025	13,732,714.84	13,700,855.72	31,859.12	-0.23
2026	14,397,170.44	14,363,785.04	33,385.40	-0.23
2027	15,102,247.15	15,067,250.15	34,997.00	-0.23
2028	15,849,852.29	15,813,136.25	36,716.04	-0.23
2029	16,642,065.23	16,605,459.79	36,605.44	-0.23
2030	17,481,135.22	17,440,674.58	40,460.64	-0.23

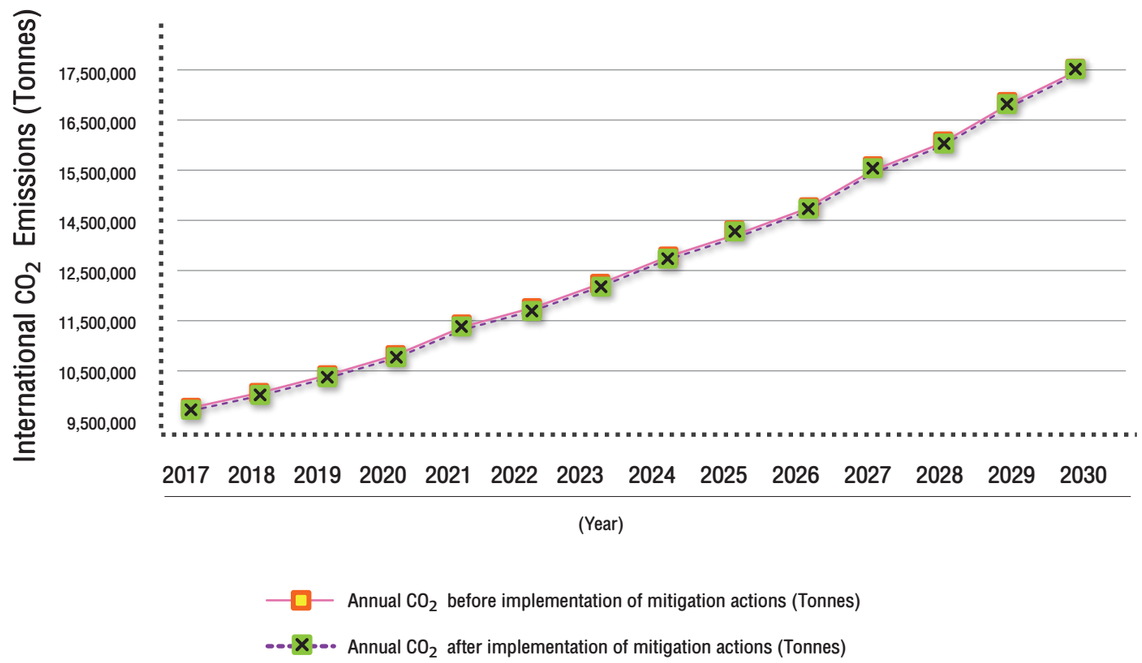


Figure 10: Projected CO_2 emission curves: without mitigation and with mitigation action

05
Mitigation Measures

5.1 INTRODUCTION

The Kyoto Protocol, adopted in the framework of the UNFCCC, has engaged developed countries in reducing their GHG emissions of 5% during the period 2008 - 2012 in comparison to 1990 values. Aviation sector has included among the ones considered by the Protocol, nevertheless developed countries have been engaged to limit and reduce their CO_2 emission for the aviation sector through ICAO.

In February 2004, ICAO published circular n.303 AN/176 for interested nations and stakeholders aimed at informing and recommending existing operational and technical opportunities/solutions to minimize fuel use and therefore emissions in civil aviation operations. This Document was drafted by ICAO Committee on Aviation Environmental Protection (CAEP) which is in charge of measuring current and estimate future progress toward GHG emissions reduction. This circular reflects the content of the Special Report submitted by IPCC annually, stating and demonstrating that, since 1999, the environment has benefitted from the civil aviation sector introducing ad hoc and dedicated measures on ATM (Air Traffic Management,) gate to gate and airport system.

Aviation airport system has a major impact on environment, including the emissions of nitrogen oxides (NOx), unburned hydrocarbons (HC) and particulate matter (PM10 and PM2.5). Emissions from vehicles used in taxi operations as well as those from different sources present at the airport also intensify the effect. As one tonne of fuel burnt is equivalent to 3.16 tonnes of CO_2 , CAEP's attention was primarily focused on reducing carbon dioxide (CO_2) and identifying the most suitable measures to reduce fuel consumption.

Therefore, with Circular n. 303, ICAO has identified a basket of feasible measures aimed at reducing fuel consumption for 8% - 18%.

SCOPE :[21]

ICAO circular n.303 is the first real guidelines describing how to detect, identify and develop the most feasible measures capable of minimizing fuel consumption and therefore emissions from the civil aviation sector.

The main targets of these measures are as follows:

- A more appropriate use of efficient fuel by aircraft during operations;

- Airport infrastructure improvements;

- Technical and operational improvements of ATM system;

- Regulatory measures to improve sustainable development in the sector.

Thailand's reviews, an update and improvement to the previous measures submitted by the former competent body (DCA), followed a multi-disciplinary approach and focused on CAAT's ability to improve regulatory quality; to reform regulations; and to foster competition, innovation, economic growth and important environment, climate change targets.

Stakeholders have to be informed and advised about the importance of constructing basket of measures (both operational and technical) capable of minimizing the adverse effects of international civil aviation on the environment. Stakeholders and State entities involved must cooperate on the effort to find the most suitable combination of measures bearing in mind of safety conditions/requirements, airport characteristics, existing environmental pollution level, as well as forecast impacts and benefits linked to the introduction of the measures into the operating conditions of the airports and in the ATM system.

Improvements in air traffic management (ATM) and other operational procedures could reduce aviation fuel burn by between 8 and 18%. The large majority (6 to 12%) of them comes from ATM improvements which will be fully implemented in the next 20 years. All engine emissions will be reduced as a consequence and the Improvements in ATM will depend on the implementation of the essential institutional arrangements at international level.

[21]Operational Opportunities to Minimize Fuel Use and Reduce Emissions (Cir. 303); Report of the Committee on Aviation Environmental Protection, Seventh Meeting (Doc 9886); Annex 16 to the Convention on International Civil Aviation Environmental Protection; Volume II Aircraft Engine Emissions: Independent Experts NOx Review and the Establishment of Medium and Long Term Technology Goals for NOx (Doc 9887), Airport Air Quality Guidance Doc 9889 Procedures for Air Navigation Services — Aircraft Operations (OPS) (Doc 8168), ICAO Circular on NADP Noise and Emissions Effects, ICAO Airport Planning Manual Part 2^ - Land Use and Environmental Control (DOC 9184), ICAO Engine Exhaust Emissions Data Bank (Doc 9646) ICAO Carbon Emission Calculation

[22]IPCCC

5.2 UPDATES ON MITIGATION MEASURES CITED IN THE 2013 ACTION PLAN

5.2.1 OVERVIEW

The basket of measures designed, submitted, and started, under Thailand's Department of Civil Aviation (DCA) in 2011 has been re-evaluated, and related data have been updated, in order to reflect the real status of the civil aviation sector in Thailand after the changes incurred during the transfer of power from DCA to the newly established Civil Aviation Authority of Thailand (CAAT). This will give ICAO a better overview of the current framework which defines the official position of Thailand in contributing to the ICAO's global aspirational goals.

It shall be pointed out that most of the quoted previous mitigation measures cannot be assessed in terms GHG and CO2 reduction due to lack of appropriate controlling standards and methodologies on data quality check before the application of the measures and at their natural end. DCA had none of procedure in place to verify the data submitted by operators/stakeholders. The procedure has since been developed after the establishment of CAAT, however, the exact results regarding the environmental and climate impacts of the measures suggested in the previous version of the Action Plan cannot be ascertained.

To demonstrate the development, efficacy and follow up of each measure started under DCA in 2011, CAAT opted to use the same Action Plan measure template submitted by DCA to ICAO in 2013, adding and including dedicated columns and lines to update on what was available and has been modified from the previous report to sensitize operators and stakeholders to become greener via environmental friendly and carbon neutral solutions.

Despite lacking the appropriate data collection and verification procedures in the past, it should be emphasized that, recently, the purchase of more advanced and bigger aircrafts to replace dated models (measure n. 2) as well as the implementation of more efficient ATM planning, ground and terminal operations, and the increasing efficiency level in infrastructure use have already produced the first noticeable results – a decrease in CO2 emissions by 392,764 tonnes; down from 2015's 9,557,098 tonnes to 2016's 9,164,334 tonnes.

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

5.2.2 BASKET OF MEASURES TO LIMIT OR REDUCE CO_2 EMISSIONS FROM INTERNATIONAL CIVIL AVIATION

1) Aircraft-related Technology Development
   a. Aircraft minimum fuel efficiency standards
   b. Aggressive aircraft fuel efficiency standards, setting standards for the future
   c. Purchase of new aircraft
   d. Retrofitting and upgrade improvements on existing aircraft
   e. Optimizing improvements in aircraft produced in the near to mid-term
   f. Adoption of revolutionary new designs in aircraft/engines

2) Alternative Fuels
   a. Development of biofuels
   b. Development of other fuels with lower life cycle CO_2 emissions
   c. Standard/requirements for alternative fuel use

3) Improved Air Traffic Management and Infrastructure Use
   a. More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), en-route operations, airspace design and usage, aircraft capabilities
   b. More efficient use and planning of airport capacities
   c. Installation of airport infrastructure such as Fixed Electrical Ground Power and Pre-Conditioned Air to allow aircraft APU (Auxiliary Power Unit) switch-off
   d. Construction of additional runways and taxiways if used solely to relieve traffic congestion
   e. Collaborative research endeavours

4) More efficient operations
   a. Best practices in operations
   b. Optimized aircraft maintenance (including jet engine cleaning/washing)
   c. Selecting aircraft best suited to mission

MEASURE N. 1

Category	Aircraft-related technology development
Measure	Retrofitting and upgrade improvements on existing aircraft
Action	Modification of B777 aircrafts - B777 performance improvement program
Start Date	January 2010
End Date	December 2012
Title	B777 performance improvement program
Description	Boeing777 Performance Improvement Program (PIP) is to retrofit B777 airplanes by modifying: 1) Wing Vortex Generator, 2) High Speed Aileron, and 3) Ram Air Exit /Inlet Door
Date of full implementation	January 2013
Economic cost	200,000,000
Currency	THB
Reference to existing legislation	None
Legislation is proposed	No
Assistance needed	Financial
Other assistance	No
List of stakeholders involved	Thai Airways International Public Company Limited Boeing company

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	The Boeing 777 PIP measure implies the development of 3 different elements: 1) an improved ram air system, 2) aileron droop, and 3) resized vortex generators. This measure is based on the following consideration as submitted by Boeing Company pointing out that: for an operation carrying the same payload as a non-PIP airplane, the PIP-equipped airplane will fly farther; for an operation flying the same range as a non-PIP airplane, the PIP-equipped airplane will carry more payload; for an operation carrying the same payload and flying the same range as a non-PIP airplane, the PIP-equipped airplane will reduce fuel consumption as well as reducing CO_2 and NOx emissions.
Produced results	RETROFITTING: the Boeing 777 fleet retrofitted by PIP revealed a lower deterioration rate compared to the aircraft fleet without retrofit registering a fuel consumption increased about 2.7% per year
Benefits after introduction of this measure in terms of CO_2 and GHG	32,766 tonnes of CO_2 reduced in 2013 In the future, once advanced technologies for B777 becomes available, the values in terms of CO_2 emissions reduction and fuel saved will continue to increase
Period	This measure was completed and fully implemented under the DCA, however, it shall be regarded and considered as an ongoing and continuous practice aimed at scrapping and/or retrofitting old aircrafts where feasible endowing them with the cleanest technology solutions and engines.
List of stakeholders involved	Thai International Airways Public Company Limited Boeing company

MEASURE N. 2

Category	Aircraft-related technology development
Measure	Purchase of new aircrafts
Action	Buy new Airbus A320-200 NEO
Start Date	Mid of 2016
End Date	Onward to replace A320-200 in the feet[23]
Title	Purchase of new aircraft
Description	Buying Airbus A320-200neo to replace the old A320-200 aircrafts in the fleet. The new NEO will replace the oldest aircrafts and onward.
Date of full implementation	Onward until replace all aircraft fleet
Currency	USD
Reference to existing legislation	None
Legislation is proposed	No
List of stakeholders involved	Thai AirAsia Company Llimited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	Advance of aviation technology in aviation improves the safety performance and fuel efficiency of new aircrafts, making them more environmentally friendly. Using new and higher-performance aircrafts will help significantly improve the fleet's fuel efficiency. Thai Air Asia is expanding its fleet by ordering four new Airbus A320neo aircrafts
Period	First step from Middle 2016-November 2016 Two new aircrafts have been delivered.
Produced results	1) FUEL SAVING INCREASE: Four new A320neo aircrafts bought by Thai Air Asia allow saving of fuel up to 15% in comparison to the old ones. 2)FUEL EFFICIENCY INCREASE: bigger and more advanced aircrafts allow reducing expenses directly relate to flight operations. Fuel consumption will gradually decrease.
Benefits after introduction of this measure in terms of CO_2 and GHG	With fuel reduction up to 15% comparing to old models, reduction of CO_2 emissions is expected. However, the stakeholder is not able to quantify this data for the time being
List of stakeholders involved	Thai AirAsia Company Llimited

[23] As of the end of 2017, however, the old A320-200 aircrafts have not been replaced by new ones. They are still in use with the addition of 4 newly ordered aircrafts to the fleet.

MEASURE N. 3

Category	Improved air traffic management and infrastructure use
Measure	More efficient ATM planning, ground operations, terminal operations (departure and arrivals), en-route operations, airspace design and usage, aircraft air navigation capabilities
Action	Measures to improve ground operations
Start Date	Operational Trial on 24 Oct 2011. Full implementation expected on 8 Aug 2012.
End Date	Permanent
Title	Gate Hold Procedure
Description	Gate Hold Procedure is developed to reduce taxi-out time and fuel consumption of departing aircrafts at Suvarnabhumi Airport due to delay at holding points. The procedure is expected to reduce carbon-emission in the taxi-out phase of flight. During peak periods or when it is anticipated that there are more than four departure aircrafts at holding points, Ground Controller will assign a proper expected push-back time when an outbound aircraft is ready for pushback. In calculation of the expected pushback time, parking stand and variable taxi-out time is taken into account. Additionally, the optimization of airport traffic flow by dynamically allocating appropriate ratio of arriving and departing aircrafts to traffic patterns is supported by Gate Hold Procedures
Date of full implementation	Full implementation on 08/08/2012.
List of stakeholders involved	Aeronautical Radio of Thailand Company Limited Airlines operating at Suvarnabhumi Airport

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	The original scope of the measure has been extended into a new measure, an upgrade of this one suggested and implemented during DCA time. The new measure is explained in more details at the new measure section.
Period	N/A

MEASURE N. 4

Category	Improved air traffic management and infrastructure use
Measure	More efficient ATM planning, ground operations, terminal operations (departure and arrivals), en-route operations, airspace design and usage, aircraft air navigation capabilities
Action	Measures to improve flexible use of civil-military airspace Measures to improve the use of optimum routings
Start Date	1 July 2011
End Date	18 October 2012
Title	Parallel Route (Bangkok-Chiang Mai, Bangkok-Phuket)
Description	Parallel Route project includes design and implementation of unidirectional parallel routes between major airports, increasing flight efficiency and enhancing safety. The project aims to reduce complexity of busy crossings points and relieve congestion on major trunk routes, specifically serving two major traffic flows: Bangkok-Chiang Mai and Bangkok-Phuket. Due to routing through major military Special Use Airspace, these routes will be implemented as Conditional Routes (CDR), available during the weekends.
Date of full implementation	18 Oct 2012
Reference to existing legislation	N/A
Legislation is proposed	N/A
Assistance needed	N/A
List of stakeholders involved	Aeronautical Radio of Thailand Company Limited, Airlines operating within the Bangkok FIR especially through Bangkok - Chiang Mai and Bangkok - Phuket city pair

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	Aeronautical Radio of Thailand Company Limited is expanding air traffic route capacity by: Preparing special routes considering PDCMAC Committee's (Provisional Directorate Civil Military ATM Cooperation managing the project) decision on using their airspace in order to widen flight path at certain times Using Unidirectional Parallel routes: - In 2012, flights Bangkok-Phuket and Phuket-Bangkok started operating using such route - In 2013, adding routes Y6 and Y7 to BKK-CNX-BKK flight - In 2015, adding routes M757 and M769 to flights from Bangkok to the south of Thailand, with possibility of extending up to Malaysia border - In 2016, adding routes Y13 and Y16, reducing charter distance up to5 nm and 1 nm respectively in comparison to normal routes
Period	ONGOING
Produced results	- Reduction of charter distances; - Reduction of fuel consumption; - Increase of air traffic capacity
Benefits after introduction of this measure in terms of CO_2 and GHG	Considering the 3 existing routes, reduction of GHG emission is estimated to be as following: - Y1 / one way (Udon - Bangkok) / GHG emissions reduction of 2 - 6% - Y2 / one way (Khon Kaen - Bangkok) / GHG emissions reduction of 5% - Y5 / one way (Phuket - Bangkok) / GHG emissions reduction of 1 - 2%
List of stakeholders involved	Aeronautical Radio of Thailand Company Limited, Airline Operators

MEASURE N. 5

Category	More efficient operations
Measures	Minimizing weight Flight planning system retune
Action	Flight Planning retune to reduce fuel uplift before flight
Start Date	August 2011
End Date	March 2013
Title	Flight planning system retune
Description	New Thai Automatic Flight Planning System (New TAFS) gives more accuracy and efficiency in flight planning which leads to appropriate fuel uplift for the flight
Economic cost	29,000,000
Currency	EUR
Reference to existing legislation	None
Legislation is proposed	No
List of stakeholders involved	Thai Airways International Public Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	This measure is focused on allowing airlines to reduce fuel consumption and costs by improving the quality, accuracy and efficiency of flight plans, leading to the most suitable fuel uplift for the flight capable of saving fuel and reducing emissions
Period	Fully implemented from 2014 and still in use on these 4 routes
Results	Saved 3,352 tonnes of fuel on flights to Europe, Australia, Japan and Korea in 2014; Saved 2,348 tonnes of fuel on flights to Europe, Australia, Japan and Korea in 2015; Saved 2,300 tonnes of fuel on flights to Europe, Australia, Japan and Korea in 2016
Benefits after introduction of this measure in terms of CO_2 and GHG	Reduction of tCO_2 10,592 in 2014 Reduction of tCO_2 7,419 in 2015 Reduction of tCO_2 7,268 in 2016
List of stakeholders involved	Thai Airways International Public Company Limited

MEASURE N. 6

Category	Reduce Aircraft weight
Measure	Reduce Potable Water Quantity in Aircraft
Action	Designed to reduce Potable water as follow by the Water Loading Matrix table
Start Date	20 August 2012
End Date	N/A
Title	Reduce Potable Water
Description	Reduce Potable Water as per Water Loading Matrix: 1. Double load water every flight except DAC, BOM, MLE or flight hours over 4 hrs. 2. Water uplift as follow by passenger number on board. 3. Quantity of potable water variation direct with flight hours.
Date of full implementation	20-Aug-12
Reference to existing legislation	None
Legislation is proposed	No
Assitance needed (check one or more)	Records and statistics
List of stakeholders involved	Bangkok Airways Public Company Limited Thai Airways International Public Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	Aircraft weight is an important factor affecting directly values and amount of fuel consumption, therefore all unnecessary in-flight equipment, manuals shall be removed and/or replaced with lighter ones. -Bangkok Airway has optimized quantity of potable water needed by creating potable water loading matrix table explaining information on optimum quantity of potable water for each flight. Some flights of A319 and A320 lasting less than 2 hours have already a potable water service -Thai Airways has introduced potable water optimization measure in Boeing 777 and in Airbus A330 fleet starting from 2013/2014
Period	FULLY IMPLEMENTED-PERMANENT MEASURE
Results- OUTPUTS-	-Ecological and economic benefits in terms of fuel saving and environmental impact of this measure in terms of CO_2 reduction -Reduction of fuel consumption due to reduced weight through the elimination of non/used equipment and manuals no longer carried on board corresponding to a decrease in terms of CO_2
Benefits after introduction of this measure in terms of CO_2 and GHG	Since the application of this measure, Bangkok Airways Public Company Limited has reduced CO_2 emissions by: 52.45 tonnes betwee November 21 and December 31, 2014; 441 tonnes in 2015; 452 tonnes in 2016. Since the application of this measure, Thai Airways has reduced fuel consumption by: - 0.125%
List of stakeholders involved	Bangkok Airways Public Company Limited Thai Airways International Public Company Limited

MEASURE N. 7

Category	More Efficient operations
Measure	Optimised aircraft maintenance (including jet engine cleaning/washing)
Action	Aircraft and engine wash
Start Date	1 January 2011
End Date	N/A
Description	Aircraft wash can reduce friction and improve fuel efficiency which result in 0.4% fuel consumption reduction
Date of full implementation	1 June 2011
Economic cost	95,000,000
Currency	THB
Reference to existing legislation	None
Legislation is proposed	No
List of stakeholders involved	Thai Airways International Public Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	Thai Airways started cleaning its aircrafts using airplane wash equipments since 2011. Dust, sand, insects, HFHc and others can pollute the engine if not cleaned properly, therefore reducing its performances. If not clean, the engine has to use more fuel in order to maintain the same performance; and it exhaust gases increase in temperature. A scheduled washing procedure allow engine to perform well and waste less fuel.
Period	ONGOING from 2011
Results-OUTPUTS-	-REDUCTION OF WATER AMOUNT: 9,000 litres per aircraft -REDUCTION OF FUEL CONSUMPTION: 0.4% (55,392 gallons)
Benefits after introduction of this measure in terms of CO_2 and GHG	CO_2 EMISSION REDUCTION: 34,560 tonnes per year starting from 2011
List of stakeholders involved	Thai Airways International Public Company Limited

MEASURE N. 8

Category	Reduce Fuel Used
Measure	One Engine Taxi-in for Airbus
Action	One Engine Taxi-in Campaign
Start Date	
End Date	
Title	Airbus One Engine Taxi-In
Description	Keep record of the Airbus Pilot for one engine taxi-in. 1. Add the "One Engine Taxi-in" record form in Flight Log. 2. Pilot check in record form. 3. Keep record and summary and calculate the reduced fuel from one engine taxi-in. 4. Report to Flight Operations Control Director. 5. Monitor and Evaluate.
Reference to existing legislation	None
Legislation is proposed	No
Assistance needed	Records and statistics
List of stakeholders involved	Bangkok Airways Public Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	Creation of a system allowing single engine taxi as a normal procedure for departure and arrival
Period	This measure has been used on all international flights from Suvarnabhumi (VTBS) starting from March 2017 and will continue to be the standard procedure used
Results	Not yet available, the records so far account for 19,332 aircraft movements at Suvarnabhumi airport in 2016
Benefits after introduction of this measure in terms of CO_2 and GHG	Annual fuel saved: 26 tonnes Estimated annual CO_2 reduction: 82 tonnes
List of stakeholders involved	Bangkok Airways Public Company Limited

MEASURE N. 9

Category	More efficient operations
Measure	Best practices in operations – ICAO Circular n. 303 Optimised aircraft maintenance (including jet engine cleaning/washing)
Action	Introduction of best practices to make operations more efficient
Start Date	1 January 2013
End Date	1 January 2018
Description	9.1 Coordinate with GE Aviation Company (USA) to create GE Fuel & Carbon Technology Solution for Thai Airasia, Jet engine cleaning and washing and Aircraft washing (Best practices in operations – ICAO Circular n. 303) 9.2 Use of GPU during light maintenance and overnight maintenance (Improved Ground Operation,) 9.3 Full use of RNAV and RNP APP to cut tracks and Use of ETOP operation, Pre-departure Planning for short taxi route and reduce ground time operate (Improved Air Traffic Management)
Currency	USD
Reference to existing legislation	None
Legislation is proposed	No
Assistance needed	YES
Assistance needed	Technology
List of stakeholders involved	Thai AirAsia Company Limited, GE Aviation Company, Airbus Company, Airports of Thailand Public Company Limited (AOT), Department of Civil Aviation, Aeronautical Radio of Thailand Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated Description	This measure has been developed including the followings aspects: - At Suvarnabhumi airport: airlines wishing to park in the contact gate shall use 400 Hz and PC Air, otherwise they may park at the dedicated parking area the remote gate At Don Muang: it is not feasible to apply 400Hz and PC Air considering the geographical restriction of the area. - Development of RNP approach chart
Period	Started in January 2013 and ongoing, stakeholders are planning to extend the implementation period due to importance of the measure
Results	- Jet engine cleaning schedule is set, taking place every two months - Thai AirAsia Company Llimited is using GPU in DonMuang Airport (VTBD), Chiangmai airport (VTCC), Kribi (VTSG), U-Tapao (VTBU). Thai Air Asia will have additional 4 by the end of December 2017. Below template showing results from DonMuang Airport. However, no data have yet become available on fuel saved for APU as of now. - RNAP&RNP as a tool to improve air traffic management is not yet in place. Documents have been submitted to Aviation Authority in charge of approving.
Benefits after introduction of this measure in terms of CO_2 and GHG	No data are yet available in this area
List of stakeholders involved	Airport of Thailand Public Company Limited, Thai AirAsia Company Limited, Aeronautical Radio of Thailand Company Limited

Table 8: APU Runtime Reduction at Don Mueang Airport (DMK)

Year	APU Average Monthly Runtime (hr)
2012	207
2013	193
2014	171
2015	180

Source: Thai AirAsia Company Llimited

MEASURE N. 10

Category	More efficient operations
Measure	Energy conservation
Action	The air temperature is set at 25°C
Start Date	August 2011
End Date	March 2013
Description	At Don Muang International Airport, the air temperate was set at 25° C in the following parts: - On the 1st floor of the Terminal building - Baggage Claim area on the 2nd floor of the Domestic and International terminal building. - Walkway and corridor in Pier 1-2 international building, Pier 3-5 domestic building.
Reference to existing legislation	None
Legislation is proposed	No
List of stakeholders involved	Airport of Thailand Public Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated description	From 2013, this measure was progressively extended to other 4 additional airports (Suvarnabhumi International Airport, Chiang Mai International Airport, Mae Fah Luang Chiang Rai International Airport, Hatyai International Airport)
Period	ONGOING
Results	Only for Suvarnabhumi International Airport, Carbon Footprint information is available. (cfr. Text below)
Benefits after introduction of this measure in terms of CO_2 and GHG	Due to the lack of existing data, baseline, and indicators in place at the start of the project, it is not feasible to define such results. CAAT is now in the phase of verifying accuracy of all emission data in order to be able to consider these factors in the framework of the next mitigation measures included in the present Action Plan.

FROM SUVARNABHUMI INTERNATIONAL AIRPORT (BKK): CARBON FOOTPRINT

An overview of the 2015 BKK carbon footprint for all three scopes of emissions is presented in the table below. The total emissions for all three scopes are 1,495,089.54 tonnes of carbon dioxide equivalent (tCO_2e). Scope 3 emissions were 1,404,031.12 tCO_2e or around 94% of total emissions, which are obviously the largest contributors of airport carbon footprint. Around 87% of Scope 3 emissions come from landing and take-off (LTO) cycle and airport surface access. Scope 1 and Scope 2 emissions were 1,770.91 tCO_2e and 89,287.51 tCO_2e, respectively. Although Scope 1 and Scope 2 emissions account for only around 6% of total emissions, they should be closely monitored, because they can be directly controlled and reduced by the airport through the implementation of carbon reduction measures outlined in the Carbon Management Plan.

Table below summarizes carbon emissions from BKK activities for 2015 on the 3-year rolling average (R-Average), which allows BKK to compare the performance in 2015 against previous years. Note that Scope 3 emissions comparison is not available because this is the first year that BKK calculate Scope 3 emissions. However, the result shall be the baseline, which allows BKK to gain better understanding of Scope 3 emissions and to plan strategies on how to engage stakeholders to reduce carbon emissions in the years to come.

Absolute emissions	2012	2013	2014	R-average	2015	%change[24]
tCO_2e						
Scope 1 emissions	1,951.76	1,878.87	1,863.74	1,898.12	1,770.91	-6.70%
Scope 2 emissions	86,487.58	83,214.28	82,082.95	83,928.27	86,492.72	+3.06%
Total scope 1 and 2	88,439.33	85,093.15	83,946.69	85,826.39	88,263.63	+2.84%
Scope 3 emissions	N/A	N/A	N/A	N/A	1,404,031.12	N/A
Total all scopes of emissions	88,439.33	85,093.15	83,946.69	N/A	1,492,294.75	N/A
Relative emissions $KgCO_2e$[25]	2012	2013	2014	R-average	2015	%change
Emissions per passenger movement	1.67	1.66	1.81	1.71	1.67	-2.50%

Source: Deliverable 3, 2015 Carbon Footprint Report (Verified), Airports of Thailand Public Company Limited (AOT), January 2017

Note that Scope 2 emissions from the new infrastructure, Transfer Baggage Terminal (TBT), that operated since 2014 were excluded from the table to allow like-for-like comparison.

In 2015, Scope 1 emissions reduced around 6.7%, but Scope 2 emissions increased around 3.1%. This resulted in an overall increase in carbon emissions from controlled sources of about 2.8%. Despite this overall increase, both the relative emissions per passenger movement and per aircraft movement decreased about 2.5% and 2.6% respectively. This shows that BKK has used less energy per passenger and per aircraft movement.

In 2015, the carbon emissions per passenger movement and per aircraft movement were 1.67 kilograms of carbon dioxide equivalent ($kgCO_2e$) and 278.38 $kgCO_2e$, respectively. Nevertheless, the carbon emissions per passenger in 2015 was still higher than the interim reduction target of 1.60 $kgCO_2e$ per passenger. This suggests that BKK should closely monitor and implement additional measures to effectively manage and reduce CO_2 emissions to achieve the interim target of 1.57 $kgCO_2e$ per passenger for the 2016 reporting period according to carbon management plan.

[24] A comparison of 2015 and R-average
[25] Scope 1 and scope 2 emission only
[26] A comparison of 2015 and R-average

MEASURE N. 11

Category:	More efficient operations
Measure:	Energy conservation -Measure of Electricity-
Action:	In Don Muang International airport the LIGHTING SYSTEM CONTROL is located in: - the Baggage Claim area on the 2nd floor of the Domestic terminal building - the Corridor in Concourse A, B, C, E, F, G - the Airside Center East and Airside Center West area
Start Date	September 2012
End Date	December 2012
Description	All lamps in Concourse A-G are still turn on after midnight.
Reference to existing legislation	None
Legislation is proposed	No
Assistance needed (check one or more)	Technical Support/ education campaigns, programs
List of stakeholders involved	Airport of Thailand Public Company Limited

UPDATED INFORMATION AS OF DECEMBER 2017 UNDER SUPERVISION OF CAAT

Updated description	FROM 2013, this measure was progressively extended to other 4 additional airports (Suvarnabhumi International Airport, Chiang Mai International Airport, Mae Fah Luang Chiang Rai International Airport, Hatyai International Airport)
Period	ONGOING
Results	Only for Suvarnabhumi International Airport, Carbon Footprint information is available. (cfr. text and related information quoted in the measure n. 10)
Benefits after introduction of this measure in terms of CO_2 and GHG	Due to the lack of existing data, baseline, and indicators in place at the start of the project, it is not feasible to define such results. CAAT is now in the phase of verifying accuracy of all emission data in order to be able to consider these factors in the framework of the next mitigation measures included in the present Action Plan.
List of stakeholders involved	Airport of Thailand Public Company Limited

5.3 NEW MITIGATION MEASURES

5.3.1 INTRODUCTION

The newly structure of the mitigation measures has been developed in order to point out clearly which is the general objectives of each measure, the specific ones (c.d. direct effect) as well as the expected results.

The introduced Logical Framework aims at laying the path for CAAT to work and assess the procedures at a later phase in terms of identifying existing situations, indicators and baseline, and how they will evolve during the measure development and implementation through the identification of verification sources.

With the phase ruled by Thailand's previous civil aviation authority, Department of Civil Aviation – DCA, being characterized by the lack of accurate, consistent, and complete data on CO_2 emissions reduction efforts, and CAAT being created as the new structure in charge of regulating the sector, now indicators with their objectives and reference values have been quoted into the matrix of the logical framework, but merely as an example which can vary during the implementation of the measures without having any concrete impact on the final results.

Admittedly, the introduced measures set mininum goals which could be reached easily with enough cooperation from stakeholders and enough powers and authority awarded to CAAT. To include more ambitious indicators would have appeared too unrealistic at the time, considering the lack of a consolidated baseline capable of reaching them.

The logical framework will evolve during the implementation of the measures where additional points will be introduced. Activities will be assessed and added to maximize the benefits. Additional columns will be presented to point out the intermediate targets in order to fulfil the expected outputs as per quoted indicators.

5.3.2 LOGICAL FRAMEWORK

	Types of intervention	Indicators	Reference Value / Reference Year	Targets	Means of Verification	Assumption
General objective[27]	To limit and reduce the impact of international aviation on environment and on climate change as a way to fulfil aspirational goals set by ICAO	i) CO_2 emission reduction	i) N/A	i) 0.2% by 2030[29]	- MRV system in place	- Ministry of Transport continues its practices aimed at reduction of GHG emissions in all transport sub sectors.
		ii) Percentage of GHG reduction in the aviation sector	ii) N/A	ii) 1.5% less by 2030[30]	- Reports on mitigation measures introduced	- CAAT has the required policy and legal framework to fulfill its role of sector regulator.
		iii) Fuel saved	iii) 2016 level	iii) 1% less by 2030[31]	- Action Plan	- Stakeholders are fully engaged in reducing emissions through the adoption of more efficient operations, introduction of greener technology development in terms of aircraft, fuel solutions and infrastructure, and in ATM system.
		iv) Increased efficiency	iv) 0.363 by 2010	iv) 0.5% less by 2030[32]	- CAAT's database	

[27] The general objective is related to all measures contained in the action plan, therefore short-, medium- and long-term measures are included.
[28] Emission from aviation sector have never been included in the data analyzed by Ministry of Transport. However, due to the new strategy for transport 2017-2036 emission from aviation sector have to be considered
[29] estimation
[30] estimation
[31] estimation
[32] estimation

	Types of intervention	Indicators	Reference value: reference year	Targets	Means of Verification	Assumption
Specific objective	To reinforce aviation emission management system	i) Number of implemented measures/projects using and referring to CAAT's emission aviation policy and database	i) 0	i) at least 3 by 2030	- GHG and emission data available in the GHG emission database of CAAT	- CAAT has full cooperation of different stakeholders involved in aviation sector in terms of environment and climate change issues, exchanges data and information in order to strengthen synergies and facilitate sharing of data and information
		ii) Environmental/cc actions introduced by airlines in their day-to-day practice	ii) 0	ii) at least 3 by 2030	- Mitigation reports	-Stakeholders are committed to becoming greener, starting with the introduction of carbon neutral solutions
	To improve data quality in terms of actions and policies	i) Number, % of actions including GHG emission data and CO_2 reduction benefits	i) 0	i) at least 1% increase by 2030	- Aviation emission database working perfectly. Data kept up to date	

	Types of intervention	Indicators	Reference value	Targets	Means of Verification	Assumption
Measurement results[33]	R1 Improved air traffic management and infrastructure use	i) Number of operations;	i) N/A	i) Reduction of fuel burn 0.06t per operation	- MRV report - CAAT DATABASE	- Involved stakeholders are fully engaged in cooperating with CAAT
	R2 Aircraft related technology development	ii) % of increased fuel saved, number of tCO_2 decrease after 1 year of fully implementation, % of increased efficiency;	ii) N/A	ii) reduction of fuel burn	- MRV report - CAAT DATABASE	
	R3 More efficient operations	iii) Number of operations;	iii) N/A	iii) 460 t. of fuel reduction yearly	- MRV report - C FORM - CAAT DATABASE	
	R4 More efficient operations	iv) Number of reduced kilos;	iv) Number of reduced kilos;	iv) 50 t. fuel saved per year	- MRV report - C FORM - CAAT DATABASE	
	R5 More efficient operations	v) Number of reduced kilos; n. of yearly flight hour;	v) Number of reduced kilos; n. of yearly flight hour;	v) 295 t. fuel saved per year	- MRV report - C FORM - CAAT DATABASE	
	R6 Airport improvement	vi) Number of saved minutes from taxi time;	vi) Number of saved minutes from taxi time;	vi) 7,400 t. fuel saved per year	- MRV report - C FORM - CAAT DATABASE	
	R7 Improved air traffic management and infrastructure use	vii) Number of minutes reduced;	vii) Number of minutes reduced;	vii) 1,000 t. fuel saved per year	- MRV report - C FORM - CAAT DATABASE	
	R8 GMBMs	viii) % of compliance towards CORSIA requirements	viii) % of compliance towards CORSIA requirements	viii) 100% tracked annual increase in total CO_2 emissions	- MRV report - C FORM - CAAT DATABASE	

[33] These results are only related to 8 short term measures cited in the action plan.

5.3.3 LIST OF NEW MEASURES

The new measures will be focused on greening the aviation sector, introducing efficiency solutions in terms of improving fuel efficiency, minimizing fuel use, reducing emissions and environmental impacts at the gate and on the ground from taxi operations, auxiliary power units and more advanced group support equipment using renewable energy solutions where feasible.

These measures have to be regarded as the result of the consultation process between the Civil Aviation Authority of Thailand (CAAT), the National airlines, the airport authority, as well as all other stakeholders involved and affected by the sector including TGO, ONEP, OTP and Ministry of Energy. The process started immediately when CAAT took office officially (less than two years ago) and continuously evolved into framework, implementation policies, and regulations capable of guarantying transparency, consistency, completeness of national priorities and needs through the introduction of SMART (specific, measurable, assignable, realistic, time-related) indicators, ROM (result oriented monitoring) procedures, and MONITORING AND REPORTING platforms.

In the context of continuing improvement of the logical framework of the mitigation actions and of giving a real and updated assessment of the required time framework of what will happen in the aviation sector in the coming 20 years, the measures have been divided mainly into three categories:

- SHORT-TERM MEASURES: including those quoted in the previous action plan not developed under DCA but under CAAT (e.g. from 2016), those just started, those starting within a short period of time (i.e. coming months, coming years);

- MEDIUM-TERM MEASURES: including those already planned and capable of producing lasting effects for at least the next 5 years after the completion of the regulatory planning and negotiating phase; and those that require time for the regional and institutional cooperation processes to be settled, fixed and approved;

- LONG-TERM MEASURES: including those like R&D requiring time to produce their effects as mainly based on using best embryonic experience of other more developed countries and testing on the local context if feasible. The principle of economy of scales will be applied covering some costs but this will, however, require time and cooperation with national/international research centers, industries and donors

NEW COMMITMENTS OF THAILAND TOWARDS REACHING ASPIRATIONAL TARGETS:

Development of interconnected activities belonging to different areas of intervention without any ranking intention

The existing and ongoing practices started under CAAT's and all the newly-planned short-, medium-, and long-term measures are mainly focused on:

- Improving fuel efficiency among Thailand's civil aviation industry;
- Being committed to annual reporting capable of identifying and tracking progress and problems towards meeting forecast targets and aspirational goals;
- Updating the ongoing, planned activities in the short- to medium-term focusing on reducing GHG emissions both from international and domestic activities, decreasing the impact of the aviation system on the environment.

In particular, CAAT along with the industry stakeholders are planning and programming to raise awareness to and campaign for the followings actions:

- introduction of new technologies for the reduction of noise and emissions; introduction of new engines integrating technologies for low fuel
- consumption, capable of reducing noise and nitrogen oxides; introduction of alternative fuels tailored for aviation through R&D and
- regional/international cooperation: sustainable biofuels as a way to promote renewable energy for the mitigation of climate change; introduction of green operations through the introduction of electrical
- systems; introduction of carbon footprint procedures through environmental impact
- analysis of the life-cycle of related products; support voluntary action (from carbon mapping up to carbon neutrality):
- cooperation with existing programs dealing with this topic like airport carbon accreditation certification program for carbon management at airports by ACI EUROPE, endorsed by ELAC and supported by UNEP.

Preliminary note: Cited emissions include NOx, SOx, PM10, HC, CO and CO_2
'All' signifies reduction of all cited emissions
'N/A' signifies that type of intervention WILL NOT HAVE DIRECT AND PRIMARY BENEFITS to emissions reduction.

SHORT-TERM MEASURES

Areas of intervention	Types of intervention	Reduced emissions	Potential Gains[34] / Benefits/Effects
Aircraft- related technology development	- Purchase of new aircrafts	All	-Relative potential gains: Very high -Reduce GHG emissions -Improve average annual fuel efficiency (%) between 2017-2030
More efficient air operations	Single engine taxi-in Weight reduction optimization - Aircraft wash/engine wash - reduced flap landing - RNAV& RNP	All	-Relative potential gains: Low -Reduce GHG emissions -Improve average annual fuel efficiency (%) between 2017-2030 -Fuel savings increased (%)
Improved capabilities in air traffic management	- Continuous descent operation (CDO) - Improved flexible use of civil-military airspace, conditional route (CDR) - Improved the use of optimum routings (parallel route)	All	An improved air traffic management system will better optimize cruise altitudes through reduced vertical separation minimum (RVSM) and reduced delays and holding patterns on arrival. Optimizing the air traffic management system is regarded as a one-off saving measure. -Relative potential gains: Low to medium -Fuel savings increased (%) -Emission savings increased (%) -reduction of CO_2 (%)by n. x of years -better tailored and more efficient air operations (% in comparison to existing baseline) through short-medium term, medium long-term and long-term measures -routes designed through efficient manner procedures
Airport Group Operations and Infrastructure Use	- Construction of new runways at Suvarnabhumi airport (n. 3)	All	-Reduction on GHG emissions through cooperation with different stakeholders involved in ground operations (air carriers and airports) - Relative potential gains: Low to high -Introduction of best practices adopted in regional and international contexts -Improved taxiing and queuing procedures -Reduction of aircraft operating times -Reduction of gate-to-gate movements
GMBMs	CORSIA system	All	-Relative potential gains: Very high - Increased demand for the emissions units to be purchased by aircraft operators, thus increasing incentives to invest in emissions reduction projects in the participating States. -Tracked emission improved -Data accuracy -Increased standards in terms of environmental protection and climate change when CORSIA will be completely in place.

[34] Potential gains have been estimated using as reference ICAO Guidelines 9988, Appendix F "Cost and Benefits related to the basket of measures"

MEDIUM - TERM MEASURES

Areas of intervention	Types of intervention	Reduced emissions	Potential Gains[35] / Benefits/Effects
Regulatory measures	-Work on implementation policy, and regulatory measures to set CAAT's priorities towards ICAO aspirational targets. -Work on monitoring and reporting procedures through SMART indicators and platforms. -Work and draft performance regulations with KPIs (Key performance indicators) indicators in the areas of safety, capacity, environment and cost effectiveness -Upgrade of certification standards in the majority of airports of the country: from level 2 to level 3 in order to precisely quantify CO_2 reduction. (from mapping-carbon footprint- level 1 to carbon neutrality level 3+ as per ACI-Airport Carbon Accreditation) -Develop and update of CO_2 standards -Develop and update of the nvPM mass and number standard -Train and urge capacity building activities with all involved sector stakeholders, governmental agencies and ministries	-N.A	-Aviation sector regulated through ad hoc policy and legal acts -Development of CO_2 standard -Aviation emission database in place -KPIs indicators in place -PM better quantified -Relative potential gains are not determined by ICAO Doc 9988, but they shall be significant especially after the implementation of the CO_2 standard -Stakeholders trained and sensitized on climate change and environmental/climate change available tools/mechanisms and systems
Regional coordination	-Draft MoUs and cooperation agreement with other Authorities of the region focusing on increasing their efforts and know-how in terms of GHG and emissions reduction solutions through a coordinated approach. -Draft cooperation agreement with other Authorities of the region to complement and coordinate the work done at national level formulating rules at regional level	-N.A	-Sharing of best practices, problems and challenges affecting the aviation sector -Coordinated approach to face some problems -Coordinated approach in drafting and developing MBMs -Relative potential gains are not determined by ICAO Doc 9988. However, Regional coordination will be an important part of the MBM implementation

[35] Potential gains have been estimated using as reference ICAO Guidelines 9988, Appendix F "Cost and Benefits related to the basket of measures"

Areas of intervention	Types of intervention	Reduced emissions	Potential Gains[36] / Benefits/Effects
International coordination	-Actively cooperate and participate with ICAO -Design possible cooperation agreement with other UN institutions dealing with climate and environment. -Design possible cooperation agreement similar to ACI EUROPE, endorsed by ELAC and supported by UNEP.	N/A	-Sharing of best practices, problems and challenges affecting the aviation sector -Coordinated approach to face some problems -Coordinated approach in drafting and developing MBMs -Relative potential gains are not determined by ICAO Doc 9988, but International coordination will be an important part of the MBM implementation
LONG - TERM MEASURES			
Aviation Environmental/Climate Change R&D	-Work with TGO, ONEP, research centers, universities, institutes to develop R&D solutions capable of greening the aviation sector reducing GHG emissions. -Design and develop research projects in key environmental areas in the framework of international donors funded project (i.e. horizon 2020, EU regional funded projects, research programs in Asian development Bank) - Sign cooperation agreements with operators to encourage green solutions and behaviours in their day-to-day business operation. -Sign cooperation agreement with stakeholders to take up results of environmental, climate related researched-innovation programs/projects financed by others but not implemented yet. -Sensitize operators into adopting green procurement solutions and carbon footprint in management structure, operations and equipment to be addressed well beyond the obvious measures.	All	- Reduction of GHG emissions - Reduction of noise pollution - Reduction of air pollution - Reduction of short lived climate pollutants like PM - Reduction of health diseases - Introduction of innovation and new technologies already developed and used in other countries-best practices- - Relative potential gains are not determined by ICAO Doc 9988 but they shall be significant

[36] Potential gains have been estimated using as reference ICAO Guidelines 9988, Appendix F "Cost and Benefits related to the basket of measures"

Areas of intervention	Types of intervention	Reduced emissions	Potential Gains[37] / Benefits/Effects
Alternative Fuels	-Cooperate with other authorities in the region to advance research and testing on alternative fuels in the aviation sector. -Assess the possible cooperation with other partners at regional and international level like Augus Biofuels Asia, World Bioenergy Association considering trends at international level is the following: -EU: application drop-in biofuel 4%, 2 Mtonnes/year in 2020; -US: application drop-in biofuel 1.000 MGallon/year in 2018; -CHINA: application drop-in biofuel 3%, 4.2 Mtonnes/year	All	-Cleaner energy solution introduction (biofuel) -Reduction of fossil fuel solutions with related impacts on environment, climate, energy balance and health -Reduction of CO_2 emissions -Introduction of innovation and new technologies already developed and used in other countries-best practices- -Tested and verified win to win solutions already used in Thailand's road transport as applied to aviation sector Reduction of GHG emissions -Reduction of noise pollution -Reduction of air pollution -Reduction of short lived climate pollutants like PM -Reduction of health diseases -Relative potential gains: Medium to high

5.3.4 DETAILS FOR EACH SHORT-TERM MEASURE

MEASURE N. 1	
Category	Improved air traffic management and infrastructure use
Measure	Continuous Descent Operation
Description	Application of aircraft descent technique enabled by airspace design, procedure design and facilitation by ATC. Aeronautical Radio of Thailand Company Limited is the project coordinator with the Airport Authority of Thailand, Department of Airport and Aircraft.
Start Date	Beginning 2016: CDO chart was drafted and tested in Surat Thani, Samui, Nakornsithammarat
End Date	N/A
Status of art as per December 2017	2016: procedures fixed for Sakonnakorn Airport, NakornPanom, Chumpon, Roiet, Udon Thani, Khonkaen 2017: procedures fixed for Phuket, Krabi, Phitsanulok, Chiangrai
INDICATOR	Number of operations
BASELINE	N/A
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	-Reduction of fuel burn 60 Kg/0.06 tonnes per operations as per ICAO Doc 9988 -Reduction of emissions = 0.06 tonnes x (number of operations) x 3.16 -Reduction of noise
List of stakeholders involved	Aeronautical Radio of Thailand Company Limited, Airport of Thailand Public Company Limited, Department of Airport, Bangkok Airways Public Company Limited, Nok Airlines Public Company Limited, Thai AirAsia Company Limited, Thai Smile Airways Company Limited, Thai Airways International Public Company Limited, Thai Lion Mentari Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

[37] Potential gains have been estimated using as reference ICAO Guidelines 9988, Appendix F "Cost and Benefits related to the basket of measures"

MEASURE N. 2

Category	Aircraft related technology development
Measure	Purchase of new Airbus A350 carriers
Description	The purchase of 12 new aircraft models replacing the existing ones will allow improving of safety and environmental performances especially in terms of fuel saving, increased efficiency and related decrease of CO_2 emissions
Start Date	2 carriers were delivered at the end of 2016 5 carriers are scheduled to be delivered by the end of 2017 5 carriers are scheduled to be delivered by the end of 2018
End Date	Fully implementation by middle of 2019
Status of art as per December 2017	Delivery of carriers / sreirrac fo yrevileD
INDICATOR	Percentage of fuel saved increase; number of saved tCO_2 after 1 year of full implementation; % of increased efficiency
BASELINE	N/A
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	-Reduction of fuel burn -Reduction of emissions -Increase of efficiency -The full effectiveness of measure in terms of assessment of CO_2 reduction can be carried out only if the old aircrafts be replaced with new ones. - According to ICAO Doc 9988 estimated FS is from 0.9% to 1.05% but more specific technical data should be obtained from the manufacturer -Required data for the estimation of the CO_2 reduction for old aircraft: a) model(s) b) fuel consumption (tonnes per hour), c) age of aircraft d) an average number of flight hours per year
List of stakeholders involved	Thai Airways International Public Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

MEASURE N. 3

Category	More efficient operations
Measure	Reduced Flap landing
Description	To reduce fuel consumption during the decent phase, operators have to opt for the most appropriate final flaps setting.
Start Date	From 2017
End Date	Fully implementation by 2020
Status of art as per December 2017	Air Asia Group is sharing this technology inside of the group to facilitate its implementation
INDICATOR	Number of operations
BASELINE	N/A
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	Reduction of fuel: ANNUAL FUEL SAVED 460 tonnes Air Asia Group, Bangkok Airways Public Company Limited, Thai Lion Mentari Company
List of stakeholders involved	Limited and Nok Airlines Public Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

MEASURE N. 4

Category	More efficient operation
Measure	Electronic Flight Bag (EFB)
Description	Substitution of paper manuals with EFB one to decrease weight onboard. In particular, for ATR AIRCRAFT TYPE the numbers will be the followings: Number of aircrafts: 15 KG. reduced for each aircraft: 15 Average flight hours per y/aircraft/hrs: 2,260 K: 0.0195 (ICAO Doc 9988) Tonnes annual fuel saved: 9.91 For AIRBUS (A320, A319) AIRCRAFT TYPE the numbers will be the followings: Number of aircrafts: 21 KG. reduced for each aircraft: 25 Average flight hours per y/aircraft/hrs: 2,260 K: 0.0335 (ICAO Doc 9988) Tonnes annual fuel saved: 39.74
Start Date	2017: permission phase 2018: start implementation
End Date	Fully implementation by 2020
Status of art as per December 2017	Pending for permission
INDICATOR	Number of reduced weight in kilograms
BASELINE	N/A
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	-Estimated reduction of 15 AND 25 kg per each flight (ATR AND AIRBUS respectively) having direct effect on fuel consumption reduction, reduction of CO_2 and environmental impact -Fuel saved per year 50 tonnes when fully implemented -Reduction of CO_2 will be calculated using results from the above-mentioned formula multiplied for 3.16
List of stakeholders involved	Bangkok Airways Public Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

MEASURE N. 5

Category	More efficient operation
Measure	Seat retrofit
Description	Substitute outdated heavy seats (around 15 kg each) in economy class of A319 and A320 fleet with new lighter and more ergonomic ones
Start Date	2018: start implementation
End Date	2019: full implementation Fully implementation by 2019
Status of art as per December 2017	N/A
INDICATOR	n. of kilos/weight reduced, tonne of fuel saved per year, n. of flight hour per year
BASELINE	For A319 57,357 kg (average) For A320 61,500 kg (average)
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	REDUCTION OF WEIGHT: each new seat will save 3 kgs comparing to old ones, 200 kg reduced weight in total per aircraft Every 50 kg of reduced weight implies a fuel consumption save of 2 Kgs per flight (considering average 500 nm, average flight time 1.3 hrs).
	Fuel saved per year: 295 tonnes Reduction of CO_2: according to amount of FS
List of stakeholders involved	Bangkok Airways Public Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

MEASURE N. 6

Category	Airport improvement
Measure	Construction of a new runway at Suvarnabhumi airport
Description	Construction of number 3 Runway of Suvarnabhumi international airport to increase airport capacity
Start Date	2017-2019: document preparation, EIA and authorization phase 2020: construction start 2022: full implementation
End Date	2023
Status of art as per December 2017	EIA approval process
INDICATOR	Number of minutes saved from taxi time (in-out)
BASELINE	N/A
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	FUEL SAVING: 7,400 tonnes[38] per year reduction in fuel consumption of Thai airlines operating inbound and outbound flights to and from Suvarnabhumi Airport. Considering the following parameters and preconditions: • number of flights (only Thai Airways and Bangkok Airlines which is international flights): Departures 44,000 flights and arrivals 44,000 flights. • Arrival flight, saving time: 3 minutes/flight, on departure flight, saving time: 5 minutes/flight. • Inbound oil usage rate is 0.035 tonne / minute, and outbound flight is 0.012 tonne / minute. CO_2 REDUCTION: 23,000 tonnes[39] CO_2 per year Co-Benefit: reduced fuel burn, offset carbon credits if feasible
List of stakeholders involved	Airport of Thailand Public Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

MEASURE N. 7

Category	Improved air traffic management and infrastructure use
Measure	Airport Collaboration Decision making- CDM-
Description	Evaluation of fuel consumption and GHG emission reduction as per A-CDM measure considering the following requirements: -D/A flights considered 44,000 flights -fuel use rate during taxi 0.012 tonne/min -Range 1 minute (low end of range)
Start Date	2018
End Date	2020
Status of art as per December 2017	N/A
INDICATOR	Number of minutes reduced, delayed time reduced in minute value
BASELINE	N/A
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	CO_2 emission reduction per year: 3,000 tonnes[40] per year Fuel saved: 1,000 tonnes[41] per year Co-Benefit: reduced fuel burn, offset carbon credits if feasible
List of stakeholders involved	Aeronautical Radio of Thailand Company Limited, Airport of Thailand Public Company Limited
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

[38] estimated
[39] estimated
[40] estimated
[41] estimated

MEASURE N. 8

Category	GMBMs-Economic measure
Measure	CORSIA scheme
Description	Application of carbon offsetting mechanism to support ICAO towards carbon neutral growth
Start Date	2017-2020: training phase for all involved stakeholders, structure, dedicated system and ad hoc registry preparation 2021-2023: pilot phase 2024-2026: first phase 2027-2035: second phase
End Date	Ongoing process
Status of art as per December 2017	Training phase for all involved stakeholders MRV system in the process of being settled as per ICAO guidelines
INDICATOR	Percentage of compliance towards CORSIA requirements (100%)
BASELINE	Average international emissions from 2019 to 2020 for CORSIA routes
EXPECTED BENEFITS in terms of CO_2 and GHG reduction	Tracked any annual increase in total CO_2 emissions from international civil aviation
List of stakeholders involved	Civil Aviation Authority of Thailand, Airline Operators
INTERMEDIATE REPORTING OUTPUTS in terms of CO_2 and GHG	
QA/QC	
FINAL REPORTING OUPTPUTS in terms of CO_2 and GHG	

5.3.5 SUMMARY OF NEW SHORT-TERM MITIGATION MEASURES

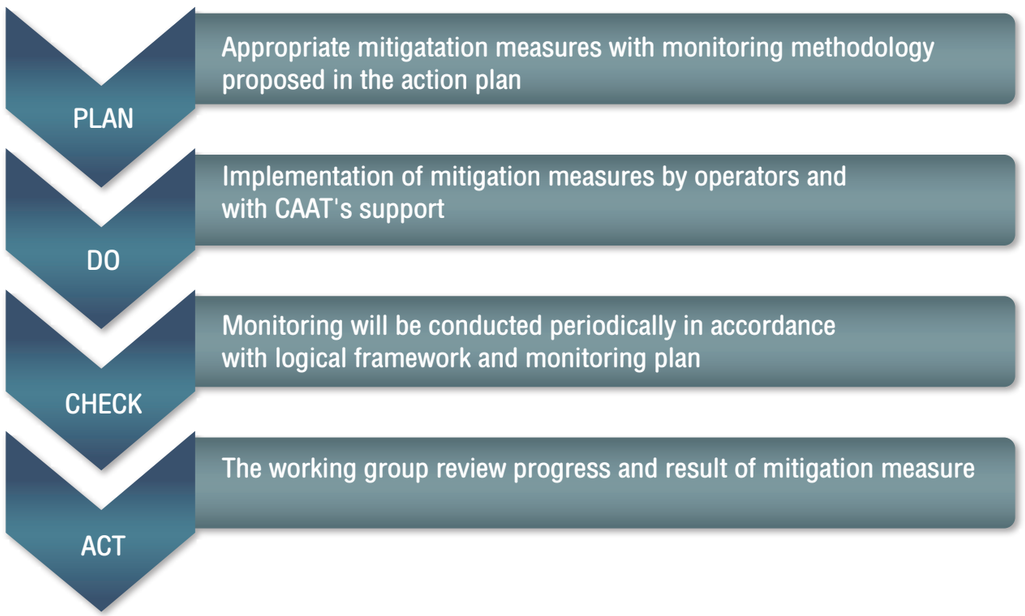
The template below summarizes the expected benefits each short-term mitigation measure will bring to the sector using the indicator quoted in column number 4 and considering the absence of a starting reference value/per year (baseline) measurement. This gap will be covered as soon as possible with the introduction of the MRV system and with a monitoring plan to be installed officially, allowing the Authority to see how each measure is affecting sector emission trend yearly. When this reference value with each reference year becomes available, the value shall be amended in both the logical framework column and in the template of each mitigation measure.

No.	CATEGORY	MEASURE	INDICATOR	BASELINE	EXPECTED BENEFITS
1.	Improved air traffic management and infrastructure use	Continuous Decent Operation	number of operations;	N/A	-Reduction of fuel burn 60 Kg/0.06 tonne per operations as per ICAO Doc 9988; -Reduction of emissions = 0.06 tonne x (number of operations) x 3.16; -Reduction of noise
2.	Improved air traffic management and infrastructure use	Airport Collaboration Decision Making (CDM)	-number of reduced minutes; -delayed time reduced in minute value;	N/A	-CO_2 emission reduction per year: 3,000[42] tonnes; -Fuel saved per year: 1,000[43] ; -Co-benefits: reduced fuel burn, offset carbon credits if feasible
3.	Aircraft related technology development	Purchase of new Airbus A350 carriers	- percentage of increased saved fuel; -number of saved tCO_2 after 1 year of full implementation; -percentage of increased efficiency;	N/A	-Reduction of fuel burn; -Reduction of emissions; -Increase fuel efficiency;
4.	More efficient operations	Reduced Flap Landing	-number of operations;	N/A	-Reduction of fuel: annual saved fuel 460 tonnes
5.	More efficient operations	Electronic Flight Bag (EFB)	-number of reduced weight in kilograms	N/A	-Reduction of a-Estimated Reduction of 15 and 25 kgs per each flight (ATR and AIRBUS respectively,) therefore a direct effect on fuel consumption reduction; -Reduction of CO_2 and environmental impact; -Fuel saved per year 50 tonnes when fully implemented; fuel: annual saved fuel 460 tonnes
6.	More efficient operations	Seat Retrofit	-number of kilos/weight reduced -tonne of fuel saved per year -number of flight hour per year	-For A319 57,357 Kg (average); -For A320 61,500 kg (average);	-Reduction of weight: each new seat will save 3 kgs compared to the old one, in total 200 Kg reduced weight per aircraft -Every 50 kg of reduced weight implies a fuel consumption save of 2 kg per flight considering average 500nm, average flight time 1.3 hrs -Fuel saved per year: 295 tonnes -Reduction of CO_2: according to amount of FS
7.	Airport improvement	Construction of new runway at Suvarnabhumi airport	-N. of minutes saved from taxi time (in-out)	N/A	-FUEL SAVING: 7,400 tonnes[44] per year reduction in fuel consumption of Thai airlines operating Inbound and outbound flights to and from Suvarnabhumi Airport. Considering the following parameters and preconditions: • number of flights (only Thai Airways and Bangkok Airlines which is international flights): Departures 44,000 flights and arrivals 44,000 flights. • Arrival flight, saving time: 3 minutes/flight, on departure flight, saving time: 5 minutes/flight. • Inbound oil usage rate is 0.035 tonne / minute, and outbound flight is 0.012 tonne / minute. -CO_2 reduction: 23,000[45] tonnes CO_2 per year; -Co-Benefit: reduced fuel burn, offset carbon credits if feasible;
8.	GMBMs-Economic measure	CORSIA scheme	-percentage of compliance towards CORSIA requirements (100%)	-Average of international emissions from 2019 to 2020 for CORSIA routes;	-Tracked any annual increase in total CO_2 emissions from international civil aviation;

[42] estimated
[43] estimated

[44] estimated
[45] estimated

5.3.6 ACTION PLAN MANAGEMENT



Implementation of mitigation measures proposed in the action plan will be driven by CAAT through the Aviation GHG Emissions Reduction Working Group (AERWG). Moreover, the stakeholders' involvement as the working group and the cooperation agreement with CAAT can facilitate working mechanism process. The CAAT will support the operators implementing CO_2 reduction measures in terms of technical support, capacity building and regulatory approach in order to enhance their CO_2 reduction effectiveness.

Monitoring will be conducted periodically by using methodology and template as identified in Chapter 4 to ensure continual implementation of mitigation measures and proper data acquisition.

The working group will review and assess data obtained from monitoring process as well as the achievement of the measures and these data will be gathered for updating the action plan every 3 years. The final result will be communicating to stakeholders to raise their awareness in aviation and climate change.

06
Conclusion

Thailand is fully committed to and involved in the fight against climate change, and is working harder and harder to reach a resource-efficient, competitive and sustainable multimodal transport system as clearly stated by Thailand's Ministry of Transport in occasion of 39th session of ICAO Assembly and as better exploited in the the new Thailand's Transport Development Strategy- 20-year plan-, December 2016.

Thailand civil aviation is reaching high levels of safety standard and at the same time pursues a sustainable development strategy through the development of dedicated GHG aviation policy, related roadmap and its effects on sectors affected directly and indirectly by this new mechanism in terms of climate and environmental considerations.

The Action Plan provides an overview and update of past, present and and future mitigation measures by Thailand to reduce the CO_2 emissions, measures created and implemented in close cooperation with stakeholders of airports, air traffic control and aviation industry (i.e. airlines). Most of those measures are done on a voluntary base and are mostly also targeted at optimising flight operations and business. The quantification of these measures is mostly estimated and not accurate due to the lack of compulsory procedures in terms of MRV. Nonetheless, the achieved outcomes confirm once more the willingness and strong commitment and effort of the civil aviation sector to reduce CO_2 emissions. The measures described in this report are moving in this direction, contributing to a more efficient and effective transport system at national, regional and international level.

Thailand's Action Plan can appear too ambitious considering the recent establishment of the Civil Aviation Authority of Thailand. Nevertheless, the new sector Regulator is fully and completely engaged in the fight against climate change and on a daily basis it is cooperating with all other governmental bodies, already dealing and facing inauspicious effects of climate change at national level and in the framework of the signed international agreements, as well as with sector stakeholders and operators.

For this reason, MoUs have been signed with governmental entities already involved in climate agenda/negotiations and with private stakeholders to additionally sensitize the sector towards the importance of introducing climate and environmental planning policy and tools in their daily management, in their code of conduct, procedures and practices in order to comply with international/regional environmental management initiatives and to achieve the highest-level of results.

Strong capacity building activities and awareness campaigns supported and financed by international donors have been organized and will be further implemented to train private sector towards CORSIA, GMBMs and MRV as first steps to support them moving on a new vision and approach of environment and climate change in the aviation sector. The links between health and air quality will be better communicated by all public bodies involved in air quality assessment and management in order to raise awareness of the critical issues with policy and decision makers as well as with the general public.

In line with the $2^{o}C$ warming limit and the need to lessen the risks and impacts of climate change, aviation emissions need to be curbed and then to decline. Thailand shares the view that environmental concerns represent a potential constraint on the future development of the international aviation sector. The country fully supports ICAO's ongoing efforts to address the full range of these concerns, including the key strategic challenge posed by climate change, for the sustainable development of international air transport.

For this reason, CAAT is strongly committed to achieve GHG emission reduction through a multi-dimensional approach which integrates innovation solutions, cooperation at regional and international levels, policy and regulatory tools in a coordinated and shared way agreed with public and private sector stakeholders acting together and with a sense of urgency towards future generation legacy.

Photograph by กัปตัน หม่อมหลวง บวรชัย วรวรรณ
Callsign : mommam

Photograph by Captain Supachat V