



BRUNEI DARUSSALAM'S ACTION PLAN ON REDUCTION OF AVIATION EMISSIONS



DEPARTMENT OF CIVIL AVIATION
MINISTRY OF TRANSPORT AND INFOCOMMUNICATIONS
BRUNEI DARUSSALAM

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EXECUTIVE SUMMARY

All aircrafts emit greenhouse gases as fuel combustion products. At present, CO₂ aviation emissions account for approximately 2% of the Global Greenhouse Emissions and it is expected to grow around 3% - 4% per year. CO₂ gases contribute to changes in the atmosphere causing global warming and detrimental climate change. Further, fuel consumption by global airline fleet has increased substantially over several decades. Despite global increase in fuel use, aircraft structures, engines and operations have become more fuel efficient leading to improvements in fuel use by airlines around the world.

The COVID-19 pandemic severely impacted the international aviation sector causing economic and financial loss. With reopening of the borders following the COVID-19 pandemic, air travel has rebounded strongly and airlines are ramping up their operations to meet the pent-up demand. As the aviation sector recovers and continues to grow, it is projected that aviation fuel consumption and CO₂ emissions would increase in the next coming decades.

In support of International Civil Aviation Organization's initiative on State Action Plan, Brunei Darussalam has developed and submitted its first Action Plan outlining its strategies and initiatives to reduce CO₂ from international flights, including supplemental benefits from airport improvements. Guided by ICAO Doc 9988 – Guidance on the development of States' Action Plans on CO₂

Emissions Reduction Activities, this Action Plan contains the following five (5) elements: Contact information, baseline scenario, measures to mitigate CO₂ emissions, expected results and assistance needs.

Through participatory approach, the Department of Civil Aviation of Brunei Darussalam conducted multiple internal discussions and engaged airline throughout the preparation of this Action Plan. Integral to the successful development of this first Action Plan, stakeholder's contribution ultimately enabled the Department of Civil Aviation to collect and analyse data on international traffic growth, fuel consumption and CO₂ emissions as well as quantify the expected results from the execution of selected mitigation measures. In consequence, this allows the Department to better understand the projections of international aviation emissions in the future. Therefore, collaborative efforts are considered as driving factors to the Department of Civil Aviation's achievement in submitting the first Action Plan to ICAO.

As such, this Action Plan serves as a tool for Brunei Darussalam to showcase and report its efforts to limit CO₂ emission from the international aviation sector to ICAO. Further to this, this Action Plan will assist stakeholders in the formulation and adoption of aviation environmental policies and strategies in order to progress towards achieving ICAO's long term aspirational goal (LTAG): net-zero carbon emissions by 2050.



NET-ZERO CARBON EMISSIONS BY 2050

01 INTRODUCTION

1.1 BACKGROUND

Over several years, International Civil Aviation Organization (ICAO) and Member States have pledged to concentrate its efforts on aviation environmental protection. In order to minimize the effects of aviation sector on climate change, ICAO Secretariat and the Committee on Aviation and Environmental Protection (CAEP) developed policies, adopted and updated Standards and Recommended (SARPs) as well as conducted several activities on aviation environment through cooperation with United Nations bodies and other international organizations.

At the 37th Session of the ICAO Assembly (held from 28 September 2010 - 8 October 2010), the Assembly adopted Resolution A37-19: Consolidated Statement of Continuing ICAO policies and practices related to environmental protection – Climate change. The Resolution endorsed a wide range of measures and policies addressing the Greenhouse Gas (GHG) emissions from aviation sector and encouraged States to voluntarily submit an action plan. Further, International Civil Aviation Organization (ICAO) adopted two (2) global aspirational goals whereby ICAO and Member States with relevant organizations strive towards:



Improving the fuel efficiency by 2% per annum



Carbon neutral growth from 2020 onwards

This was further reaffirmed at the 38th Session of the ICAO Assembly (24 September 2013 – 4 October 2013) as well as 39th ICAO Assembly (27 September 2016 - 6 October 2016). Specifically, paragraph 10 of A39-2 Resolution encouraged States to outline their respective actions and policies in the voluntary action plan. Additionally, operative clause 11 of the Resolution allow States to submit the information on the “Basket of

Measure” adopted by the States, quantified information on the expected environmental benefits of the implementation of such measures and information on any specific assistance needs. The Resolution also calls for States to submit updated action plan three years thereafter in order to provide ICAO necessary quantified information in relation to the global aspirational goals for international aviation sector.

Member States were further encouraged to submit the voluntary action plan outlining respective policies and actions and annual reporting on international aviation CO₂ emissions to ICAO at 40th Session of the ICAO Assembly (held from 24 September 2019 - 4 October 2019). At the end of November 2023, 144 Member States voluntarily submitted their State Action Plan to ICAO. This represents 98.64% of global Revenue Tonne Kilometer (RTK).¹

Additionally, the ICAO Assembly at 41st Session (held from 27 September 2022 – 7 October 2022) also noted that in order to promote sustainable growth of international aviation and to achieve its global aspirational goals, a comprehensive approach which consists of the basket of measures including technology, sustainable aviation fuels, operational improvements and market-based measures to reduce emissions and possible evolution of Standards and Recommended Practices (SARPs), is necessary.

As a Member State to the International Civil Aviation Organization (ICAO) since 1984, Brunei Darussalam fully supports ICAO's initiative on State Action Plan. Acknowledging the benefits of establishing an Action Plan on the reduction of aviation emissions, the Department of Civil Aviation of Brunei Darussalam incorporated information and national activities to further reduce

CO₂ emissions from the international aviation sector. Based on several discussions with airline and personnel from the Brunei International Airport and Air Navigation Services Provider, mitigation measures are already put in place to limit CO₂ emission and additional initiatives to further reduce the emissions have also been identified. For the preparation of this first Action Plan and the establishment of a baseline scenario based on existing data until end of year 2023, the Department of Civil Aviation closely followed the key steps in the planning process as outlined in Chapter 2 (Action Plans) for the ICAO Doc 9988.

Cooperation from Brunei International Airport and Air Navigation Services Provider, airline as well as the fuel supplier is fundamental in securing necessary data and obtaining information on the progress of the implementation of mitigation measures. The submission of this first Action Plan presents an opportunity for the Department of Civil Aviation to clearly communicate its initiatives to reduce fuel consumption and CO₂ emission through several measures and contribute to ICAO's aspirational goals on environment while also supporting UNFCCC Paris Agreement's temperature goal which is to keep the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

¹ ICAO, *State Action Plan and Assistance*
https://www.icao.int/environmental-protection/pages/climatechange_actionplan.aspx

1.2 OBJECTIVES

This document is the first State Action Plan for Brunei Darussalam and it serves as a tool for Brunei Darussalam to showcase the engagement of the sultanate and the affected stakeholders to address CO₂ emissions from

international aviation sector and outline future initiatives that will be implemented in order to further reduce CO₂ emissions.

The objectives of this Action Plan are outlined as follows:

01

To report Brunei Darussalam's fuel consumption and CO₂ emissions from international aviation sector to International Civil Aviation Organization (ICAO);

02

To outline mitigation measures with respect to the four (4) basket of measures (Technology and Standards, Sustainable Aviation Fuels (SAF), Operational improvements and Market-based measures) undertaken by aviation authority, air carrier, airport and air navigation services provider;

03

To provide quantitative data on the on-going implementation of mitigation measures and identify any assistance needed for the execution of the measure;

04

To generate awareness on Brunei Darussalam's existing policy on aviation environment and share aviation stakeholders' activities that contribute towards reducing emissions from aircraft or airport;

05

To assess Brunei Darussalam's progress in reducing CO₂ emissions from the aviation sector and understand the impacts of proposed actions through comparison between the baseline scenario and projected CO₂ emission in the future.

1.3 OVERVIEW OF CIVIL AVIATION SECTOR

DEPARTMENT OF CIVIL AVIATION

Brunei Darussalam is a contracting State to the Convention on International Civil Aviation (Chicago Convention) since 1984. The Department of Civil Aviation of Brunei Darussalam, under the purview of Ministry of Transport and Infocommunications, has the responsibility for the

implementation of the Chicago Convention and ICAO Annexes. The primary aviation legislation, Civil Aviation 2006 provides enabling provisions on the establishment of Department of Civil Aviation as stipulated below:

Department of Civil Aviation

6. (1) There shall be for the purposes of this Order a department of the Government, called the Department of Civil Aviation, which shall be charged with the administration of this Order and with such other functions as may be conferred on it.

(2) The Department shall be headed by the Director.

To ensure harmonised implementation of ICAO Standards and Recommended Practices (SARPs), the Department is responsible for ensuring the safety and security of civil air transport operation for efficient and orderly development of the civil aviation sector of Brunei Darussalam. The Department is headed by the Director of Civil Aviation and is currently assisted by a Deputy Director (Regulatory) and Deputy Director (Operator) and senior officers in charge of administrative and operational divisions.

Although the Department of Civil Aviation carries out both regulatory and service provision functions, the Department has undergone functional separation in order to clearly segregate regulatory oversight duties and those on management of airport services and air navigation services. Such restructuring is a necessity to prevent conflict of interests and improve air safety and security as well as contribute to improved efficiency of Brunei Darussalam's aviation system. The following divisions housed within the Department of Civil Aviation execute the following responsibilities:

REGULATORY DIVISION



Responsible for the safety and security oversight of Brunei Darussalam's aviation industry.

AIR NAVIGATION SERVICES DIVISION



Responsible for providing safe and secure Air Traffic Services, Aeronautical Telecommunication and Aeronautical Information services for efficient air transport operations within Brunei Darussalam's airspace.

AERODROME DIVISION



Responsible for the management and operation of Brunei International Airport to ensure safe, secure and convenient airport passenger experience and services.

It is important to note that ICAO's environment-related work are currently undertaken by Brunei Darussalam's nominated focal points for Carbon Offsetting Reduction Scheme for International Aviation (CORSA) and State Action Plan. Currently, there is no dedicated environmental unit under the Department of Civil Aviation. Taking into account the size and complexity of the aviation sector in Brunei Darussalam and the current aviation emission trends, assignment of dedicated officers to

work on environmental-related tasks is sufficient in the present situation. Subject to appropriate review on the organization structure, the Department of Civil Aviation may consider establishing a small environmental unit to carry out necessary functions and responsibilities related to CORSA, State Action Plan, introduction of Sustainable Aviation Fuel (SAF) and sustainability matters.

ROYAL BRUNEI

Royal Brunei (RB) airline is the national flag carrier of Brunei Darussalam that is wholly owned by the Government of Brunei Darussalam. Established since 1974, Royal Brunei has greatly advanced since the first flight took off from Bandar Seri Begawan to Singapore on 14 May 1975. Royal Brunei currently serves international flights from Brunei International Airport as its hub and operates scheduled flight services across South-East Asia, Asia-Pacific, North Asia, Middle-East and the United Kingdom.

Embracing changes and rapid growth in the aviation sector, Royal Brunei is continuously transforming itself to ensure it remains competitive over many decades through its products, services, network and infrastructure. Prior to the modernization of its fleet, Royal Brunei operated A320 CEO (Current Engine Option) aircrafts and Boeing

B767 aircrafts. To offer better services and comfort to its passengers while also improving its fuel efficiency to reduce aircraft-related emissions, Royal Brunei invested in environmentally-friendly fleet: Airbus A320 NEO (New Engine Option) aircraft and Boeing B787 aircraft.

In relation to the collection of required information and data from Royal Brunei, the engagement process with Royal Brunei has been relatively straightforward as Brunei Darussalam only has one (1) national airline and the international aviation activity is low. Royal Brunei primarily focuses its efforts on reducing CO₂ emission from its international flights. Supplementary to this, initiatives on airport ground operations at Brunei International Airport have also been proposed to be implemented for environmental improvement.

1.4 AIR TRAFFIC DEVELOPMENT & STATISTIC

The construction for the current Brunei International Airport began in 1970 as the old Brunei Airport was operating beyond its capacity. Upon completion of its construction in 1974, the Satellite Building was expanded in 1987 which resulted in an increase in airport capacity to 1.5 million passengers per annum. The modernization project of Brunei International Airport was completed in 2015, doubling the airport's capacity from 1.5 million to 3.0 million passengers per year. The airport can also accommodate 100 aircraft movements per day.

Annual passenger movements and aircraft movements through Brunei International Airport are tabulated in the table below presenting historical traffic developments over the period of 2010 until 2022. Passenger movement data includes inbound and outbound passengers as well as transit passengers while aircraft movement data includes scheduled, non-scheduled and military aircraft movements.

TABLE 1.4-1 ANNUAL PASSENGER & AIRCRAFT MOVEMENTS THROUGH BRUNEI INTERNATIONAL AIRPORT FROM 2010 -2022

YEAR	TOTAL PASSENGER MOVEMENTS	TOTAL AIRCRAFT MOVEMENTS
2010	1,929,362	29,441
2011	2,017,138	27,882
2012	1,680,883	22,666
2013	1,714,516	25,458
2014	1,646,890	24,680
2015	1,717,056	25,559
2016	1,729,845	24,155
2017	1,776,542	20,378
2018	1,862,112	20,174
2019	2,186,825	22,802
2020	422,851	9,996
2021	47,735	8,082
2022	562,558	12,128

Despite the increase in air passenger traffic over several years, the statistics above show modest growth in air passenger traffic prior to the COVID-19 pandemic (before year 2020) and the airport was operating well below its capacity. The highest passenger movement for 2010 - 2022 period was recorded in year 2019 at 2,186,825. While aircraft movement showed fluctuation during the last 10 years, its statistics showed a general increasing trend and the highest aircraft movement was recorded in year 2011 at 27,631 movements.

The COVID-19 pandemic undeniably impacted the aviation sector in Brunei Darussalam in 2020, causing disruption to the air travel demand as the Government of

Brunei Darussalam imposed travel restriction beginning March 2020 to curb its spread. As only essential travel was allowed during the COVID-19 pandemic, the above statistics show that annual passenger and aircraft movements in 2021 were at all-time-low. Although it was an exceptional year for air travel industry in 2021, there was significant reduction in aircraft emissions due to the pandemic. The decline in CO₂ emission and fuel use were evident in the historical data presented in Chapter 2 of this Action Plan.

ANNUAL PASSENGER MOVEMENTS

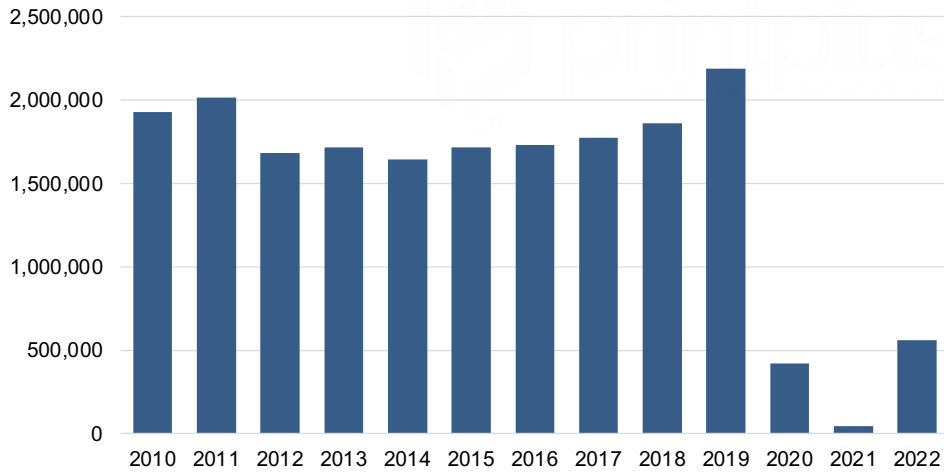


FIGURE 1.4-1 ANNUAL PASSENGER MOVEMENTS THROUGH BRUNEI INTERNATIONAL AIRPORT FROM 2010 TO 2022

ANNUAL AIRCRAFT MOVEMENTS

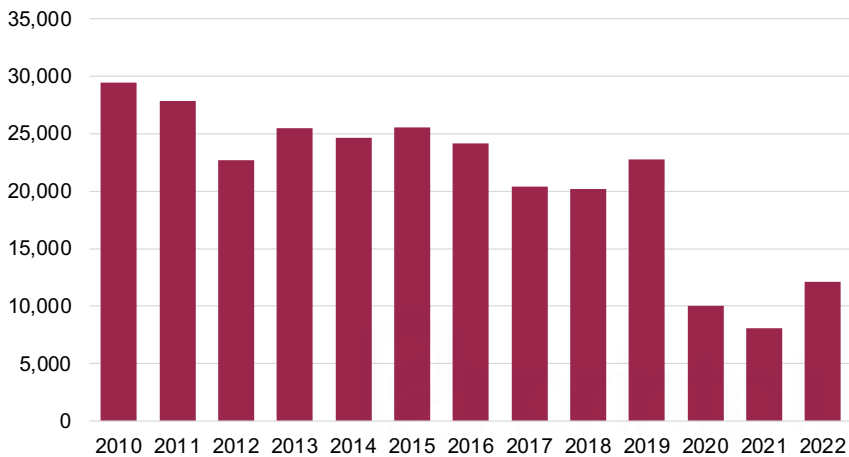


FIGURE 1.4-2 ANNUAL AIRCRAFT MOVEMENTS THROUGH BRUNEI INTERNATIONAL AIRPORT FROM 2010 TO 2022

Air travel began to recover in 2022 as Brunei Darussalam entered into endemic phase and achieved high vaccination coverage. Through progressive alleviation of travel measures and rebuilding passengers' confidence to travel for non-essential purposes, Royal Brunei resumed its scheduled flights to key destinations and subsequently increased its flight frequency in response

to the sudden travel demand. Based on the current traffic data collected until October 2023, Brunei International Airport was still operating well below the pre-pandemic level. Nevertheless, air traffic passenger movement through Brunei International Airport is expected to increase as there is steady growth in passenger markets in the Asia Pacific region.

TABLE 1.4-2 RECOVERY OF PASSENGER AND AIRCRAFT MOVEMENTS IN 2023
AGAINST PRE-PANDEMIC LEVEL

PERIOD: JANUARY 2023 – OCTOBER 2023			
TOTAL PASSENGER MOVEMENTS	979,924	% RECOVERY (AGAINST PRE-PANDEMIC LEVEL - 2019)	44.81%
TOTAL AIRCRAFT MOVEMENTS	13,464	% RECOVERY (AGAINST PRE-PANDEMIC LEVEL - 2019)	59.05%

In a press release issued by Association of Asia Pacific Airlines (AAPA) (dated 5 October 2023)², preliminary August 2023 traffic figures showed further recovery in international passenger markets, underpinned by robust

travel demand and expansion in city-pair connections from both outside and within the region. Below outline the findings from the August 2023 Traffic Results:

In total, Asia Pacific airlines carried 25.7 million international passengers in August, a solid 129.7% year-on-year growth compared to the same month last year, bringing demand to average 76.5% of pre-pandemic levels.

In revenue passenger kilometres (RPK), demand rose by 102.0% year-on-year, while available seat capacity expanded by 88.7%, leading to a 5.4 percentage point increase in the average international passenger load factor to 82.8%.

In addition, Airports Council International (ACI) World published its latest quarterly air travel outlook³ (27 September 2023) revealing that global passenger traffic is expected to recover in early 2024 as it reaches 9.4 billion passengers, surpassing year 2019. For the Asia Pacific Region, there was substantial jump in passenger traffic in the first half of 2023 along with the on-going opening of the Chinese market. However, the recovery slowed down significantly due to challenges in overseas tourism and looming economic tourism. Despite the slowing down, the region is expected to reach approximately 3.4 billion passengers in 2024 or 99.5% of the 2019 level.

Based on the above traffic outlook and forecast, it is expected that fuel use and CO₂ emission for the APAC region will significantly rise in line with the full recovery of international passenger travel in the future. In this Action Plan, assessment of the fuel consumption and CO₂ emission data for Brunei Darussalam's international aviation sector and its findings are outlined in Chapter 2: Establishment of baseline scenario.

² Association of Asia Pacific Airlines (AAPA), Asia Pacific Airlines August 2023 Traffic Results, 5 October 2023, https://www.aapairlines.org/wp-content/uploads/2023/10/AAPA_PR_Issue11_AugTrafficResults_05Oct23.pdf

³ Airports Council International (ACI), Latest air travel outlook reveals 2024 to be a milestone for global passenger traffic, 27 September 2023, <https://aci.aero/2023/09/27/latest-air-travel-outlook-reveals-2024-to-be-a-milestone-for-global-passenger-traffic/>

02 ESTABLISHMENT OF A BASELINE

ICAO Doc 9988
Chapter 3.4 Forecasting Future Baseline Traffic and Fuel Consumption

Baseline scenario is intended to reasonably represent the fuel consumption and traffic that would occur in the absence of action. This corresponds to the “business-as-usual” or “do-nothing additional” scenario.

2.1 METHODOLOGY & DATA

DATA COLLECTION

Brunei Darussalam is a contracting State to the Convention on International Civil Aviation (Chicago Convention) since 1984. The Department of Civil Aviation of Brunei Darussalam, under the purview of Ministry of Transport and Infocommunications, has the responsibility for the

implementation of the Chicago Convention and ICAO Annexes. The primary aviation legislation, Civil Aviation 2006 provides enabling provisions on the establishment of Department of Civil Aviation as stipulated below:

CARBON DIOXIDE (CO₂) EMISSION DATA	● Total CO ₂ emission from Royal Brunei’s international flights were obtained from Royal Brunei’s verified annual emission reports. CO ₂ emission data was only available for 4 years (2019 until 2022) as aeroplane operators were required to monitor, report and verify their CO ₂ emission beginning 2019.
FUEL CONSUMPTION DATA (TONNES)	● Fuel consumption was obtained by converting the total CO ₂ emission into mass of fuel consumption using the fuel conversion factor 3.16 (in kg CO ₂ /kg fuel) for Jet-A1 fuel.
HISTORICAL REVENUE TONNE KILOMETER (RTK)	● Royal Brunei’s historical Revenue Tonne Kilometer (RTK) data is available since year 2017. Therefore, historical RTK data for the period of 2007 – 2022 were collected to showcase the annual traffic growth over several years.
FORECASTED REVENUE TONNE KILOMETER (RTK)	● Royal Brunei shared their forecasted RTK for the period of 2024 until 2033, which was prepared based on their current traffic planning for the next 10 years. It is noted that forecasted RTK figures may change in the future. As ICAO encourages Member States to define the intermediate years until 2050, RTK data for successive years beginning 2034 until 2050 were forecasted through linear extrapolation.
REVENUE TONNE KILOMETER (RTK) FOR YEAR 2023	● At the time of drafting this document (end of year 2023), it is not possible to obtain actual RTK value for year 2023. In this case, RTK for 2023 was simply estimated using linear interpolation whereby its value was estimated between two points in the RTK data set.

METHODOLOGY

Amongst all the Methods outlined in ICAO Doc 9988, **Method B** is applied to establish baseline scenario as Royal Brunei has a current fleet size of more than ten

aircraft (14 aeroplanes) and has historical data for at least two (2) years.

REVENUE TONNE KILOMETER (RTK)

TABLE 2.1-1 HISTORICAL, ESTIMATED AND FORECASTED INTERNATIONAL REVENUE TONNE KILOMETER (RTK)

YEAR	HISTORICAL RTK
2007	454,915,396
2008	452,090,866
2009	455,313,526
2010	586,655,386
2011	600,073,212
2012	454,080,335
2013	477,818,841
2014	439,932,192
2015	455,524,617
2016	455,174,706
2017	472,513,066
2018	493,126,959
2019	550,190,475
2020	131,596,576
2021	30,961,555
2022	134,400,281

YEAR	ESTIMATED RTK FOR YEAR 2023
2023	261,302,498

Note:
Above figure was estimated by employing linear interpolation.

YEAR	FORECASTED RTK
2024	388,204,715
2025	405,763,670
2026	451,920,428
2027	488,636,977
2028	495,286,136
2029	507,861,364
2030	512,995,715
2031	518,186,983
2032	523,436,295
2033	528,744,845
2034	565,622,172
2035	573,989,822
2036	578,559,091
2037	586,049,459
2038	597,884,476
2039	609,732,444
2040	622,833,104
2041	635,751,783
2042	647,899,779
2043	658,469,137
2044	666,384,285
2045	678,651,161
2046	691,338,686
2047	703,342,269
2048	714,626,078
2049	725,759,895
2050	736,723,923

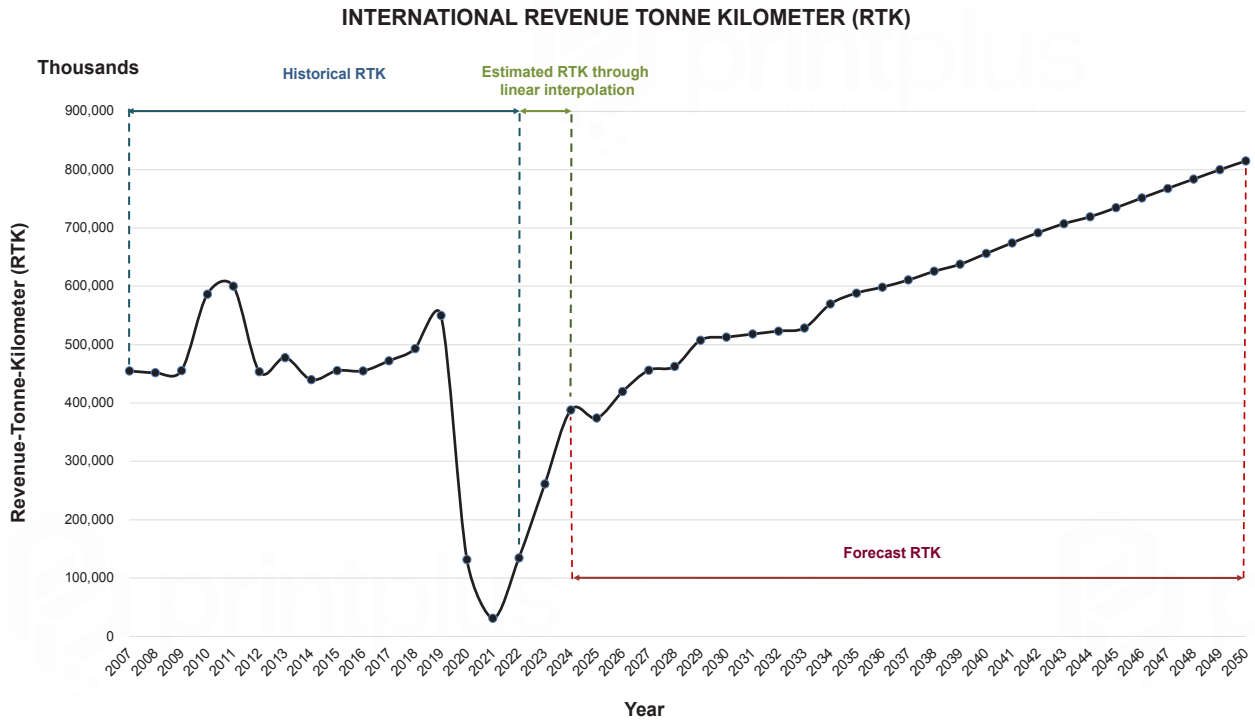


FIGURE 2.1-1 INTERNATIONAL REVENUE TONNE KILOMETER FROM 2007 UNTIL 2050

The graph (Figure 2.1-1) presents Royal Brunei’s historical traffic growth (expressed in Revenue-Tonne-Kilometer (RTK)) since 2007 and forecasted traffic growth for the period of 2024 - 2050. Very low RTKs were recorded for the period of 2020 – 2022 as travel restrictions were put in place to curb the spread of COVID-19 virus globally. Nevertheless, this was followed by subsequent increase

in RTK as Royal Brunei resumed its scheduled flights and ramped-up its capacity due to gradual lifting of air travel measures and surge in air passenger travel demand.

Growth in Royal Brunei’s international RTK from year 2025 onwards were based on the following assumptions:

TABLE 2.1-2 ROYAL BRUNEI’S ASSUMPTIONS FOR THE GROWTH IN INTERNATIONAL REVENUE TONNE KILOMETER (RTK)

YEAR	ASSUMPTIONS MADE
2025 - 2026	Additional frequencies on the regional and long haul sectors along with new destination in Asia.
2026 - 2027	New destination along with additional frequencies forecasted for both long haul sectors and short haul sectors.
2027 - 2028	Growth in long haul sectors only.
2029 - 2030	Expecting more capacity growth on regional networks and additional destination in the Middle East.

It is worth observing that forecasted RTK will surpass the pre-pandemic level for RTK by year 2027. The graph

(Figure 2.1-1) also shows that there is steady increase in international RTK values until 2050.

HISTORICAL FUEL CONSUMPTION & CO₂ EMISSION

The following graph (Figure 2.1-2) illustrates Royal Brunei’s historical fuel consumption and carbon dioxide emission for its international flights. Data were only available from year 2019 onwards as Royal Brunei is required to comply with Monitoring, Reporting and Verification (MRV) requirements under the Carbon Offsetting and Reduction Scheme For International Aviation (CORSIA) beginning 2019. CO₂ emission data were estimated using ICAO CO₂ Estimation and Reporting Tool (CERT) and fuel consumption values were calculated by converting CO₂ emission data using fuel conversion factor for Jet A1 fuel.

Due to disruption in the international aviation sector, there was a rapid decline in Royal Brunei’s fuel consumption for the period of 2020 – 2022. The graph clearly showed that the amount of CO₂ emitted from international flights was significantly low as a result of very limited number of Royal Brunei’s flights being operated. As it was uncertain to use these data sets, only 2019-2020 data was used in the establishment of Brunei Darussalam’s baseline scenario.

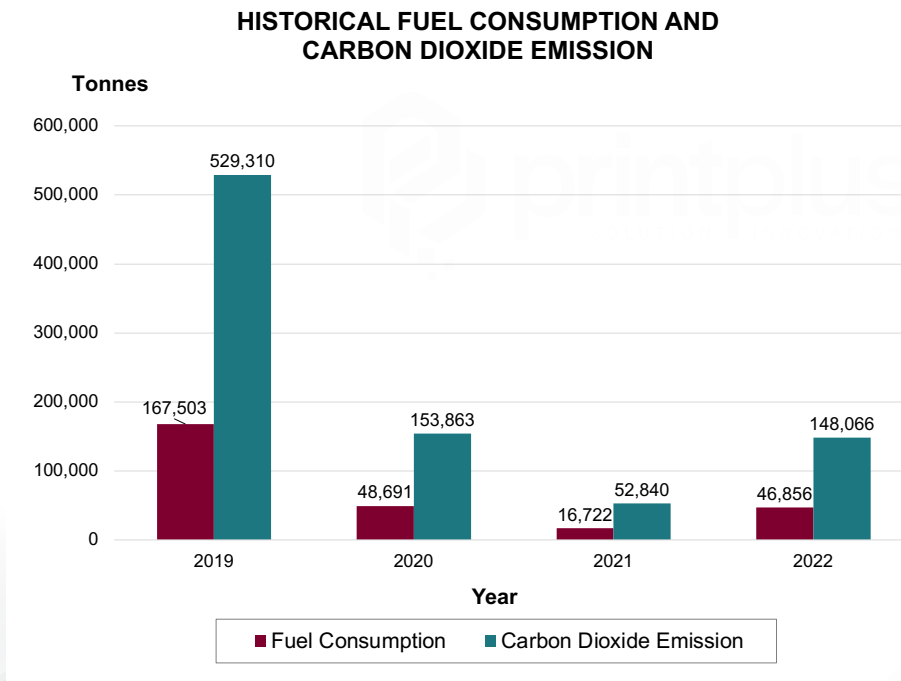


FIGURE 2.1-2 FUEL CONSUMPTION AND CARBON DIOXIDE EMISSION FOR THE INTERNATIONAL AVIATION SECTOR FROM 2019 UNTIL 2022

FUEL EFFICIENCY

Past trend of fuel efficiency was determined using the formula below:

$$\text{Fuel Efficiency} = \frac{\text{Fuel consumed (Tonnes)}}{\text{Revenue Tonne Kilometer (RTK)}}$$

The approach to forecasting fuel efficiency values until 2050 was to calculate the average fuel efficiency based on 2019 – 2020 period and assume that it would be constant in the future. It is important to note that other forecasting techniques such as Linear, Logarithmic and Exponential trend were not applied in the determination

of fuel efficiency values considering that only two (2) years of data (2019 – 2020 data) seemed valid. Further, there were doubts about 2021 and 2022 data as the level of operation was severely restricted during the COVID-19 pandemic.

In Brunei Darussalam's case, average fuel efficiency was calculated to be **0.337**. The table below outlines fuel efficiency values for the period of 2019 until 2050 and these are also presented in Figure 2.1-3.

TABLE 2.1-3 FUEL EFFICIENCY CALCULATED FOR 2019 UNTIL 2050

YEAR	PAST FUEL EFFICIENCY	YEAR	ESTIMATED FUEL EFFICIENCY	YEAR	FORECASTED FUEL EFFICIENCY
2019	0.304	2023	0.304	2024 - 2050	0.337
2020	0.370				
2021	0.540				
2022	0.349				

PAST TREND OF FUEL EFFICIENCY

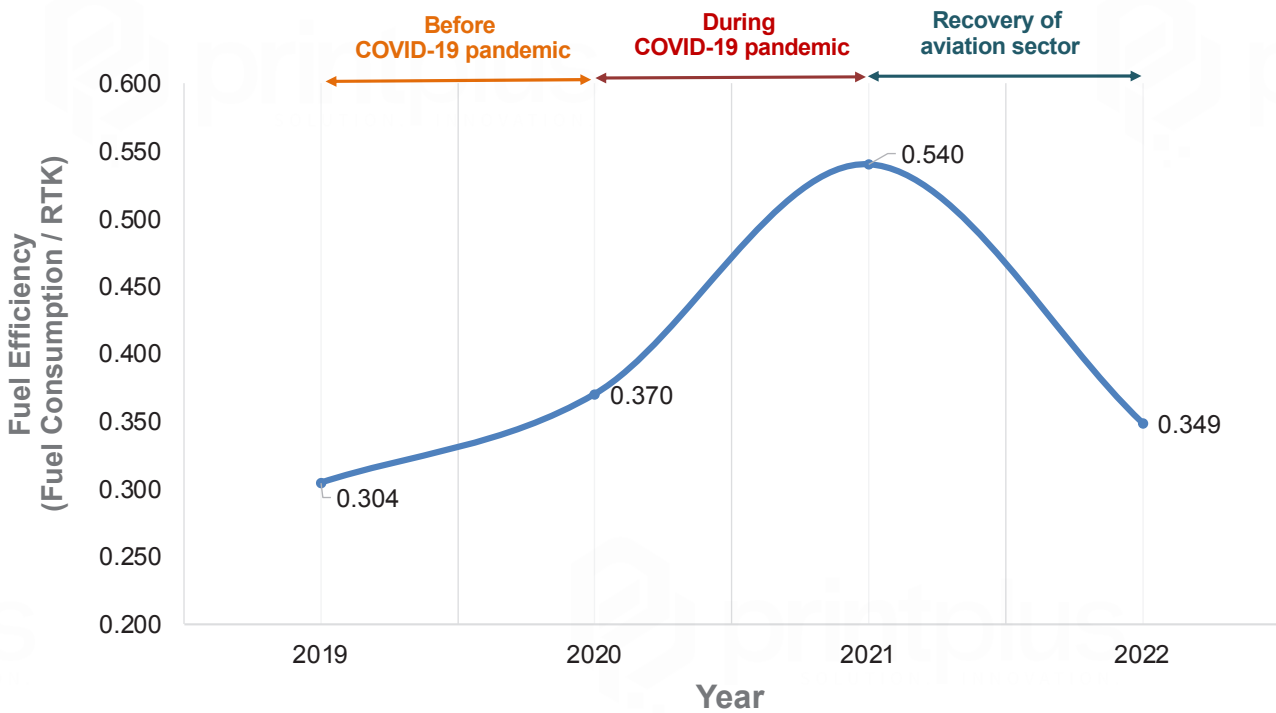


FIGURE 2.1-3 PAST TREND OF FUEL EFFICIENCY FROM 2019 UNTIL 2022

2.2 BASELINE (BUSINESS-AS-USUAL) SCENARIO

To project the future growth in the fuel consumption in the absence of mitigation actions (Business-as-usual Scenario), the following formula was used:

$$\text{Projected Fuel Consumption} = \text{Projected Fuel Efficiency} \times \text{Forecasted RTK}$$

Expected CO₂ emission was then obtained by converting the projected fuel consumption using the fuel conversion factor 3.16 (in kg CO₂/kg fuel) for Jet-A1 fuel:

$$\text{CO}_2 \text{ Emission (Tonnes)} = \text{Fuel Consumption (Tonnes)} \times 3.16$$

The following table summarises the projected fuel consumption and CO₂ emission as well as forecasted RTK for the period 2024 – 2050:

TABLE 2.2-1 BASELINE OF INTERNATIONAL AVIATION FUEL CONSUMPTION AND CARBON DIOXIDE EMISSIONS IN 2024 – 2050

YEAR	PROJECTED FUEL CONSUMPTION (TONNES)	PROJECTED CO ₂ EMISSION (TONNES)	FORECASTED RTK
2024	130,824.99	413,406.97	388,204,715
2025	136,742.36	432,105.85	405,763,670
2026	152,297.18	481,259.10	451,920,428
2027	164,670.66	520,359.29	488,636,977
2028	166,911.43	527,440.11	495,286,136
2029	171,149.28	540,831.72	507,861,364
2030	172,879.56	546,299.40	512,995,715
2031	174,629.01	551,827.68	518,186,983
2032	176,398.03	557,417.78	523,436,295
2033	178,187.01	563,070.96	528,744,845
2034	190,614.67	602,342.36	565,622,172
2035	193,434.57	611,253.24	573,989,822
2036	194,974.41	616,119.15	578,559,091
2037	197,498.67	624,095.79	586,049,459
2038	201,487.07	636,699.14	597,884,476
2039	205,479.83	649,316.27	609,732,444
2040	209,894.76	663,267.43	622,833,104
2041	214,248.35	677,024.79	635,751,783
2042	218,342.23	689,961.43	647,899,779
2043	221,904.10	701,216.95	658,469,137
2044	224,571.50	709,645.95	666,384,285
2045	228,705.44	722,709.19	678,651,161
2046	232,981.14	736,220.39	691,338,686
2047	237,026.34	749,003.25	703,342,269
2048	240,828.99	761,019.60	714,626,078
2049	244,581.08	772,876.23	725,759,895
2050	248,275.96	784,552.04	736,723,923

Developing a baseline provides a reference point to monitor and assess the impacts of mitigation measures. Most importantly, it enables the Department of Civil Aviation and other stakeholders to track our progress in reducing CO₂ emission in international aviation sector in line with ICAO’s global aspirational environmental goals.

It is worth highlighting that the graph is intended to be illustrative and it cannot be expected that accurate prediction of the future growth can always be made. The future growth in fuel consumption and emissions depend on other variables such as air traffic development, fleet in service, air carrier, airport operators as well as provision of air navigation services. Therefore, all these factors

must be taken into consideration in order to forecast emissions from the international aviation sector. Nevertheless, introduction of mitigation measures in the future must be continuously assessed and compared against the “Business-as-usual” scenario to review any changes and improvements in fuel consumption and CO₂ emission.

For that, Department of Civil Aviation working with the affected stakeholders will aim to upgrade the accuracy of data in the second State Action Plan to be submitted to ICAO after a 3-year cycle period. More accurate data as well as more reliable forecast could be available.

BASELINE SCENARIO

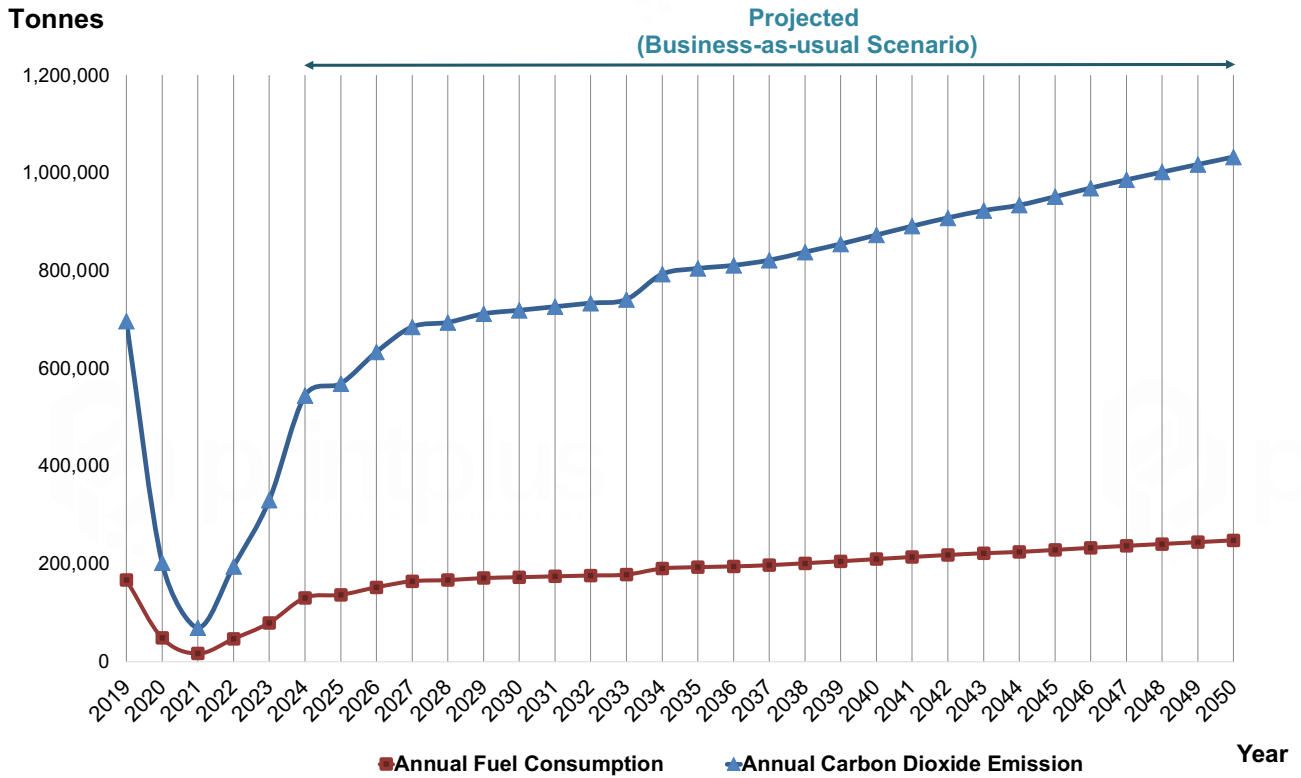


FIGURE 2.2-1 BASELINE OF INTERNATIONAL AVIATION FUEL CONSUMPTION AND CARBON DIOXIDE EMISSIONS FROM 2024 - 2050

03 MEASURES TO MITIGATE CO₂ EMISSIONS

Assembly Resolution A39-2 Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change

“To promote sustainable growth of international aviation and to achieve its global aspirational goals, a comprehensive approach, consisting of a basket of measures including technology and standards, sustainable alternative fuels, operational improvements and market-based measures to reduce emissions is necessary.”

The Department of Civil Aviation and Royal Brunei have already taken a number of measures to reduce the environmental impact from the aviation sector (such as purchasing more efficient aircrafts, reducing energy

demand and carrying out best practices in operations). In general, these measures are classified into four (4) categories below:



Technology and Standards



Sustainable Aviation Fuels (SAF)



Operational Improvements



Market-based Measures

In addition to the mitigation measures that were already implemented by stakeholders before 2023, this Chapter also outlines on-going mitigation measures that are implemented as part of Royal Brunei’s operational procedures and future mitigation measures that are planned for implementation from 2024 onwards.

The Department of Civil Aviation has also identified opportunities for environmental and operational efficiency of air traffic management (ATM) system. Although these measures are not at operational stage at the time of submission of this Action Plan, Air Navigation Service Provider recognized that improved air traffic management will offer significant fuel and emission savings in the future.

As airport improvements will also contribute to important environmental improvements, initiatives such as changes made to the airfield, reducing energy demand and different source of energy are also outlined in this Action Plan to showcase Department’s efforts in limiting the emissions at the airport level. However, these benefits do not directly influence international aviation fuel consumption and/or CO₂ emissions and fall under the category: supplemental benefits for domestic sectors.

Through the preparation and development of this action plan, it has assisted the Department of Civil Aviation and relevant stakeholders in identifying specific assistance needs for the implementation of such measures such as financing, technical assistance and training / capacity building.

3.1 AIRLINE - ROYAL BRUNEI

PURCHASE OF NEW AIRCRAFTS

PURCHASE OF B787 AIRCRAFTS & A320 NEW-ENGINE OPTION (NEO) AIRCRAFTS

Royal Brunei replaced the long-haul fleets with the new B787 Dreamliner aircrafts, fuel-efficient and light-weighted aircrafts in 2013. The fleet modernization continued through to 2015, when all four B767s were replaced. The new B787 Dreamliner aircraft incorporated new engines with solid laminated graphite skin. The aircraft is also equipped with zonal drier to minimize condensation on the aircrafts, leading to weight reduction. Further, the aircraft cabin lighting utilizes high power LEDs causing reduced energy demand.

Royal Brunei also invested on a Fleet Renewal programme in 2018, which included the acquisition of seven (7) A320 NEOs (New Engine Options) and one (1) B787 aircraft. The addition of the A320 NEO aircrafts to RB fleet has reduced airline's long-term costs. The new A320 aircraft incorporates new engines and "Sharklet" wing tip devices which lead to fuel efficiency, thereby reducing environmental impact of operating the A320 NEO aircraft.

Title:	Purchase of B787 aircrafts and A320 NEO aircrafts	
ICAO Category:	Technology and Standards	
Measure:	Purchase of new aircraft	
Action:	<ul style="list-style-type: none"> • Purchase of B787 aircrafts to replace B767 • Purchase of A320 NEO (New Engine Option) aircrafts to replace A320 CEO (Current Engine Option) aircrafts 	
Start Date:	Purchase of B787 aircrafts to replace B767	Purchase of A320 NEO aircrafts to replace A320 CEO aircrafts
	1 October 2013	23 May 2018
Date of full implementation:	Purchase of B787 aircrafts to replace B767	Purchase of A320 NEO aircrafts to replace A320 CEO aircrafts
	30 September 2018	13 December 2018
List of stakeholders involved:	Royal Brunei's Board of Director (BOD) Fleet Committee	

OPTIMIZED AIRCRAFT MAINTENANCE

ENGINE WASH

As required in Royal Brunei's maintenance schedule, Royal Brunei optimizes maintenance of its A320 aircrafts by performing core wash on the engines. Core wash has the effect of lowering the exhaust gas temperature (EGT)

and reducing the fuel demands. Not only will this cut the aircraft operating costs, but it will also produce lower emissions as a result of lower fuel requirements.

Title:	A320 Engine Core Wash for fuel efficient and efficient Exhaust Gas Temperature (EGT) Margins improvements
ICAO Category:	Operational improvements - Operations
Measure:	Optimised aircraft maintenance
Action:	Perform engine wash on all A320 aircrafts
Start Date:	23 September 2003
Date of full implementation:	On-going
List of stakeholders involved:	Part 145 Maintenance Organization

ZONAL DRYER

Aircraft can accumulate and retain more than 200kg of moisture from condensation.⁴ The excess weight as a result of the condensation can be avoided by careful maintenance. To control condensation in the aircraft

operating environment, zonal driers were installed on Royal Brunei's B787 aircrafts causing less amount of fuel burnt and leading to a lighter aircraft.

Title:	Reduction in aircraft electrical power utilisation through the installation of zonal dryers
ICAO Category:	More efficient operations
Measure:	Optimised aircraft maintenance
Action:	Installation of zonal dryer on B787 aircrafts
Start Date:	23 September 2014
Date of full implementation:	On-going

⁴ ICAO, *Examples of Weight Reduction, Doc 10013 – Operational opportunities to Reduce Fuel Burn and Emissions, 2014*

BEST PRACTICES IN OPERATIONS

SINGLE ENGINE TAXI-IN

Royal Brunei conducts a number of best practices in operations, which lead to reduction in fuel requirements. One of the best practices implemented by Royal Brunei (RB) is the pilot conducts a single engine taxi for its A320 aircraft. Taxiing to the gate with less than all engines has been found to be efficient as it results in significant fuel burn reduction together with reduction in ground noise.⁵

Taxi-out measures are executed. However, the current practise is Royal Brunei's pilots are encouraged to execute Single Engine Taxi-in after landing, thus reducing the amount of fuel burn during taxi operations to arrival stands or gates. The execution of this mitigation measure is monitored through Fuel Efficiency Management Software (SkyBreathe app).

This fuel-efficiency best practice has potential to deliver further improvements in fuel consumption and CO2 reductions when both sets of Single Engine Taxi-in and

Title:	Single Engine Taxi-In for Aircraft A320
ICAO Category:	Operational improvements - Operations
Measure:	Best practices in operations
Action(s):	Taxiing to the airport gate or stand with single engine operating
Start Date:	1 June 2020
Date of full implementation:	On-going
List of stakeholders involved:	Flight Operations Fleet and Technical Section Flight Safety and Skybreath Section
Assistance needed:	Technical Support
Description of assistance:	<p>Technical support for the execution of single-engine taxi and quantification of fuel savings:</p> <ul style="list-style-type: none"> ○ Pilot to adhere to SOP for Single Engine Taxi Operation. ○ Flight Operations Technical Section to log into SkyBreathe Fuel Efficiency Management System and acquire monthly reports on actual & potential fuel savings.

⁵ ICAO, Taxi, Doc 10013 – Operational opportunities to Reduce Fuel Burn and Emissions, 2014

CONTINUOUS DESCENT APPROACH (CDA) AND REDUCE ACCELERATION ALTITUDE (RAAL)

Royal Brunei pilots also execute Continuous Descent Approach (CDA) in which the aircraft is descending continuously with idle thrust power and without leveled steps. Application of this best practice greatly reduce fuel consumption compared to descent with steps which will result in higher fuel consumption.

Furthermore, Royal Brunei also exercises Reduced Acceleration Attitude (RAAL) which allows fuel consumption during the climb phase to be reduced as the aircraft is accelerated at a lower altitude (i.e. at an altitude lower than what is usually done) and this is done through the retraction of the flaps. Both initiatives will reduce utilization of engine power, resulting in less fuel burn and CO₂ emission.

Title:	Continuous Descent Approach (CDA) and Reduced Acceleration Altitude (RAAL)
ICAO Category:	Operational improvements - Operations
Measure:	Best practices in operations
Action(s):	Execution of Continuous Descent Approach (CDA) and Reduced Acceleration Attitude (RAAL) to reduce fuel burn and emissions
Start Date:	1 June 2020
Date of full implementation:	On-going
Assistance needed:	Technical Support
Description of assistance:	<p>Technical support for the execution of CDA and RAAL as well as quantification of fuel savings:</p> <ul style="list-style-type: none"> ○ Pilot to execute CDA and RAAL in accordance with Standard Operating Procedures (SOP), whenever feasible. ○ Actual and potential fuel savings are closely monitored within the Skybreathe Fuel Efficiency Management System.

IDLE REVERSE THRUST

Another pilot action to minimize aircraft fuel usage and CO₂ emissions is to execute Idle Reverse Thrust (REVT) instead of applying full-reverse thrust. However, pilot must retain full authority over the safe operation of the aircraft during this execution. Execution of REVT will result in reduction of CO₂ emission and noise emissions.

Title:	Idle Reverse Thrust (REVT)
ICAO Category:	Operational improvements - Operations
Measure:	Best practices in operations
Action:	Minimizing the use of reverse thrust on landing
Start Date:	1 June 2020
Date of full implementation:	On-going
Assistance needed:	Technical Support
Description of assistance:	<p>Technical support for the execution of CDA and RAAL as well as quantification of fuel savings:</p> <ul style="list-style-type: none"> ○ Pilot to execute CDA and RAAL in accordance with Standard Operating Procedures (SOP), whenever feasible. ○ Actual and potential fuel savings are closely monitored within the Skybreathe Fuel Efficiency Management System.

WEIGHT REDUCTION

Royal Brunei implemented a number of opportunities to reduce its aircraft operating weight and this would immediately result in reduction of fuel burn and emission. By reducing the amount of potable water uploaded onto its B787 aircraft, its fuel consumption is significantly reduced. The potable water load can be optimized to suit the requirements of each flight.

To further reduce aircraft weight, Royal Brunei implements the "Paperless Cockpit" initiative whereby Royal Brunei pilots would use Electronic Flight Bag (EFB) to perform

flight management tasks and bulky paper manuals are replaced with iPad allowing access to the most up-to-date information and digital navigation charts.

Royal Brunei is also reducing the uplift of paper or reading materials and moving towards the digitalization of cabin environment and services, which further support in reducing the weight of the aircraft. For example, menu is presented by the cabin crew using an iPad for Business class customers to place their order and paper-based reading materials such as magazines and newspapers are removed to decrease the cabin weight.

Title:	Opportunities for aircraft weight reduction		
Category:	Operational improvements - Operations		
Measure:	Best practices in operations		
Action(s):	i) Potable water management for B787 aircraft; ii) Paperless Cockpit; iii) Minimize the paper uplift in the cabin;		
Start Date:	Potable water management	Paperless Cockpit	Minimize paper uplift in the cabin
	N/A	1 June 2020	10 Jan 2022
Date of full implementation:	Potable water management	Paperless Cockpit	Minimize paper uplift in the cabin
	On-going	1 June 2020	10 Jan 2022
List of stakeholders involved:	RB Ground Services RB Engineering RB Cabin Crew	Vendors offering LPC products (Less paper in Cockpit products)	-
Assistance needed:	Potable water management	Paperless Cockpit	Minimize paper uplift in the cabin
	Technical Support	Technology	-
Description of assistance:	Potable water management	Paperless Cockpit	Minimize paper uplift in the cabin
	How to conduct best practise on potable water uplift based on requirements of each flight. Its potential fuel savings can be monitored & calculated in Skybreathe.	Royal Brunei's paperless digitalization projects are currently on going where RB is currently looking into available products offered by vendors to support LPC (Less paper in Cockpit) concepts.	-

UTILIZATION OF GPU DURING INTRADAY AIRCRAFT TURNAROUNDS

During intraday aircraft turnarounds, Royal Brunei's aircrafts would utilize Ground Power Units (GPUs) that are made available at other airports. This reduces or eliminates aircraft auxiliary power unit (APU) usage and

subsequently contributes to fuel / maintenance savings. This mitigation measure is implemented on a case-by-case basis as it depends on the availability of GPUs at other airport's gates or maintenance areas.

Title:	Utilization of GPU during intraday aircraft turnarounds
ICAO Category:	Operational improvements - Operations
Measure:	Best practices in operations
Action(s):	Use of the external Ground Power Units (GPU) provided at other airports for electrical power and pre-conditioned air to the aircraft cabin
List of stakeholder involved:	Part 145 Maintenance Organisation

SUPPLEMENTAL BENEFITS FOR DOMESTIC SECTORS: AIRPORT IMPROVEMENTS

REDUCED ENERGY DEMAND AND PREFERRED CLEANER ENERGY SOURCES

Besides implementing mitigation measures for the purpose of reducing emissions from Royal Brunei's international flights, Royal Brunei is also considering to install solar photovoltaic panel at its hangar for power generation. It is expected that installation of solar photovoltaic panel would result in high amount of CO₂

savings. Currently in the initial planning stage, this initiative requires careful consideration of several factors such as selection of potential supplier, total required energy consumption, estimating the procurement and maintenance cost as well as setting up back-up supply power.

Title:	Use cleaner alternative sources of power generation for Royal Brunei's hangar building	
ICAO Category:	Supplemental benefits for domestic sectors: Airport improvements	
Measure:	Airport improvement: Reduced energy demand and preferred cleaner energy sources	
Action:	<ul style="list-style-type: none"> • Use solar photovoltaic panel for power generation for Royal Brunei's hangar building • Estimate operations and maintenance cost for Solar PV system 	
Start Date:	N/A	
Date of full implementation:	N/A	
List of stakeholders involved:	Facilities Management HSE / Safety Department	
Assistance needed:	(1) Finance	(2) Technology
Description of assistance:	Sufficient budgetary provisions for the installation of solar photovoltaic system	Sourcing suitable and reliable solar photovoltaic panels

CONVERSION OF GSE TO CLEANER FUELS

The utilization of alternative fuel in Royal Brunei's ground vehicles has also been proposed to further reduce emissions from vehicles and equipments serving aircraft at the Brunei International Airport. Under this initiative, a blended fuel of conventional diesel and bio-diesel fuel would be used to operate the Airport Ground Support Equipment (GSE) resulting in improvement in greenhouse gas reductions in the vicinity of the airport.

Proper engagement and discussion with the fuel supplier on the purchase or supply of bio-diesel fuel is necessary to successfully implement this initiative in the future.

Alternative proposal would be to replace the GSE with electrically-powered equipments, making it environmentally friendly. Additionally, electrical power may also be supplied from renewable sources.

Title:	Alternative fuel operated ground vehicles	
ICAO Category:	Supplemental benefits for domestic sectors: Airport improvements	
Measure:	Airport improvement: Conversion of GSE to cleaner fuels	
Action:	Conversion of GSE to cleaner fuels – gas operated ground vehicles	
Start Date:	N/A	
Date of full implementation:	N/A	
List of stakeholders involved:	Facilities Management Ground Services / Engineering	
Assistance needed:	Finance	Technical Support
Description of assistance:	Sufficient budgetary provisions for the phasing of Ground Support Equipment (GSE) to electrical equipment, in the event that fuel provider does not offer alternative fuel (bio-diesel).	Sufficient technical support for the implementation of new technologies.

SUSTAINABLE AVIATION FUEL (SAF)

At the 41st ICAO Assembly (2022), the ICAO Assembly adopted an ambitious long-term aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050 to support the temperature goal set by United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement's temperature goal, which is to limit the temperature increase even further to 1.5 degree Celsius. Based on ICAO's report on the feasibility of a Long-Term Aspirational Goal (LTAG) for International Civil Aviation CO₂ Emission Reductions, it was found that Sustainable Aviation Fuel (SAF) has the highest potential to reduce CO₂ emissions from international aviation.

Therefore, the introduction of Sustainable Aviation Fuel (SAF) in Brunei Darussalam is considered a very important issue as it is a new mitigation measure that would contribute to a significantly lower environmental impact from international air transport operations. Recognizing that collaboration between public and private sector is instrumental to SAF deployment in Brunei Darussalam, the Department of Civil Aviation successfully conducted the first sharing session on Sustainable Aviation Fuel (SAF) in September 2023

involving representatives from the Ministry of Transport and Infocommunications, Royal Brunei and Brunei Shell Marketing (Jet A1 Fuel Supplier). Through the sharing session, stakeholders were able to share their views and respective goals on the use of SAF in Brunei Darussalam as well as proposed timeline to enable the supply of SAF to Brunei International Airport on an ad-hoc basis or on-going basis. Royal Brunei is committed to use SAF in line with the goal set by Association of Asia Pacific Airlines (AAPA): 2% use of blend SAF in 2025. Stakeholders concurred that launching the first ever SAF flight from Brunei International Airport would mark a major milestone for Brunei Darussalam in the deployment of SAF.

To get top management "buy-in" and sponsoring to progress with SAF in Brunei Darussalam, relevant national SAF stakeholders need to be identified, informed and onboarded. Key players in the SAF value chain as well as relevant government bodies that have the power to regulate the SAF value chain were identified as follows:

TABLE 3.1-1 TABLE OUTLINING RELEVANT SUSTAINABLE AVIATION FUEL (SAF) STAKEHOLDERS IN BRUNEI DARUSSALAM

MINISTRIES	DEPARTMENTS	POTENTIAL FUEL SUPPLIER / FUEL PRODUCER	AIRLINE
Ministry of Finance & Economy	Department of Civil Aviation	Brunei Shell Marketing	Royal Brunei
Ministry of Development	Department of Energy	Brunei Shell Petroleum	
Ministry of Transport & Infocommunications	Department of Agriculture & Agrifood	Brunei Liquefied Natural Gas	
Ministry of Primary Resources & Tourism	Forestry Department	Hengyi Industries	
	Department of Environment, Park and Recreation		

It is expected that further recommendations on the step forwards and SAF targets may be included in the next update of State Action Plan as several discussions are currently underway to support this initiative.

Title:	Introduction of Sustainable Aviation Fuel (SAF)		
ICAO Category:	Sustainable Aviation Fuel (SAF)		
Measure:	Standards / requirements for SAF use		
Action:	Use of Sustainable Aviation Fuel (SAF) to operate Royal Brunei's international flights		
Start Date:	September 2023		
Date of full implementation:	TBA		
List of stakeholders involved:	Department of Civil Aviation Ministry of Transport and Infocommunications Royal Brunei (Airline) Brunei Shell Marketing (Fuel Supplier) Potential Fuel Producer SAF Experts		
Assistance needed:	(1) Technical Support	(2) Research	(3) Training
Description of assistance:	(1) Technical Support	(2) Research	(3) Training
	Technical support on the deployment of SAF to Brunei International Airport	Conduct continuous research on SAF for latest information and updates on SAF to ensure practical implementation of this initiative	Acquire necessary knowledge on SAF through capacity-building training on SAF.

MARKET-BASED MEASURES

CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION (CORSA)

At the 39th Session of the ICAO Assembly in 2016, ICAO adopted the Assembly Resolution A39-3: Consolidated statement of continuing ICAO policies and practices related to environmental protection – Global Market-based Measure (MBM) scheme. ICAO Member States decided to implement a global MBM scheme in the form of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSA). Under this scheme, aeroplane operators conducting international flights are mandated to report their annual CO₂ emissions to the State. ICAO Member State is then required to report the verified CO₂ emission data to ICAO and the cancellation of CORSA Eligible Emission Units to offset its total final offsetting requirements for a given compliance period.

Following the adoption of Brunei Aviation Requirement on CORSA – BAR 16, Royal Brunei (RB) is obliged to monitor, report and verify its CO₂ emission data. Royal Brunei (RB) must also comply to the offsetting requirements for the routes between CORSA-participating states.

Although Brunei Darussalam is exempted from the CORSA scheme as its individual share of international aviation activities in RTKs in the year 2018 is below 0.5% of total RTKs, the Department of Civil Aviation is currently assessing the possibility of Brunei Darussalam's voluntary participation in CORSA to support the ICAO long term aspirational goal: net-zero carbon emissions by 2050.

To ensure stakeholders are equipped with necessary knowledge and training on CORSA requirements, the Department of Civil Aviation had engaged International Civil Aviation Organisation (ICAO) and the European Aviation Safety Agency (EASA) to provide guidance and training support under the ICAO CORSA Buddy Partnership and EU-South East Asia Cooperation on Mitigating Climate Change Impact from Civil Aviation (EU SEA-CCCA CORSA) Project respectively.

Title:	Adhere to ICAO standards and recommended practices (ICAO SARPs) for Carbon Offsetting and Reduction Scheme For International Aviation (CORSA)	
ICAO Category:	Market-based Measures	
Measure:	Carbon Offsetting and Reduction Scheme For International Aviation (CORSA)	
Action:	<ul style="list-style-type: none"> Harmonise national regulation with ICAO SARPs, Annex 16, Volume IV, 1st Edition and 2nd Edition. Implement ICAO CORSA requirements on Monitoring, Reporting and Verification (MRV) and offsetting accordingly. Report verified CO₂ emission data to ICAO through CORSA Central Registry (CCR). 	
Start Date:	1 January 2019	
Date of full implementation:	On-going	
List of stakeholders involved:	Department of Civil Aviation (DCA) Royal Brunei (DCA) Verification Body	
Reference to existing legislation (if applicable):	Brunei Aviation Requirement on Carbon Offsetting and Reduction Scheme For International Aviation – BAR 16	
Assistance needed:	(1) Education	(2) Research
Description of assistance:	<ul style="list-style-type: none"> Continuous engagement with Authority and other stakeholders to acquire understanding of CORSA requirements and ensure its timely implementation. Technical training & Capacity-building assistance 	<ul style="list-style-type: none"> Conduct further research on CORSA, particularly on CORSA Eligible Fuel (CEF) and CORSA Eligible Emissions unit. Carry out research on other countries' motivation for joining CORSA voluntarily as well as establishment of CORSA Taskforce in other countries.

EMISSION TRADING SCHEME (ETS)

The Emission Trading Scheme (ETS) is a 'cap and trade' principle, where a cap is set on the total amount of certain greenhouse gases that can be emitted by sectors covered by the scheme.⁶ By limiting the total amount of carbon dioxide that can be emitted, the scheme will make a significant contribution to how the Net Zero 2050 target can be achieved and other legally binding carbon reduction commitments.

Under the European Union Emission Trading Scheme (EU ETS), aircraft operators with flights ending or originating

at European Union (EU) are required by the EU to monitor and submit the CO₂ emissions report. Whereas in the UK, its participation in the European Union Emissions Trading Scheme (EU ETS) was replaced by the UK Emissions Trading Scheme (UK ETS) from 1 January 2021 onwards.

Currently, Royal Brunei is exempted from being required to participate under this scheme. However, Royal Brunei will continue to monitor any developments issued by the relevant Authority or changes in the 'cap and trade' requirements.

Title:	Emission Trading Scheme (ETS)	
Category:	Market-based measure	
Measure:	Incorporation of emissions from international aviation into regional or national market-based measures, in accordance with relevant international Standards and instruments	
Action:	Monitor the requirements of European Union Emission Trading Scheme (EU ETS) and United Kingdom (UK) Emission Trading Scheme	
Start Date:	1 January 2010	
Date of full implementation:	On-going	
Assistance needed:	(1) Education	(2) Research
Description of assistance:	(1) Education Continuous engagement with the relevant Authority to acquire understanding of the Emissions Trading Scheme (ETS)	(2) Research Conduct research on ETS requirements and monitor any proposed changes to its requirements

⁶ Gov.UK, Guidance – Participating in the UK ETS, 4 September 2023, <https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets>

3.2 BRUNEI INTERNATIONAL AIRPORT

SUPPLEMENTAL BENEFITS FOR DOMESTIC SECTORS – AIRPORT IMPROVEMENTS

INSTALLATION OF LIGHT EMITTING DIODE LIGHTS INSTEAD OF CLASSIC LIGHT

Airfield Pavement Rehabilitation Project is one of the National Development Plan projects undertaken by the Department of Civil Aviation to upgrade existing infrastructures at the Brunei International Airport (BIA). Aligned with the Department's mission to provide sustainable, safe, secure and efficient civil aviation services, the project aimed to boost airport's capacity, aircraft movements, services and safety level. Rehabilitation and upgrading works in the project included resurfacing of the runway, replacements of lighting and upgrading of necessary infrastructure.

The first phase of the rehabilitation project, which started in April 2016, involved the replacement of the airfield

ground lightings to Light Emitting Diode (LED) lights in the Main Runway and Northern Parallel Taxiway (NPT). Upon completion of the first phase of Airfield Pavement Rehabilitation project in November 2017, this has since benefited the Brunei International Airport in reducing airport's runway electrical consumption without lowering the light intensity for operations.

Further to this, the second phase of the Airfield Pavement Rehabilitation project will also require the replacement of airfield ground lightings to Light Emitting Diode (LED) lights in the Southern Parallel Taxiway (SPT). The second phase of the project is targeted to begin in November 2023 and planned for completion by October 2025. This will directly decrease energy consumption.

Title:	Upgrading of Conventional Airfield Lighting to LEDs in Airfield Pavement Rehabilitation Project Phase 1 & Phase 2	
ICAO Category:	Supplemental benefits for domestic sectors: Airport Improvement	
Measure:	Airfield Improvement	
Action:	Installation of LED lighting instead of classic light	
Start Date:	Phase 1 Project	Phase 2 Project
	April 2016	November 2023
Date of full implementation:	Phase 1 Project	Phase 2 Project
	November 2017 (Completed)	October 2025

REDUCE ELECTRICAL DEMAND

Beginning 2017, Department of Civil Aviation (DCA) initiated an energy-saving initiative to reduce the electric consumption in the terminal building of the Brunei International Airport. Under this initiative, fluorescent lightings in the arrival drop-off area, departure drop-off area, baggage collection area and airport parking were completely replaced with energy-saving bulbs. It

is expected that this initiative will also apply to other zones in the terminal building in the near future, resulting in further reduction of energy and electrical demand. Air conditioners within the terminal building were set at temperature of 22 oC permanently (previously set to 18 oC), contributing to significant decrease of airport's electricity demand and providing cost-saving benefit to the Department of Civil Aviation.

Title:	Energy Saving Initiative at Airport Terminal Finding
ICAO Category:	Supplemental benefits for domestic sectors: Airport Improvement
Measure:	Airport Improvement: i. Reduced energy demand ii. Reduced electrical demand
Action:	i. Reduce energy demand by replacing the fluorescent lighting to energy saving bulbs ii. Reduce electrical demand by setting the temperature control of the air-conditioner in airport terminal building from 18 °C to 22 °C
Start Date:	2017
Date of full implementation:	On-going

INSTALLATION OF ELECTRICAL GROUND POWER UNITS (GPU)

Installation of fixed Ground Power Units (GPU) at all aircraft stands using electric power supplied from the airport's terminal building may be proposed to be included in the next phase of the Rehabilitation Project. Although this proposal has yet to be taken up, it is

expected that the full-scale installation of Ground Power Units (GPU) will reduce fuel requirements for aircrafts taking off from / landing at Brunei International Airport and subsequently reduce CO2 emissions and pollution in the vicinity of airports.

Title:	Installation of electrical Ground Power Units (GPU)
ICAO Category:	Supplemental benefits for domestic sectors: Airport Improvement
Measure:	Installation of fixed Electrical Ground Power Units (GPUs) and pre-conditioned air allow aircraft APU switch off
Action:	Full-scale installation of fixed Ground Power Units (GPU) at all aircraft stands using electric power supply from Brunei International Airport Terminal Building

3.3 AIR NAVIGATION SERVICES PROVIDER

IMPROVED AIR TRAFFIC MANAGEMENT (ATM)

AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST (ADS-B)

Automatic Dependent Surveillance – Broadcast (ADS-B) is an advanced surveillance technology by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.⁷

In 2016, the Department of Civil Aviation successfully commissioned the Automatic Dependent Surveillance-Broadcast (ADS-B) system. However, the Department has yet to begin implementing the operational procedures of ADS-B. It is expected that the full operational use of

ADSB will lead to a more efficient Air Traffic Management (ATM) planning by reducing the flight time and as a result, aircrafts taking off from and landing at Brunei International Airport can benefit from fuel reduction and reduced aviation emissions.

Procedures to fully utilize ADS-B surveillance is part of the 11th National Development Project: Implementation of Procedural – Airspace Design and Air Traffic Control (ATC) procedures. The implementation of the project is aligned with Brunei Darussalam CNS / ATM Masterplan and expected to be completed by September 2024.

Title:	Operational usage of Automatic Dependent Surveillance - Broadcast (ADS-B)	
ICAO Category:	Operational improvements – Air Traffic Management	
Measure:	More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), enroute operations, airspace design and usage, aircraft capabilities	
Action:	Measures to fully utilize ADS-B surveillance	
Start Date:	January 2023	
Date of full implementation:	September 2024	
List of stakeholders involved:	<ul style="list-style-type: none"> • Air Traffic Services Section • Aeronautical Telecommunication Services Section 	
Assistance needed:	(1) Technical Support	(2) Education
Description of assistance:	(1) Technical Support	(2) Education
	Technical specifications on the ADS-B according to ICAO Standards	To undergo operational training on ADS-B surveillance

⁷ ICAO, Definitions, Doc 4444 – Procedures for Air Navigation Services – Air Traffic Management, 2016

IMPLEMENTATION OF SURFACE MOVEMENT RADAR (SMR)

Surface Movement Radar (SMR) can make valuable contribution to the safety and efficiency of surface movement control in low visibility and at night. Surface movement radar permits a continuous check on runway occupancy and taxiway usage and facilitates clearances for aircraft and vehicles. During emergencies, it can play a part in the expeditious movement of emergency vehicles and the safe disposition of other traffic.⁸

As part of the Advanced – Surface Movement Guidance and Control System (A-SMGCS) Phase 1 Project under the National Development Plan, the Surface Movement Radar (SMR) will be commissioned and implemented at Brunei International Airport. SMR will enable the detection and display of the movement of all aircraft and vehicles

on the manoeuvring area in a clear and unambiguous manner.⁹ As aircraft burn fuel and emit CO₂ emissions during taxi at the airport runway, it is expected that implementation of the Advanced – Surface Movement Guidance and Control System (A-SMGCS) during peak periods, low visibility and night operations, fuel savings can be achieved from the taxi-out time reduction and reduced number of ground delays.

This project is currently in a design stage and it will commence next year (January 2024) and take 12 months for completion.

Title:	Implementation of Surface Movement Radar (SMR) as part of the Advanced-Surface Movement Guidance and Control System (A-SMGCS) Project	
ICAO Category:	Operational improvements – Operations	
Measure:	More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), enroute operations, airspace design and usage, aircraft capabilities	
Action:	The Supply, Delivery, Installation, Integration, Testing, Training and Commissioning of Surface Movement Radar (SMR)	
Start Date:	9 January 2024	
Date of full implementation:	31 September 2025	
List of stakeholders involved:	Air Navigation Services provider	
Assistance needed:	(1) Technical Support	(2) Education
Description of assistance:	(1) Technical Support	(2) Education
	Technical specifications according to ICAO standards	To undergo technical and operation training on ADS-B surveillance

⁸ ICAO, *The Role of Surface Movement Radar, Doc 9476 - Manual of Surface Movement Guidance and Control Systems (SMGCS), 1986*

⁹ ICAO, *Use of ATS Surveillance systems for surface movement control, Doc 4444 – Procedures for Air Navigation Services – AirTraffic Management, 2016*

IMPLEMENTATION OF PERFORMANCE BASED NAVIGATION (PBN)

Performance-based navigation (PBN) is area navigation based on performance requirements for aircraft operating along an Air Traffic Service (ATS) route, on an instrument approach procedure or in a designated airspace.¹⁰

Brunei Darussalam's implementation of PBN will fulfil the Beijing Declaration on the implementation of Performance Based Navigation (PBN) and also enable the creation and utilization of customized routes, departure procedures, arrival procedures and approach procedures while considering factors such as airspace requirements.

Routes defined by navigating from navaid to navaid are usually the most environmentally inefficient means of navigation. Therefore, airspace design that takes advantage of Performance-based navigation (PBN) capabilities with an objective of allowing unrestricted climbs and descents will maximize the environmental benefits of aircraft operations¹¹. This project is expected to begin in January 2024 and implementation period will be 18 months.

Title:	Performance Based Navigation (PBN)	
ICAO Category:	Operational improvements – Air Traffic Management	
Measure:	More efficient ATM planning, ground operations, terminal operations (departure, approach and arrivals), enroute operations, airspace design and usage, aircraft capabilities	
Action:	Utilise Performance-based navigation (PBN) capabilities to re-design airspace routes and terminal procedures (departure, approach and arrivals), which will generate fuel savings	
Start Date:	30 January 2024	
Date of full implementation:	30 May 2025	
List of stakeholders involved:	Air Navigation Services (ANS) provider	
Assistance needed:	(1) Research	(2) Education
Description of assistance:	<ul style="list-style-type: none"> • Provision of best airspace design for safer and efficient Air Traffic Management operations and terminal operations (departure, approach and arrival) • Establishment of seamless air navigation with neighbouring countries 	<ul style="list-style-type: none"> • Undergo training on PBN – Operation and Safety

¹⁰ ICAO, *Glossary, Doc 9613 – Performance based Navigation (PBN) Manual, 2023*

¹¹ ICAO, *Air Navigation Services, Doc 10013 – Operational opportunities to reduce fuel burn and emissions, 2014*

04 BRUNEI DARUSSALAM'S EXPECTED RESULT

To understand the impacts of the proposed mitigation measures and the improvements in fuel consumption and CO₂ emissions against the baseline (Business-as-usual) scenario, bottom-up approach is employed to identify selected mitigation measures and aggregate the expected results. Expected result fundamentally represents the projected fuel consumption and CO₂ emissions after the implementation of the measures.

For the purpose of estimating fuel / CO₂ savings, a consultative process between State Action plan Focal Points and stakeholders responsible for executing particular measure was held to gather necessary and useful information on the potential benefits from the implementation of the measure. This also enables State

Action Plan Focal Points to monitor the progress of its on-going implementation.

The Department of Civil Aviation has also differentiated initiatives that would contribute to decreased fuel consumption from international aviation and those that offer supplemental benefits. In line with the recommendation from ICAO Doc 9988 (Chapter 4 Selection of measures and quantifying their expected results), expected savings generated from supplemental benefits are not reported in this State Action Plan. Nevertheless, estimated savings at the airport level may be quantified as part of Brunei Darussalam's reporting obligation under the UNFCCC obligations.

4.1 ASSESSMENT OF MITIGATION MEASURES & ESTIMATED SAVINGS

Due to unavailability of data or lack of detailed information on certain associated measures, the Department was unable to obtain or quantify estimated savings from the implementation of certain mitigation measures. As some of the mitigation measures are already in operation, only mitigation measures that will continue to be executed during aircraft operations in the future have been included in the assessment of fuel and CO₂ emission improvement against the baseline scenario. As such, its continuous implementation would depend on whether the pilots are able to successfully execute the measures in specific conditions.

To determine expected reduction in fuel use and CO₂ emission from 2024 onwards, expected results from the implementation of these on-going measures were aggregated for the baseline period: 2024 – 2050. In addition, the assumption made in this assessment is Royal Brunei's fleet will remain identical until 2050.

Considering that projects under Air Navigation Services Division are either in design stage or have yet to be operational, emission savings from the implementation of mitigation measures for improved air traffic management were not quantified in this Action Plan. In the subsequent revision or update of this Action Plan, the Department of Civil Aviation may utilize ICAO Fuel Savings Estimation tool (IFSET) or Rule of Thumbs to provide reasonable approximation of the benefits associated with the mitigation measure. While mitigation measures that fall under the category: supplemental benefits for domestic sectors are not quantified as these do not directly influence international aviation fuel consumption.

The table below summarises which mitigation measures were included in the assessment of fuel and CO₂ emission improvement against the baseline scenario.

TABLE 4.1-1 ASSESSMENT OF MITIGATION MEASURES AGAINST BASELINE SCENARIO

NO.	ALREADY IMPLEMENTED MEASURES	
1	Purchase of A320 NEO & B787 aircrafts	Mitigation measures were already implemented before the baseline period. Therefore, these were not included in the assessment against baseline scenario.
2	Minimising paper uplift in the cabin	
3	Paperless Cockpit	

NO.	ON-GOING IMPLEMENTATION OF MITIGATION MEASURES	ESTIMATED FUEL SAVING & CO ₂ SAVING
1	Single Engine Taxi In (A320 only)	Expected results from the implementation of these measures were aggregated from 2024 until 2050.
2	Continuous Descent Approach (CDA)	
3	Reduced Acceleration Altitude (RAAL)	
4	Idle Reverse Thrust	
5	Potable Water Management	
5	Engine Wash	Not quantified
6	Zonal dryer	Not quantified

NO.	IMPLEMENTATION OF FUTURE MITIGATION MEASURES	ESTIMATED FUEL SAVING & CO ₂ SAVING
1	Sustainable Aviation Fuel (SAF)	Fuel and CO ₂ savings for these proposed mitigation measures are not approximated in this Action Plan. Its benefits may be quantified once stakeholder obtains sufficient information and necessary data.
2	Measures to fully utilize ADS-B surveillance	
3	Implementation of Surface Movement Radar (SMR)	
4	Implementation of Performance-Based Navigation (PBN)	

4.2 EXPECTED RESULTS - MITIGATION MEASURES

Expected results on the reduction of fuel consumption and CO₂ emission from international aviation sector for the period of 2024 – 2050 as well as percentage improvements are tabulated in Table 4.2-1 below. Expected improvements in fuel consumption and CO₂ emission as a result of implementation of the mitigation measures are also presented in Figure 4.2-1 and Figure 4.2-2 respectively.

Noting that mitigation measures that will be operational in the future are not quantified and hence, these are not included in the assessment at the time of publication of this Action Plan. However, it is expected that further improvements in fuel use and CO₂ emission can be achieved in the future by optimising operations as much as possible based on existing technologies and fuels. Looking at the projected data, execution of operational measures will deliver environmental benefits in the near to medium term.

Major reduction in CO₂ emission will come from the uptake of Sustainable Aviation Fuel and implementation of other mitigation measures. Significant reduction in fuel use and CO₂ emissions can be realized through the adoption of Sustainable Aviation Fuel (SAF) as it has the potential to reduce greenhouse gas emissions up to 80%. Mitigation measures under improved air traffic management will also contribute to fuel and CO₂ savings once these are operational in the next 3 - 4 years.

In order to further encourage emission reduction, the Department of Civil Aviation may employ a top-down approach whereby realistic and achievable environmental goals are defined. Through this approach, measures would need to be identified and prioritized according to certain criteria such as their cost-effectiveness or cost-benefit analysis. Hence, such approach may be implemented and monitored prior to the development of Brunei Darussalam's second Action Plan.

TABLE 4.2-1 EXPECTED RESULTS OF INTERNATIONAL FUEL CONSUMPTION AND CARBON DIOXIDE EMISSIONS IN 2024-2050, COMPARED TO THE BASELINE

YEAR	BASELINE		EXPECTED RESULTS (AFTER IMPLEMENTATION OF MITIGATION MEASURES)		
	FUEL CONSUMPTION (TONNES)	CO ₂ EMISSION (TONNES)	PROJECTED FUEL CONSUMPTION (TONNES)	PROJECTED CO ₂ EMISSION (TONNES)	% REDUCTION
2024	130,824.99	413,406.97	114,747.55	362,602.27	12.29%
2025	136,742.36	432,105.85	119,969.19	379,102.64	12.27%
2026	152,297.18	481,259.10	133,810.90	422,842.43	12.14%
2027	164,670.66	520,359.29	144,795.30	457,553.14	12.07%
2028	166,911.43	527,440.11	146,769.24	463,790.80	12.07%
2029	171,149.28	540,831.72	150,508.35	475,606.38	12.06%
2030	172,879.56	546,299.40	152,032.04	480,421.24	12.06%
2031	174,629.01	551,827.68	153,572.64	485,289.55	12.06%
2032	176,398.03	557,417.78	155,130.50	490,212.37	12.06%
2033	178,187.01	563,070.96	156,705.95	495,190.81	12.06%
2034	190,614.67	602,342.36	167,733.09	530,036.58	12.00%
2035	193,434.57	611,253.24	170,219.42	537,893.38	12.00%
2036	194,974.41	616,119.15	171,575.92	542,179.91	12.00%
2037	197,498.67	624,095.79	173,801.12	549,211.53	12.00%
2038	201,487.07	636,699.14	177,320.43	560,332.56	11.99%
2039	205,479.83	649,316.27	180,843.60	571,465.78	11.99%
2040	209,894.76	663,267.43	184,740.33	583,779.43	11.98%
2041	214,248.35	677,024.79	188,582.78	595,921.57	11.98%
2042	218,342.23	689,961.43	192,195.43	607,337.55	11.98%
2043	221,904.10	701,216.95	195,337.61	617,266.84	11.97%
2044	224,571.50	709,645.95	197,689.46	624,698.70	11.97%
2045	228,705.44	722,709.19	201,337.49	636,226.48	11.97%
2046	232,981.14	736,220.39	205,110.93	648,150.54	11.96%
2047	237,026.34	749,003.25	208,680.49	659,430.36	11.96%
2048	240,828.99	761,019.60	212,035.56	670,032.37	11.96%
2049	244,581.08	772,876.23	215,345.94	680,493.17	11.95%
2050	248,275.96	784,552.04	218,605.74	690,794.12	11.95%

FUEL CONSUMPTION (BASELINE) VS FUEL CONSUMPTION (AFTER IMPLEMENTATION OF MITIGATION MEASURES)

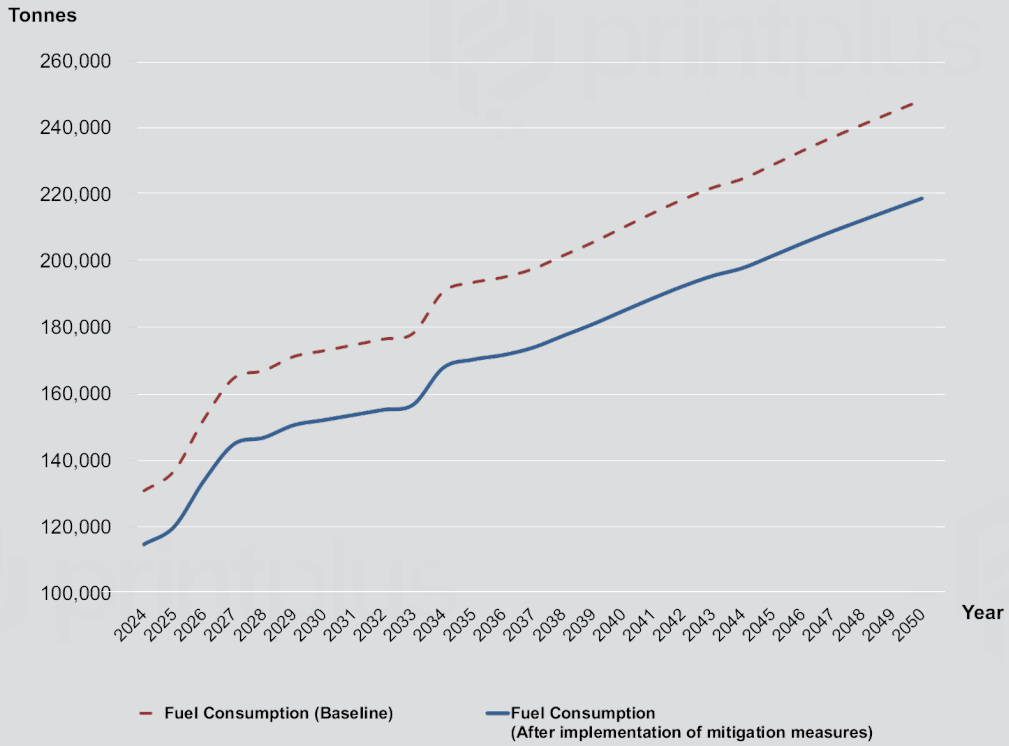


FIGURE 4.2-1 EXPECTED RESULTS OF FUEL CONSUMPTION (AFTER IMPLEMENTATION OF MITIGATION MEASURES), COMPARED TO THE BASELINE

CARBON DIOXIDE EMISSIONS (BASELINE) VS CARBON DIOXIDE EMISSIONS (AFTER IMPLEMENTATION OF MITIGATION MEASURES)

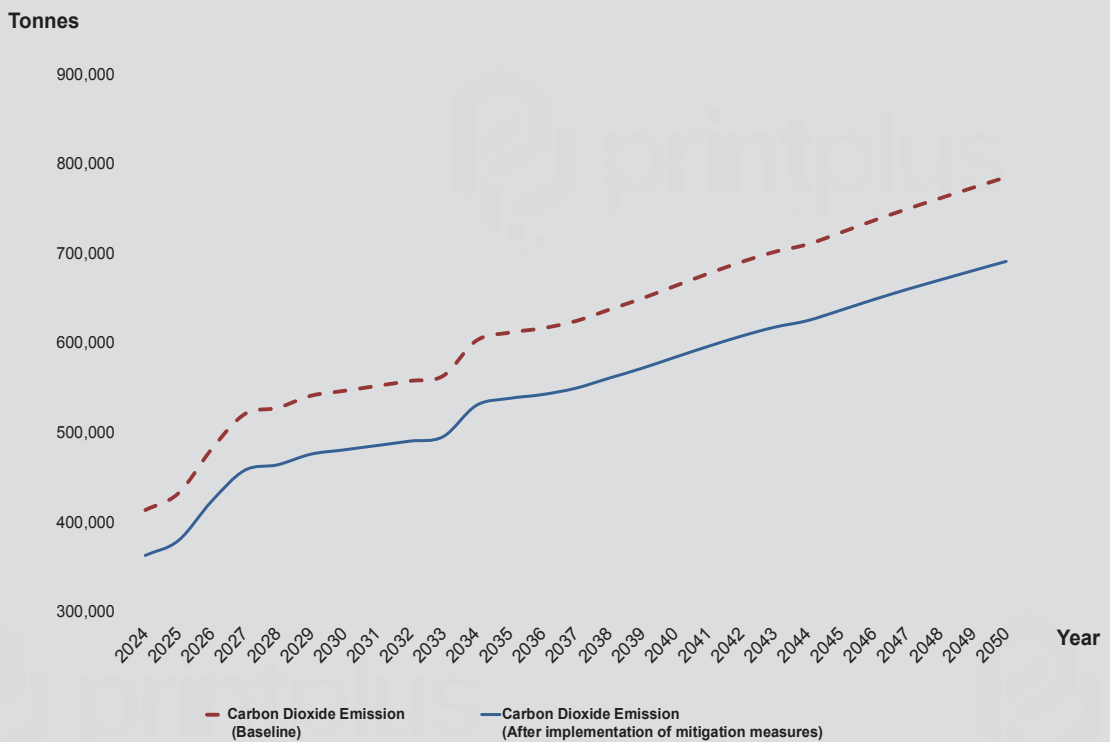


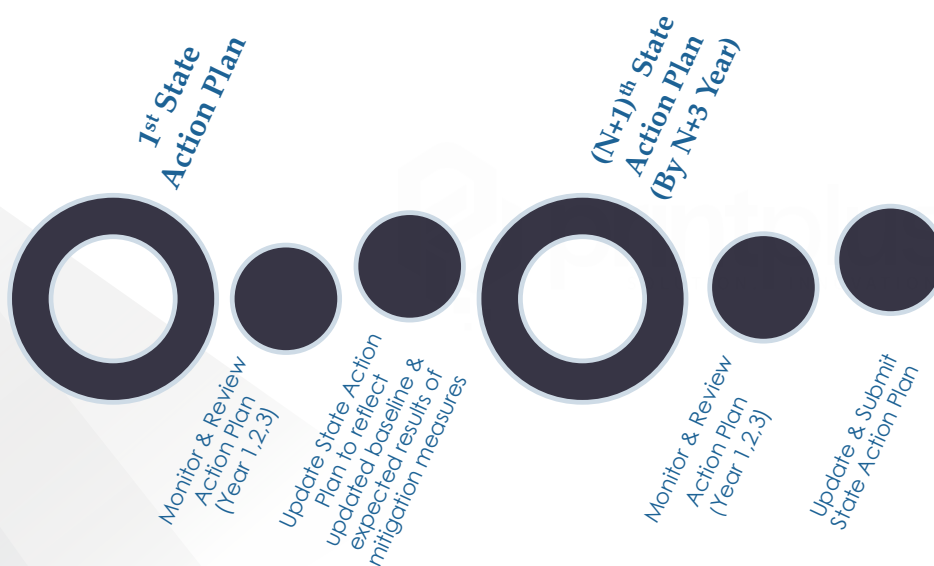
FIGURE 4.2-2 EXPECTED RESULTS OF CO₂ EMISSION (AFTER IMPLEMENTATION OF MITIGATION MEASURES), COMPARED TO THE BASELINE

05 FUTURE LOOKING

At the 41st ICAO Assembly¹² (2022), ICAO recognised the need to further develop and update State Action Plans, including the quantification of CO₂ emissions reduction benefits with practical tools, for sustainable aviation and infrastructure with the focus on environment-driven innovations. ICAO Member States were further encouraged to submit and update voluntary action plans

to ICAO to reduce CO₂ emissions from international aviation, outlining respective policies, actions and roadmaps, including long-term projections.

A 3-year cycle tool to update and progressively scale up Brunei Darussalam’s State Action Plan is illustrated in the following diagram:



As such, the Department of Civil Aviation will endeavour to review and subsequently update this Action Plan within the next three (3) years. It is expected that stakeholders would gain more experience in the implementation of mitigation measures and quantification of its environmental benefits. Guided by the indicative

sequence of steps for developing an Action Plan and continuous engagement with internal and external stakeholder, updating this Action Plan will present opportunity for improving the preparation process and its content as follows¹³:

- i. Increase robustness of the data collection process;
- ii. Understand stakeholders’ operating needs and constraints;
- iii. Improve stakeholders’ preparedness for the implementation of mitigation measures;
- iv. Demonstrate progress in CO₂ emission reduction.

¹² ICAO, Resolution A41-21: Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate Change

¹³ ICAO, Updating An Existing Action Plan, Doc 9988 – Guidance on the Development of States’ Action Plans on CO₂ Emissions Reduction Activities, 2019

Participation of Brunei Darussalam's Focal Points and stakeholders in the Regional Workshop on "New Mitigation Measures for the ICAO State Action Plan for the Reduction of CO₂ Emissions from International Aviation" (6 – 7 November 2023) presented an opportunity to learn more about potential mitigation measures and initiatives from civil aviation authorities, service providers and the industry. Organized by the European Aviation Safety Agency (EASA) under EU-South East Asia Cooperation on Mitigating Climate Change Impact from Civil Aviation

(EU SEA-CCCA CORSIA) Project, ASEAN Member States were encouraged to consider **new measures** to reflect changed circumstances and **more ambitious targets** in the next submission of State Action Plan.

Based on the main takeaways from the Regional workshop, the table below lists out "future looking" initiatives, actions and collaboration opportunities that will contribute towards improving fuel efficiency and CO₂ emissions reduction:

OPERATIONAL MEASURES

- Encourage uptake of best practices in operation which will deliver "quick wins" for airspace users and operators.
- Further opportunities for collaborative mitigation measures between Air Navigation Service Providers, Airlines, Civil Aviation Authorities and Airports.
- New ASEAN initiatives such as ASEAN ANS Master Plan and ASEAN Sustainable Aviation Action Plan may create new impetus for regional collaboration.
- Benchmark operational environmental performance at State level and eventually at the ASEAN Level.

TECHNOLOGY

- Promising future technology for aircraft in the pipeline such as the use of electric, fuel cell and hydrogen to power the aircrafts.
- Increase efficiency of new aircraft around 2035 could be up to 30% improvement.
- Production of Boeing and Airbus commercial aircraft that can fly on 100% Sustainable Aviation Fuel (SAF) by 2025-2030.

MARKET-BASED MEASURES

- Market-based measure plays a crucial role in reducing international aviation net CO₂ emissions:
 - Levies
 - Emission Trading Scheme (ETS)
 - Carbon offsetting
- Other Member States' voluntary participation in the CORSIA global scheme is a "wake up" call for Member States to join CORSIA voluntarily and be committed to offset CO₂ emissions from international aviation sector.

SUSTAINABLE AVIATION FUEL (SAF)

- Maximum blending of SAF is currently possible up to 50% but this may grow in the future with deployment of aircraft that fly on 100% SAF.
- Define SAF ecosystem and frame it within the specific regional/national regulatory context requiring collaboration between different governmental bodies.
- Foster the use of SAF through discussion, economically, financial regulatory decisions at state level
- State Action Plan which reflects the State strategy, involvement of stakeholders and roadmaps, and if possible, quantifying reduction.

06 CONCLUSION

Brunei Darussalam's first Action Plan on reduction of international aviation emissions showcased several on-going and future initiatives undertaken by the Department of Civil Aviation and Brunei Darussalam's national carrier, Royal Brunei. Both Department of Civil Aviation and Royal Brunei worked collaboratively in the preparation of all required elements of this Action Plan. The details presented within this Action Plan would enable ICAO to compile quantified information in order to determine global progress in meeting the goals set by Assembly Resolution A37-19, reaffirmed by Assembly Resolution A38-18, A39-2 and A40-18 and A41-21.

Relative to global CO₂ emissions from aviation sector, Brunei Darussalam's contribution of CO₂ emission from international aviation sector is very low as its individual share of international aviation activities in Revenue Tonne Kilometers (RTKs) in year 2018 only accounted for 0.07% (below 0.5% of total RTKs). Regardless, the Department of Civil Aviation and other relevant stakeholders will harness available opportunities to encourage emission reductions taking into consideration that Brunei Darussalam's fuel consumption and CO₂ emission will rise corresponding to the traffic growth in the future.

It is worth noting that there will not be a single solution in decarbonizing the aviation sector and reaching ICAO's Long-Term Aspirational Goal (LTAG) by 2050. Implementation of mitigation measures from all four (4) categories is necessary and to demonstrate resulting improvements beyond business as usual case, it is important that everyone exercises collective responsibility and accountability in producing the next State Action Plan.

Recognising international aviation community's preference for the use of aircraft technologies, operational improvements and sustainable aviation fuels to provide environmental benefits within the aviation sector, it is imperative that the Department of Civil Aviation and other relevant stakeholders focus its efforts on implementing environmentally sustainable actions in line with the commitments set out by International Civil Aviation Organization.

07 CONTACT INFORMATION – FOCAL POINTS

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