DEPARTMENT OF TRANSPORT

Papua New Guinea's State Action Plan on CO2 Emissions Reductions from International Aviation

OCTOBER | 2023

Acknowledgment

The Papua New Guinea State Action Plan on Carbon Dioxide Emissions Reduction from International Aviation was prepared and coordinated through the Department of Transport and Civil Aviation in consultation with all aviation sub-sector agencies including the Civil Aviation Safety Authority of PNG, NiuSky Pacific Limited, National Airports Corporation, National Weather Services, Air Niugini Limited, the National Energy Authority, Climate Change and Development Authority and, Conservation Environment and Protection Authority, with technical assistance from the International Civil Aviation Organization.

We appreciate the overwhelming support of the aviation sector stakeholders who participated in the consultations and have provided data and statistics which has established the basis of the development of this plan.

We are grateful for the efforts already undertaken by the government entities and the private sector in addressing environmental sustainability and carbon neutrality in their operations ensuring a greener aviation sector in PNG.

Finally, we thank the PNGAus Partnership - Transport Sector Support Program for technical and financial assistance to guide the formulation of this Plan.

Table of Contents

Table of Figures

Table of Tables

ABBREVIATION

ANG	Air Niugini
AIS	Aeronautical Information Services
ARFFS	Aerodrome Rescue and Fire Fighting Service
ATM	Air Traffic Management
CARs	Civil Aviation Rules
CASA	Civil Aviation Safety Authority
CCDA	Climate Change Development Authority
CCO	Continuous Climate Operation
CDO	Continuous Decent Operation
CEPA	Conservation Environment and Protection Authority
CNS	Communication Navigation Surveillances
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CO2	Carbon Dioxide
DNPM	Department of National Planning and Monitoring
DoT	Department of Transport
EBT	Environment Benefit Tool
FIR	Flight Information Region
FIS	Flight Information Services
GHG	Green House Gas
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LTAG	Long Term Global Aspirational Goal
NAC	National Airport Corporation
NSPL	NiuSky Pacific Limited
NWS	National Weather Services
PBN	Performance Base Navigation
PNG	Papua New Guinea
PNG NSAP	Papua New Guinea National State Action Plan
RTK	Revenue Ton Kilometer
SAF	Sustainable Aviation Fuel
SAP	State Action Plan
SAR	Search and Rescue
UNFCCC	United Nations Framework on Climate Change Convention

EXECUTIVE SUMMARY

Papua New Guinea (PNG) is a member state of International Civil Aviation Organisation (ICAO) under the Convention on International Civil Aviation (1944) following the signing and ratifying on the 15th of December 1975. PNG is obligated to the ICAO Assembly Resolution A37-19 in support of the global effort through its Environmental Protection policies and practices in development of the State Action Plan (SAP) for CO2 emissions reduction.

The SAP being the first ever plan provides an overview of the independent state of PNG major initiatives to reduce CO2 emissions from international aviation. PNG has thus pledged to manage the carbon footprint of its civil aviation industry while improving its safety and efficiency. The ICAO methodology has been used as a guiding tool in the development of PNG's National State Action Plan (NSAP).

Given its recognition of the impact of global warming, PNG has made sincere efforts to minimize the carbon footprint of aviation through pursing a basket of Measures as denoted by ICAO. They include Aircraft technology, Operational Improvements, Sustainable Aviation Fuels, and Marketbased Measures (Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Intrinsic is the fact that each measure will have its own potential activities to reduce CO2 emissions within.

In consideration of the achievements so far, the SAP sets a goal for reducing CO2 emissions from international aviation activities to contribute to global efforts in line with ICAO Member States agreed global aspirational goals for the international aviation sector. This includes a 2 per cent annual fuel efficiency improvement through to 2050 and carbon-neutral growth from 2020 onwards, and a Long Term Global Aspirational Goal (LTAG) of net-zero carbon emissions by 2050.

This action plan is a living document that will be continually reviewed and updated in accordance with the ICAO Assembly Resolution A41-21: Consolidated statement of continuing ICAO policies and practices related to environmental protection - climate change. Overall, PNG, as a nation, will as much as possible implement ICAO's environmental protection programs toward a greener aviation sector.

1. INTRODUCTION

1.1. Background and Objective

Papua New Guinea (PNG) comprises the eastern half of the island of New Guinea in the South-West Pacific. It is one of the developing regions in the world with low per capita income with existing serious health and social problems. A large proportion estimated to be almost 9 million population where 70-80% of this population live by subsistence farming. This has remained unchanged since independence from Australia in 1975. Therefore, absolute, and per capita greenhouse-gas (GHG) emissions are relatively low.

The Convention on International Civil Aviation known also as the Chicago Convention was ratified and domesticated on the 15th day of December 1975. Thus, PNG adhering to the ICAO Assembly Resolution A37-19 in support of the global effort has pursued to developing therefore objectivized through its Environmental Protection policies and practices by the development of State Action Plan (SAP) for CO2 emissions reduction.

The SAP describes the circumstances of civil aviation activities in PNG and its key stakeholders that have initiated some efforts to reduce CO2 emissions in international aviation. In addition, this SAP describes the mitigation measures selected by the NSAP Team to address CO2 emissions reduction in international aviation at the national level. The projection of the trends of CO2 emissions whether it is with and without the implementation of these measures is also described, reflecting the positive impact of these initiatives on the carbon footprint of the national aviation sector in PNG.

Furthermore, these initiatives represent PNG's contribution towards the achievement of the global aspirational goals set by the ICAO. At its 41st Session in 2022, the ICAO Assembly reaffirmed the two global aspirational goals for the international aviation sector of 2 per cent annual fuel efficiency improvement through to 2050 and carbon-neutral growth from 2020 onwards, as well as adopted a collective long-term global aspirational goal (LTAG) of net-zero carbon emissions by 2050. PNG also adheres to ICAO's call to its Member States during its 41st Assembly (2022) to submit voluntary SAPs to communicate on the progress towards the environmental goals set by ICAO and, where appropriate, request assistance in implementing these plans.

1.2. Contact Information

The focal point of the SAP for PNG is the Department of Transport and Civil Aviation, as shown in Table 1 below.

Table 1: PNG's Focal Point and contact information.

Name of Authority	Department of Transport
Point of Contact	Mr. Kevin Luana, Deputy Secretary (Service Delivery)
Street Address	Airways Road, 7 Mile
Country	Papua New Guinea
Province	National Capital District
Telephone Number	+675 325 7500 or +675 7662 6158 or +675 7180 7753
Fax Number	+675 323 3339
E-mail address	kluana@transport.gov.pg or kluana4@gmail.com

2. OVERVIEW OF CIVIL AVIATION IN PNG

2.1. Current Situation and Future Trend

The civil aviation industry in PNG has a short history which began soon after WWII (1942). Theindustry is relatively small and more regulated and is dynamic in aviation service provision. The industry has seen dramatic changes to its fleet of airplanes over time with about 211 aircraft on itsaircraft registry today. The earlier days saw DC3s in operation until they were replaced with the F28 as passenger airplanes. New airport infrastructures (82 airports and airfields, both active and non-active, to date) were built as passenger movement by air transport became more frequent and inclusive for rural airstrips. The aviation industry has continued to grow in the number of passenger and cargo movements thus warranting expansion and modernization of a new fleet with bigger and faster capabilities in the 1990s and this was especially true with the introduction of two wide-body and three narrow-body aircraft servicing international routes. This meant that new Air Services agreements were entered into allowing an increased number of destinations to be visited. More importantly, the current trend into the future has promise for the National carrier Air Niugini to grow into an aviation service provider readily willing to implement ICAO's environmental protection programs toward greener aviation.

The main stakeholders in the aviation industry are:

1) Department of Transport (DoT)
2) National Weather Services (NWS)
3) Civil Aviation Safety Authority of PNG (CASA PNG)
4) NiuSky Pacific Limited (NSPL)
5) National Airports Corporation (NAC)
6) Airline Operators (e.g. Air Niugini)

2.1.1. The Department of Transport

The DoT is the policyholder of civil aviation in PNG. As such DoT is the leader in international best practices in compliance to the International Civil Aviation Organisation (ICAO) Standards and Recommended Practices (SARPs). The DoT also performs administrative functions including the sponsoring to the PNG National Parliament, ratifications of aviation related treaties (bilateral and multilateral). DoT also negotiates and ratifies bilateral air service agreements for international travel. It also issues permits for international flights landing into PNG airports and for overflights utilizing the Port Moresby FIR.

2.1.2. Air Operators

The ICAO and IATA recognized Air Operators in PNG conducting international flights either as scheduled, non-schedule, passenger and for cargo are Air Niugini (ANG), PNG Air and Hevilift.

Table 2: Airport Operators in PNG

Air Operators	***ICAO***	***IATA***	***Type of Operations (scheduled/ non-scheduled passengers/ cargo, domestic/ international)***
Air Niugini	ANG	PX	Both scheduled and non-schedule- passengers/ cargo at domestic and international levels
PNG Air	TOK	CG	Non-scheduled charter flight- cargo/ passengers & medevac at domestic level
Hevilift		IU	Charter flights passengers/cargo at domestic level

However, as tabulated below, Air Niugini is the bigger service provider in PNG aviation. Air Niugini and its subsidiary, Link PNG operate regular public transportation within PNG and internationally in the Asia Pacific Region. Charter operations are limited to the domestic sector. Air Niugini's fleet is composed of 22 aircraft with an average of 11 operating daily and 11 in maintenance. The representative data for the 2022 calendar year is summarized and illustrated in Table 3 and Figure 1, provided hereunder:

Table 3: PNG airline operators providing international, domestic and cargo services.

January to December 2022						
PNG Airlines Operating International and Domestic Flights						
				% Sectorization		
Airline	**International**	**Domestic**	**Total**		**Int**	**Dom**
Air Niugini (ANG)	2256	24294	26550	ANG	8%	92%
PNG Airlines (TOK)	128	11249	11377	PNGA	1%	99%
Hevilift Limited (IU)	228	15488	15716	HEVI	1%	99%
	2612	**51031**				

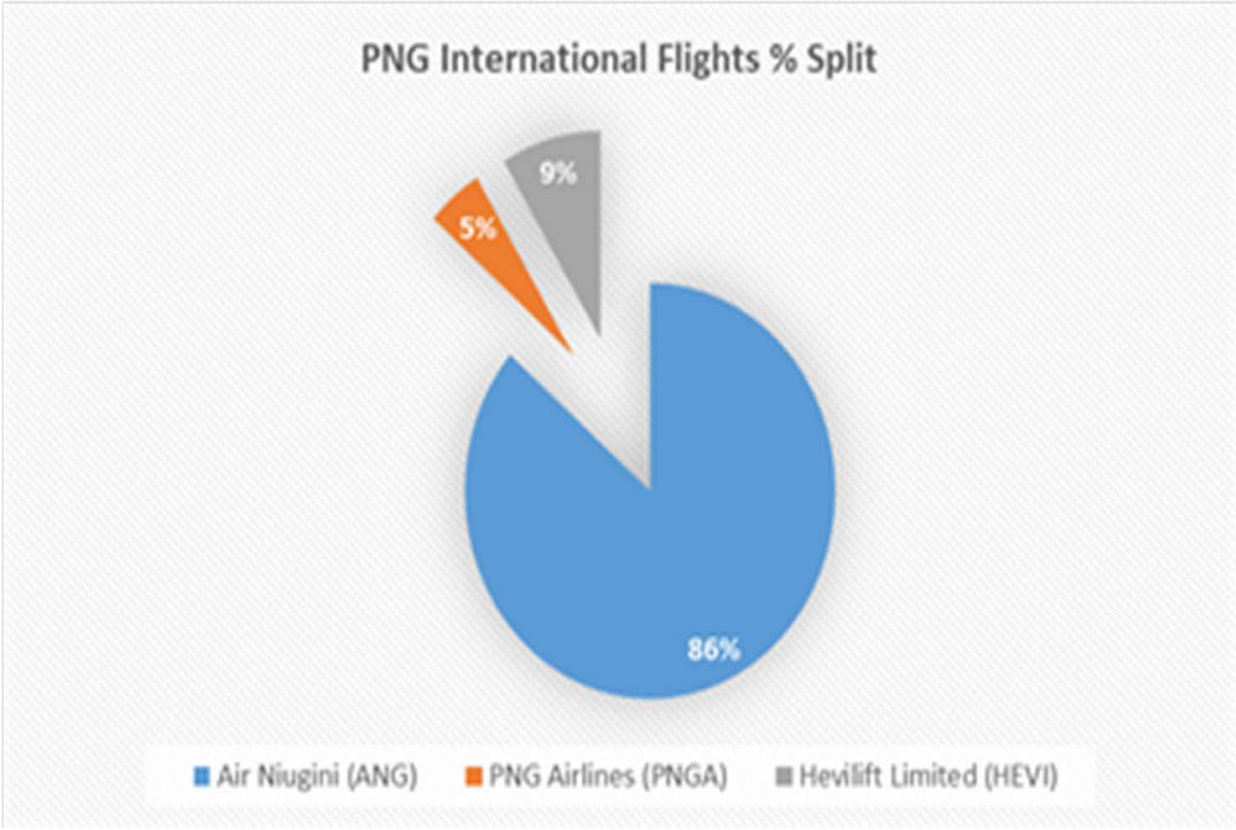

Figure 1: Percentage share of International Flights for PNG Operators.

2.1.3. Number of passengers from 2020 until 2022

Number of passengers (domestic and international) and air cargo (domestic and international) from 2020 until 2022 are collated and show a relatively increasing trend as in Table 6 below:

Table 4: Data on air passenger and cargo for domestic and international flights

Year	Number of passenger (persons)	Number of passenger (persons)	Numbers of Air Cargo (kilograms)	Number of Air Cargo (kilograms)
	(Dom & Int)	(Int)	(Dom & Int)	(Int)
2020	682,833	79,729	13,419,040	8,156,870
2021	833,428	42,005	16,032,064	9,756,303
2022	1180,462	175,495	15,317,292	8,351204

2.1.4. Airport Operators in PNG

The National Airport Corporations (NAC) is an incorporated State-owned Aviation Enterprise (SAE) which operates and/or manages all government owned airports in PNG. There are twenty two (22) national airports in PNG with Port Moresby's Jacksons Airport as the only designated ICAO International Airport. In addition, there are 58 other domestic airports plus airfields where some are active and others not active.

The NAC also provides ground navigation aids, design, construction, and maintenance of the runways, stop ways, runway end safety areas, access rounds, with terminal infrastructure facilitation including security (of both land and air side) and management of identified hazards.

Table 5 provides a listing of the number of the airports operated by NAC and indicates which airports provide both international and domestic services. The only gazetted international airport in PNG is the Port Moresby Jacksons International Airport. That means the other airports providing international services are primarily for special services as approved.

Table 5: List of NAC operated 22 airports with only three providing international services.

Airport Operators	Airport Names and Cities	Domestic/ International
National Airports Corporation	Jacksons International Airport/ Port Moresby	Domestic/ International
National Airports Corporation	Nadzab/ Lae	Domestic/ International
National Airports Corporation	Kagamuga/ Mt. Hagen	Domestic/ International
National Airports Corporation	Wapenamanda/ Wabag	Domestic
National Airports Corporation	Goroka/ Goroka	Domestic
National Airports Corporation	Chimbu/ Kundiawa	Domestic
National Airports Corporation	Mendi/ Mendi	Domestic
National Airports Corporation	Tari/ Tari	Domestic
National Airports Corporation	Vanimo/ Vanimo	Domestic
National Airports Corporation	Boram/ Wewak	Domestic
National Airports Corporation	Madang/ Madang	Domestic
National Airports Corporation	Girua/ Popondetta	Domestic
National Airports Corporation	Gurney/ Alotau	Domestic
National Airports Corporation	Kerema/ Kerema	Domestic
National Airports Corporation	Daru/ Daru	Domestic/ International
National Airports Corporation	Kiunga/ Tabubil	Domestic
National Airports Corporation	Aropa/ Arawa	Domestic
National Airports Corporation	Kieta/ Buka	Domestic
National Airports Corporation	Hoskins/ Kimbe	Domestic
National Airports Corporation	Tokua/ Rabaul	Domestic
National Airports Corporation	Kavieng/ Kavieng	Domestic
National Airports Corporation	Momote/ Lorengau	Domestic

2.1.5. Air Navigation Service Providers

The Air Navigation Services Provider (ANSP) in PNG includes Air Traffic Management (ATM) and Communications, Navigation & Surveillance (CNS). PNG's ANSP NiuSky Pacific Limited (NSPL) is an incorporated State Aviation Enterprise that works in close collaboration with the National Weather Service (NWS) as well as other aviation stakeholders as alighted in the table below:

Table 6: Air navigation service providers

Air Navigation Service Providers	Type of Service
NiuSky Pacific Limited	Provider of Air Traffic Management and Communications, Navigations & Surveillance (CNS)
PNG National Weather Services (Department of Transport & Civil Aviation)	Provision of Meteorological (MET) Services

The ATM supports national airports, which form the bulk of domestic operations as well as international operations within the Port Moresby Flight Information Region (FIR). The NSPL provides ground, aerodrome, approach, en-route control, flight information Service, aeronautical information services (AIS) including an aviation rescue coordination centre for aviation search and rescue service.

2.1.6. Civil Aviation Safety and Security Regulator

The Civil Aviation Safety Authority PNG (CASA PNG) is the regulatory authority for environmental Protection in Civil Aviation. CASA PNG implements and monitors compliance with the provision of ICAO Annex 16. CASA PNG has promulgated operating rules for environmental protection in domestic and international civil aviation through the specification for the design, manufacture and aircraft operational requirements.

CASA PNG also promulgates rules and specifications for air traffic management, airport operations, and aviation meteorology so that the consequential elements of environmental protection are managed appropriately.

3. BASELINE SCENARIO

3.1 Methodology and data

The baseline scenario describes the historical evolution of fuel consumption, CO2 emissions, and airline traffic in PNG as well as the expected future evolution in the absence of measures.

Given the availability of data annual revenue tonne kilometre (RTK) and annual international fuel consumption from international flights) is very limited, the Environmental Benefit Tool (EBT) version v2.8.2 is used to assist in the process of defining a baseline scenario, estimating the quantifiable benefits resulting from the selected mitigation measures, and generating the expected results estimate.

Based on available data, Method C was selected when using the EBT. In addition, the following inputs are collected and used in developing the baseline:

- **Baseline year:** 2022
- **International RTK:** 111,675,000 Tonne-Kilometres
- **International fuel burn:** 27,858 Tonnes
- **Number of aircraft used for international flights:** 12 aircraft
- **Annual RTK growth:** 5.80 %

3.2 Baseline

The following table and chart provide an estimated baseline of fuel consumption and CO2 emissions for international flights for the years 2022 to 2050.

For the definition of "international flight" used in this document, reference is made to the ICAO methodology (all international flights operated by all air carriers registered in PNG).

Table 7: Baseline Scenario for International Flight (generated by the EBT)

Baseline_International RTK-Fuel Burn and Efficiency

Year	International RTK ('000)	International Fuel burn (Tonnes)	Efficiency (Fuel burn / RTK)
2022	111,675.00	27,858.00	0.249
2023	118,152.15	29,473.76	0.249
2024	125,004.97	31,183.24	0.249
2025	132,255.26	32,991.87	0.249
2026	139,926.07	34,905.40	0.249
2027	148,041.78	36,929.91	0.249
2028	156,628.20	39,071.85	0.249
2029	165,712.64	41,338.01	0.249
2030	175,323.97	43,735.62	0.249
2031	185,492.76	46,272.28	0.249
2032	196,251.34	48,956.08	0.249
2033	207,633.92	51,795.53	0.249
2034	219,676.69	54,799.67	0.249
2035	232,417.94	57,978.05	0.249
2036	245,898.18	61,340.78	0.249
2037	260,160.27	64,898.54	0.249
2038	275,249.57	68,662.66	0.249
2039	291,214.04	72,645.09	0.249
2040	308,104.46	76,858.51	0.249
2041	325,974.51	81,316.30	0.249
2042	344,881.04	86,032.65	0.249
2043	364,884.14	91,022.54	0.249
2044	386,047.42	96,301.85	0.249
2045	408,438.17	101,887.36	0.249
2046	432,127.58	107,796.82	0.249
2047	457,190.98	114,049.04	0.249
2048	483,708.06	120,663.88	0.249
2049	511,763.12	127,662.39	0.249
2050	541,445.39	135,066.81	0.249

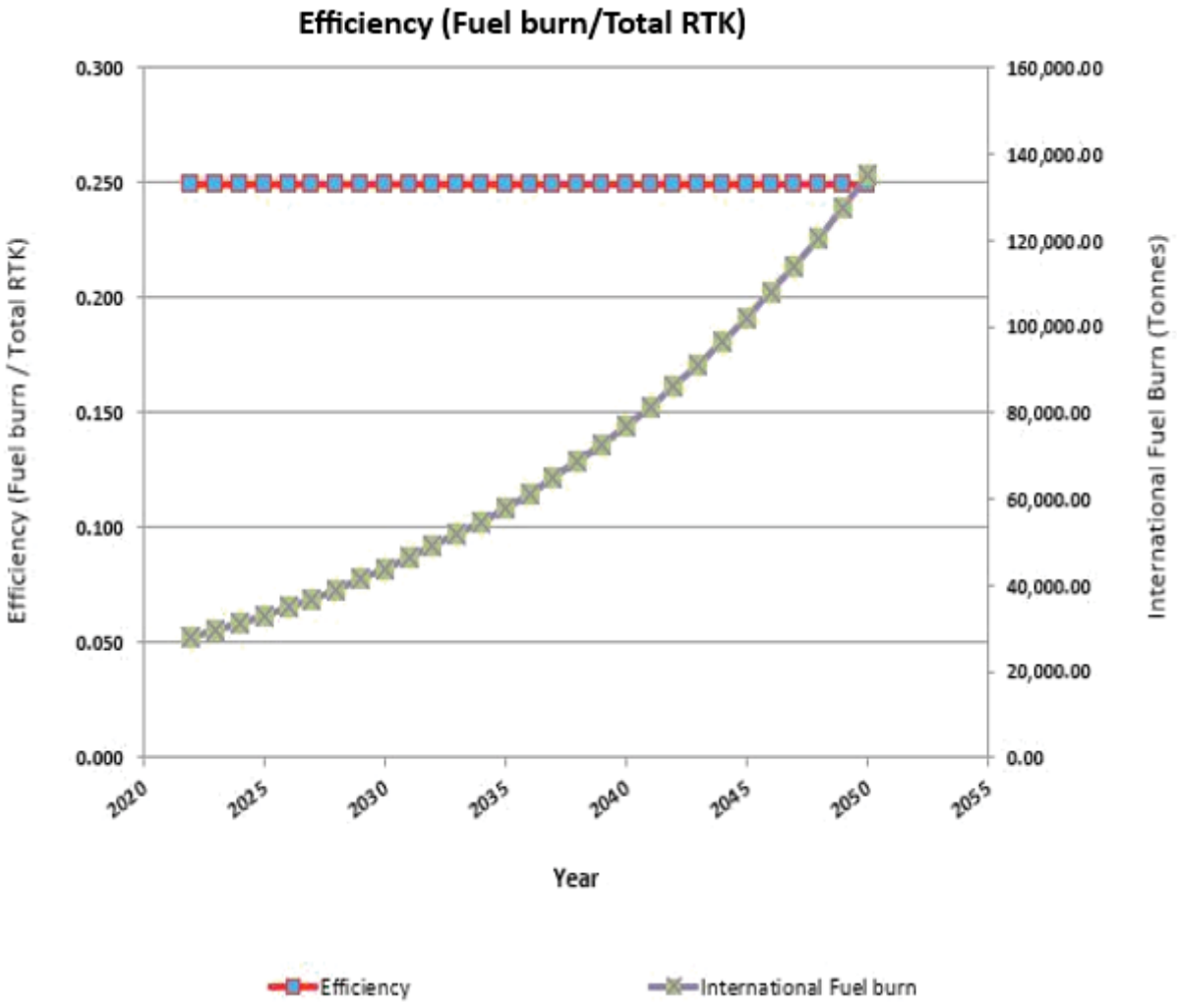

Figure 2: Fuel burn efficiency estimated from 2022 to 2050 without measures.

Table 7and the Fig. 2 show the baseline data projections from the reference year 2022 to 2050 as the terminal year. The result represents the baseline scenario for international flights in terms of the revenue ton kilometer (RTK) and the fuel burn. It can be deduced that the fuel consumption will be around 43, 735.62 tons in 2030 and around 135, 066.81 tons in 2050. This is about 0.25% of fuel consumption.

The estimated fuel consumption will have reached around 135,066.81 tonnes by 2050 correlated by annual fuel efficiency constant at 0.250. An annual average tonnage increase of 3,753.43 (3.6%) from the reference year is calculable.

(NOTE: The average is derived using 2022, 2036, 2043 and 2050 as data-set-years.)

4. MITIGATION MEASURES

With reference to the ICAO Doc 9988 Chapter 4 and Appendix A are the four main stipulations of CO2 emission mitigation measures implemented by PNG's aviation stakeholders as follows: 1). technology and standards, 2). operational improvement, 3). sustainable aviation fuels, and 4). market-based measures, of which details are narrated in the following:

4.1. Technology and Standards

A. Purchase of new aircraft, see details in Table 8.

Table 8: Re-fleeting of aircraft utilized on international routes

Title	Measure 1- Re-fleeting of aircraft
Description	Re-fleeting of aircraft utilized on international routes
Measure	The Airline is introducing B737 technology with winglets.
Action	Air Niugini to progressively introduce the B737 technology with winglets i) to reduce CO2 emissions, the rate of fuel burn; ii) to increase the efficiency of the aircraft
Start Date	2023
Date of Full implementation	2025
Indicator	% of reduced fuel burnt from 2023- 2025 linked to the introduction of new technology (or compared to the previous generation engines) % of reduced emissions linked to the introduction of B737 technology
Implemented by	Air Niugini
Economic Cost	There is a significant cost layout. It is to be funded locally either via government support or through a share offer (public listing)
Currency	USD
Reference to existing Legislation	Civil Aviation Act 2000 (as amended), Civil Aviation Rules (CARs), Public Finances Management Act 1995 and the Companies Act (1997)
If new legislation is proposed	TBD
Compliance to the legislation Voluntary Mandatory N/A	 Recommended
Assistance needed	Technology, Finance, Technical support, Education support, Research support
Currency for financial assistance	USD
List of Stakeholders involved	Air Niugini, DoT, PNG NSPL, NAC & CASA PNG

4.2. Sustainable Aviation Fuels

The potential use or development of Sustainable Aviation Fuel (SAF) will be explored by the airlines and the responsible National agency mandated to manage Energy use and consumption.

PNG is ready to gain more knowledge about SAF by joining the ICAO ACT-SAF program.

4.3. Operational Improvements

A. Improved air traffic management and infrastructure use. See details in Table 9 below:

Table 9: Improved air traffic management and infrastructure use

Title	Measure 2- Performance Based Navigation in Port Moresby
Description	PNG NSPL has introduced Performance Based Navigation (PBN) in Port Moresby FIR.
Measure	More efficient ATM planning, ground operations, terminal operations (departure and arrivals), en-route operations, airspace design and usage, aircraft air navigation capabilities.
Action	PNG NSPL to monitor performance
Start Date	2023
Date of Full Implementation	2025
Indicator	PBN Baseline in 2023 to be established as a % of all operations. The Objective is to monitor this % every year and compare with 2023 metric to understand the benefits linked to CDO and CCO implementation.
Implemented by	NSPL
Economic Cost	Airlines to bear costs of RNP and look at other options. Satellite and ground stations installed under various aid programs.
Currency	USD
Reference to existing Legislation	Civil Aviation Act 2000 (as amended) and Civil Aviation Rules (CARs)
If new legislation is proposed	NA
Compliance to the legislation Voluntary Mandatory N/A	 Mandatory
Assistance needed	Technology, Technical support, Education, Research & Finance support
Currency for financial assistance	USD
List of Stakeholders involved	PNG NSPL, Air Niugini, NWS, NAC, CASA PNG & DoT

B. More efficient use and planning of airport capacities. See Table 11 for essential details:

Table 10: More efficient operations

Title	Measure 4- National Weather Service Improvement of Weather Services/ forecast conditions in Port Moresby FIR
Description	On time delivery of Significant Weather Conditions (Turbulence, Jet Streams, Wind shear, Thunderstorms, Cyclones, Volcanic Ash, Wind Vectors) in the Port Moresby FIR. Timely delivery of TAFs, ARFORs, SIGMETs for domestic use is another consideration.
Measure	More efficient ATM planning, ground operations, terminal operations (departure and arrivals), en-route operations, airspace design and usage, aircraft air navigation capabilities.
Action	NWS to improve its service charter and service level agreements with NAC, PNG NSPL, and Air Niugini so that the level of service delivery is at acceptable levels.
Start Date	2023
Date of Full implementation	2025
Indicator	% of reduced fuel costs is linked to the high-quality forecasts on upper-air temperature, humidity, winds, and weather extreme events.
Implemented by	NWS, DoT, CCDA, DNPM, NAC, PNG NSPL, Operators

Economic Cost	Stevenson Screens (barometer, thermometers, wind system), Wind vanes Maintenance Facilities and Office Space are initial costs and are required at all 22 Regional Airports. AWS,
Currency	USD
Reference to existing Legislation	Civil Aviation Act 2000 (as amended) and Civil Aviation Rules (CARs),
If new legislation is proposed	NWS to develop own ACT
Compliance to the legislation Voluntary Mandatory N/A	 Mandatory
Assistance needed	Technology, Finance, Technical support, Education support, Training support & Research support
Currency for financial assistance	USD
List of Stakeholders involved	NWS, National Airports Corporation, Air Niugini, PNG NSPL & CASA PNG

C. Regulatory Measures/ Other. See Table 11 for more details:

Table 11: Other regulatory measures

Title	Measure 5 - Regulatory Measures to Implement CORSIA
Description	Drafting regulation to transpose ICAO Annex 16 Volume IV into PNG regulation
Measure	Transposition of ANNEX 16 VOLUME IV into a national regulation framing the offsetting under CORSIA
Action	PNG volunteering to CORSIA to increase the number of routes falling under the offsetting.
Start Date	2023
Date of Full implementation	Ongoing aligned with ICAO SARPs Annex 16 Volume IV
Indicator	No. of flights/ routes operated between volunteering states to increase the effectiveness of the scheme.
Implemented by	CASA
Economic Cost	Operational costs are on-going costs to CASA PNG. No additional cost.
Currency	NA
Reference to existing Legislation	Civil Aviation Act 2000 (as amended) and Civil Aviation Rules (CARs)
If new legislation is proposed	NA
Compliance to the legislation Voluntary Mandatory N/A	 Mandatory
Assistance needed	Technical Support, Education support, Research support
Currency for financial assistance	USD
List of Stakeholders involved	CASA PNG & DoT

4.4. Market-based Measures by CORSIA

A. PNG is voluntarily participating in CORSIA requirements from its Pilot Phase working closely with CASA PNG and the DOT.

B. Supplemental benefits for domestic sectors

Mitigation Measure conditional on financial support- The NAC contribution to mitigation measures is through a planned solar panel project. The intent is to emulate the Jamaican at-gate pilot project supported by ICAO and UNDP. See Table 12 for more details:

Table 12: Solar panel project

Title	**Measure 3- Solar Power at gate (pilot activity in Port Moresby)**
Description	Port Moresby Jackson International Airport to introduce Solar Power for use by its services (air conditioning & lighting) as well as gate to gate power provision.
Measure	Conversion of airport infrastructure and ground support equipment to solar and minimize use of diesel-generated power.
Action	NAC Monitor its Energy use for comparison purposes. Extending this project to the other 22 regional airports would be useful.
Start Date	2023
Date of Full implementation	Ongoing process after the implementation in a pilot airport.
Indicator	% volume of emissions reduction linked to minimized use of diesel generated power.
Implemented by	
Economic Cost	The proposed project is at the Concept Stage. Fully costed option to be included in the next submission to UNDP GEF and GCF.
Currency	USD
Reference to existing Legislation	Civil Aviation Act 2000 (as amended) and Civil Aviation Rules (CAR)
If new legislation is proposed	Nil
Compliance to the legislation Voluntary Mandatory N/A	 Mandatory
Assistance needed	- Technology, Finance, Technical support, Education support & Research support
Currency for financial assistance	USD
List of Stakeholders involved	NAC, PNG NSPL, Air Niugini & CASA PNG, UNDP, CEPA, CCDA, DoT

5. EXPECTED RESULTS

By implementing the mitigation measures as described above, ascribing to aircraft technology improvements, operational improvements, sustainable aviation fuels, and CORSIA, the forecasted estimate of the total fuel and CO2 savings would be as depicted in their respective table and graph hereunder:

Table 13: Table of Expected Results- Fuel Savings (as generated by the EBT)

Expected Results: Fuel Savings

Year	Annual Fuel burn before implementation of mitigation actions (Tonnes)	Annual Fuel burn after implementation of mitigation actions (Tonnes)	Annual Fuel savings (Tonnes)	Change Fuel savings (%)
2022	27,858.00	22,423.16	5,434.84	-19.51
2023	29,473.76	24,038.72	5,435.04	-18.44
2024	31,183.24	25,522.23	5,661.01	-18.15
2025	32,991.87	22,044.26	10,947.61	-33.18
2026	34,905.40	23,957.79	10,947.61	-31.36
2027	36,929.91	25,982.30	10,947.61	-29.64
2028	39,071.85	28,124.24	10,947.61	-28.02
2029	41,338.01	30,390.40	10,947.61	-26.48
2030	43,735.62	32,788.01	10,947.61	-25.03
2031	46,272.28	35,324.68	10,947.61	-23.66
2032	48,956.08	38,008.47	10,947.61	-22.36
2033	51,795.53	40,847.92	10,947.61	-21.14
2034	54,799.67	43,852.06	10,947.61	-19.98
2035	57,978.05	47,030.44	10,947.61	-18.88
2036	61,340.78	50,393.17	10,947.61	-17.85
2037	64,898.54	53,950.93	10,947.61	-16.87
2038	68,662.66	57,715.05	10,947.61	-15.94
2039	72,645.09	61,697.48	10,947.61	-15.07
2040	76,858.51	65,910.90	10,947.61	-14.24
2041	81,316.30	70,368.69	10,947.61	-13.46
2042	86,032.65	75,085.04	10,947.61	-12.72
2043	91,022.54	80,074.93	10,947.61	-12.03
2044	96,301.85	85,354.24	10,947.61	-11.37
2045	101,887.36	90,939.75	10,947.61	-10.74
2046	107,796.82	96,849.21	10,947.61	-10.16
2047	114,049.04	103,101.43	10,947.61	-9.60
2048	120,663.88	109,716.27	10,947.61	-9.07
2049	127,662.39	116,714.78	10,947.61	-8.58
2050	135,066.81	124,119.20	10,947.61	-8.11

Annual Fuel efficiency improvement before implementation of mitigation actions :	0.00%
Annual Fuel efficiency improvement after implementation of mitigation actions :	-0.47%

Table 14: Expected Results- CO2 Savings (as generated by the EBT)

Expected Results: CO2 Savings

Year	Annual CO_2 emissions before implementation of mitigation actions (Tonnes)	Annual CO2 emissions after implementation of mitigation actions (Tonnes)	Annual CO_2 savings (Tonnes)	Change CO_2 savings (%)
2022	88,031.28	70,857.19	17,174.09	-19.51
2023	93,137.09	75,962.37	17,174.73	-18.44
2024	98,539.05	80,650.16	17,888.89	-18.15
2025	104,254.31	69,659.76	34,594.55	-33.18
2026	110,301.06	75,706.51	34,594.55	-31.36
2027	116,698.52	82,103.98	34,594.55	-29.64
2028	123,467.04	88,872.49	34,594.55	-28.02
2029	130,628.12	96,033.58	34,594.55	-26.48
2030	138,204.56	103,610.01	34,594.55	-25.03
2031	146,220.42	111,625.87	34,594.55	-23.66
2032	154,701.20	120,106.66	34,594.55	-22.36
2033	163,673.87	129,079.33	34,594.55	-21.14
2034	173,166.96	138,572.41	34,594.55	-19.98
2035	183,210.64	148,616.10	34,594.55	-18.88
2036	193,836.86	159,242.31	34,594.55	-17.85
2037	205,079.40	170,484.85	34,594.55	-16.87
2038	216,974.00	182,379.46	34,594.55	-15.94
2039	229,558.49	194,963.95	34,594.55	-15.07
2040	242,872.89	208,278.34	34,594.55	-14.24
2041	256,959.51	222,364.97	34,594.55	-13.46
2042	271,863.17	237,268.62	34,594.55	-12.72
2043	287,631.23	253,036.68	34,594.55	-12.03
2044	304,313.84	269,719.30	34,594.55	-11.37
2045	321,964.04	287,369.50	34,594.55	-10.74
2046	340,637.96	306,043.41	34,594.55	-10.16
2047	360,394.96	325,800.41	34,594.55	-9.60
2048	381,297.87	346,703.32	34,594.55	-9.07
2049	403,413.14	368,818.60	34,594.55	-8.58
2050	426,811.11	392,216.56	34,594.55	-8.11

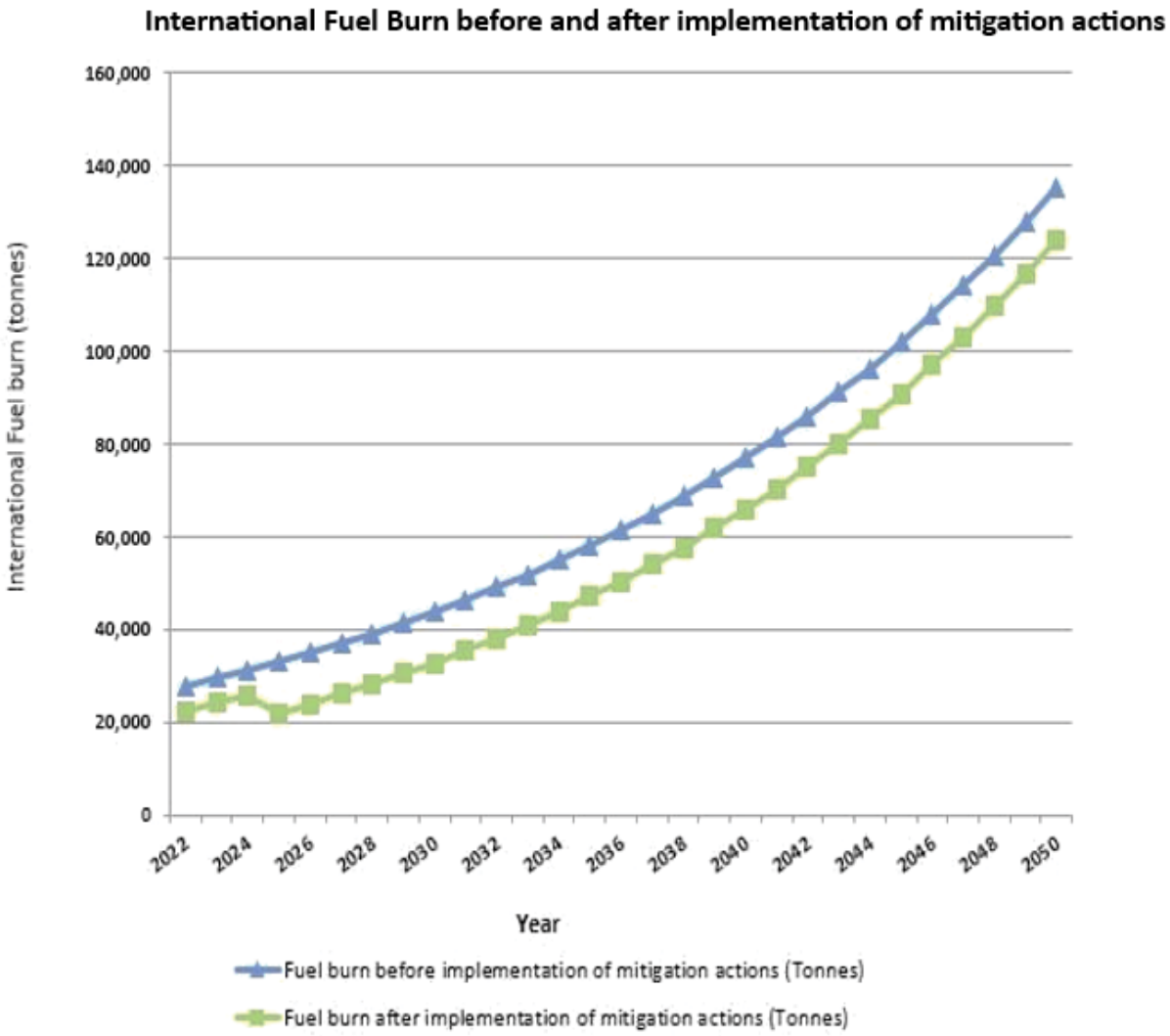

Figure 3: Fuel Savings baseline vs after implementation of mitigation measures (generated by EBT)

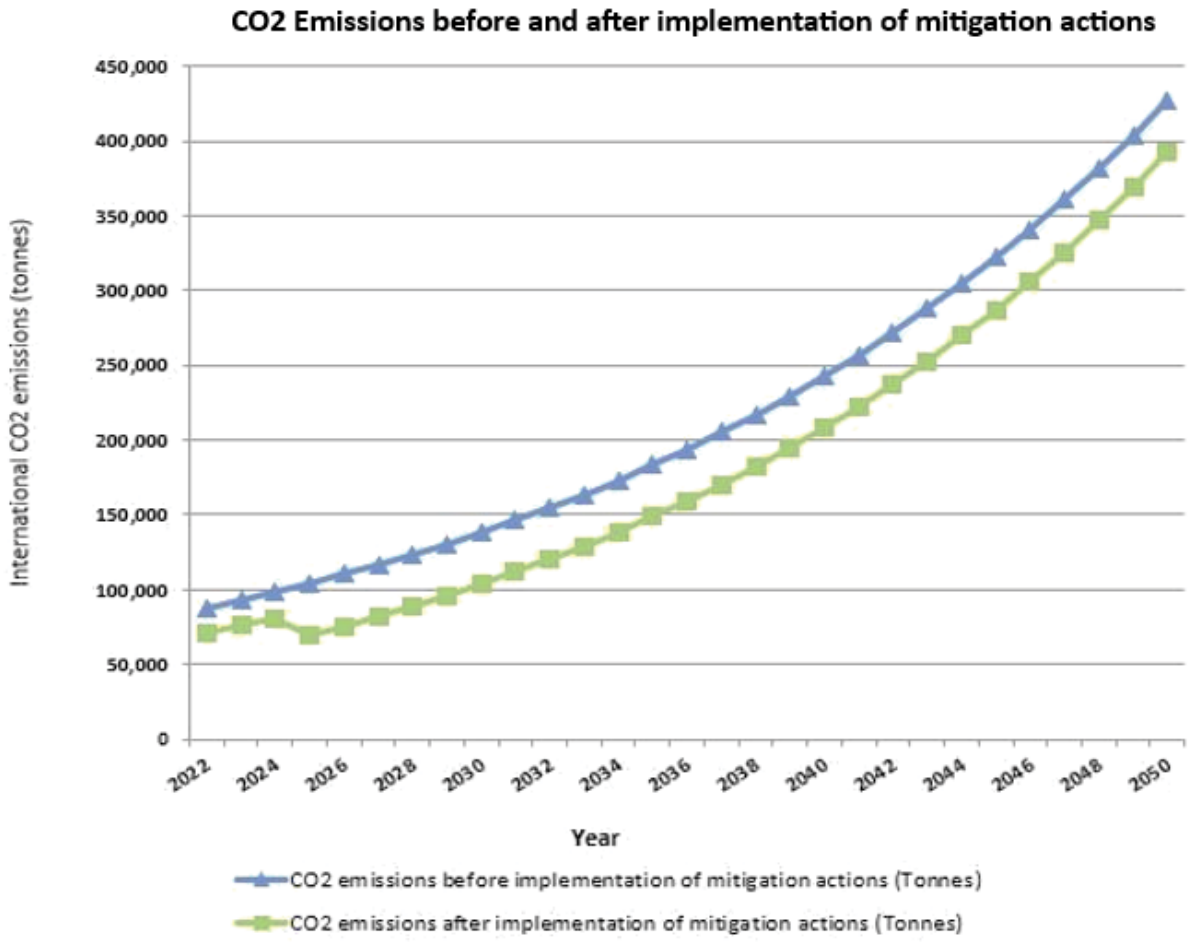

Figure 4: CO2 Emissions before vs after mitigation measures (generated by EBT)

The resulting tables (13-14) and figures (3-4) have data that are correlated, meaning that fuel burn will directly influence the amount of CO2 emissions. The figures show a graphical representation of the CO2 emissions before and after the implementation of mitigating measures. There is a marked decrease in the year 2023 and then there is an exponential growth curve projected to the end of the year 2050. This could be related to the fact that the mitigation actions identified will take effect from the year 2023 onwards. The difference or change in CO2 Saving is shown as a minus percentage implying that these changes though important indicators of improvement so far yet they are insignificant for now; that is, in terms of meeting ICAO goals of 2% annual fuel efficiency through 2050 and carbon neutral growth for 2020 onwards; both of which will lead to the LTAG of net-zero carbon emissions by 2050. It is recommended that for real radical mitigation actions to be implemented in the ensuing years for the Change Co2 Saving to be meaningful towards the implied goals.

6. ASSISTANCE NEEDS

Identified below is PNG's 'assistance needs' analysis that could potentially maximize efforts to reduce CO2 emissions within the international aviation sub sector. These 'assistance needs' are further categorized into: funding, technological and Capacity-building issues of which associated issues of relevance to improve PNG's action plan include:

6.1 Financial Issues

6.1.1 Funding requirement to support the development of sustainable aviation fuels;

6.1.2 Financial support is required to address deficiencies identified by all stakeholders to realise the LTAG of zero carbon emission by 2050.

6.2 Technological Issues

6.2.1 Development of green technology for aviation.

6.2.2 Regulations and certifications on energy efficiency technology requirements and sustainable aviation fuels

6.2.3 Technical Training support required to address deficiencies identified by all stakeholders to realise the LTAG of zero carbon emission by 2050.

6.3 Capacity Building Issues

6.3.1 Capacity building for the development of sustainable aviation and sharing implementation experience;

6.3.2 Navigation and airport system management

6.3.3 Data collection and management training to include:

- 6.3.3.1 Fuel Data Management for the Aviation sector
- 6.3.3.2 Reviewer training of GHG data
- 6.3.3.3 CORSIA Inventories and review
- 6.3.3.4 Training and development of specific reporting guidelines under ICAO but different to UNFCCC requirements for the energy data inventories.

6.3.4 Monitoring Reporting and Verification

7. Monitoring and Evaluation

This will take effect every tripartite year according to Doc 9988 Sub section 2.5 & 2.5.1 "Updating an existing plan" so that means the next is going to in the 2025 calendar year.

APPENDIX One - Estimated Fuel Savings Using Current and Proposed Mitigation Measures

Below are the measures under Operational Improvements that NSPL currently implements and planning to implement in the future:

I. Measures to improve the use of optimum flight levels
II. Measures to improve the use of optimum routings
III. Measures to improve flexible tracks
IV. Measures to improve fuel-efficient departure and approach procedures
    a. PBN STAR
    b. PBN SID
V. Measures to fully utilize RNAV/RNP capabilities
    a. Measures to fully utilize ADS-B surveillance
    b. Implementation of RNP AR APCH procedures for reducing approach minima and the possibilities of missed approach/diversion.

1. Calculation of PBN SID/STAR, ADS-B Surveillance and RNP AR APCH Estimated Fuel Savings

To calculate the estimated fuel savings, the derived data from the ATM system (Table 12) and the Rules of thumb Table (ICAO Doc 9988, Appendix C, Table C-2) are used.

Table 15 ANG international flights in 2022

CITY-PAIR	ACFT TYP	Total flights per ACFT TYP	Total Flights per CITY-PAIR
POM-HIR	F70 F100 B738	15 14 15	44
HIR-POM	B738 F100 F70	15 14 15	44
POM-MNL	B738 B763	144 14	158
MNL-POM	B738 B763	143 14	157
POM-HKG	B738 B763	2 55	57
HKG-POM	B738 B763	2 56	58
POM-SIN	B738 B763	9 229	238
SIN-POM	B738 B763	9 229	238
POM-BNE	F100 B733[1] B738 B763	8 2 52 287	349
BNE-POM	F100 B733[1] B738 B763	8 2 52 277	339

POM-CNS	DH8C DH8D F70 F100 B763	1 9 149 38 6	203
CNS-POM	DH8C DH8D F70 F100 B738 B763	1 9 148 37 1 16	212
POM-SYD	B733[1] B738 B763	1 37 20	58
SYD-POM	B733[1] B738 B763	1 37 20	58
POM-SPN	B738	2	2
SPN-POM	B738	2	2
POM-PNI	B738	1	1
POM-KCH	B738	2	2
KCH-POM	B738	2	2
CITY-PAIR	ACFT TYP	Total flights per ACFT TYP	Total Flights per CITY-PAIR
POM-CGK	B738	1	1
CGK-POM	B738	1	1
POM-SZB	B738	1	1
SZB-POM	B738	1	1
POM-TSV	B763	1	1
TSV-POM	B763	1	1
POM-YIA	B763	2	2
YIA-POM	B763	2	2
POM-DRW	F100	1	1
DRW-POM	F100	1	1
POM-NTL	B763	1	1
POM-PEK	B763	1	1
PEK-POM	B763	1	1
POM-CAN	B738	1	1
POM-SZX	B763	1	1
SZX-POM	B763	1	1
POM-XMN	B763	2	2
XMN-POM	B763	2	2
WWK-DJJ	F100	4	4
DJJ-WWK	F100	4	4
GUM-POM	B763	1	1
MAJ-POM	B738	1	1
MNL-CNS	B738[2]	1	1
AMQ-POM	DH8D	1	1
		Total # of Flights	2,250[1]
		Total # of DEPs	1,121[1]
		Total # of ARRs	1,129[1]

[1] ANG's scheduled flight using Australian registered ACFT (6 flights); excluded from calculations

[2] Flight from MNL to POM diverted to CNS

Table 16 Estimate fuel savings using part of the Rule of Thumb

Measure (References)	Rule of thumb	Estimation of Fuel Savings
Measures to improve fuel efficient departure and approach procedures: PBN STAR (CAEP/10 Report 2016)	Use IFSET[1] Or FS = 20 kg to 50 kg of fuel (.02 to .05 tonnes) * number of arrivals on PBN STAR	ANG estimates about 2,250 international flights annually. It is estimated that in 2024 all arrivals will be done via PBN STAR, which is estimated to be about 1,130 arrival movements. Expert judgement is that 100% of these arrivals will fly the PBN STAR. The annual fuel savings from 2024 onwards can be estimated as: • 0.02 * 1,130 = 22.6 tonnes of fuel saved (low end of range) • 0.05 * 1,130 = 56.5 tonnes of fuel saved (high end of range)
Measures to improve fuel efficient departure and approach procedures: PBN SID (CAEP/10 Report 2016)	Use IFSET[1] Or FS = 0 kg to 30 kg of fuel (0 to .03 tonnes) * number of departure movements on PBN SID	ANG estimates about 2,250 international flights annually. It is estimated that in 2024 all departures will be done via PBN SID, which is estimated to be about 1,120 departure movements. Expert judgement is that 100% of these departures will fly the PBN SID. The annual fuel savings from 2024 onwards can be estimated as: • 0.0 * 1,120 = 0 tonnes of fuel saved (low end of range) • 0.03 * 1,120 = 33.6 tonnes of fuel saved (high end of range)
Measures to fully utilize ADS-B surveillance (CAEP/10 Report 2016)	Use IFSET[1] Or FS = number of flights in un-surveillance airspace * equipage rate (70%) * average flight time (hours) * fuel burn (per hour) * number of climbs to optimal level (1-2) * fuel savings (1% to 2%)	PNG's non-RADAR airspace handles about 1,032 2 international ANG flights annually. Each flight spends, on average, 1 hour in un-surveillance airspace, burning about 2 – 4.9 tonnes 3 of fuel per hour. Estimated ADS-B equipage of the flights in un-surveillance airspace is 100%. It is assumed that an aircraft can benefit by approximately 1-2% fuel reduction for each 1,000 feet of altitude toward the optimal en-route altitude and that between 1-2 climbs of 1,000 feet can be made in the airspace using ADS-B surveillance The annual fuel savings from the implementation of alternative surveillance (ASUR) can be estimated as: • 1,032 * 1 * 1 * 2 * 1 * 0.01 = 20.64 tonnes of fuel saved (low end of range) • 1,032 * 1 * 1 * 4.9 * 2 * 0.02 = 202.3 tonnes of fuel saved (high end of range)

Implementation of RNP AR APCH procedures for reducing approach minima and the possibilities of missed approach/diversion	Use IFSET 1 Or FS = total arrival movements * 0.5 * 0.005 * fuel savings (381-471 kg)	With 1,130 arrival movements at Jacksons TMA, NSPL is planning to implement an RNP AR APCH procedure. It is assumed that 50% of arrivals to this airport will fly this approach procedure. It is estimated that in the event of a missed approach or diversion the average extra fuel burn used ranges from 381-470 kg. It is assumed that the minima are sufficiently reduced to require an aircraft to carry out a missed approach or diversion in 0.005 operations. The annual fuel savings can be estimated as: • 1,130 * 0.5 * 0.005 * 381 kg = 1 tonne of fuel saved (low end of range) • 1,130 * 0.5 * 0.005 * 470 kg = 1.3 tonnes of fuel saved (high end of range)

[1] IFSET method not used due to non-availability of required data
[2] All flights (except for those between POM and Australian city-pairs, which are on full radar coverage whilst in PNG airspace)
[3] Fuel burn per hour in cruise flight, from Airliners.net, used as an estimate for ACFT used internationally, ranging from F100 (2 tonne/hr.) – B763 (4.9 tonne/hr.)

2. Calculation of Optimum Routings and Flexible Tracks Estimated Fuel Savings

According to ATM data, these international ANG flights are usually given flexible tracks in PNG's airspace (Table 14)

Table 17 ANG flights being given flexible tracks (track-shortening) and the associated fuel savings

City Pair	ACFT TYP	EET [1] in PNG Airspace (mins)	Actual Time [1] in PNG Airspace (mins)	# of flights annually [1]	Time saved (mins)	Fuel Savings Estimation
POM-ROR	B763	98	88	48	10	FS = fuel burn [2] * time saved * annual flights = 4.9 * 0.167 * 48 = 39.3 tonnes of fuel saved annually
ROR-POM	B763	100	97	48	3	FS = fuel burn [2] * time saved * annual flights = 4.9 * 0.05 * 48 = 11.76 tonnes of fuel saved annually

[1] Estimated average
[2] Estimated fuel burn per hour in cruise-flight for B763 (4.9 tonne/hr.), from Airliners.net