



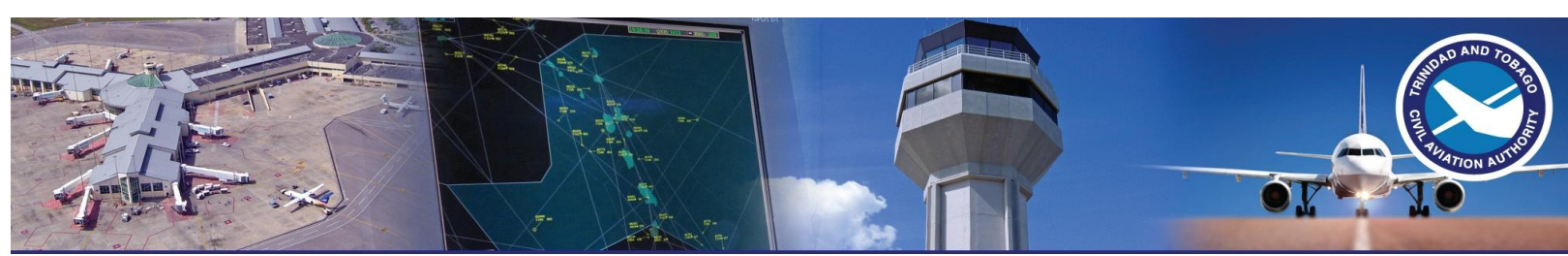
**TRINIDAD AND TOBAGO
CIVIL AVIATION AUTHORITY**

**FUEL SAVINGS AND EMISSIONS
REDUCTION PLAN**

FOR THE

**PIARCO FLIGHT INFORMATION
REGION (FIR)**

December 2012



1.0 Introduction

Under the ICAO Convention, the Government of the Republic of Trinidad and Tobago has responsibility for the provision of air traffic services within the airspace above its territory. In addition, ICAO has delegated to Trinidad and Tobago the responsibility for the provision of Air Traffic Services within an airspace, known as, the Piarco Flight Information Region (FIR), of some seven hundred and fifty thousand (750,000) square miles that includes the airspace over the entire group of Eastern Caribbean islands from north of Antigua to south of Trinidad and stretching eastward to halfway across the Atlantic. The Trinidad and Tobago Civil Aviation Authority provides services within this FIR on behalf of the Government of the Republic of Trinidad and Tobago (GORTT).

The GORTT through the TTCAA has taken significant operational steps over the last five (5) years to assist the airlines traversing the Piarco FIR with new and modern air navigation equipment, implementation of Performance Based Navigation and with Air Traffic Control being fully procedural with the installation of a new radar. All these will assist the airlines in their efforts to reduce fuel and emissions.

2.0 Performance Based Navigation (PBN)

Flight planning supported by PBN is utilized to reduce fuel consumption. PBN is area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace. It is comprised of Area Navigation (RNAV) and Required Navigation Performance (RNP).

Table 1 refers to the PBN ENR route structure and Action Plan for the Piarco FIR for which all airlines currently have access. The information shows data for Caribbean Airlines Limited (CAL) and LIAT (1974) Limited in particular and reflects some of the current destinations flown and the available RNAV routes in the Piarco FIR for these flights.

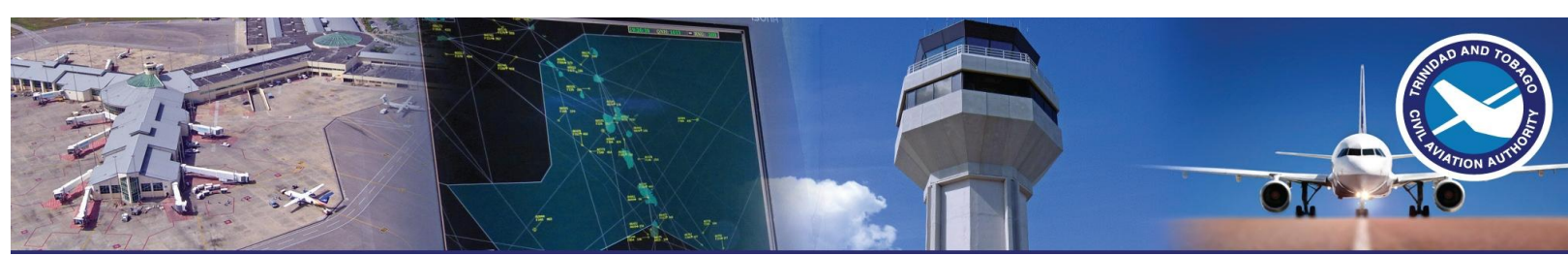
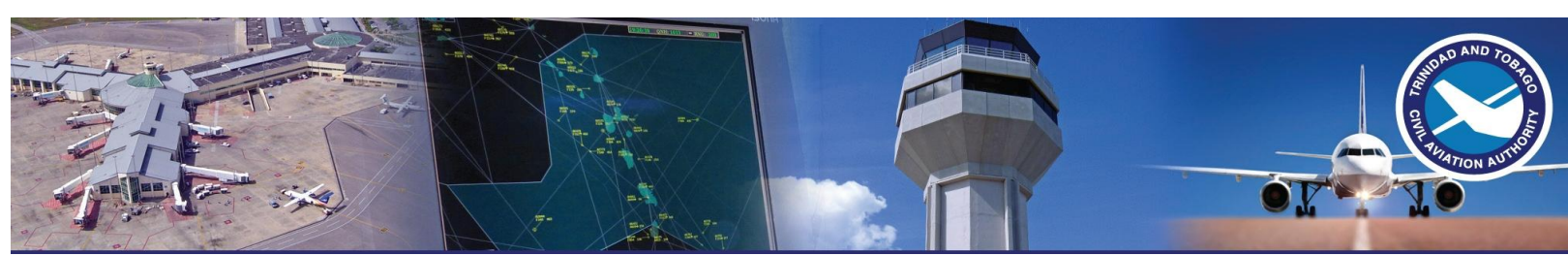


TABLE 1 - PBN Requirements

<i>Area of Application</i>	<i>Navigation Specification</i>	<i>Navigation Accuracy (NM)</i>	<i>Requirement onboard monitoring and alerting</i>	<i>Radio-Navigation Sensors</i>
Oceanic /Remote	RNAV 10 / (RNP 10)	10	No	GNSS / INS-IRU
	RNP 4	4	Yes	GNSS
En route Continental	RNAV 5	5	No	GNSS / INS-IRU / DME-DME / DME-DME-IRU / DME-VOR
En route Continental and Terminal	RNAV 2	2	No	GNSS / DME-DME / DME-DME-IRU
	RNP 2 (TBD)	2	Yes	GNSS
Terminal	RNAV 1	1	No	GNSS / DME-DME / DME-DME-IRU
	Basic RNP 1	1	Yes	GNSS
Approach	RNP APCH	0.3	Yes	GNSS
	RNP AR	0.3-0.1	Yes	GNSS

- **PBN Milestones within Piarco’s Airspace - En-Route Oceanic Airspace:** Three (3) established RNAV routes east of 57°W (UL435, UL695 and UL375).
- **En-Route Continental:** Three (3) established RNAV routes west of 57°W (UL337, UL776 and UL205).
- **Approaches** - Established RNAV (GNSS) approaches for Piarco, ANR Robinson and Maurice Bishop International Airports.



- Example of a present RNAV route which facilitates reduced mileage and reduced fuel emissions.

Conventional

- vs -

RNAV Flight Paths

POS – ANU A324-A312

POS – ANU UL205



Distance from POS – ANU via the conventional route = 418nm

Distance from POS – ANU via the RNAV flight path = 398nm

DIFFERENCE = 20nm

This represents savings in time and fuel for the airlines and ultimately reducing fuel emissions. Both Caribbean Airlines and LIAT presently utilise this route.

- **Example of Fuel Savings and Fuel Emission Reduction of a Caribbean Airlines Flight:**
Fuel burn for the B737 is approximately **5.3 kg per nm** (as given by Caribbean Airlines)



Distance from POS – ANU via conventional route (A324) = 418nm
 Distance from POS – ANU via RNAV flight path (UL205) = 398nm
DIFFERENCE = 20nm

Distance from POS – MIA via conventional route (UG449...) = 1525nm
 Distance from POS – MIA via RNAV flight path (UL337) = 1492nm
DIFFERENCE = 33nm

ATS vs RNAV Routes	ATS Route length nm	RNAV Route NM	Old Fuel Consumption KG	New Fuel Consumption KG	Fuel Savings KG	Fuel Savings (%)	CO ₂ Reduction in KG
A324/A312 vs UL205	418	398	2215.4	2109.4	106	5	333.9
UG449 vs UL337	1525	1492	8082	7907.6	174.9	2	550.9

NOTE:

Caribbean Airlines indicated that the UL 337 is not frequently used. While there is a small fuel saving, the enroute charges on this route far outweigh the fuel savings. Apart from Piarco, San Juan and Miami airspace, CAL indicated that they also transit Maiquetia, Santa Domingo and Haiti. These three (3) regions impose large overfly fees and as a result the UL 337 is not used often.

3.0 Statistical Data

The following information is based on statistical data collected monthly from the Piarco FIR flight planning/billing database. By end of 2012, the data will be sourced from the new radar system for flights through the Piarco FIR.

The available RNAV routings for Caribbean Airlines and LIAT are based on their destinations and the number of flights according to filed flights flown for the period to those destinations that can access these RNAV routes.



The projected reduced distances within the FIR, fuel burn, time, and therefore carbon emissions, are based on the availability of RNAV routes.

Table 2, 3 and 4 represents data received from Caribbean Airlines operating from within the Piarco FIR.

Table 5 represents the destinations for LIAT flights for which there are available RNAV routes in the Piarco FIR.

Table 2 – Caribbean Airlines, 2010

Number of Caribbean Airlines flights able to access RNAV routes in the PIARCO FIR

CARIBBEAN AIRLINES FLIGHTS - 2010 for destinations where RNAV routes in the PIARCO FIR are available													
ROUTE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FLTS
KMIA	70	67	71	71	70	68	84	76	71	77	70	82	877
KJFK	196	233	176	172	175	171	262	257	208	205	187	222	2464
KFLL	62	56	62	59	61	61	61	57	59	64	59	62	723
KMCO													0
CYYZ	132	115	124	119	122	119	152	144	99	96	93	124	1439
TAPA	0	0	0	0	0	0	0	0	2	0	0	13	15
TNCM	0	1	0	0	0	1	0	0	0	2	0	0	4
MKJP	0	0	0	0	0	0	0	0	1	0	0	1	2
												TOTAL FLTS FOR 2010=	5524

Table 3 – Caribbean Airlines, 2011

Number of Caribbean Airlines flights able to access RNAV routes in the PIARCO FIR

CARIBBEAN AIRLINES FLIGHTS - 2011 for destinations where RNAV routes in the PIARCO FIR are available													
ROUTE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FLTS
KMIA	74	65	79	70	72	70	76	75	88	78	81	86	914
KJFK	198	167	198	180	180	181	254	271	199	184	180	209	2401
KFLL	57	50	54	50	54	52	63	62	52	52	52	58	656
KMCO							17	19	2			4	42
CYYZ	115	103	113	99	95	94	151	74	92	98	92	121	1247
TAPA	37	34	38	35	38	38	34	36	26	18	16	17	367
TNCM	13	16	17	19	17	16	18	17	15	18	20	19	205
MKJP			7	4	13	18	22	25	37	22	24	28	200
												TOTAL FLTS FOR 2011=	6032

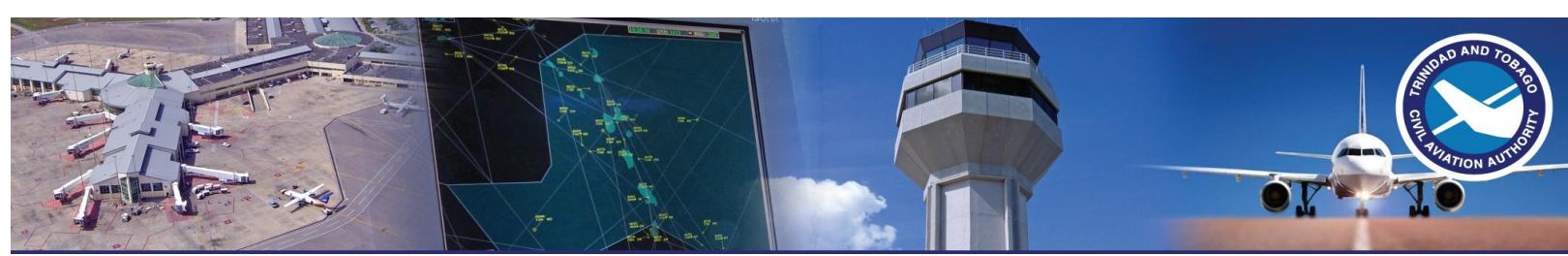


Table 4 – Caribbean Airlines, 2012 (Jan – May)

Number of Caribbean Airlines flights able to access RNAV routes in the PIARCO FIR

CARIBBEAN AIRLINES FLIGHTS - 2012 for destinations where RNAV routes in the PIARCO FIR are available													
ROUTE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FLTS
KMIA	83	80	85	75	82								405
KJFK	207	195	161	177	158								898
KFLL	62	58	64	60	62								306
KMCO	2	4	4	8	8								26
CYYZ	109	104	101	107	96								517
TAPA	18	19	22	19	16								94
TNCM	15	18	18	16	7								74
MKJP	21	25	23	20	21								110
												TOTAL FLTS FOR 2012:	2430

- UL337 and UL205 are available to CAL for these destinations.
- UL205 or POS DCT ANU is available to LIAT and is used for traffic between Trinidad and Antigua.

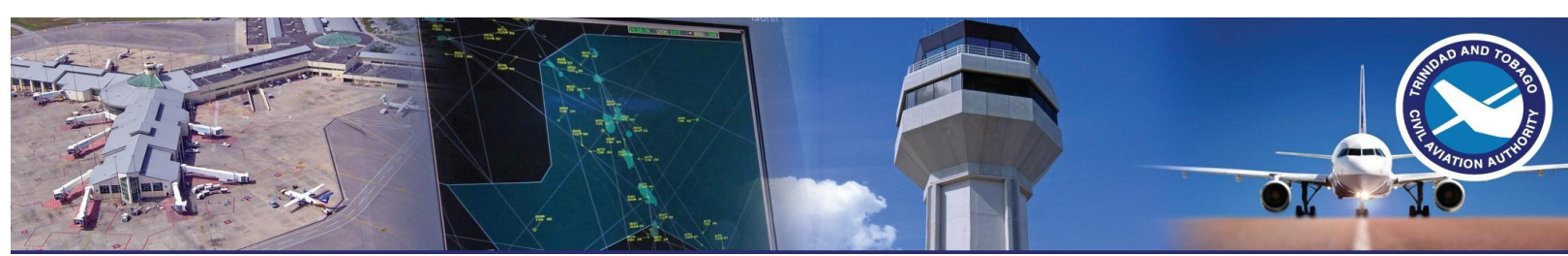
Table 5 – LIAT 2010 to 2012 (Jan – May)

Number of LIAT flights able to access RNAV routes in the PIARCO FIR

2010													
ROUTE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FLTS
TAPA	0	0	5	6	6	3	64	73	16	9	4	2	188

2011													
ROUTE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FLTS
TAPA	3	8	10	7	3	3	59	89	29	5	6	5	227

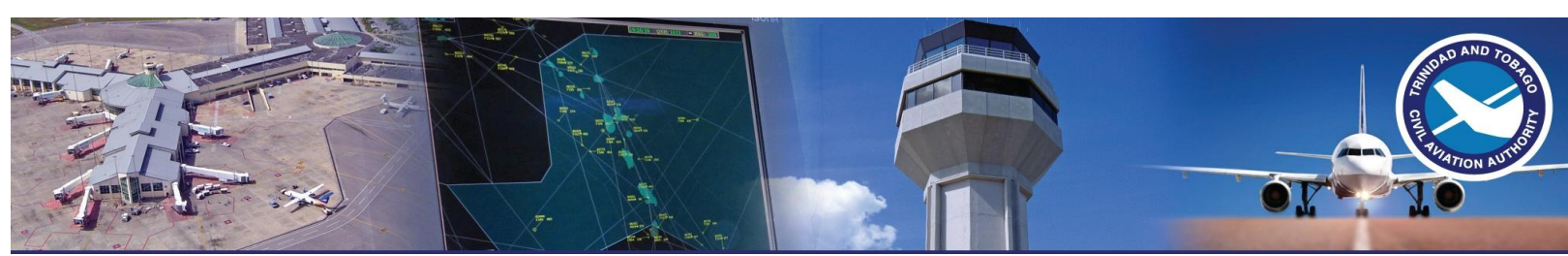
2012													
ROUTE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL FLTS
TAPA	10	6	9	9	1	1							36



4.0 Other Operational Initiatives

Other developments and initiatives within the Piarco FIR which would lead to fuel efficiency and reductions in fuel emissions:-

- Established RNAV (GNSS) and ILS approaches available for Piarco, ANR Robinson and Maurice Bishop International Airports. These RNP/RNAV procedures planned are aimed at efficiency to achieve reduced CO₂ emissions.
- In 2010, Air Traffic Control was completely procedural. In 2011, the TTCAA installed a new Radar which allowed for Radar services to commenced for the northern sector of the Piarco FIR West of 55W. This has led to reduced required spacing and reduction in CO₂ emissions.
- Implementation of ADS-C and CPDLC in the near future.
- Reduction of the separation in the EOS to 50nm with the implementation of the above.
- Realignment of the AERO/APP airspace.
- Realignment of the route structure in the long term.
- On going Radar training for all Air Traffic Controllers (ATCs). Full Radar Services in the Piarco FIR West of 57W has commenced which facilitates less restrictions and holding resulting in reduced fuel burn and reductions in CO₂ emissions.



5.0 Measures by the Major Airlines in the Piarco FIR

- **Caribbean Airlines Limited**

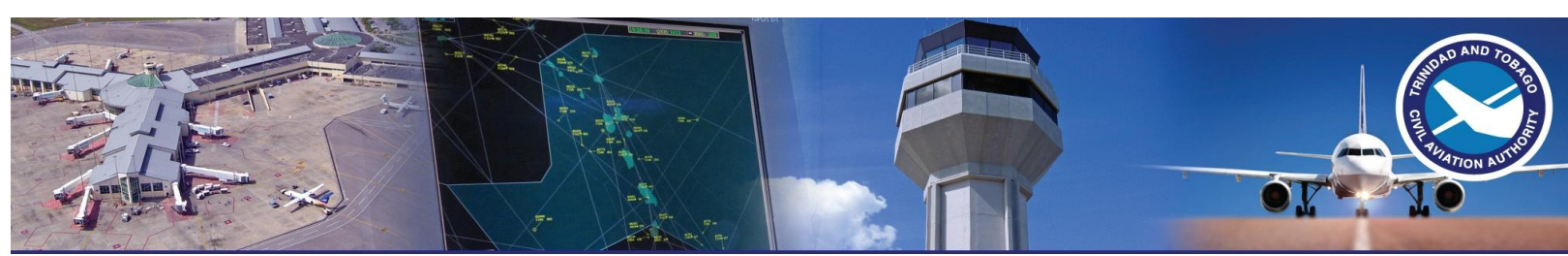
Caribbean Airlines is the national airline of the State of Trinidad and Tobago. The airline is committed to operating efficiently and environmentally-friendly and subscribes to carbon offsetting practices. One of airline's biggest projects to reduce carbon emissions was investing in wing tips for its entire Boeing 737-800 fleet. That project alone decreased its CO₂ emissions by up to 3,825 tonnes in 2008.

To offset the amount of CO₂ that CAL must produce, it continues to look for ways to support projects outside of its business that reduces CO₂. Basically, for every one tonne of CO₂ generated, they aim to invest in a project to save an equivalent one tonne of CO₂ through a project somewhere else such as like planting trees or swapping kerosene in remote areas of India for 'solar panels. Caribbean Airlines partners with The CarbonNeutral Company® in this effort.

The airline has formulated a Fuel Management Committee which has implemented several initiatives and which has been tasked with providing a plan for future initiatives. These initiatives include:

Extended Range with Twin-engines aircraft Operations (ETOPS) – Caribbean Airlines has acquired two (2) B767 aircraft which have been certified with ETOPS capability of 120 minutes. The ETOPS concept aims to settle and support the operations of twin-engine aircraft on long distances. It allows twins on routes containing points further than 60 minutes flying time from an adequate landing airport. When required to fly over water or deserted areas, ETOPS allows the airline more direct routes resulting in reduced fuel usage and gas emissions.

Wind Forecasting - Winds have a significant influence on fuel consumption and it is value to consider this meteorological effect in a fuel saving policy. The wind speed can vary with altitudes. Wind forecasting is presently used by CAL to reduce flight times which assist the airline in their efforts to reduce fuel burn and emissions. However, it varies based on the weight of the aircraft. An example of this is when the aircraft flies from POS/YYZ it saves **approximately** 15 minutes of flight time reducing emissions as follows:



Type of Aircraft	Normal time for flight	New Time based on Wind	Time Saved	Old Fuel Consumption Kg	New Fuel Consumption Kg	Fuel Savings Kg	Fuel Savings (%)	CO ₂ Reduction in Kg (per flight)
B737	POS/YYZ 5 hours	4 hrs 45 mins	15 mins	250	237.5	12.5	5	39.375
B767	POS/YYZ 5 hours	4 hrs 45 mins	15 mins	425	404.5	20.5	5	64.575

Additionally, the airline uses jet stream from POS/LGW to reduce flight times which as well leads to reduction in fuel burn and emissions.

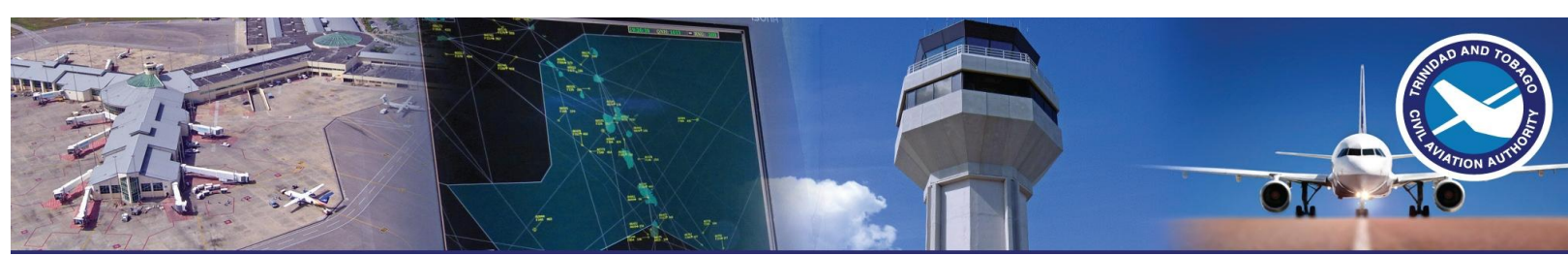
Cruise Performance Monitoring - In order to avoid unnecessary fuel weight, the airline has implemented systems to ensure that flights are planned very precisely to calculate the exact fuel quantity to be embarked.

The airline has instituted a program of polishing the aircraft when the necessary checks are due to maintain good aerodynamics. This reduces the drag increment and improves the aircraft performance which assists in reducing fuel and gas emissions.

Flight Management - Caribbean Airlines has minimal delays for taxing, i.e. their average time is five (5) minutes. At other busy stations such as JFK, Flight Operations will plan departure times to allow for periods with the least amount of traffic. This is tied into their overall plan for reducing fuel, emissions and to decrease flight times.

In January 2012, the airline introduced Cost Index Flight Planning on its B737 fleet (cost index 20) which all ties into contributed to fuel savings and gas emissions.

Taxing procedures at Landing – Flight Crew Operating Manual (FCOM) procedures require not less than a defined time before shutting down the engine after landing.



Caribbean Airlines is exploring this measure at international stations with long taxi lines. Once the runway is cleared, engine 1 will be feathered, and that once the appropriate cooling time has expired, it will be shut down, even if the parking stand has not been reached.

Departures - Caribbean Airlines presently use reduced thrust take-off which is cost savings through increased engine life and which reduces overhaul costs as well as include fuel savings. It may also be possible to increase the maximum take-off weight for a specific runway by using a reduced thrust profile.

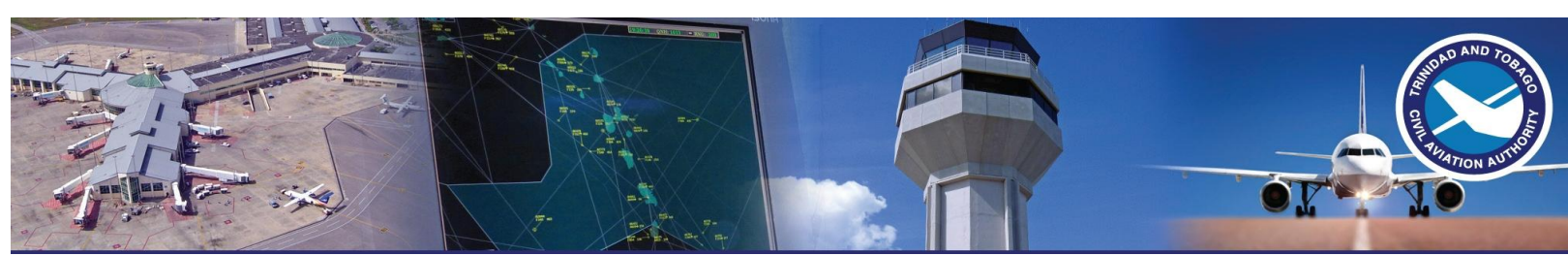
Fuel Reserves - In order to avoid unnecessary fuel weight, the airline plans its flights precisely to calculate the exact fuel quantity to be embarked. This is based on the aircraft performance monitoring by taking into account performance factors derived from specific range variations.

The fuel reserves will be based on a policy that aims at obtaining the minimum values required within the regulations, a fuel saving can be especially achieved on the contingency of fuel reserves.

Caribbean Airlines plans and chooses alternate airports that are as near as possible to the destination. These are dependent on the meteorological conditions and the suitability of the airport. The airline uses a minimum holding fuel of ten (10) minutes for destinations in the Caribbean and twenty (20) minutes for airports in the USA.

Weight Management – The airline is making efforts to reduce weight by taking on board less manuals and lighter catering equipment. This was implemented in 2011 and continues to date.

Investments: Wing Tips, New Fleet – The airline has invested in wing tips for its fleet and has also upgraded its fleet from Dash 8s to new ATRs which are more fuel efficient.



Performance Incentives for pilots are tied into the airline’s Fuel Management Plan. Incentives such as bonuses are paid if the actual fuel burn for the year is reduced by 2%.

- **LIAT (1974) LIMITED**

LIAT is one of the leading Caribbean airlines. It is owned by regional shareholders, with major shareholders being the Governments of Barbados, Antigua & Barbuda and St. Vincent & the Grenadines.

The airline operates a Dash 8 fleet of aircraft within the Caribbean and the Piarco FIR.

LIAT is presently formulating a plan through its Fuel Management Committee to assist the airline in its efforts to reduce greenhouse gas emissions. LIAT operated 46,540 flights in 2010 and 43,163 flights in 2011.

In 2011 LIAT’s total flight were reduced by 3377 which accounted for reduction in fuel consumption. Steady increase in fuel cost in 2011 represents a 24% increase on its total fuel cost (12,431,592) and its fuel index for 2012 stands at \$4.08.

Total fuel consumption:

Comparison of Fuel Savings for Liat (1974) Limited using 2010 as baseline

Type of Aircraft	Old Fuel Consumption (Kg) in 2010 (Baseline)	New Fuel Consumption (Kg) in 2011	Fuel Savings (Kg) 2011	Fuel Savings (%)	CO ₂ Reduction (Kg) in 2011
Dash 8	28,452,059.80	24,289,954.10	4,162,105.7	15	13,110,632.96



Projections - In 2012, Liat projected a 3% saving on fuel as a result of implementation of reduced power, take-off and landing. Liat now uses a lower RPM of 900 for landing as opposed to their normal full throttle 1200 RPM resulting in 150,000 pounds of fuel saved per flight.

The airline have identified three (3) major advantages of reduce power, take-off and landing.

- i. Lower maintenance cost
- ii. Lower fuel consumption
- iii. Comfortable cabins for passengers

The airline is committed to reducing its fuel consumption by 3% in the last quarter of 2012, by reviewing operating and maintenance procedures and policies. The plans and policies are in the discussion stage.

LIAT has projected a 3% saving in 2013 of 8.85Mt of fuel based on existing measures and new measures to be implemented.

Measures

1. In July 2012, LIAT received approval from the respective Governments to renegotiate its fleet to replace the existing DASH 8s with more fuel efficient ATRs.
2. LIAT uses an Automated Flight Information Reporting System (AFIRS) which is an on board satellite based aircraft management system that automatically reports critical flight data to ground based operations. This allows LIAT to monitor whether pilots exceed parameters which ultimately leads to greater fuel burn.
3. LIAT recently implemented an Airframe Maintenance Programme to reduce drag and increase efficiency.
4. To reduce cost, LIAT will be conducting more intersection departures.



6.0 Regulatory Measures by the State

The GORTT is committed to reducing aviation greenhouse gas emissions and will make policies, standards and procedures in the form of Regulations that will supplement or support efforts on technology, operations and fuel to achieve the carbon neutral growth goal. These Regulations will also support ICAO Annex 16 on Environmental Protection.

The Regulations will also require airlines to have transparent carbon reporting systems in place as well as to ensure that the data is collected and submitted to the Reuglator.

7.0 Assistance Required

- The GORTT is challenged with airlines in the Piarco FIR not keeping accurate data of fuel consumption. Assistance will be required to guide or direct the airlines in what types of software are available for collecting fuel data and transforming this data into the format required by ICAO.
- Training seminars and awareness programmes are needed in the region on the importance of fuel management for all stakeholders i.e. airlines, ground handlers, fuel companies. Each individual must understand how they can make an impact on the environment while carrying out their responsibilities.
- Presently, the airlines do not have a plan to use alternative fuels. In this regard, assistance will be needed to develop a plan to assist the airlines in exploring the use of alternative fuels.