REPORT

New International Airport of Cabinda (NAIC Project) - Angola

Environmental and Social Impact Assessment - Chapter 14 - GHGs emission calculation

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Table of Contents

TABLES

14.0 CLIMATE CHANGE INTRODUCTION

This chapter is the estimated Green House Gases (GHGs) emissions calculation for the Project in response to the OECD requirements.

Climate change is one of the most pressing global challenges of our time, with far-reaching implications for ecosystems, human societies, and economies. It refers to the long-term alteration of Earth's climate patterns, driven primarily by the increase in GHG concentrations in the atmosphere. These gases trap heat in the atmosphere, creating a greenhouse effect that warms the planet. As human activities have intensified over the past century, so have the emissions of GHGs, resulting in significant changes to the Earth's climate system.

The aviation industry, including airports, plays a critical role in contributing to GHG emissions. Scientific studies currently attribute around 5% of the current anthropogenic climate change to global aviation industry, and this number is expected to increase since aviation passenger transport are expected to grow[1]. Greenhouse gases released from various airport operations, such as aircraft movements, ground transportation, and energy consumption, contribute to the sector's carbon footprint. The primary GHGs associated with aviation include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HFCs).

14.1 Legal Framework

GHGs inventory and a GHG assessment of the Project has been conducted as part of the Impact Assessment, to identify the potential impacts of the Project on the climate, for both the construction and the operation phases. This task has been included in the impact assessment, line with the OECD Common Approaches (CAs) and the Equator Principles IV requirements.

14.1.1 OECD Common Approaches

The OECD Common Approaches require that Members and non-Members adhering to the OECD recommendation (defined as “Adherents”) recognise the responsibility to implement the commitments undertaken by the Parties to the United Nations Framework Convention on climate change. Adherents are required to “*report the estimated annual GHG emissions from projects whose emissions are projected to be in excess of 25,000 tonnes CO_2-equivalent annually and where the applicant or project sponsor has provided the Adherents with the necessary information, e.g. via the ESIA report (this report)*”[2].

14.1.2 EP4 requirements

The Equator Principles[3] (EP) define a financial industry benchmark for determining, assessing, and managing environmental and social risk in projects. The EP support the objectives of the 2015 Paris Agreement and encourage financial institutions to improve the availability of climate-related information, such as the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) when assessing the potential transition and physical risks of projects.

The fourth edition of Equator Principle (EPIV, July 2020) states that the client should quantify Scope 1 and Scope 2 GHG Emissions. GHG emissions should be calculated in line with the GHG Protocol to allow for aggregation and comparability across Projects, organisations and jurisdictions. Practitioners may use other reporting methodologies if they are consistent with the GHG Protocol.

[1] Grewe, V., Gangoli Rao, A., Grönstedt, T. et al. *Evaluating the climate impact of aviation emission scenarios towards the Paris agreement including COVID-19 effects*. Nat Commun 12, 3841 (2021).

[2] OECD – Section VIII - Reporting and Monitoring of the Recommendation – para 43.

[3] https://equator-principles.com/

In addition, EPIV also require that the client will report publicly, on an annual basis, GHG emission levels (combined Scope 1 and Scope 2 Emissions, and, if appropriate, the GHG efficiency ratio) during the operational phase for projects emitting over 100,000 tonnes of CO_2 equivalent annually.

14.1.3 Angola legislation

- Angola has been committed to implementing measures and programs to stabilize the national GHG emission rate since May 2000, when it ratified the United Nations Framework Convention on Climate Change (UNFCCC). Angola reaffirmed its commitment in 2007, by ratifying the Kyoto Protocol and receiving the approval for its first strategy for climate change[4]. In 2015, Angola determined its intended contribution to the UNFCCC[5], which has been revised in 2021, setting the target of an **unconditional reduction of its GHG emissions by 15% by 2025** compared to the base year 2015, and an additional reduction of 10% with international financing. Additionally, Angola set the unconditional target of a 21% emission reduction by 2030. It is expected that through a conditional mitigation scenario the country could reduce an additional 15% reduction by 2030.

- In response to the Paris Agreement and in line with the Sustainable Development Goals of Agenda 2030, Angola has defined its **National Strategy for Climate Change 2020-2035**[6]. This national policy is structured to cover both mitigation and adaptation measures to the effects of climate change. These include targets for the transition to a low-carbon economy, the improvement of the energy efficiency in buildings, and a proposal for an electricity regulation that encourages investment in renewable energy.

14.1.4 Specific standards and guidelines for GHG emissions calculation

The GHG emissions estimation methods used in this assessment are in line with the major requirements of internationally accepted practices, namely:

- **GHG Protocol Corporate Accounting and Reporting standard** by the World Business Council for Sustainable Development/World Resources (April 2004)**:** It includes a **Scope 2 Guidance**, which allows companies to credibly measure and report emissions from purchased or acquired electricity, steam, heat, and cooling.

- **GHG Protocol Corporate Value Chain (Scope 3) Standard:** The Standard presents a method for organizations to account for indirect GHG emissions, from 15 categories of Scope 3 activities, both upstream and downstream of their operations. The Scope 3 framework also includes a **Scope 3 Calculation Guidance**.

- **IEMA Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance**: The guide is developed by the Institute of Environmental Management & Assessment to assist practitioners with addressing GHG emissions assessment and mitigation in statutory and non-statutory Environmental Impact Assessment.

- **AIC Airport Greenhouse Gas Emissions Management Guidance Manual**: Air Carbon Accreditation (AIC) is an institutionally-endorsed, carbon management certification standard for airports. This manual provides guidance for airport operators to account and manage GHG emissions.

[4] *Estratégia Nacional de Implementação da Convenção-Quadro das Nações Unidas sobre as Alterações Climáticas e do Protocolo de Kyoto*, Ministério do Urbanismo e Ambiente, 2007

[5] *Intended Nationally Determined Contribution (INDC) of the Republic of Angola*, November 2015

[6] *Estratégia Nacional para as Alterações Climaticas*, August 2017

14.2 Operation Phase emissions

14.2.1 Goal and Scope

This GHG Inventory is an assessment of the operational GHG emissions of NAIC project, during an average operational year.

In line with the ESIA study, the GHG Inventory has considered two different time frames for the estimation of GHG emissions. The first estimation corresponds to the average year during Phase 1 of the airport's operations, until 2032. The second estimation reflects the average year in Phase 2, after the projected airport expansion, until 2050.

The GHG assessment covers the accounting and reporting of seven greenhouse gases covered by the Kyoto Protocol – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PCFs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). Following the GHG Protocol definition of direct and indirect emissions and scopes, GHG emissions are accounted for under three broad categories, as follows:

- **Scope 1 – Direct GHG emissions**: GHG emissions occurring from sources that are owned or controlled by the airport (e.g., emissions from combustion in owned or controlled boilers, furnaces and vehicles, process, and fugitive emissions).
- **Scope 2 – Indirect GHG emissions**: GHG emissions from the generation of purchased electricity, heat or steam consumed by the airport.
- **Scope 3 – Other indirect GHG emissions**: GHG emissions which are a consequence of a company's activity but occur from sources not financially or operationally controlled by the company (e.g., aircraft ground movements, waste treatment, and employee travel to and from work).

In order to identify the sources of emissions and determine whether they could be relevant to the assessment, we followed the AIC Manual's list of minimum requirements for calculating carbon footprints.

14.2.2 Methods

This GHG calculation adopts the **Operational control approach**. This means that we accounted for those GHG emissions from operations over which the airport has control. This comprehensive approach allows to consider emissions arising from airport activities that may not be directly owned by the airport but are still associated with its operations and that would not be generated otherwise.

To estimate the expected annual contribution of each selected GHG source, we multiplied the available project data (activity data) by an emission factor. The results are given in tCO_2e (tons of carbon dioxide equivalent). CO_{2e} is a metric measure used to compare the emissions from various greenhouse gases based on their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide.

The **activity data** were collected as specific to the Project (primary) whenever available, and if not, literature data (secondary) were used. The elaboration of the collected data and all the assumptions made are explained for each item in the following paragraphs.

For the calculation of the impacts, unless otherwise specified, we selected **emission factors** from the EcoInvent database and used the Simapro software. The selected emission factors represent average values for the global market and are in line with the latest IPCC (International Panel on Climate Change) AR6 report from 2021, referring to Global Warming Potential factors - 100 years.

14.2.3 Activity data and assumptions

14.2.3.1 Scope 1

14.2.3.1.1 Power generation

GHG emissions related to power generation are associated to diesel combustion for the backup generators. Since an estimate of the annual usage of the backup generators is not yet available, it is assumed that they are used to generate electricity for the entire airport one day per week. This corresponds to approximately 14% of the airport's expected annual electricity consumption (see Section 14.2.3.2.1) and it is equal to 6.289 MWh, corresponding to a diesel consumption estimated with the EcoInvent dataset on the basis of a global average.

14.2.3.1.2 Ground Support Equipment

Ground Support Equipment (GSE) comprises vehicles and machinery used at airports to provide essential services, such as baggage handling, aircraft towing, and maintenance whose GHG emissions are associated to fuel combustion.

Data available included the expected number and type of GSE vehicles, which is 75 for Phase 1 and 112 for Phase 2. To estimate the total operations of the GSE in a year, we used literature parameters such as engine power, load factor, and estimated operating time for each GSE vehicle, derived from the ICAO Doc. 9889 "Airport Air Quality Manual." Literature data has been integrated as follows:

- As a conservative estimate, if there was a range of load factor and operating time parameters, the highest value has been used in the calculation.
- As a conservative estimate, if more than one type of fuel is specified, we have assumed that the fuel is diesel.
- Since it is not known what proportion of flights are expected to be passenger or cargo, the operating time parameter has been divided by two if an item applies only to passenger flights or only to cargo flights.
- When the operating time parameter was not indicated, "10 minutes" has been used in the calculation because it is the most frequent value.

Data used to calculate the average fuel consumption per piece of equipment is presented in Table 1. Afterwards, the estimated fuel consumption per piece of equipment is summed and multiplied by the expected number of flights, to calculate the expected overall GSE fuel consumption per year.

Table 1 : GSE Equipment parameters derived from ICAO 9889, Table 3-A2-1

Item	Function	Engine type/ equipment	Load factor	Service time per turn (min)	Pieces in Phase 1	Pieces in Phase 2
Catering Truck	Restocks food and supplies	85–130 kW diesel with scissors lift	20%	10	3	5
Cabin Cleaning	Cleans	85–130 kW diesel	20%	10	2.5	3.5
Lavatory Vehicle	Empties aircraft toilet storage	120 kW diesel with tank and pumps	25%	5	3	5
Potable Water	Refills aircraft water storage	120 kW diesel with tank and pumps	25%	5	3	5

Item	Function	Engine type/ equipment	Load factor	Service time per turn (min)	Pieces in Phase 1	Pieces in Phase 2
Loaders	Lifts and carries heavy objects	30–100 kW diesel	25%	10	6	10
Main deck loader	Lifts heavy cargo and containers to assist transfer	60 kW diesel or gasoline with lift devices	25%	10	5	7
Conveyor Belts	Transfers bags between carts and aircraft	33 kW diesel, gasoline or CNG (Compressed Natural Gas)	25%	5	2.5	3.5
Tow Tug Tractor	Pushback and maintenance towing	400 kW diesel	25%	10	2.5	3.5
Air Conditioning Unit	Provides preconditioned air and/or heat to aircraft	150 kW diesel or gasoline	50%	15	2.5	3.5
Ground Power Unit	Provides electrical power to aircraft	100–150 kW diesel or gasoline	40%	15	2.5	3.5
Pax. Busses	Transports passengers to and from aircraft	100 kW diesel, CNG or gasoline	25%	5	6	10
Pax. Stairs	Provides easy ramp access	30–65 kW diesel or gasoline	25%	5	3	5
Cargo Cart	Transfers cargo from dollies to loader	30 kW diesel or gasoline with lift devices	25%	25	3	5
Hydrant Dispenser	Delivers fuel from pits to aircraft	70–110 kW diesel with pumps	40%	40	3	5
Maintenance	Lift that provides access to outside of aircraft	70–120 kW diesel, CNG or gasoline	25%	10	2.5	3.5
Operations	Miscellaneous services	50–150 kW diesel, CNG or gasoline	20%	10	2.5	3.5
Baggage Dolly Trains	Tows loaded carts to exchange baggage	30 kW diesel, CNG or gasoline	50%	25	18	30

14.2.3.1.3 Vehicle Fleet

GHG emissions associated with the airport fleet of vehicles are generated from fuel combustion. The GHG assessment from vehicles was based on the number of vehicles per hour mobilized in the airport and secondary data sources and assumptions made for distance, load capacity, and operational patterns. Three vehicle types were considered in the assessment:

- **Cars**: the vehicles per hour data was multiplied by 8 hours (representing an average working day) and 365 days. The distance of 31 km, representing the distance of the project site from Cabinda, was used to calculate the total distance covered by the cars during their operation.
- **Trucks**: similarly, the vehicles per hour data is multiplied by 8 hours and 365 days, and the distance of 31 km was considered, while an average load of 3.29 tons is assumed for each truck.
- **Buses**: the usage was forecasted from the expected demand of employees and passengers. For employees, 40% of the total number of airport employees working in 3 shifts, 365 days a year, has been considered, while for passengers, 11% of the forecasted arrivals and departures from the airport have been taken into account. The distance of 31 km was also used for buses.

14.2.3.1.4 Refrigerant losses

Refrigerant gases losses are accounted for in the GHG Inventory because they have a high global warming potential (GWP), which means that when leaked or released into the atmosphere due to system inefficiencies or maintenance practices, they can trap significantly more heat than an equivalent amount of carbon dioxide (CO_2).

To calculate the direct GHG emissions related to refrigerant gas losses, we started from the available project data of the cooling capacity of air conditioning (AC) and pre-conditioned air (PCA) systems. The specific refrigerants utilized are R-410a for AC and R-134a for PCA.

The cooling capacity provided in Tons of Refrigeration (TR) has been converted to kilograms using the coefficient 2.27 kg/TR. The total weight of gas for AC and PCA has then been multiplied by 2.5% to estimate the annual refrigerant leakage or refill. Finally, the amount of refrigerant losses is converted to CO_2e using the specific GWP of the gases.

14.2.3.2 Scope 2

14.2.3.2.1 Electricity

GHG emissions related to purchased electricity are those generated by its production outside the boundaries of the airport.

The **expected annual electricity consumption** of the airport (kWh) is not yet available. To estimate it, we converted the provided load in megavolt-amperes (MVA) to kilowatts (kW) and then multiplied it by the number of hours in a year. Based on the given estimated load of the airport facilities (5.49 MVA) and assuming a power factor[7] of 0.9, the estimated annual electricity consumption of the airport would be approximately 44,024 MWh.

This is a conservative estimation based on the assumption that every facility in the airport would be in use every hour of every day. The actual electricity consumption may vary based on factors such as operational hours, seasonal variations and energy efficiency measures implemented at the airport.

Since it has been assumed that part of the electricity will be produced by the airport's emergency generators (see par. 14.2.3.1.1), it has been estimated that the electricity purchased from the grid will be 37,735 MWh, equal to 86% of expected annual consumption.

[7] The power factor is a dimensionless number that represents the ratio of real power (kW) to apparent power (kVA) in an electrical system. For most commercial and industrial facilities, the power factor is typically around 0.85 to 0.95. For the sake of this estimation, we assumed a power factor of 0.9.

The electricity will be supplied by the Malembo Thermal Power Station, which is located adjacent to the NAIC, through a dedicated supply cable infrastructure of about 4.5 km. This is a 95 MW gas fired power plant owned by PRODEL, supplied with fuel gas from the Malongo oil field.

The plant has two turbines and dual system (diesel and gas). Diesel consumption is only foreseen for exceptional cases, such as gas shortages. Because its use could not be estimated, emissions related to the combustion of diesel for electricity production is not attributed to the airport.

14.2.3.3 Scope 3

14.2.3.3.1 Aircraft LTO Cycle

GHG emissions are generated during the Landing and Take-off (LTO) cycle of flights due to fuel combustion in aircraft engines. In this assessment, they have been estimated based on the expected number of jets flights, classified as:

- Code E aircraft includes B777 and B787 jets, which have two jet engines. The expected average number of flights per year for Code E jets in Phase 1 is 72, and in Phase 2, it is 326.
- Code C aircraft include B737-8Max and A220, which also have two jet engines, and the Q400, equipped with two turboprop engines. The expected average number of flights per year for Code C jets is 5542 in Phase 1 and 8193 in Phase 2.

To calculate GHG emissions, secondary data sources were utilized. Fuel type and LTO fuel consumption data specific for every engine type was obtained from the ICAO EBD emission databank.

All data used for the calculation are reported in Table 2. The following assumptions have been made:

- As a conservative estimate, we used the engine with the highest fuel burn when an aircraft can be equipped with more than one type of engine.
- Since it is not known how many aircrafts of a certain type are expected to arrive per year, fuel consumption and GHG emissions were calculated on the average of the aircraft category (class E or Class C).
- Since a forecast of helicopters' movement is not available at this stage, GHG emissions related to their LTO cycle are excluded from the current calculation.

Table 2 : Data used in the estimation of aircraft GHG emissions during the LTO cycle.

Jet type	Engine number	Engine classification	Engine type	LTO fuel consumption (kg)	GHG emissions per LTO cycle
B777	2	jets engines	General Electric GE90	2905	9.2
			General Electric GE9X	N.A.	N.A.
			Pratt & Whitney PW4000	1814	5.7
			Rolls-Royce Trent 800	2029	6.4
B787	2	jets engines	General Electric Genx	1684	5.3
			Rolls-Royce Trent 1000	N.A.	N.A.
Code E Average				2294	7.3
B737-8Max	2	jets engines	CFM International LEAP-1B	721	2.3

Jet type	Engine number	Engine classification	Engine type	LTO fuel consumption (kg)	GHG emissions per LTO cycle
A220	2	jets engines	Pratt & Whitney PW1500G	544	1.7
Q400	2	turboprop engines	PW150	N.A.	N.A.
Code C Average				633	2.0

14.2.3.3.2 On airport aircraft fuel consumption

GHG emissions are generated during the ground movements of aircraft, engine run-up and aircraft Auxiliary Power Units (APU), due to fuel combustion in aircraft engines (both primary and auxiliary). For the purpose of this report, they are estimated based on the expected number of jets flights, classified as exposed before.

To calculate GHG emissions, secondary data sources are utilized. Fuel type and fuel consumption data for APU average use and engine starting are obtained from the ICAO EBD emission databank.

14.2.3.3.3 Staff commuting

GHG emissions related to airport employees commuting are generated through the fuel consumption, related to the use of personal vehicles (cars) for transportation. GHG emissions from the employees' use of public transport and company buses were not included in this section as they fall under Scope 1 emissions.

The available primary data were the forecasted annual number of employees and the percentage of employees using cars versus public transportation for their daily commute:

- Expected number of employees commuting by car: 328 in phase 1 and 812 in phase 2.
- Expected number of employees commuting by bus: 218 in phase 1 and 541 in phase 2.

The average commuting distance was assumed to be 31 km, which represents the distance from Cabinda, and which was assumed to be travelled twice a day, to take account of outward and return journeys. To estimate GHG emissions from employee commuting by cars, the estimated number of employees using cars was multiplied by the assumed average commuting distance of 31 km.

14.2.3.3.4 Third party vehicles

In the NAIC inventory, GHG emissions related to fuel combustion for transport by third parties refer to the use of private vehicles (cars) by air passengers to reach the airport. GHG emissions from the use of public transport, company buses, and freight vehicles were not included in this section as they fall under Scope 1 emissions.

The available primary data were the expected annual number of passengers and the percentage of them using owned or rented cars versus public transportation:

- Expected number of passengers arriving and departing from the airport by car (own, rented or taxi): 484,386 in phase 1 and 1,197,821 in phase 2.
- Expected number of passengers arriving and departing from the airport by bus: 61,811 in phase 1 and 155,538 in phase 2.
- The average driven distance was assumed to be 31 km, which represents the distance from Cabinda, and which was assumed to be travelled twice per passenger, to take account of outward and return journeys.

To estimate GHG emissions from third parties use of cars, the estimated number of employees using cars was multiplied by the assumed average commuting distance of 31 km.

14.2.3.3.5 Off- site waste treatment

GHG emissions related to the treatment of waste generated at the airport by third parties are associated to the combustion of fuel in the transportation of waste and the landfilling of unsorted waste. GHG emissions related to the recycling processes were excluded from this section according to the Polluter Pays Principle[8].

The available primary data used were the forecasted quantity of collected waste per day, as follows:

- 3,3 tonnes/day in Phase 1.
- 6,8 tonnes/day in Phase 2.

In line with conservative approach, we assumed that the same amount of waste is generated every day of the year. Thus, the expected quantity of collected waste was multiplied by 365.

It was assumed that all waste will be transported to the Cabinda waste treatment centre (approx. 60 km from the airport) and, in line with the objectives of the PESGRU (Strategic Plan for Urban Waste Management in Angola), between 30% and 45% of solid waste will be recovered, recycled, or valorised.

14.2.3.4 Exclusions

Here follows a list of excluded activities and the reasons for their exclusion.

Scope	GHG Source	Reason for exclusion
1	On-site waste management	At present, only a solid waste collection area is projected
1	Fire-fighting exercises	The impact is considered minor or irrelevant
1	Use of de-icing substances	The impact is considered minor or irrelevant
3	Passengers maritime surface access	At present, there is no deep-water port in Cabinda
3	Staff business travel	The impact is considered minor or irrelevant
3	Production and transportation of goods purchased by the airport	Accounting for these impacts is not requested by the Airport Carbon Accreditation program
3	Non-road construction vehicles and equipment	Construction emissions are calculated separately. Note that some other buildings are to be built for the second phase (Aircraft Maintenance Hangar, fuel Tanks)
3	Third parties use of de-icing substances and refrigerant losses	The impact is considered minor or irrelevant
3	Off-site processing of wastewater	We assumed that all wastewater is treated on site
3	Third parties GSE	The associated impacts are considered to be highly variable, and the uncertainty could not be quantified

[8] The “Polluter-Pays principle” (PPP) states that the waste producer is responsible for the environmental impacts of waste to be recycled until the point, in the product's life cycle, where waste is delivered to a storage or treatment plant. The waste consumer must bear the environmental impact of their treatment.

Scope	GHG Source	Reason for exclusion
3	LTO cycle of helicopters	The associated impacts are considered to be highly variable, and the uncertainty could not be quantified
3	Cruise, climb and descent of aircraft	Accounting for these impacts is considered voluntary by the Airport Carbon Accreditation program

14.3 Emission Factors

For the calculation of the impacts, activity data are multiplied by **emission factors**. From the EcoInvent database[9], factors are selected representing average values for the global market and in line with the latest IPCC (International Panel on Climate Change) AR6 report from 2021, referring to Global Warming Potential factors - 100 years.

The emission factor selected for aviation fuel (3.16 kg CO_2e per kg of fuel) is sourced from IATA[10] Recommended Practice on Aircraft CO_2 Calculation Methodology. The kg CO_2e per kg of fuel factor was combined with specific engine fuel consumption to derive the jet class-specific conversion factor.

Table 3 shows the selected emission factors.

Table 3 : Emission factors.

Item	GHG source	Emission Factor	EF UoM	EF Source
Scope 1: Direct GHG emissions and removals				
Power generation	Diesel backup generators	0.8290	tCO_2e/MWh	EcoInvent
Ground Support Equipment	Small diesel engine equipment	0.0002	tCO_2e/min	EcoInvent
	Medium diesel engine equipment	0.0004	tCO_2e/min	EcoInvent
	Large diesel engine equipment	0.0027	tCO_2e/min	EcoInvent
Vehicle fleet	Cars (private, taxi)	0.0004	tCO_2e/km	EcoInvent
	Buses (public & company bus)	0.0001	$tCO_2e/pax.km$	EcoInvent
	Goods vehicles	0.0005	tCO_2e/km	EcoInvent
Refrigerant losses	R 410-A	2.2555	tCO_2e/kg	IPCC AR6
	R 134-A	1.5260	tCO_2e/kg	IPCC AR6
Scope 2: Indirect GHG Emissions from imported energy				
Purchased electricity	Natural gas thermal station	0.3870	tCO_2e/MWh	EcoInvent

[9] https://ecoinvent.org/the-ecoinvent-database/

[10] International Air Transport Association (IATA) Recommended Practice RP 1726

Item	GHG source	Emission Factor	EF UoM	EF Source
Scope 3: Other indirect GHG Emissions				
Aircraft landing and take-off	Code C jets	7.2503	tCO_2e/LTO cycle	IATA+ICAO
	Code E jets	1.9994	tCO_2e/LTO cycle	IATA+ICAO
	Helicopters	0.1790	tCO_2e/LTO cycle	EcoInvent
On airport aircraft fuel consumption	Code C jets	0.9480	tCO_2e/turn	IATA+ICAO
	Code E jets	0.2528	tCO_2e/turn	IATA+ICAO
Staff commuting	Cars	0.0004	tCO_2e/km	EcoInvent
Third parties' vehicles	Cars	0.0004	tCO_2e/km	EcoInvent
Waste management	Waste collection service	0.0014	tCO_2e/t.km	EcoInvent
	Off-site waste treatment (landfill)	0.0543	tCO_2e/t	EcoInvent

14.4 Results

Table 4 shows the results of the calculations based on the data presented in the previous paragraphs. The results summarize the contribution of each source to the annual overall emissions in tonnes of CO_2e for the Project phases 1 and 2. For both the phases considered, the Project annual GHG emissions are not expected to exceed the threshold of 100,000 tCO_{2e}, that triggers different assessment and information disclosure requirements.

Table 4 : NAIC GHG Inventory.

	Phase 1		Phase 2	
Item	Total Emissions (tCO_2e)	Share	Total Emissions (tCO_2e)	Share
Scope 1: Direct GHG emissions and removals				
Power generation	5214	*10%*	5214	*6%*
Ground Support Equipment	2083	*4%*	4938	*6%*
Vehicle fleet - Cars (private, taxi)	2015	*4%*	3250	*4%*
Vehicle fleet - Buses (public & company bus)	527	*1%*	1316	*2%*
Vehicle fleet - Goods vehicles	88	*0%*	441	*0%*
Refrigerant losses	149	*0%*	149	*0%*
Scope 1 total	**10076**	***19%***	**15307**	***18%***
Scope 2: Indirect GHG Emissions from imported energy				
Purchased electricity	14603	*29%*	14603	*17%*
Scope 2 total	**14603**	***29%***	**14603**	***17%***
Scope 3: Other indirect GHG Emissions				

	Phase 1		Phase 2	
Item	Total Emissions (tCO_2e)	Share	Total Emissions (tCO_2e)	Share
Aircraft landing and take-off	11603	*23%*	18745	*22%*
On airport aircraft fuel consumption	1469	*3%*	2380	*3%*
Staff commuting (by car)	2661	*5%*	6595	*8%*
Third party vehicles (passenger departing and arriving by car)	10781	*21%*	26661	*32%*
Waste management (collection service)	100	*0%*	206	*0%*
Waste management (Off-site waste treatment)	39	*0%*	81	*0%*
Scope 3 total	**26654**	***52%***	**54668**	***65%***
Overall total	**51333**		**84578**	

Table 5 presents an overview of key performance indicators (KPIs) for the Project during its two operational phases. The KPIs relate the Project GHG emissions (tCO_2e) to the expected number of passengers and flights.

The data signifies a positive trend towards improved environmental performance for the airport between Phase 1 and Phase 2, with reduced emissions per passenger and flight, particularly in Scopes 1 and 2. The only exception is the increase in Scope 3 GHG emissions per flight, mainly due to the expected increase in the use of third-party vehicles by passengers and commuting employees.

Table 5 : Project Key Performance Indicators.

	Phase 1 (2032)		Phase 2 (2050)	
Item	CO_2e/passenger	tCO_2e/flight	CO_2e/passenger	tCO_2e/flight
Scope 1	0.02	1.80	0.01	1.80
Scope 2	0.03	2.60	0.01	1.70
Scope 1+2 total	**0.04**	**4.40**	**0.02**	**3.51**
Scope 3	0.05	4.75	0.04	6.42
Overall total	**0.09**	**9.15**	**0.06**	**9.93**

14.4.1 Considerations for a comparison to the previous Airport

NAIC project aims to replace the existing Airport of Cabinda, addressing its capacity and safety limitations. The prospective airport is strategically positioned to provide a greenfield site devoid of existing developments, with ample room for future expansion and improvement.

As the Project replaces an existing activity, NAIC's operations are not considered to be a new source of GHG emissions in Angola. For this reason, existing airport operations are used as a baseline against which to compare the results of this calculation. The comparison shall be qualitative as no data is available on the carbon footprint of the existing Cabinda airport.

The Project absolute Carbon Footprint is expected to exceed that generated by the existing airport, because of the growth in air traffic demand. At the same time, it should be considered that that the impact generated by the Project will be minimised because of the modern technologies, compared to those of the existing airport.

Below we depict a list of possible factors that may be considered strengths in reducing the caron footprint:

- **Electricity demand:** installation of LED lighting luminaires (low energy consumption) and occupancy sensors and the implementation of energy efficient technologies would be expected to improve the Scope 2 GHG emissions related to the airport handling capacity.
- **Optimized Ground Operations:** thanks to the new airport design, advanced ground handling equipment and procedures, if implemented, could minimize fuel consumption and GHG emissions during aircraft taxiing and ground operations.
- **Use of more Sustainable Aviation Fuel:** the aviation sector is expected to be subject to stricter regulation of its GHG emissions in the medium to long term under the CORSIA programme. If national and international airlines would establish programmes to monitor and reduce their greenhouse gas emissions, the Project Scope 3 emissions related to the LTO cycle of aircraft could be reduced. Additional consideration about the technologies are included in the Alternatives chapter (Chapter 3) and in the assessment of transitional risks (chapter 16).
- **Road traffic:** dedicated buses are planned to link the airport with Cabinda, and if there are enough of them, this will reduce the need for private cars and their associated emissions. Moreover, the location of the airport outside the city of Cabinda, with a dedicated road, avoids extreme traffic congestion within the city and, consequently, the GHG emissions of the vehicles stuck in traffic.

Additionally, it is listed below some possible weakness factors that may potentially lead to an increase of the overall carbon footprint of the project:

- **Increased number of expected flights:** the impact of the aircraft LTO cycle would be expected to increase as the number of flights grows.
- **Larger and relatively more polluting aircraft in terms of emissions:** because of the development of an international airport at 4E ICAO code, it is expected the arrival of larger and more polluting aircrafts.
- **Increased employee commuting:** the growth in airport operations would be expected to require a large number of employees, and if projections are met, the number of employees commuting to work would be likely expected to increase, along with the associated GHG emissions.
- **Road traffic:** as for the overall carbon footprint, also the increase in passenger and freight operations would be potentially expected to increase traffic on the road network and the related emissions of GHG. Moreover, assuming that the majority of trips for both passengers and goods are likely expected to be to/from Cabinda City, the increased distance from the city would imply more fuel consumption and associated GHG emissions.

Other relevant factors that should be considered to deepen the comparison would be related to electricity procurement. However, a detailed analysis of such factors was not feasible at the time of writing this report, due to the lack of available information, especially on the actual expected electricity consumption and the frequency of blackouts.

14.4.2 Comparison to Angolan National emissions

In Table 6, the results of the calculations for the Project expected average GHG emissions during the two operational phases are expressed as a portion of the overall GHG emissions attributed to Angola at the country level, as reported to the UNFCCC in the last national GHG Inventory available (2015).

Based on our calculations, the Project's contribution to climate change can be considered negligible, as it does not alter the Angolan GHG emissions scale. Moreover, the Project's carbon footprint is expected to make a very minor contribution to the national climate impact, also according to its national reduction goals.

It is important to note that the Project is not to be considered as an additional GHG source in the context of Angola, but rather as a replacement for an existing airport facility.

Table 6: Comparison of Project GHG emissions to National GHG emissions and projections.

Term of comparison	Angola-wide GHG Emissions (tCO_2e)	Project Phase 1 share	Project Phase 2 Share
Angola 2015 GHG Inventory	99,992,231	0.05%	0.08%
Angola 2025 unconditional reduction goal	84,993,396	0.06%	0.10%
Angola 2030 unconditional reduction goal	78,993,862	0.06%	0.11%