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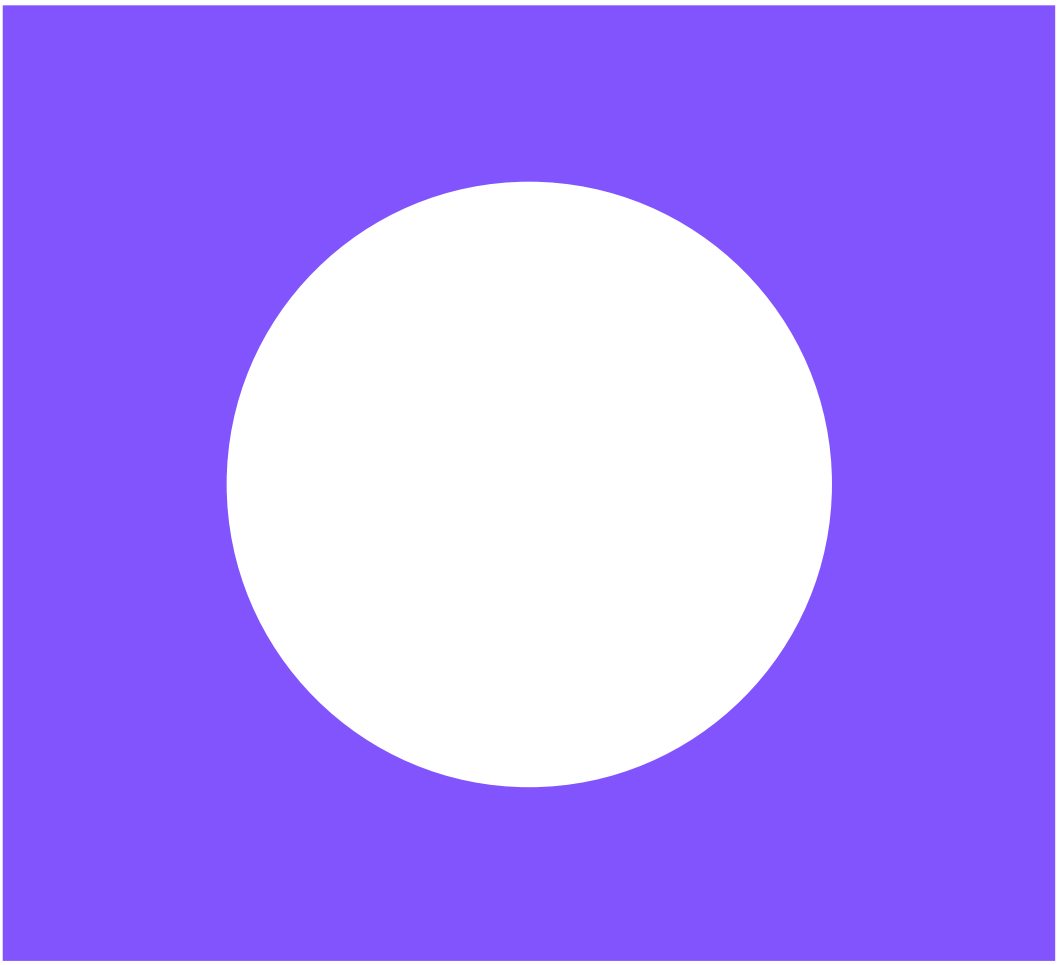

Almaty International Airport

Environmental and Social Impact Assessment Report - Chapter 10

September 2025

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Almaty International Airport

Environmental and Social Impact Assessment Report - Chapter 10

September 2025

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	31/07/2025	MM	NF	KD/BM	Draft report
B	15/09/2025	MM	KD	BM	Updated report following external comments
C	17/09/2025	SM	KD	BM	Minor updates following external comments

Document reference: 100124651 | ESIA Report Chapter 10 | C

Contents

Tables

Figures

Acronyms and abbreviations

Abbreviation / Acronym	Definition
ACERT	Airport Carbon and Emissions Reporting Tool
AGL	Airfield Ground Lighting
ALA	Almaty International Airport
APU	Auxiliary Power Unit
DEFRA	Department for Environment, Food and Rural Affairs
EF	Emission factor
EPC	Engineering, Procurement, and Construction (EPC) Contractor
EPD	Environmental Product Declaration
ESAP	Environmental and Social Action Plan
ESIA	Environmental And Social Impact Assessment
ESMP	Environmental and Social Management Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GSE	Ground Support Equipment
ICE	Inventory of Carbon and Energy
IFC	International Finance Corporation
LTA	Lender's Technical Advisor
PGS	Pavement Grading System
PVC	Polyvinyl Chloride
t CO_2e	Tonnes of carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change

10 Greenhouse gases

10.1 Introduction

10.1.1 This chapter of the Environmental and Social Impact Assessment (ESIA) reports the findings of an assessment of potential significant environmental effects associated with greenhouse gas (GHG) emissions resulting from the Project.

10.1.2 An assessment of potential significant effects has been undertaken for each of the sensitive receptors identified in the study area. Where appropriate, commitments to mitigation measures have been made to manage potential impacts on these receptors.

10.2 Methodology

Applicable guidelines and standards

10.2.1 In addition to the applicable overarching policy and legislation for the Project that is presented in ESIA Chapter 3: Policy, legal and institutional framework, the following section presents further policy and legislation which specifically relates to GHG for the Project.

National requirements

10.2.2 Kazakhstan has the following legal framework relating to GHG emissions:

- Nationally Determined Contributions (2023)[1]: Kazakhstan ratified the Paris Agreement and has committed to reducing its GHG emissions. In 2023, Kazakhstan submitted its revised NDC to include more ambitious targets and detailed plans to achieve them. This includes quantifiable targets with time frames, such as a reduction in the energy intensity of the Gross Domestic Product (GDP) from the 2008 level by 50% by 2050 and increasing alternative sources of electricity generation to 50% by 2050 – currently accounting for under 10%.
- Development Strategy of Kazakhstan Until 2050 (2012)[2] Sets out the long-term basis for the development of the state planning system. One of the strategic objectives is the transition to a low-carbon economy. For example, by 2050, alternative and renewable energy should account for at least half of total national energy consumption.
- Law on Energy Saving and Energy Efficiency (2012)[3]: Adopted in 2020, the law introduces requirements to implement energy saving policies and increase energy efficiency. The law makes it mandatory for entities that consume 1,500 tonnes or more of fuel equivalent per year to report annually on energy saving and efficiency measures. The law includes energy efficiency requirements for transport, applicable to road and air transport amongst others.
- Order Nº 27301: Establishes the legal basis for regulating GHG emissions and absorption and aligns with Kazakhstan's Environmental Code and internal obligations. This applies to all legal entities and individuals engaged in activities that emit or absorb GHGs.

[1] Kazakhstan (2023), Updated Nationally Determined Contribution of the Republic of Kazakhstan to the global response to climate change. Available online: Kazakhstan First NDC (Updated submission) | UNFCCC. Accessed July 2025.

[2] Astana (2012), Strategy Kazakhstan-2050. Available online: Presidential Address 'Strategy Kazakhstan-2050' (EN).pdf. Accessed July 2025.

[3] IEA (2022), Kazakhstan Energy Conservation and Energy Efficiency Law. Available online: Kazakhstan Energy Conservation and Energy Efficiency Law – Policies - IEA. Accessed July 2025.

International requirements

10.2.3 Kazakhstan has signed up the following international agreements relating to GHG emissions:

- United Nations Framework Convention on Climate Change(UNFCCC)[4]: ratified May 1995.
- Kyoto Protocol to the United Nations Framework Convention on Climate Change[5]. The UNFCCC reporting guidelines on annual inventories requires all Parties to submit to the Conference of the Parties an annual national anthropogenic GHG emissions inventory of all GHG not covered by the Montreal Protocol. As a non-Annex I Party, Kazakhstan has no obligations to reduce GHG emissions under this protocol.

Area of Influence

10.2.4 This chapter will consider the emissions resulting from the Project activities associated with the construction and operational stages. It is noted that unlike some other impacts, the nature of GHG emissions means that the ultimate receptor is the global climate system. Climate change resulting from GHG emissions will lead to social, environmental and economic impacts felt globally, regardless of where the GHGs are emitted. The area of influence associated with the GHGs are the emission sources which will have an impact on global climate, and country emissions.

Methodological approach

10.2.5 This section of the chapter presents the methodology applied to the assessment of impacts.

10.2.6 The assessment identifies the major potential sources of GHG. **Error! Reference source not found.** summarises the emission sources. These align with the GHG Protocol guidance which classifies GHG emissions into three “scopes”.

10.2.7 The assessment identifies the major potential sources of GHG. These sources align with the GHG Protocol guidance which classifies GHG emissions into three “scopes”. The sources of emissions assessed is as follows:

- Scope 1: Direct Emissions Airport Operator
  - 1.1 Vehicles (incl. airside transport, machinery, GSE)
  - 1.2 Buildings (boilers, furnaces)
  - 1.3 Emergency Generator
  - 1.4 Fire training
  - 1.5 Refrigerants
  - 1.8 De-icing chemicals
  - 1.9 Other emitting sources
- Scope 2: Airport Operator Net Energy from External Supplier
  - 2.1 Electricity purchased
  - 2.2 Heat purchased
- Scope 3: Upstream and downstream indirect emissions
  - 3.1 Construction - plant and equipment fuel use
  - 3.2 Construction - raw materials (for pavements, drainage, airfield ground lighting, fence)

[4] United Nations Treaty Collection (2021) United Nations Framework Convention on Climate Change. Available at: UNTC. Accessed July 2025.

[5] OECD (2016) Financing Climate Action in Kazakhstan. Available at: The Organisation for Economic Co-operation and Development | OECD. Accessed July 2025.

– 3.3 Operation – flights

10.2.8 Note that the following emissions sources have been excluded: construction of new buildings (insufficient data at this stage); temporary worker accommodation (assumed not relevant - workers expected to be accommodated in existing buildings within the airport surrounding region); aircraft on stand: auxiliary power unit (APU) (insufficient data at this stage); land-use change (considered negligible as no significant land use change); and terminal energy use (insufficient data at this stage).

10.2.9 Typically, when calculating GHG emissions, activity or consumption data is multiplied by a published emission factor from a recognised source:

Emissions (tCO_2e) = rate of activity (unit) x emission factor (tCO_2e/unit)

10.2.10 For each source, the activity data and emission factor should be selected using the best available project data and emission factors – this method is consistent with the calculation approach adopted by International Finance Corporation (IFC).

10.2.11 In addition, an uplift factor of 10% was used to adjust the total GHG inventory to account for relevant emissions which cannot be reasonably quantified or estimated, such as APU and terminal energy use emissions.

10.2.12 Table 10.1 sets out the emissions sources considered and summarises the methods used for GHG estimation.

Table 10.1: Estimation approach per emission source

Emission Source		Estimation approach
Construction	Raw materials (for pavements, drainage, airfield ground lighting, fence)	The materials and respective quantities used for construction were provided for the following project components: ● Full depth reconstruction of main runway ● New taxiway ● New cargo apron ● Full depth reconstruction of existing VIP apron ● New de-icing pad ● Rehabilitation of parking stands The emission factors used were sourced from the Inventory of Carbon and Energy (ICE) V4[6] database. Where the emission factor was not available in this database, Environmental Product Declaration (EDPs)[7] which reflect a representative material were used.
	Plant and equipment fuel use	Fuel consumption data was provided for the different vehicles used in the construction of the project components which are part of the YDA scope of works: ● Full depth reconstruction of main runway ● New taxiway ● New cargo apron ● Full depth reconstruction of existing VIP apron ● New de-icing pad ● Rehabilitation of parking stands The emission factor used was of 2.6988kgCO_2e/litre, as used in the baseline. This is sourced from DEFRA, 2022 UK GHG conversion factors, full set.

[6] ICE (2024) Available at: Embodied Carbon Footprint Database - Circular Ecology. Last accessed July 2025.

[7] EPDs were used where material data was not available on embodied carbon databases. EPDs were obtained from a variety of online sources e.g. manufacturer's website.

Emission Source		Estimation approach
Operation	Onsite electricity consumption from Project components	Emissions are based on studies completed by WSP for the Project Horizon[8].
	Emissions from flights	Emissions are based on studies completed by WSP for the Project Horizon[8].

10.2.13 The assessment separates construction and operational emissions to align with standard ESIA practice and ensure consistency across environmental topics such as air quality and traffic. This approach allows for clearer identification of impacts and mitigation measures at each stage of the Project. While a full lifecycle assessment was not undertaken, Section 10.5 provides a whole-life summary of emissions, offering a comprehensive view of the Project's overall carbon footprint.

Limitations and assumptions

10.2.14 The impacts presented are an estimation based on the available data, intended to provide an indication of the level of impact of the Project.

10.2.15 The construction footprint of the Project is based on a high-level assessment of the main materials required and anticipated fuel-use for construction. Additionally, there is uncertainty within emissions factors themselves as they represent industry averages and are calculated on a set of assumptions and thus may not reflect real world scenarios or specific products that are later used in the construction. The final carbon footprint is likely to be different to the estimation presented here as it is dependent on the final products selected and the fuel used on site.

10.2.16 Several assumptions were made to calculate the GHG emissions from construction materials, this is due to the level of detail included in the data provided. These assumptions are summarised in Table 10.2.

Table 10.2: Construction materials assumptions

	Material	Calculation Assumption
Pavements	Fly ash	Density: 600kg/m3
	Capping Layer (Pavement Grading System (PGS))	Assume similar materials to aggregate Density: 2240kg/m3 (ICE V4)
	Crushed aggregate	Density: 2240kg/m3 (ICE V4)
	Aggregate	Density: 2240kg/m3 (ICE V4)
	Sealing cord made of foamed polyethylene	Diameter: 10mm, and 0.02kg/m
	Bituminous mastic	Primary material is bitumen and no specific EPD available. 1.8kg/L
Stormwater drainage	Polyvinyl Chloride (PVC) pipe 300mm diameter	Assumes thickness: 18.7 mm Density: 1400kg/m3 Weight per meter: 25 kg/m
	Drainage manholes	Material: reinforced concrete
	Corrugated drainage pipe	Material: plastic Diameter: 300mm, and 4.2kg/m
Marking	Reflective paint for marking	Density: 1.5kg/l
Airfield Ground Lighting (AGL)	Airfield manholes (F900-D400)	Material: reinforced concrete
	Bare coppers for earthing	Assume cross section: 16mm2 - 0.142kg/m

[8] WSP (2025) Chapter 6: Emissions Estimation, Draft Red Flag Report 10th July 2025. 2025UK383375

10.2.17 Additional assumptions include:

- The assessment of GHG emissions from construction fuel was based on data provided and it has been assumed this is the most representative source of data.
- Annual electricity consumption figures were assumed to be static across the operational years, as well as Kazakhstan's grid's emission factors (assumed no decarbonisation). This would result in emissions from operation being equal across all operational years.
- Emissions were assessed over a 6-year operational period, based on ALA currently exploring development scenarios extending to 2030.

10.2.18 The limitations of the GHG emissions estimates are summarised in Table 10.3.

Table 10.3: Limitations of emission estimates

Emission Source		Limitations
Construction	Raw materials (for pavements, drainage, airfield ground lighting, fence)	The assumptions made for construction materials were based on previous project experience and have been conservative. However, they may not be accurate to what is being constructed on site. Additionally, the calculations only cover the first six Project components as described in Table 2.1 of **ESIA Chapter 2: Project description**.
	Plant and equipment fuel use	The calculations only cover the first six Project components as described in Table 2.1 of **ESIA Chapter 2: Project description**.

10.2.19 This ESIA does not include an assessment of decommissioning or demolition activities, as these are not anticipated within the foreseeable planning horizon of the Project.

10.2.20 The Scope 3 assessment for flights is provided in Appendix 10.A.

10.2.21 Based on professional opinion, these limitations will be covered by a generic uplift factor of 10%, which excludes air traffic emissions, and addresses the uncertainty in GHG emissions estimates.

10.3 Baseline

Current baseline

10.3.1 In 2024, ALA conducted a desk-based quantitative assessment to evaluate the impact of its investment plans for 2025, 2026, and 2027 on climate change, as part of Project Horizon. This assessment, documented in a report prepared by Rever Academi, included a GHG inventory and identified carbon reduction strategies such as implementing energy efficiency projects, increasing the use of renewable energy sources, and delivering training and awareness programs for employees.

10.3.2 ALA has committed to achieving level 3 Airport Carbon Accreditation (ACA) by 2030 as part of its carbon reduction strategy. The action plan focuses on carbon management and energy reduction initiatives, with additional use of offsetting for residual emissions. The mitigations outlined in this report would help ALA achieve this goal.

10.3.3 Baseline Scope 3 emissions were sourced from studies completed for the Project Horizon (WSP, 2025). The emissions were estimated for the year 2024 using each flight distance, estimated fuel burnt per flight and a carbon emission factor of 3.16kg CO_2e per kg of fuel burn. The estimated emissions included passenger, cargo and other flight types. As shown in Table 10.4, indirect emissions from flights' fuel currently contribute the greatest to the carbon footprint of the airport (99%).

10.3.4 Note that the baseline data does not provide a full estimation of the airport's emissions as it excludes emissions such as those from APUs and terminal energy use.

Table 10.4: 2024 Carbon Footprint Report – ALA baseline

Source		Group	Entity	t CO_2e	% CO_2e
Scope 1: Direct Emissions Airport Operator					
1.1	Vehicles (incl. airside transport, machinery, GSE)	Mobile	Airport Operator	4,955.3	0.18%
1.2	Buildings (boilers, furnaces)	Stationary	Airport Operator	213.8	0.01%
1.3	Emergency Generator	Stationary	Airport Operator	7.3	0.00%
1.4	Fire Training	Process	Airport Operator	0.1	0.00%
1.5	Refrigerants	Process	Airport Operator	1,562.4	0.06%
1.6	Solid Waste	Process	Airport Operator	-	0.00%
1.7	Waste Water (on-site)	Process	Airport Operator	-	0.00%
1.8	De-icing chemicals	Process	Airport Operator	913.9	0.03%
1.9	Other emitting sources	Process	Airport Operator	0.1	0.00%
Subtotal	**Airport Operator Scope 1**			**7,653**	**0.28%**
Scope 2: Airport Operator Net Energy from External Supplier					
2.1	Electricity purchased, Location-based emission factor (EF)	Energy	Airport Operator	19,495.4	0.71%
2.2	Heat purchased	Energy	Airport Operator	3,730.0	0.14%
Subtotal	**Airport Operator Scope 2**			**23,225.4**	**0.85%**
Airport Operator Gross Sub-total (Scopes 1 & 2)				**30,878.2**	**1.13%**
Scope 3: Upstream and downstream indirect emissions					
Subtotal Air Transport Scope 3				**2,708,000**	**98.87%**
Total				**2,738,878**	**100.00%**

Future baseline

10.3.5 Future baseline GHG emissions associated with airport operations are not expected to increase in line with the increasing number of flights over time, due to improvements in aircraft fuel efficiency, increased use of sustainable aviation fuels (SAFs), and potential shifts toward electrification of ground support equipment and airport vehicle fleets. These advancements, alongside broader decarbonisation efforts in the aviation sector, may help offset increases in air traffic expected even without the Project.

10.4 Potential impacts

10.4.1 The assessment outlines several potential impacts on climate change from the Project construction and operation:

- Construction materials are the largest contributor to the GHG emissions quantified in this assessment, over 6 years of operation. There will be additional emissions from the construction materials used in the Project components that have not been quantified: the project components 7 – 14, identified in Table 2.1 of **ESIA Chapter 2: Project description**.
- Construction fuel for the project components 1 – 6, as identified in Table 2.1 of **ESIA Chapter 2: Project description,** is the second largest contributor to the total emissions quantified in this assessment. Additional emissions will result from the fuel used in the construction of the remaining Project components.

- Annual emissions for the electricity used during operation of all Project components will contribute to the total GHG emissions and will occur each year of airport operation.

10.4.2 The Scope 3 assessment for flights is provided in Appendix 10.A. The impact of emissions from future air traffic is expected to be significant and become the largest contributor to the total GHG emissions, as shown in in the current 2024 baseline.

10.4.3 Unlike other impacts, the nature of GHG emissions means that the ultimate receptor is the global climate system. GHG emissions are by their nature cumulative, as the global increase in emissions increase the impacts on climate change. In the context of this report, GHG emissions are considered in the context of the impact from the Project emissions with no separate cumulative impact assessment.

10.5 Assessment of effects

10.5.1 Impacts and significance of the resulting effects have been assessed taking into account the interaction between magnitude of the impacts and sensitivity of the receptors.

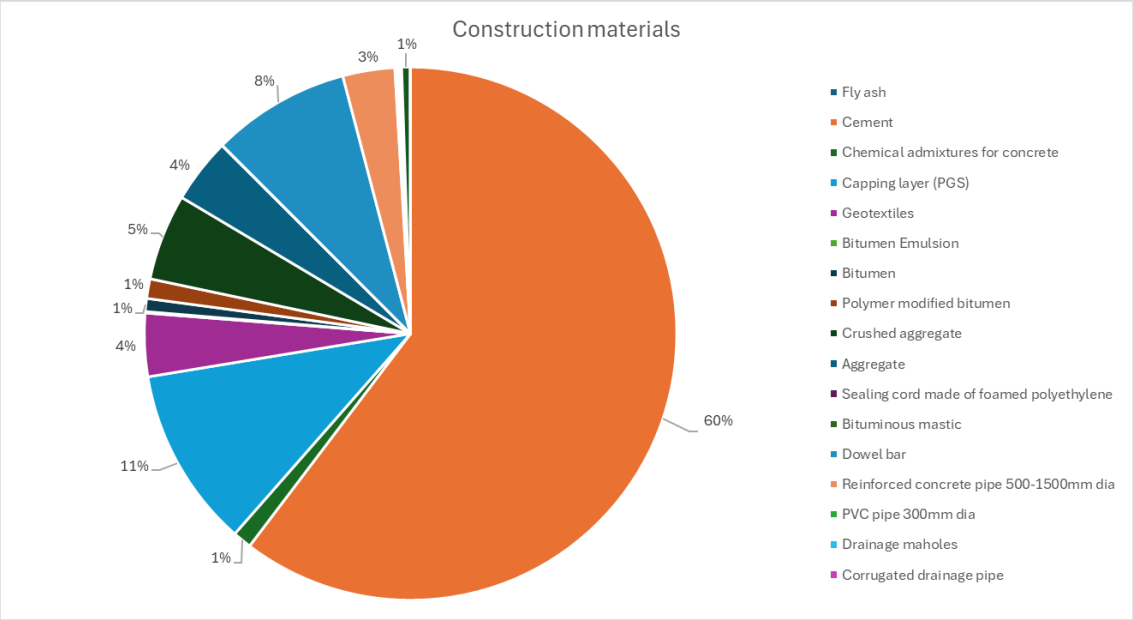
- Magnitude – there is currently no globally accepted threshold of GHG emissions which, if exceeded, can be defined as significant from an Environmental Impact Assessment perspective. There are various forms of guidance and industry standards available, and it is of note that the guidance on evaluating significance of GHG emissions published by The Institute of Sustainability & Environmental Professionals (ISEP) advises that all GHG emissions should be considered significant, regardless of the scale of the emissions. In line with this guidance, all GHG emissions are considered to have a magnitude of major or moderate adverse.
- Sensitivity – the nature of GHG emissions means that the ultimate receptor is the global climate system. Given the nature of climate change and the global need to reduce GHG emissions to limit the degree of global warming expected, the global climate system can be considered as highly sensitive to additional GHG emissions.

Construction phase effects

10.5.2 The construction of the Project will lead to emissions of GHGs through the manufacture of materials, transport of materials, and use of construction plant. The emissions estimated are ‘Scope 3 (indirect)’ as they result from activities of other organisations, e.g. manufacture of raw materials.

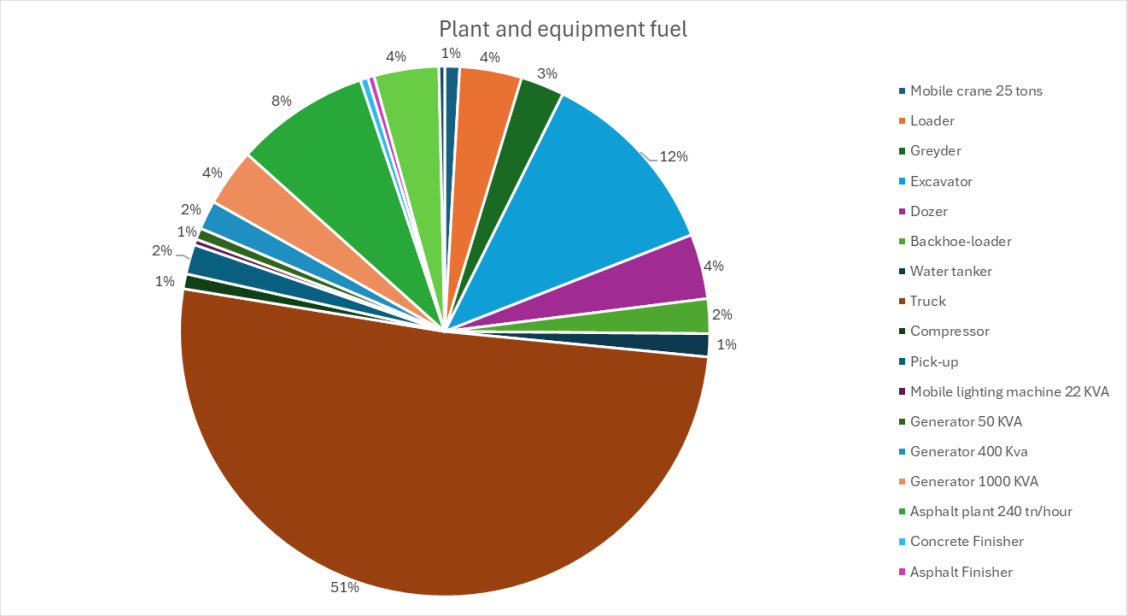
10.5.3 These emissions from construction materials, estimated as per previous sections, result in 38% of total emissions quantified in this study, with a total of 189,821 tCO_2e. The largest contributor to the material’s GHG emissions is cement accounting for 60%, followed by steel used in dowel bars, 11%. The breakdown of construction materials to be used is shown in Figure 10.1.

Figure 10.1: Construction materials – emissions breakdown



10.5.4 The emissions resulting from construction plant and equipment fuel use result in around 73,018 tCO_2e, which is 15% of overall emissions quantified. Figure 10.2 shows the largest proportion of emissions from fuel use arises from trucks.

Figure 10.2: Plant and equipment fuel – emissions breakdown



Operational phase effects

10.5.5 As mentioned in the baseline description, an assessment to quantify the impacts of the Project for the years of 2025, 2026 and 2027 on climate change was undertaken in 2024. This included Scope 1 emissions – sources 1.1 to 1.9 in the table below, as well as Scope 2 emissions for the existing airport plus the additional facilities (WSP, 2025).

10.5.6 The Scope 3 assessment for flights is provided in Appendix 10.A.

Summary

10.5.7 The assessment outlines several potentially significant impacts on climate change. The key impacts are from the production of construction materials, as shown in Table 10.5, particularly cement, followed by electricity and heat purchased during the operational period of 6 years.

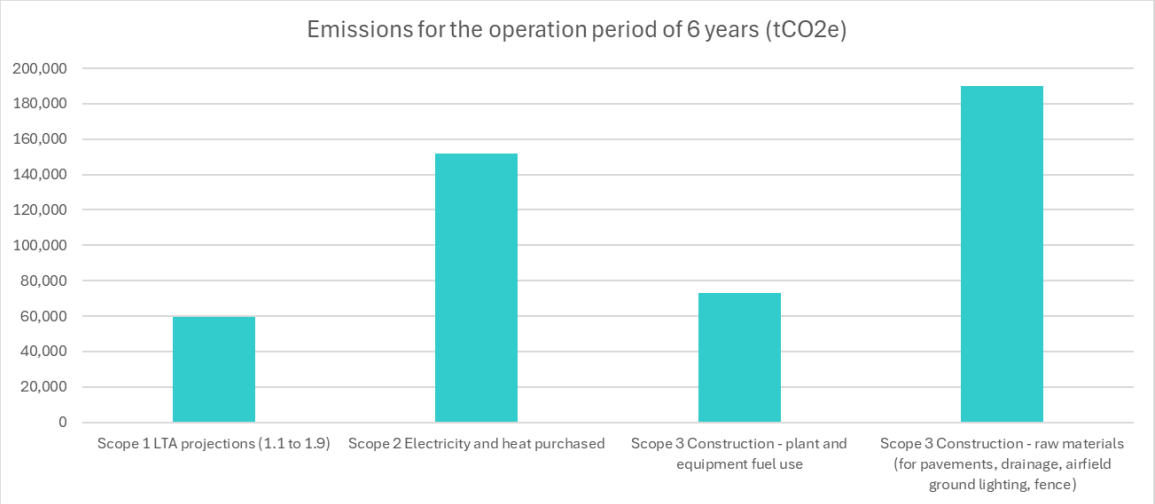
Table 10.5: Carbon Footprint Report – ALA projection

Source		t CO_2e*	% CO_2e
Scope 1: Direct Emissions Airport Operator			
1.1	Vehicles (incl. airside transport, machinery, GSE)		
1.2	Buildings (boilers, furnaces)		
1.3	Emergency Generator		
1.4	Fire training	59,750	13%
1.5	Refrigerants		
1.8	De-icing chemicals		
1.9	Other emitting sources		
Subtotal	**Airport Operator Scope 1**	**59,750**	
Scope 2: Airport Operator Net Energy from External Supplier			
2.1 and 2.2	Electricity and heat purchased	151,980	32%
Subtotal	**Airport Operator Scope 2**	**151,980**	
Airport Operator Gross Sub-total (Scopes 1 & 2)		**211,730**	
Scope 3: Upstream and downstream indirect emissions			
3.1	Construction - raw materials (for pavements, drainage, airfield ground lighting, fence)	189,820	40%
3.2	Construction - plant and equipment fuel use	73,020	15%
3.3	Operation – flights	Refer to Appendix 10.A.	Refer to Appendix 10.A.
Subtotal Air Transport Scope 3 (excluding flights)		262,840	
Total		**474,570**	**100%**

* emissions rounded to nearest 10 tonnes, totals may not sum due to rounding

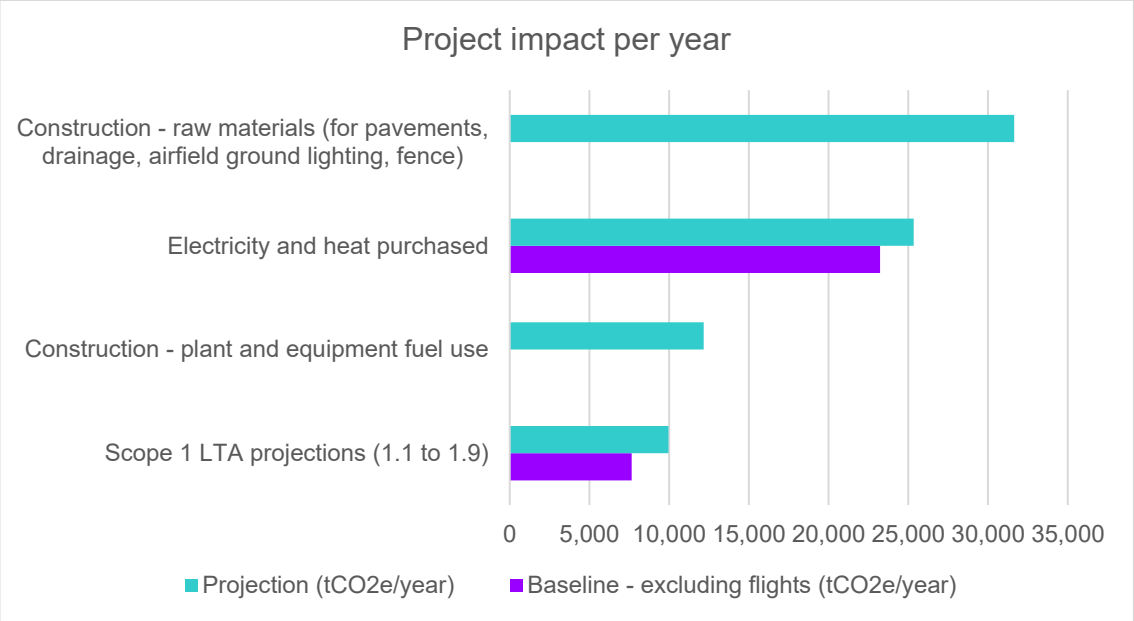
10.5.8 A summary of emission sources is shown in Figure 10.3.

Figure 10.3: Emissions breakdown by source



10.5.9 The impact of the Project has been highlighted in this ESIA. This is a significant development and therefore, there will be an increase in emissions, every operational year. Figure 10.4 below summarises the results to the 2024 baseline, excluding flights, compared to the future projection estimated emissions. It shows a yearly increase of 23% on Scope 1 emissions and 8% increase in Scope 2 emissions from electricity and heat purchased. The Scope 3 assessment for flights is provided in Appendix 10.A.

Figure 10.4: Project Impact – 2024 to future projections comparison



10.6 Mitigation

10.6.1 Mitigation measures to manage potential impacts from construction and operation of the Project are being implemented as part of the Environmental and Social Management Plan (ESMP) including:

- A plan to implement a GHG management system at the airport
- Limiting operating time of additional power supply installation (generators)
- Reduced aircraft taxi time with engine running
- Providing charging infrastructure to promote and facilitate the use of electric vehicles

10.6.2 These mitigation measures will control the GHG emissions from mobile sources and generators as well as ground vehicles. The lead Contractor will be responsible for ensuring the mitigation measures are implemented during the construction stages of the Project.

10.6.3 In addition to this, the sources of emissions may be reduced further by the following mitigations:

Construction Phase:

- Using the carbon reduction hierarchy to focus efforts on ‘build less’, challenging the requirement for materials and exploring alternative approaches. This could include use of recycled materials in construction where possible, and reuse of materials on site.
- Implementing waste management strategies during construction works.
- Sourcing materials wherever possible locally to avoid transport emissions.
- Toolbox talks for workers about switching off plant and equipment when not in use.

- Regular plant and equipment servicing, and using grid electricity to power instead of fuel where possible given the lower carbon intensity.

Operational phase:

- Electrify operations where possible, including airside vehicles.
- Use or purchase renewable electricity for use in operations.
- Complete regular maintenance of on-site equipment and vehicles to ensure optimal operational efficiency.
- Implement buildings energy efficiency measures to reduce heating, cooling, and energy demands.
- ALA is recommended to explore opportunities to promote the future use of sustainable aviation fuels (SAF), in line with global decarbonisation trends. While implementation may be outside the current Project Horizon timeline and dependent on market readiness, airports such as Heathrow and Swedavia have adopted incentive-based approaches to support SAF uptake. Early positioning may support long-term climate goals and stakeholder expectations.

10.7 Summary of residual effects

10.7.1 Residual effects after the application of mitigation are presented in Table 10.6.

Table 10.6: Summary of residual effects for greenhouse gases

Description of effect	Permanent or temporary	Sensitivity of receptor	Magnitude of impact	Significance of effect before additional mitigation	Additional mitigation	Residual effect	Proposed monitoring
Construction phase							
GHG emissions from production of construction material	Permanent	High	Major	Major adverse	Proposed use of carbon reduction hierarchy.	Moderate adverse (Significant)	None
GHG emissions from fuel used by construction plant	Permanent	High	Major	Major adverse	Use of lower carbon fuels, adherence to fuel efficiency measures, and selection of greener plant options where available.	Moderate adverse (Significant)	The EPC Contractor should produce a Construction monitoring plan to include vehicle and plant efficiency measures to encourage lower fuel use. Plan to include staff training and guidance.
Operational phase							
GHG emissions from electricity used in operation	Permanent	High	Moderate	Major adverse	Operational energy efficiency plan. Use of renewable energy sources where available and possible.	Moderate adverse (Significant)	Operational energy monitoring plan to include regular checks that equipment is running as per manufacture expectations and investigated where not the case.
Increase in flights and resulting GHG emissions	Permanent	High	Major	Major adverse	ALA is recommended to explore opportunities to promote the future use of sustainable aviation fuels (SAF), in line with global decarbonisation trends.	Major adverse (Significant)	None