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Net Zero Carbon RoadMap Olbia Airport

Charting the Path to Sustainable Aviation and Beyond

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Report

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Acronym	Full Form
ACA	Airport Carbon Accreditation
ACI	Airports Council International
APU	Auxiliary Power Unit
CAPEX	Capital Expenditure
CDP	Carbon Disclosure Project
CO_2	Carbon Dioxide
DAC	Direct Air Capture
EPA	Environmental Protection Agency (US)
EU	European Union
GHG	Greenhouse Gas
GPU	Ground Power Unit
GRI	Global Reporting Initiative
GSE	Ground Support Equipment
GWP	Global Warming Potential
HVO	Hydrotreated Vegetable Oil
HVAC	Heating, Ventilation, and Air Conditioning
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
OEM	Original Equipment Manufacturer
OLB	Olbia Costa Smeralda Airport (IATA code)
OPEX	Operational Expenditure
PCA	Pre-Conditioned Air
PFTE	Piano di fattibilità tecnica ed economica (Technical and Economic Feasibility Plan)
PQI	Piano Quadriennale degli Interventi (Four-Year Investment Plan)
PV	Photovoltaic
SAF	Sustainable Aviation Fuel
SDGs	Sustainable Development Goals
SLBP	Sustainability-Linked Bond Principles
WACC	Weighted Average Cost of Capital

1 EXECUTIVE SUMMARY

Aviation plays a pivotal role in the global economy, having significantly fueled the expansion of international trade, tourism, and national development. Over the past decades, the sector has generated substantial economic value, enhanced global mobility, created millions of jobs, and stimulated major infrastructure investments. However, as underscored by the recent COVID-19 crisis, such progress is not guaranteed. Continued growth and resilience in aviation demand ongoing investment in research, innovation, and advanced technologies to meet emerging global challenges.

Today, the urgency of addressing climate change has placed environmental sustainability at the top of the aviation agenda. Beyond the climate imperative, sustainability is increasingly shaped by broader factors such as public health, economic security, and long-term societal well-being. Central to this approach is the “triple bottom line” framework—People, Planet, and Profit—which encourages organizations to balance social responsibility, environmental stewardship, and economic viability in their strategic planning.

The aviation sector currently accounts for approximately 2–3% of global CO_2 emissions, a share that is projected to rise without decisive intervention. In recognition of this, the industry has embraced a bold environmental agenda. In 2022, the International Civil Aviation Organization (ICAO), the United Nations body governing global civil aviation, adopted a landmark target to achieve net-zero CO_2 emissions from international aviation by 2050. This global goal has been strongly supported by the Airports Council International (ACI) World, which has urged airports to act as key enablers of this transition.

Airports thus carry dual responsibility. On one hand, they are engines of economic growth, social connection, and cultural exchange. On the other, they must actively champion sustainability by adopting environmentally responsible practices and leading by example. Although airport operations represent a relatively small portion of total aviation emissions, their environmental footprint remains significant. Continuous improvement is essential, and airports are uniquely positioned to drive innovation—through the development of green infrastructure, deployment of low-carbon technologies, and engagement with stakeholders across the value chain.

Looking ahead, passenger traffic is expected to surge, with forecasts projecting around 8.3 million passengers by 2050 at Olbia Costa Smeralda Airport. This anticipated growth presents both a challenge and an opportunity: the airport must manage increased demand while pursuing a long-term environmental vision grounded in smart planning, innovation, and collaboration.

This report confirms that Olbia Airport is on track to meet key climate targets, including achieving net zero carbon emissions under its direct control (Scope 1 and 2) by 2050. This goal aligns with ACI EUROPE’s guidelines and the IPCC’s 1.5°C global warming pathway.

In what will be called the "Earliest Net Zero" scenario (Pathway 2), Olbia Airport adopts a fast-tracked and ambitious decarbonization plan aimed at reaching net zero carbon emissions well before 2050. The strategy involves targeted upgrades across vehicles, heating and cooling systems, and electricity use.

A major focus is the electrification of the airport's vehicle fleet. Over 90% of vehicles, including most ground support equipment (GSE), are converted to electric early on, while the remaining 10% of GSE switches to low-emission fuels such as HVO50 or HVO100. Key progress points occur in 2023, 2025 and 2040, reflecting continuous improvements and emissions reductions from transport activities. Simultaneously, the heating and cooling systems are fully modernized. All buildings adopt heat pump technology, undergo energy-efficient retrofits, and install improved refrigerant systems. No refrigerant refills are required until 2035, after which enhanced leak control and the use of low-GWP refrigerants help maintain downward emissions trends. The airport also steadily increases its use of renewable electricity, with major steps taken already in 2025 and then in 2030. These actions include expanding on-site renewable energy production, particularly through solar photovoltaic (PV) installations.

Olbia's commitment to achieving Net Zero is not only a response to regulatory and social expectations, but it also reflects a strategic decision to shape a more sustainable future for aviation. By embedding sustainability into every facet of its development, the airport positions itself as a climate-conscious leader in the sector, capable of generating lasting value for the region, its passengers, and the planet.

2 INTRODUCTION OF OLBIA AIRPORT

Olbia Costa Smeralda Airport (IATA: OLB), is the primary air gateway for northern Sardinia and the second busiest airport on the island. Located just 3–4 km from the city center of Olbia, the airport is a crucial hub for both domestic and international tourism, serving as the main access point to the renowned Costa Smeralda and other prominent tourist destinations such as Porto Cervo, Porto Rotondo, and the Maddalena Archipelago. Since its inauguration in 1974, the airport has undergone continuous expansion and modernization, including a major terminal upgrade in 2004 that increased its capacity to 4.5 million passengers per year.

Strategically positioned, Olbia Airport acts as a vital economic engine for the region, supporting tourism, creating jobs, and stimulating investment in Sardinia. Its connectivity to major Italian and European cities, especially during the peak summer season, underscores its role as a hub in the island's economic and social development.

Olbia Airport, managed by Geasar S.p.A., is committed to a long-term vision that balances operational excellence, passenger experience, and sustainable development. The airport has invested in infrastructure upgrades, such as the extension of the runway and the implementation of advanced baggage handling systems, to enhance capacity and resilience. Future plans include further investments in renewable energy, energy efficiency, and digitalization, aligning with both regional mobility needs and global sustainability goals.

Environmental stewardship is a core pillar of Olbia Airport's management strategy. The airport has adopted a certified Environmental Management System (ISO 14001:2015) to systematically monitor and reduce its environmental impact. Key sustainability achievements over the past years include:

- Waste Management: In 2023, the airport maintained a waste sorting rate of over 83%, with a strong focus on reducing single-use plastics and promoting plastic-free approach throughout its facilities.
- Energy and Emissions: The airport will install photovoltaic systems to generate renewable energy to cover around 21% of the energy demand and has transitioned since 2023 to purchasing 100% from renewable energy sources. Diesel-powered systems are being phased out in favour of electric alternatives.
- Airport Carbon Accreditation: OLB achieved Level 3 "Optimisation" in the Airport Carbon Accreditation programme in February 2023, certifying its commitment to reducing GHG emissions, including Scope 3 emissions.

Over the past two decades, Olbia Costa Smeralda Airport has established itself as a dynamic and forward-looking gateway, crucial to the economic vitality and tourism appeal of northern Sardinia. Its strategic approach integrates operational excellence, stakeholder value creation, and a robust commitment to environmental and social sustainability. As it moves toward the Net Zero path, Olbia Airport continues to set industry benchmarks in resilience, innovation, and responsible growth.

3 CONTEXT

The sustainability pathway[1], rooted in a Resolution by ACI EUROPE from June 26, 2019, in response to the IPCC Special Report and industry developments, embodies the commitment of European airports. This commitment includes a call to the aviation industry, ICAO, and governments to collectively pursue net-zero emissions in aviation. Furthermore, it outlines the pledge to achieve net-zero carbon emissions within the direct control of airport operators (Scope 1 and 2) by 2050 and emphasizes the importance of governments expediting the transition to clean energy systems to facilitate airports in reaching net-zero emissions. Additionally, it draws inspiration from the best practices established through the Airport Carbon Accreditation program. The pathway also champions innovation and partnership to engage with stakeholders, actively contributing to the broader decarbonisation of the aviation sector.

Consistent with ACI EUROPE's directives, Olbia Airport aims to create a Net Zero Roadmap. To move forward with this initiative, it is essential to identify the diverse sources of emissions at the airport, following the guidelines set forth in the Airport Carbon Accreditation (ACA), as detailed in its 2023 document, the Airport Carbon Accreditation Application Manual (Issue 13). Establishing clear Organisational and Operational Boundaries within the airport is significant in this pursuit, for accurate emissions accounting and reporting.

As the main airport and an active member of ACI Europe, Olbia costa Smeralda Airport (OLB) understands the significance of its role in both economic development and environmental stewardship. OLB is aspiring to achieving Net Zero emissions by 2050 and aims to lead by example through the adoption of sustainable practices and innovative technologies, aligning with the aviation sector's broader decarbonisation goals and contributing to global climate action.

Emissions can be categorized into three main segments: Scope 1, Scope 2, and Scope 3, each representing different sources of greenhouse gas emissions.

- Scope 1: Direct GHG emissions that occur from sources that are owned and/or controlled by the airport, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.
- Scope 2: Indirect GHG emissions from the generation of purchased electricity, steam, heat, or cooling consumed by the airport. Scope 2 emissions physically occur at the facility where purchased electricity is generated.
- Scope 3: All other indirect emissions, which are a consequence of the activities of the airport but occur from sources not owned and/or controlled by the company (e.g., aircraft movements, vehicles and equipment operated by third parties, off-site waste management, etc.). Such sources can be located within or outside the airport premises.

To achieve Net Zero, an airport must first reduce the emissions it directly controls, known as Scope 1 and Scope 2 emissions, by at least 90%.

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[1] ACI EUROPE Sustainability Strategy for Airports.

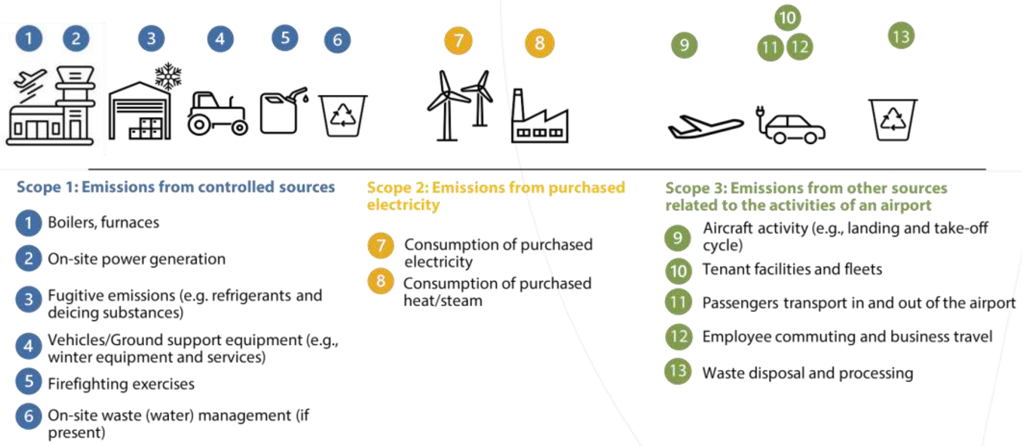

Figure 1: Airport Emission Scopes (compiled based on ACI Airport Carbon Accreditation Guidance)

4 AIRPORT NET ZERO ROADMAP - METHODOLOGY

Building upon its global commitment to achieving Net Zero carbon emissions by 2050, Airports Council International (ACI), with its five regional branches, has set forth an ambitious and unified long-term carbon reduction strategy. This coordinated global effort underscores ACI's leadership in advocating for climate responsibility within the aviation industry and its commitment to enabling airports to become proactive agents of environmental transformation.

In line with this commitment, ACI has introduced a structured, step-by-step methodology to assist airports in the development and implementation of an effective and actionable Net Zero Roadmap. This roadmap is intended not only as a planning tool, but as a practical framework that empowers airport operators to align their operational, infrastructural, and technological strategies with long-term sustainability objectives. The Net Zero Roadmap is organized around five key stages.

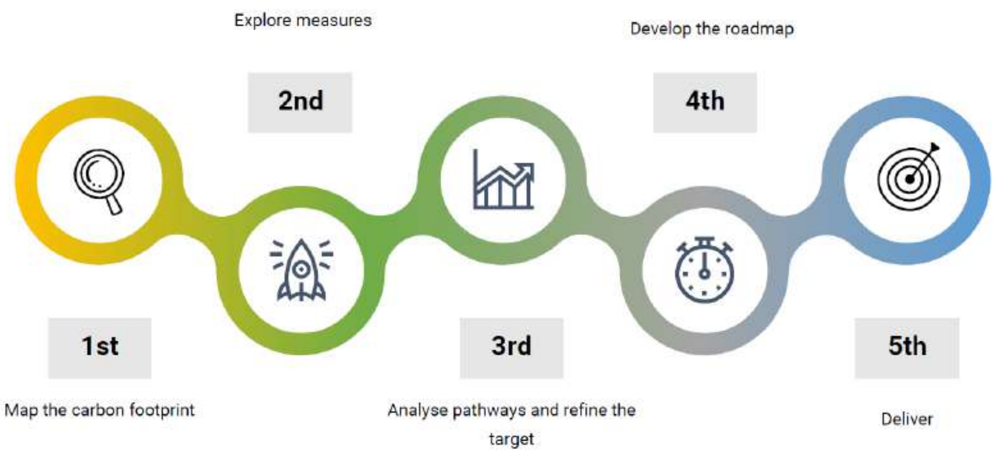

Figure 2: Steps to Net Zero Roadmap

Table 1 - Steps to Net Zero Roadmap

Step	Methodology
1 – Map the carbon footprint	The first step is to measure the airport's past and current emissions to define the Roadmap's scope. This provides an understanding of the emissions generated by different activities across the site and the value chain, serving as the foundation for setting targets.
2 – Explore measures	Once the emissions overview is complete, the next step is to identify measures to reduce emissions. This includes improving the efficiency of technologies and operations, transitioning to clean energy sources, and leveraging innovations.
3 – Analyse pathways and refine target	With the baseline established and measures identified, the next step is to model various emission reduction pathways. These scenarios consider energy use, carbon emissions, and costs to provide clarity on the impact of different mitigation measures and investment timelines.

4 – Develop Roadmap	Achieving Net Zero carbon is a long-term goal that requires careful planning. The Roadmap should integrate insights from the previous steps, turning them into a structured, actionable plan.
5 - Deliver	Feasibility and design studies for specific measures will support the implementation of the roadmap. Periodic or annual reviews will track progress, assess the effectiveness of measures, and identify any necessary adjustments.

Below is a detailed description of each step applied for OLB Net Zero Roadmap. The scope of this document indicates that within this study, Steps 1 to 3 were applied and will need to be complemented by feasibility studies to complete the roadmap.

In the first step, **'Mapping the carbon footprint'**, the baseline carbon footprint was developed based on emissions data from 2023. In this initial phase, a detailed analysis of emission distribution and quantities was conducted to understand their sources. This is covered in the Baseline Carbon Footprint chapter.

In the second step, **'Explore measures'**, To70 conducted a comprehensive benchmarking of actions taken by various airports, leveraging our extensive expertise in the field. These measures were assessed for feasibility and their adaptability to the specific conditions at OLB. This is detailed in the Airport Benchmark Chapter.

The third step consisted of **'Analyzing pathways and refining targets'**. In this chapter all the pathways were analyzed: the first pathway included the green initiatives already planned by OLB, with the goal of assessing how these measures would influence future emission forecasts, in case no additional measures were planned and the second scenario focused on introducing new measures or expanding the already planned measures in order to achieve the Net Zero goal.

In Step 4, **'Developing the Roadmap'**, the various elements collected were integrated into a clear, actionable plan. This includes operational and investment analyses to assess the financial viability and effectiveness of emissions reduction measures.

Finally, in Step 5, **'Delivering'**, as the Roadmap is a dynamic and iterative process focused on long-term goals, OLB is encouraged to carry out periodic or annual reviews. These reviews will help assess the effectiveness of measures, track the evolution of the carbon footprint, and identify any necessary adjustments.

5 LIST OF DOCUMENTS ANALYSED

To create this document, a comprehensive research and market analysis were undertaken. Notably, the following documents served as essential resources:

- Developing an airport net zero carbon roadmap. ACI EUROPE guidance document. 2nd edition. June 2023.
- Developing an airport net zero carbon roadmap. Summary of existing roadmaps. ACI EUROPE. June 2022.
- Application manual. Airport Carbon Accreditation. Issue 14. December 2023.
- Airport Carbon Accreditation annual report 2021-2022. Airport Carbon Accreditation.
- Sustainability strategy for airports. ACI EUROPE. June 2019.
- Mission possible - reaching net-zero carbon emissions from harder-to-abate sector by mid-century. Energy Transitions Commission. November 2018.
- High-level guidance for developing and costing an airport net zero roadmap. ACI. 2023.
- Airport air quality manual – DOC 9889. ICAO. Second edition. 2020.
- Directive 2013/34/EU. EUROPEAN PARLIAMENT. June 2023.
- Directive (EU) 2022/2464. EUROPEAN PARLIAMENT. December 2022.
- Regulation (EU) 2019/631. EUROPEAN PARLIAMENT. April 2019.
- Scientific advice for the determination of an EU wide 2040 climate target and a greenhouse gas budget for 2030 2050. European Scientific Advisory Board on Climate Change. June 2023.
- 2023 sustainability report. RYANAIR Group.
- Greenhouse gas inventory guidance. Indirect emissions from purchased electricity. EPA (United States Environmental Protection Agency). January 2016.
- Report di sostenibilità. Aeroporto di Olbia Costa Smeralda 2022. Edition IV.
- Report di sostenibilità. Aeroporto di Olbia Costa Smeralda 2023. Edition V.
- Piano della qualità e della tutela ambientale 2024-2027. Aeroporto di Olbia Costa Smeralda. December 2023.
- Stakeholder engagement plan 2022-2024. Aeroporto di Olbia Costa Smeralda.
- Piano di sostenibilità 2022-2026. Aeroporto di Olbia Costa Smeralda. Last update 2024.
- Relazione sugli investimenti a WACC incrementale – Piano quadriennale degli interventi 2024-2027. Aeroporto di Olbia Costa Smeralda.
- Inventario delle emissioni per l'anno 2023.

6 REFERENCE YEAR

The reference year serves as the baseline against which all future carbon reduction efforts are measured along the path to Net Zero. To facilitate target-setting in line with global climate goals, Airports Council International (ACI) recommends using 2010 as the reference year, in alignment with the Intergovernmental Panel on Climate Change (IPCC) decarbonization scenarios. Many airports have adopted this year as a common benchmark for consistency and comparability.

However, ACI also recognizes that a different reference year may be more appropriate in certain cases—particularly when it better reflects an airport's operational context or when high-quality emissions data from 2010 are not available. In such instances, airports are permitted to select an alternative baseline year, provided the choice is well-justified and based on credible data availability. Although ACI advises using 2010 as the reference year, this approach was not suitable for Olbia Costa Smeralda Airport. Instead, 2023 was selected as the baseline year for the development of OLB's Net Zero Roadmap, as it represents the first year in which complete, consistent, and high-quality emissions data were collected across all relevant scopes. This ensures a robust and verifiable foundation for measuring future progress, setting realistic reduction targets, and evaluating the impact of mitigation strategies over time.

By establishing 2023 as its reference year, Olbia Airport ensures that its decarbonization pathway is grounded in reliable data and aligned with the practical realities of its operations—laying the groundwork for a transparent, credible, and actionable transition to Net Zero.

Within Scope 1 and 2 the main sources of emissions in 2023 are reported as follows:

Table 2 - Baseline Year Categories

Emission source	Example of emissions	CO_2e emissions (t)	% of Total Carbon Footprint	Emission per passenger ($kgCO_2e/pax$)	Emission per movement ($kgCO_2e/movement$)
Scope 1 – Heating	Diesel oil used for the heating machinery	73	19%	0.02	1.90
Scope 1 - Vehicles	Fuel used in vehicles, including airside transport, maintenance machinery, ground service equipment (GSE)	225	59%	0.07	5.86

Scope 1 - Cooling	Refrigerants	85	22%	0.03	2.22
Scope 1 – Wastewater	Emissions from the water consumption	0.02	0.005%	5.41×10^{-6}	4.62×10^{-4}
Scope 2 - Electricity	Electricity purchased from 3rd party (green)	-	-	-	-
Total		**383**	**100%**	**0.12**	**9.98**

It is worth highlighting that in 2023, OLB made a significant transition from purchasing grey electricity to sourcing green electricity. As a result of this change, they were able to reduce their Scope 2 emissions to zero.

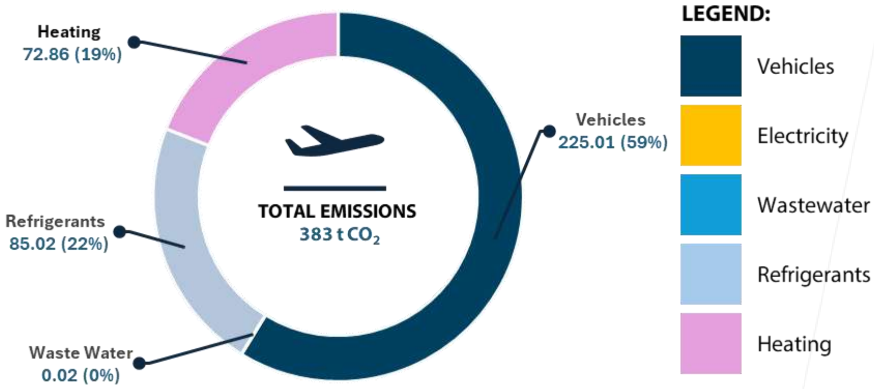

Figure 3: Baseline Year Split by Categories

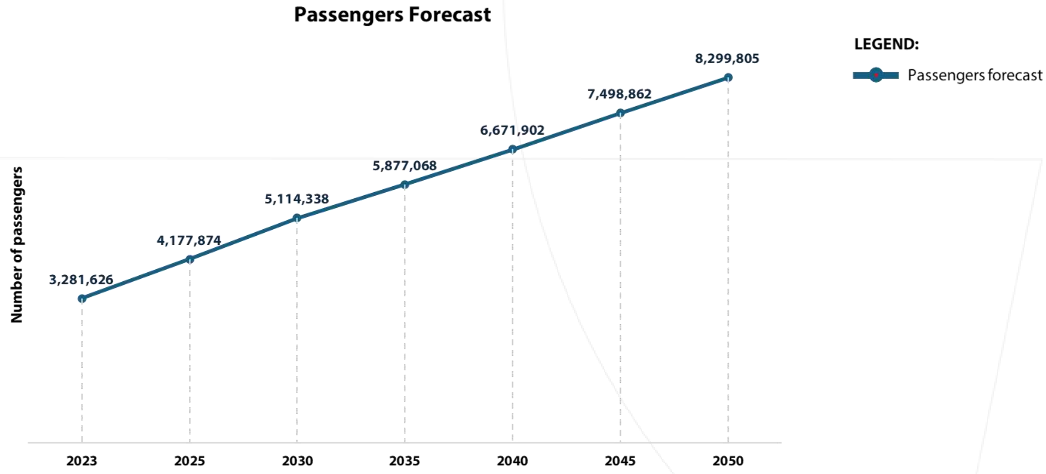

Figure 4: Passenger Forecast

The passenger forecast graph projects a steady increase in the number of passengers from 2023 to 2050. Starting at just over 3.2 million passengers in 2023, the forecast anticipates growth to approximately 4.2 million by 2025 and surpassing 5.1 million by 2030. This upward trend continues, reaching nearly 5.9 million in 2035, 6.7 million in 2040, and 7.5 million in 2045.

By 2050, the number of passengers is expected to climb to over 8.2 million. This consistent growth highlights the need for ongoing investment in infrastructure and services to accommodate increasing demand over the coming decades.

7 HISTORICAL ANALYSIS SCOPE 1&2

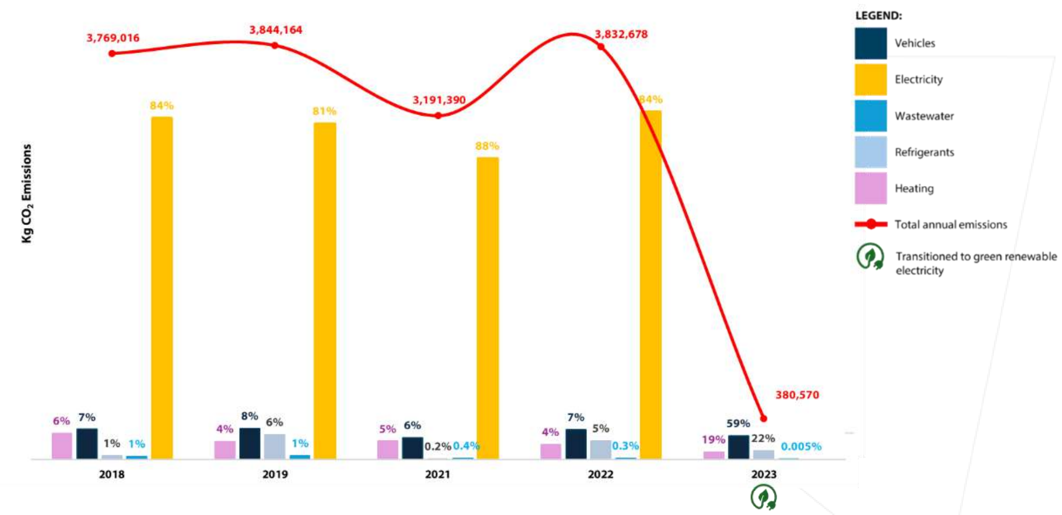

Figure 5: Historical Analysis by Categories

The figure above presents the historical greenhouse gas (GHG) emissions reported by Olbia Costa Smeralda Airport over the five-year period from 2018 to 2023. These data offer valuable insights into the airport's emissions trends and the relative contributions of different sources over time. A detailed analysis of this historical dataset reveals that Scope 2 emissions consistently represented the dominant portion of the airport's total emissions under the Scope 1 and Scope 2 categories. This predominance is primarily attributable to electricity consumption, specifically from non-renewable energy sources—commonly referred to as "grey electricity"—which significantly impacted the airport's overall carbon footprint during this period.

A pivotal development occurred in 2023, marking a major turning point in the airport's sustainability trajectory. In that year, Olbia Costa Smeralda Airport successfully completed its transition to the procurement of 100% renewable electricity, effectively eliminating Scope 2 emissions. This transition represents a critical milestone in the airport's climate action plan, reflecting a strong commitment to energy decarbonization and resulting in a dramatic reduction of emissions to zero. The impact of this shift is substantial, as it fundamentally reshapes the emissions profile and sets a new baseline for future carbon reduction strategies.

With Scope 2 emissions now eliminated, attention has shifted more directly to Scope 1 emissions, which have become the primary source of the airport's operational carbon footprint. Within this category, emissions from airport-owned vehicles now account for approximately 59%, making them the largest contributor. Refrigerant losses contribute around 22%, while heating systems—primarily fuelled by natural gas—make up the remaining 19%. These findings underscore the importance of continuing to address direct emissions sources in order to build on the progress achieved so far.

This evolution in the structure of emissions not only reflects the effectiveness of the airport's decarbonization initiatives to date but also highlights the emerging priorities in its sustainability strategy. Looking ahead, further progress toward the airport's Net Zero target will require a concentrated effort to reduce Scope 1 emissions.

8 BASELINE CARBON FOOTPRINT

The baseline scenario offers a comprehensive projection of the anticipated evolution of Scope 1 and Scope 2 greenhouse gas (GHG) emissions from the reference year, 2023, up to the long-term target year of 2050. This projection is developed under the key assumption that no additional mitigation or decarbonization measures will be implemented beyond those already in effect as 2023. In essence, it reflects a "Do nothing" scenario, where current technologies, energy sources, and operational practices remain unchanged over the coming decades.

The baseline scenario provides valuable insights into the natural trajectory of emissions in the absence of further climate action. It establishes a reference point against which all future reductions can be measured and assessed, allowing stakeholders to clearly understand the environmental implications of inaction. By visualizing what emissions levels will look like if the airport maintains the status quo, this scenario lays bare the gap between projected emissions and the desired Net Zero outcome.

Moreover, the baseline scenario plays a pivotal role in supporting decision-making and long-term sustainability planning. It helps to quantify the scale and urgency of the emissions reductions required to align with international and national climate targets. This understanding is essential for identifying high-impact intervention areas and for prioritizing investments in decarbonization initiatives such as clean energy, sustainable mobility, and infrastructure upgrades.

Ultimately, the baseline scenario acts as a strategic foundation for the airport's climate roadmap. It underscores the importance of immediate and sustained action, providing a clear contrast between a path of inertia and one of transformation. By highlighting the consequences of delayed action, it reinforces the need for a proactive and forward-looking approach to environmental management—one that ensures Olbia Costa Smeralda Airport contributes meaningfully to the global effort to limit climate change and achieve Net Zero emissions by 2050.

8.1 Assumptions and considerations

In developing the baseline scenario, several assumptions have been carefully considered to establish a realistic and data-driven projection of future developments at the airport.

Foremost among these is the expected significant growth in passenger traffic over the coming decades. Based on projections from the Master Plan, annual passenger volumes between 2040 and 2050 are anticipated to increase substantially, falling within a range of approximately 6 to 8 million passengers. This growth trajectory reflects broader trends in regional and international air travel demand and will inevitably place greater demands on airport operations, infrastructure, and associated emissions.

Concurrently, the evolution and expansion of airport infrastructure constitute another vital component shaping the baseline outlook. The scenario takes into account a series of planned capital projects and upgrades detailed in the Investment Plan and Design Feasibility Study for the expansion of the Terminal building, all targeted for completion by 2032. Key interventions include the expansion of the baggage claim area to accommodate higher passenger throughput, the enlargement of the departure lounge to improve passenger comfort and processing efficiency, and the introduction of a new swing gate facility. These infrastructure enhancements are designed to optimize airport capacity and enhance the overall travel experience. However, it is important to note that while these improvements will support increased operational efficiency, they will also contribute to changes in the airport's energy consumption patterns and, consequently, its emissions profile.

At the end, as anticipated, this projection is based on the fundamental assumption that no further mitigation or decarbonization efforts will be introduced beyond the measures already in place as of 2023. **Essentially, it represents a "do nothing" scenario in which 2023 technologies, energy sources, and operational procedures continue unchanged throughout the coming decades.**

8.2 Conclusion "Baseline Scenario"

The graph reported below presents the projected CO_2 equivalent (CO_2e) emissions, measured in tons, for Olbia Costa Smeralda Airport over the period from 2023 to 2050, under two distinct scenarios: the "Baseline – no measures since 2023" scenario, shown by the blue line, and the "Baseline year emissions" scenario, depicted by the grey spaced line. These scenarios provide a comparative outlook on how emissions may evolve depending on whether the airport maintains its current scale or experiences growth.

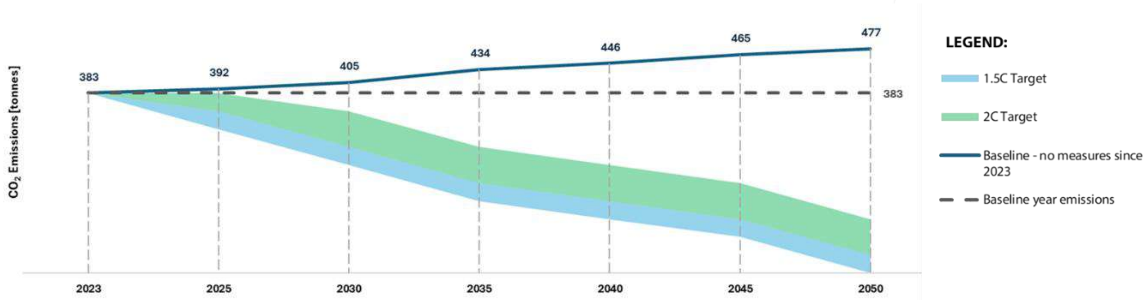

Figure 6: Baseline Emission Forecast

The blue and green areas in the graph represent the emissions reduction pathways necessary for the airport to stay in line with the global climate goals set by the Paris Agreement, aimed at limiting the average global temperature increase to 1.5°C (blue area) or, at most, 2°C (green area). This visual element serves as a reference for the level of ambition required to ensure compatibility with broader international climate targets.

In the base year of 2023, both scenarios begin at the same starting point of 383 tons of CO_2e. However, their trajectories quickly diverge. The "Baseline year emissions" scenario assumes that airport operations and passenger traffic remain relatively constant over the coming decades, resulting in stable emissions levels throughout the projection period.

In contrast, the "Baseline – no measures since 2023" scenario incorporates expected growth in airport activities, including increased passenger numbers, flights, and associated energy use. Under this assumption, emissions are projected to rise gradually, reaching approximately 477 tons of CO_2e by 2050, which represents a 25% increase compared to 2023 levels.

This comparison clearly illustrates the impact of growth-related emissions on the airport's carbon footprint and emphasizes the urgency of implementing targeted decarbonization strategies to avoid exceeding climate-safe thresholds. It also reinforces the importance of integrating sustainability planning into future airport development and capacity expansion decisions.

The following graph presents the projected trend of total CO_2 emissions (in tons) for Olbia Airport from 2023 to 2050 in the baseline scenario, with a breakdown by Scope 1 and Scope 2 emissions. Total emissions are expected to rise from 383 tonnes in 2023 to 477 tonnes in 2050, reflecting anticipated airport growth without additional mitigation measures. Scope 1 emissions, primarily from vehicles and on-site fuel use, make up the majority of the total, while Scope 2 emissions, attributable to purchased electricity, remain zero. The data emphasize the importance of addressing Scope 1 sources, particularly as electricity decarbonisation progresses, to effectively reduce the airport’s overall carbon footprint.

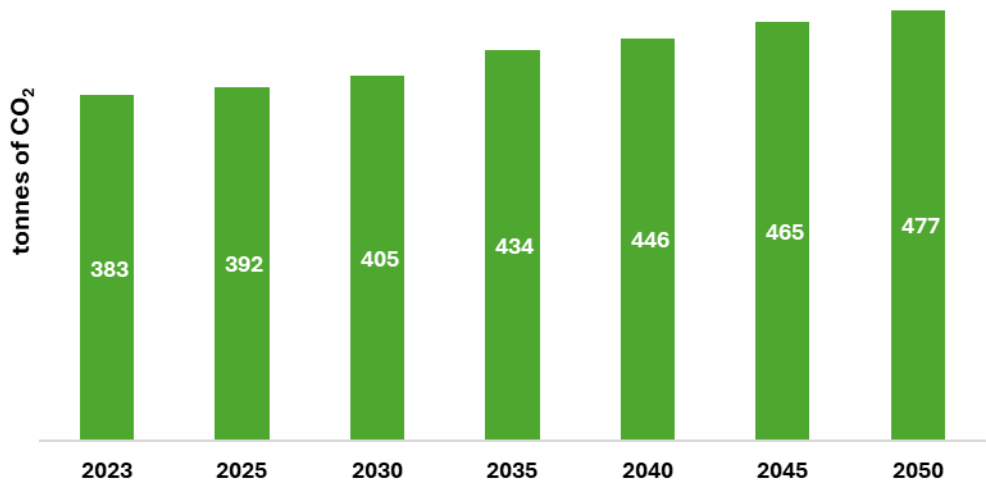

Figure 7: Baseline Forecast Emissions by Scope

The following figure presents a graphical representation of the percentage breakdown of CO_2 emissions by source at OLB from 2023 to 2050, based on the baseline scenario. This scenario assumes no additional decarbonization measures. The chart provides insight into how the relative contributions of various emission sources are expected to evolve over time. In this scenario, airport-owned vehicles consistently account for the largest share of emissions, rising from 59% in 2023 to an estimated 65% by 2050. This upward trend is primarily due to the projected growth in airport operations and associated ground transport needs, without the introduction of mitigation strategies such as electrification or alternative fuels.

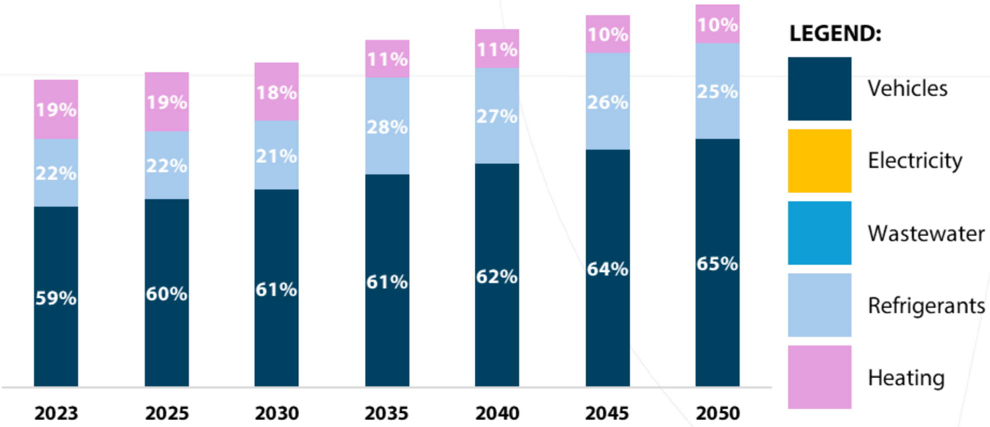

Figure 8: Baseline Split by Categories

Wastewater-related emissions contribute a relatively small but consistent portion throughout the analysis period, indicating limited variation in this source. Meanwhile, the relative share of emissions from refrigerants and heating systems gradually declines because of the increase of other emissions sources.

This evolving emissions profile highlights a shifting landscape, where ground transport becomes the dominant driver of the airport's carbon footprint in the absence of further action. As a result, it underscores the critical need for targeted mitigation measures in this area.

9 AIRPORT BENCHMARK

A comprehensive benchmarking analysis was carried out to identify a broad range of potential decarbonization measures applicable to the operations and infrastructure of Olbia Costa Smeralda Airport. This initial phase aimed to generate a long list of relevant actions, drawing on best practices, industry standards, and examples from comparable airports and transport hubs. The findings from this analysis provided a robust foundation for the next step in the process.

Each of the selected measures was carefully evaluated not only for its technical feasibility and alignment with airport operations, but also for its expected effectiveness in reducing emissions and its scalability within the context of Olbia Airport. This dual consideration ensures that the proposed actions are not only impactful in theory but also realistically implementable at the airport and at the pace required to meet climate goals. As a result of this analysis and dialogue with the Airport management, the original list was refined and prioritized, leading to the development of a shortlist of decarbonization measures, which is presented in the following section.

This shortlist primarily targets Scope 1 and Scope 2 emissions, which are directly attributable to airport operations. The focus on these categories reflects their central role in achieving the airport's Net Zero ambition, defined as a ≥90% absolute reduction in CO_2e emissions in Scopes 1 and 2 by 2050 or earlier. The measures identified aim to address key emission sources such as vehicle fleets, heating systems, energy consumption, and refrigerant use.

However, while this current phase emphasizes Scope 1 and Scope 2, it is important to recognize the growing importance of addressing Scope 3 emissions that fall outside the airport's direct control but are influenced by its activities, such as passenger and employee travel, supply chain logistics, and airline operations. To holistically reduce the airport's climate impact, a clear commitment to tackling Scope 3 emissions will be essential by 2050 or sooner.

An initial selection of potential Scope 3 mitigation measures has also been identified and is referenced in the following material, offering a foundation for future planning and broader stakeholder engagement as the airport advances along its decarbonization pathway.

Each measure has been assessed using the following criteria:

Table 3 - Decarbonisation Measures Key Performance Indicators

	Assessment criteria
	Location at airport • Terminal • Airside • Landside
	Typical emissions scope • Scope 1 • Scope 2 • Scope 3
	Emissions impact Percent emissions (Reduction against typical business as usual technology/approach)
	Implementation timeline Years (Related to technological maturity - Qualitative categorization) • High: Fully commercialized and widely adopted technologies with proven track record • Medium: Emerging technologies that are already in use but not widely adopted yet • Low: Innovative or experimental technologies that are still in development or early-stage deployment
	Financial viability • Capital Expenditure (CAPEX) • Operational Expenditure (OPEX) An indicative estimate has been derived from desktop research, including cited industry reports, relevant articles, and insights from development experience
	Stakeholders to be involved • Identified stakeholders that are affected by the measure in terms of decision making, implementation, and monitoring
	Industry benchmark example • Measures implemented at other airports

9.1 Electrification of Ground Support Equipment (GSE)

Airside ground support equipment (GSE) and vehicles are an integral part of daily airport operations, performing a wide range of essential tasks that ensure the efficient and safe handling of aircraft on the ground. These activities include baggage handling, passenger transport between terminals and aircraft, aircraft pushback and towing, and refuelling operations, among others. Given the frequency and intensity of their use, GSE represents a significant source of direct (Scope 1) emissions, particularly when powered by diesel or other fossil fuels.

In this context, the adoption of electric ground support equipment (eGSE) presents a promising opportunity for decarbonization. eGSE eliminates emissions associated with internal combustion engines, offering a cleaner, quieter, and more energy-efficient alternative to conventional GSE. When powered by electricity sourced from renewable energy, the emissions reduction potential of eGSE can reach up to 100%, making it a key strategy for achieving substantial progress toward Scope 1 emissions reduction targets.

It is important to note that a portion of the current GSE fleet is not presently eligible for electrification, due to the lack of available electric models on the market for certain specialized equipment types. As a precautionary assumption, it is estimated that approximately 10% of the fleet will remain non-electrifiable in the foreseeable future.

Table 4 - Electrification of Ground Support Equipment (GSE) - Key Performance Indicators

Location in airport: **Airside, Landside**	Emissions impact: **Up to 100%**	CAPEX Estimate: • **Purchase price 30-35% higher than petrol vehicles** • **9,000 € /charger** OPEX Estimate: • **Potentially reduce by 100% the cost of petrol if electricity is generated on site** • **Reduced maintenance cost by 35-45% per vehicle**
Typical emissions scope: **Scope 1**	Implementation timeline: • Light commercial vehicles: 2-5 years Technological maturity: high • Heavy duty vehicles: 5-10 years Technological maturity: low	Stakeholders to be involved **Airport fleet management department**
Industry benchmark example: • In 2015, Seattle-Tacoma Airport launched a $45 Million programme to install nearly 570 electric vehicle charging points at every gate by 2021, aiming to reduce CO_2e emissions by 10,000 tonnes, and save nearly 1 Million gallons of petroleum annually[2]. • In 2019, Brussels Airport invested $21 Million in thirty electric e-buses to transport passengers, saving around 600 tonnes of CO_2e annually[3]. • Bergamo Airport is aiming to convert almost all of GSE to electric vehicles.		

[2] Converting airport equipment to electric

[3] Brussels Airport introduces electric buses to serve its passengers

Table 5 - Electrification of Ground Support Equipment (GSE) – Advantages and Considerations

Advantages	Considerations
• Additional benefits include improved local air quality and reduced noise compared to combustible fuel alternatives. • Lower refuelling costs and reduced exposure to petrol price fluctuations.	• Upgrading airport electrical infrastructure may be necessary, potentially leading to high costs. • Fleet battery recharging requirements may pose challenges for 24-hour airport operations, potentially requiring a larger fleet to accommodate charging rotations.

9.2 Use of Low Carbon Fuels

Low carbon fuels (biofuels, HVO, etc.) play a key role in the transition to electrification, providing a lower-emission alternative for both stationary sources (such as generators) and mobile sources (vehicles, GSE). HVO is an effective solution for aircraft refuelling vehicles and other GSE where electric alternatives are not yet widely available. This includes tow trucks, self-propelled aircraft stairs, ground power unit, loaders, aircraft pushback vehicles, baggage belt loaders, cargo transporter, and air start units. HVO50 and HVO100 are types of renewable diesel derived from waste and residues (like animal fat, industrial waste, wastewater) making it a more sustainable option with up to 90% less emission compared to diesel.

Table 6 - Use of Low Carbon Fuels - Key Performance Indicators

Location in airport: **Airside, Landside**	Emissions impact: **Up to 90%**	CAPEX Estimate: **N/A** OPEX Estimate: **Increase of 3-10% compared to fossil-based options**
Typical emissions scope: **Scope 1**	Implementation timeline: **<2 years** Technological maturity: high	Stakeholders to be involved **Airport fleet management department**
Industry benchmark example: • London Heathrow Airport's fleet of 70 Heavy Goods Vehicles has switched to Hydrotreated Vegetable Oil (HVO), cutting the fleet's carbon footprint by 77% and reducing CO_2e emissions by over 2,400 tonnes annually[4]. • Bergamo Airport is aiming to use HVO as an interim alternative to the complete GSE fleet electrification.		

[4] Biofuel switch for UK fleet cuts dnata's CO2 emissions by over 2,400 tonnes annually

Table 7 - Use of Low Carbon Fuels – Advantages and Considerations

Advantages	Considerations
• Can be used in existing diesel-powered equipment without modifications, enabling immediate adoption. • Reduces particulate matter and NOx emissions, contributing to a healthier airport environment.	• Global production capacity is still growing, and supply constraints may impact large-scale adoption. • While HVO is an effective interim solution, it should be integrated as part of a broader strategy that includes electrification for long-term sustainability.

Planning recommendations

- Engage with OEM's to validate compatibility and ensure seamless transition to HVO without performance issues
- Implement small-scale trials on various GSE to assess efficiency and operational reliability.

A promising development is on the horizon for Sardinia's decarbonization efforts: the arrival of HVO100 (Hydrotreated Vegetable Oil) fuel supply on the island. For the first time in 2025, HVO100 is being distributed through service stations in Sardinia, starting with Mesu'e Rios in Chilivani, Sassari. This milestone signifies a major shift in local energy infrastructure, enabling businesses and operators across Sardinia to transition their existing diesel-powered vehicles, without engine modifications, to significantly lower-emission fuel.
Looking ahead, this initial rollout is expected to expand in coverage and availability, supported by broader trends in Italian and European investment in HVO production and distribution. As major refiners scale up HVO production and retrofit facilities in Sardinia and beyond, wider adoption appears increasingly feasible.

9.3 Heat Pumps

Heat pumps play a crucial role in the airport's energy transition by providing efficient heating and cooling for terminal buildings and operational areas. Unlike traditional systems that rely on fossil fuels, modern heat pumps use electricity to transfer heat, significantly reducing direct emissions. When powered by renewable energy, heat pumps can virtually eliminate greenhouse gas emissions associated with climate control, offering an effective and sustainable solution for maintaining indoor comfort.

Table 8 - Heat Pumps - Key Performance Indicators

Location in airport: **Terminal**	Emissions impact: **Up to 100% (if electricity used is 100% renewable)**	CAPEX Estimate: • **Approximately 1.5 million €** OPEX Estimate: • **Potentially reduce by 100% the cost of petrol if electricity is generated on site**

<table>
<tr><td>Typical emissions scope:
Scope 1</td><td>Implementation timeline:
<2 years
Technological maturity: high</td><td>Stakeholders to be involved - Airport energy department</td></tr>
<tr><td colspan="3">Industry benchmark example:
• In 2024, Portland International Airport received a $6 million grant to replace its fossil fuel-powered terminal heating system with an electric-powered heat pump. This upgrade is projected to reduce the airport's energy required for heating and cooling by 83% and significantly cut greenhouse gas emissions, demonstrating how large-scale adoption of heat pumps at airports can drive both operational efficiency and substantial climate benefits [5].
• Bergamo airport planned to introduce this measures in its net zero roadmap.</td></tr>
</table>

Table 9 - Heat Pumps – Advantages and Considerations

Advantages	Considerations
• Heat pumps can reduce energy usage up to 50% compared to conventional HVAC systems, leading to significantly lower utility bills and operational costs over time for large facilities like airports. • Heat pumps can reduce CO_2 emissions and improve local air quality, especially when renewable electricity is used.	• The initial costs for purchasing and installing heat pump systems can be higher than traditional systems, and proper sizing, design, and placement are crucial to ensure optimal performance and avoid operational issues.

9.4 Use of Very Low GWP Refrigerants

Very low global warming potential (GWP) refrigerants, such as R1234yf, are essential in reducing the climate impact of cooling systems at airports. These next-generation refrigerants offer a sustainable alternative to traditional high-GWP substances, significantly lowering direct greenhouse gas emissions from air conditioning and refrigeration units. R1234yf, for example, has a GWP of less than 1 making it an ideal choice for terminal HVAC systems, cold storage, and catering facilities.

[5] FlyPDX - Oregon Delegation Announces an Additional $6 Million for Major Energy Efficiency Upgrades at PDX

Table 10 - Use of Very Low GWP Refrigerants - Key Performance Indicators

<table>
<tr>
<td>Location in airport:
Terminal</td>
<td>Emissions impact:
>90% less emissions compared to traditional refrigerants</td>
<td>CAPEX Estimate:
N/A
OPEX Estimate:
• Small increase in price compared to traditional refrigerants</td>
</tr>
<tr>
<td>Typical emissions scope:
Scope 1</td>
<td>Implementation timeline:
<2 years
<u>Technological maturity:</u> high</td>
<td>Stakeholders to be involved: Airport energy department</td>
</tr>
<tr>
<td colspan="3">Industry benchmark example:
• In 2019, Gatwick Airport completed the UK's first installation of an ultra-low GWP chiller using Carrier's AquaForce 30XAV system with PUREtec HFO R-1234ze refrigerant, which has a GWP rating of less than 1. This project was part of Gatwick's broader environmental strategy to transition away from high-GWP refrigerants, reduce carbon emissions by 50%, and improve energy efficiency. The new chiller not only delivers significant reductions in the airport's carbon footprint and running costs, but also integrates seamlessly with existing building systems, demonstrating how switching to very low GWP refrigerants can help airports achieve ambitious sustainability targets while maintaining operational resilience and flexibility[6].</td>
</tr>
</table>

Table 11 - Use of Very Low GWP Refrigerants – Advantages and Considerations

Advantages	Considerations
• Very low GWP refrigerants, such as R1234yf, dramatically reduce the climate impact of cooling systems, helping airports lower their direct greenhouse gas emissions and comply with evolving environmental regulations. • These refrigerants are often compatible with modern, high-efficiency HVAC and refrigeration equipment, supporting energy savins and long-term sustainability goals.	• The transition to very low GWP refrigerants may require the replacement or significant modifications of existing equipment, which can involve upfront investments and operational downtime. • Special handling, training and updated safety protocols may be necessary, as some low GWP refrigerants have different flammability or chemical properties compared to traditional refrigerants.

By adopting very low GWP refrigerants, airports can achieve substantial reductions in their overall carbon footprint, support compliance with evolving environmental regulations, and contribute to the aviation industry's broader decarbonisation goals.

[6] Case study - Gatwick Airport Ultra Low GWP | Carrier Europe

Notably, R1234yf is also compatible with R32, the refrigerant currently used in Olbia Airport's heat pump systems, which facilitates a smoother transition with minimal technical adjustments and lower implementation costs.

9.5 On-site Solar PV

Solar photovoltaic (PV) panels capture sunlight and convert it into electricity, offering a clean and renewable energy source. These systems can be installed on rooftops, car park canopies, or ground-mounted structures, making them highly adaptable to available space. Depending on the system's capacity and configuration, excess electricity can be stored in batteries, allowing for use during periods of low solar generation or to help manage peak demand more efficiently.

Table 12 - On-Site Solar PV - Key Performance Indicators

Location in airport: **Airside, Terminal, Landside**	Emissions impact: **Up to 100%**	CAPEX Estimate: **~ 360€/sqm** OPEX Estimate: **0.016€/W**
Typical emissions scope: **Scope 2**	Implementation timeline: **2-5 years** Technological maturity: medium	Stakeholders to be involved **Airport Sustainability Department, Technical Services**
Industry benchmark example: • Rome Fiumicino Airport inaugurated in January 2025 Europe's largest airport solar farm which extends for almost 2.5km and will contribute to reducing the airprot's CO_2 emissions by over 11,000 tons per year. [7] • Denver International Airport in the United States operates multiple solar farms with a combined capacity exceeding 10 megawatts, significantly reducing its carbon footprint and lowering electricity costs[8]. • Bergamo airport has planned to install PV panels inside the airport boundary area.		

[7] ADR: Rome Fiumicino Airport's new Solar Farm

[8] Considerations for Airport Solar Farms

Table 13 - On-Site Solar PV - Advantages and Considerations

Advantages	Considerations
• Mature technology for solar PV, Battery storage technology continuously evolving and systems becoming cheaper. • Scalable to meet anticipated electrical demand and available space. • Low maintenance and a typical lifespan of +25 years. • Using battery storage improves energy supply resilience.	• Limited to the availability of space for installation. • Weight of PV panels may necessitate additional structural reinforcement for roof-mounted installations. • Large spatial provision for battery storage. required. Typically, a 40ft shipping container houses 1MWh of storage.

Planning recommendations:

- Assess the airport's energy demand profile to determine supply and demand requirements.
- Compare the airport's energy consumption patterns with projected PV generation, including battery storage potential.
- Conduct a safety assessment before implementation, including glint and glare analysis to prevent interference with aviation operations.

At Olbia Airport, plans are underway to install PV panels on the canopies covering the parking areas, maximizing space utilization while generating on-site renewable energy. This initiative is designed to enhance the airport's energy self-sufficiency, reduce exposure to electricity market price fluctuations, and ensure that the energy used is 100% green. In addition to supporting sustainability goals, the investment in solar infrastructure is expected to deliver long-term economic returns, contributing to both operational resilience and financial efficiency.

10 DECARBONISATION PATHWAYS

To define a suitable decarbonisation pathway for Olbia Costa Smeralda Airport, it is essential to conduct a comprehensive evaluation of various scenarios for each major emission source. This process involves analysing not only the technical feasibility of available solutions but also assessing their performance in the context of economic conditions, anticipated technological developments, and the evolving regulatory and policy landscape at the regional, national, and international levels.

Each scenario reflects different assumptions regarding the pace of innovation, market trends, funding availability, and the stringency of future environmental regulations. By simulating and comparing multiple trajectories, it becomes possible to better understand the range of options available, and the trade-offs associated with each.

By integrating the insights from these scenarios, flexible and adaptive decarbonization pathways that respond to uncertainty and changing priorities over time can be developed. These pathways help identify the most effective measures to implement in the short, medium, and long term, depending on the targeted level of emissions reduction, the cost-efficiency of interventions, and the infrastructure readiness of the airport.

10.1 Emission Reduction Scenarios

An overview of the decarbonisation scenarios for category (Vehicles, Heating, Refrigerants, Wastewater and Electricity) is presented in the following table. Each scenario outlines how the respective emission sources are developed in the final stage of the roadmap, corresponding to the year 2050.
The objective is to define two distinct pathways: one that minimizes CAPEX, and another that prioritizes the earliest possible achievement of net-zero emissions.

Table 14 - Overview Decarbonisation Scenarios – 2050 horizon

Scenario	Vehicles	Heating	Refrigerants	Electricity
Baseline (reference year 2023)	58% Diesel 42% Electric	72% Diesel 28% Heat pumps	Use of: R-407C, R-410 and R-32	100% Purchased green electricity
Pathway 1	90% Electric Vehicles 10% Diesel	100% Heat pumps	R-32 leak from 2035 (heat pumps used for cooling)	60% Purchased green electricity 40% PV
Pathway 2	90% Electric 10% HVO	100% Heat pumps	Transition to use of R-1234yf instead of R-32	60% Purchased green electricity 40% PV

10.2 Emission Reduction Pathways

The previous results informed the development of the forecast scenarios shown in the following figure. The graph illustrates different emissions pathways aligned with the Paris Agreement's 1.5°C and 2°C warming limits. The Paris Agreement's 1.5°C pathway (green) represents the most ambitious target, aiming for net-zero emissions by 2050 with at least a 90% reduction from the baseline. The 2°C pathway (blue) reflects a more moderate reduction, with emissions declining more gradually and net-zero reached by 2060.

The results from the preceding analysis provided the foundation for developing the forecast scenarios illustrated in the figure below. These scenarios depict a range of potential emissions reduction trajectories, each aligned with internationally recognized climate targets under the Paris Agreement, which aims to limit the rise in global average temperature to well below 2°C, and ideally to 1.5°C, above pre-industrial levels.

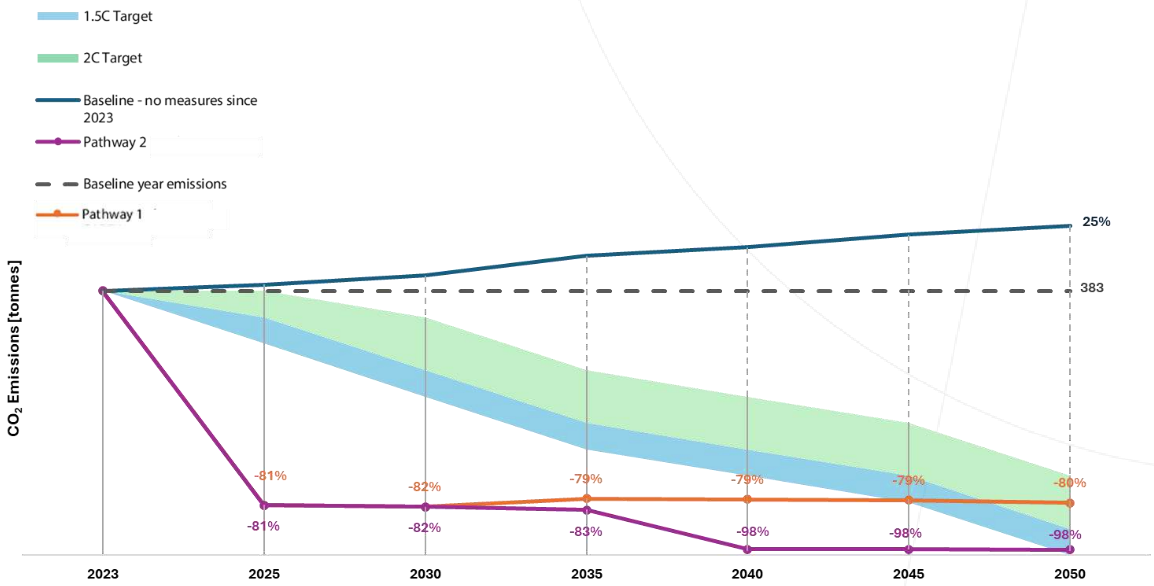

Figure 9: Evolution of Pathways

In the subsequent sections, each of these emissions pathways will be examined in detail.

10.2.1 Pathway 1 – OLB Planned Interventions

In the OLB Planned Interventions scenario (referred to as Pathway 1), the airport embarks on a cost-effective decarbonization pathway that unfolds over several distinct phases through 2050.

Beginning with ground support equipment (GSE), with an increase in electric vehicles projected between 2023 (with 44 electric GSE) and 2025 (with 91 electric GSE), the fleet will stabilize at 90% electric penetration through mid-century, solidifying a dominant low-emission GSE sector.

In parallel, the heating and cooling sector undergoes a full transformation: all systems are converted to heat pumps, existing buildings are systematically retrofitted, and refrigerant systems are overhauled with no top-ups until 2035, after which leakage becomes effective. This ensures the complete transition to efficient, low-GWP climate control.

Regarding electricity supply, an optimized strategy is adopted combining purchased green electricity and on-site generation. By 2025, the mix will be 79% procured renewable energy and 21% generated via solar PV. By 2030, this balance shifts to 56% green procurement and 44% solar self-generation, supported by expanded PV coverage. Below is a summary of the existing and planned photovoltaic systems, including their key technical specifications.

- **2024:** installation of a photovoltaic system with an annual output of 1,720.6 MWh/year, capable of covering approximately 21.4% of current electricity consumption.
- **2026:** system installed on canopies covering the GSE charging bays – Installed capacity: 310 kWp – Energy produced: 447.95 MWh/year – Occupied area: 1,800 m² – Power density: 0.173 kW/m².
- **2027:** system installed on new canopies at the Main Park – Installed capacity: 700 kWp – Energy produced: 786.17 MWh/year – Occupied area: 3,400 m² – Power density: 0.205 kW/m².

According to the 2024–2027 Quality and Environmental Protection Plan (Piano della Qualità e della Tutela Ambientale 2024-2027), the solar panel arrays, over parking zones and GSE ones, will continue to generate clean energy through 2050.

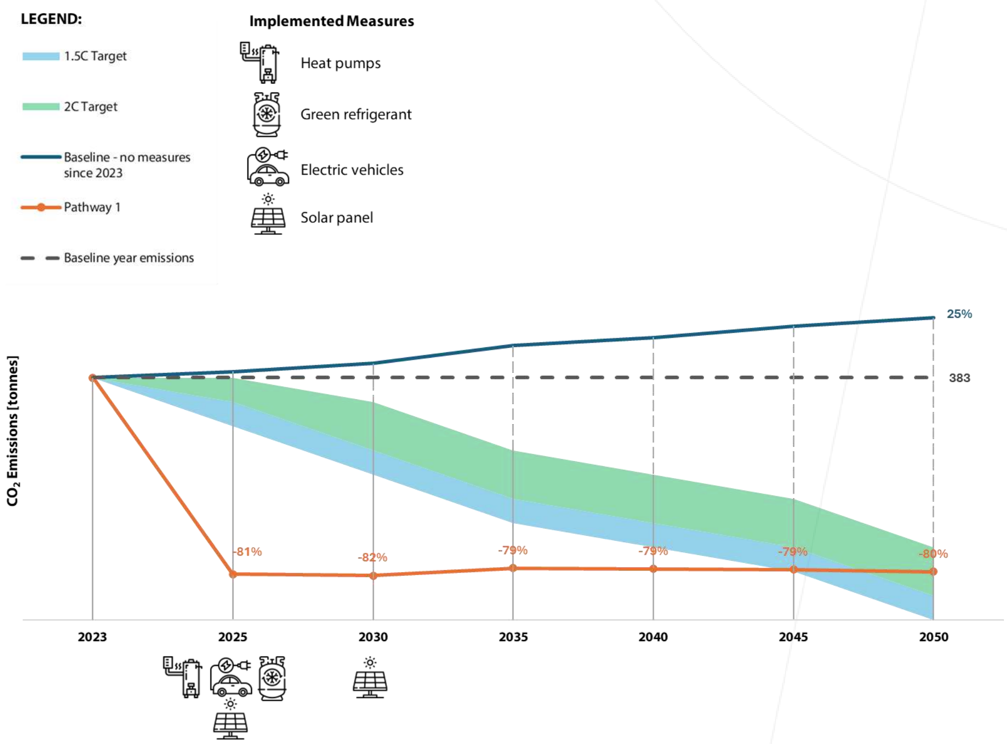

Figure 10: Pathway 1 Timeline

Collectively, this structured pathway leverages established, cost-effective technologies, such as electric vehicles, heat pumps, building retrofits, enhanced refrigerant management, and solar PV installations, to steadily drive down emissions while keeping upfront investment requirements modest. By focusing on proven and scalable solutions, the airport can progress towards decarbonization without large immediate financial outlays.

However, it is crucial to acknowledge that this approach alone does not achieve the Net Zero emissions target by 2050. Without additional and higher-cost interventions the airport cannot fully eliminate residual emissions. Therefore, while this pathway lays a solid foundation and generates meaningful emissions reductions at reasonable cost, supplementary, more ambitious measures will be essential in the coming decades to ensure compliance with the Paris-aligned 1.5 °C trajectory and to secure genuine Net Zero outcomes by mid-century.

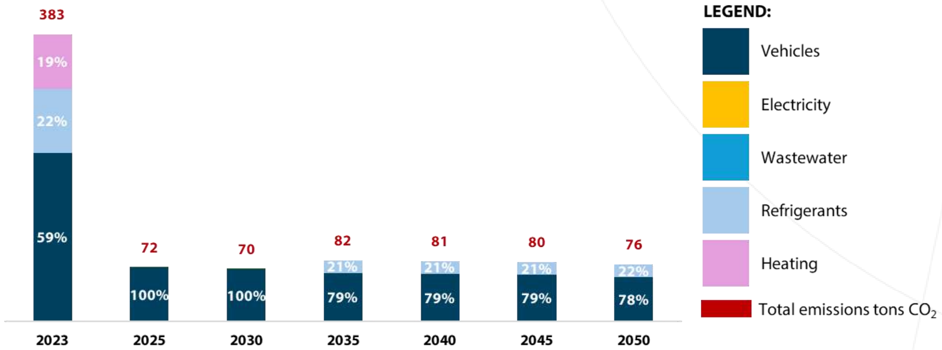

Figure 11: Pathway 1 - Distribution of emissions by categories

The figure above illustrates the projected decline in total emissions from 2023 to 2050, with emissions falling from 383 tons to 76. In 2023, emissions are divided among vehicles (59%), refrigerants (22%), and heating (19%). By 2025 and 2030, vehicles account for 100% of emissions, as other sources are eliminated. From 2035 onward, a small share of emissions from refrigerants reappear, but vehicles continue to dominate, making up almost 80% of emissions through 2050. The data highlights significant progress in reducing emissions from heating and refrigerants, while vehicle emissions remain the main contributor over the long term.

Scope 1 – Insights

The figure below offers a detailed, year-over-year breakdown of CO_2 reductions attributed to each evaluated decarbonization measure applied for Scope 1. Emissions savings are both segmented by individual measures and categorized according to their source, such as vehicles, heating/cooling, refrigerants, and electricity. This structure allows to clearly visualize the cumulative impact of each action over time and understand which emission categories contribute most significantly to overall reductions.

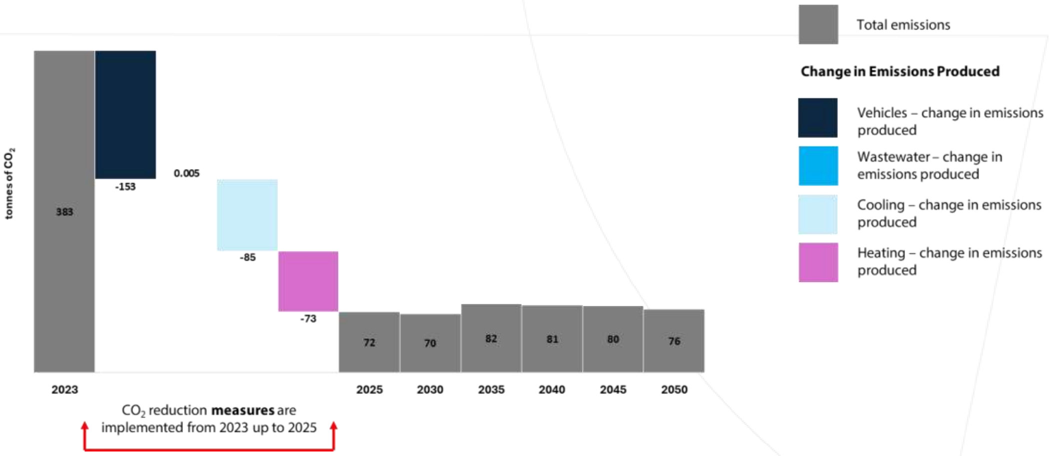

Figure 12: Scope 1 - Categories Change in Emissions 2023-2050

10.2.2 Pathway 2 – Earliest Net Zero

In the Earliest Net Zero scenario (reffered to as Pathway 2), the airport pursues an accelerated, ambisious decarbonization startegy, targeting the net zero carbon emissions well before 2050. This approach unfolds through a series of targeted interventions across vehicles, heating, cooling, and electricity systems, as illustrated in the graph.

The transition to an electric vehicle fleet (>90% including the majority of the GSE) is prioritized from the start, with significant electrification of the fleet and with the remaining of the 10% GSE transitioned to using a low emission carburant (HVO50 or HVO100). Key milestones are marked in 2023 (42% electric vehicles), 2035 (85% electric vehicles), and 2040 (90% electric vehicles), indicating ongoing upgrades to electric vehicles and sustained reductions in vehicle-related emissions.

At the same time, the heating and cooling sector undergoes a complete overhaul: all systems transition to heat pumps, existing buildings are thoroughly retrofitted, and refrigerant systems are revamped with no refilling needed until 2035, after which leakage control measures become fully effective and low GWP refrigerants are used in order to ensure continued emission reductions.

The airport systematically increases the share of self-produced renewable electricity, with major interventions in 2025, 2030 (According to the 2024–2027 Quality and Environmental Protection Plan (Piano della Qualità e della Tutela Ambientale 2024-2027) and 2045 (the airport will be able to fully meet its electricity needs with self-produced renewable energy). These include the expansion of on-site renewable generation, such as solar PV installations.

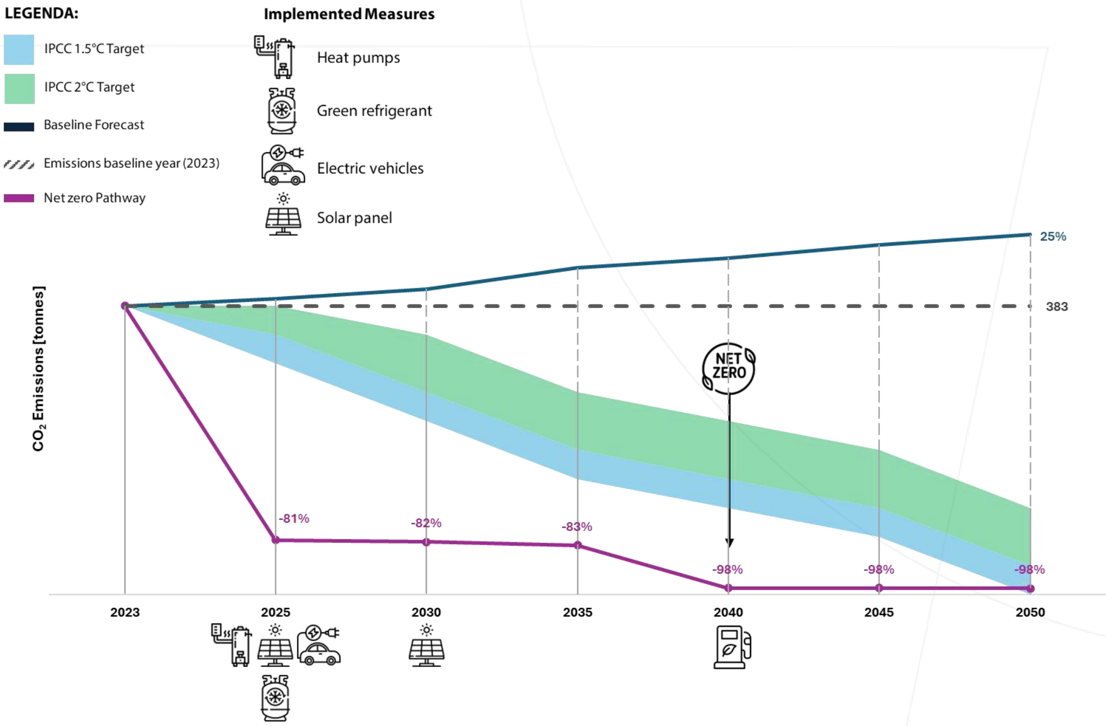

Figure 13: Pathway 2 Timeline

In the Figure above it is observed that the pathway achieves a dramatic reduction in CO_2 emissions, with an 80% decrease by 2025 compared to the baseline. By 2030, emissions are down by 825, and by 2040, a 98% reduction is achieved—reaching the net zero threshold. After reaching net zero in 2040, emissions remain at minimal levels, with a 98% reduction maintained through 2050.

The emissions trajectory stays bellow the 1.5°C target range, as indicated by the shaded area on the graph, ensuring compliance with international climate commitments.

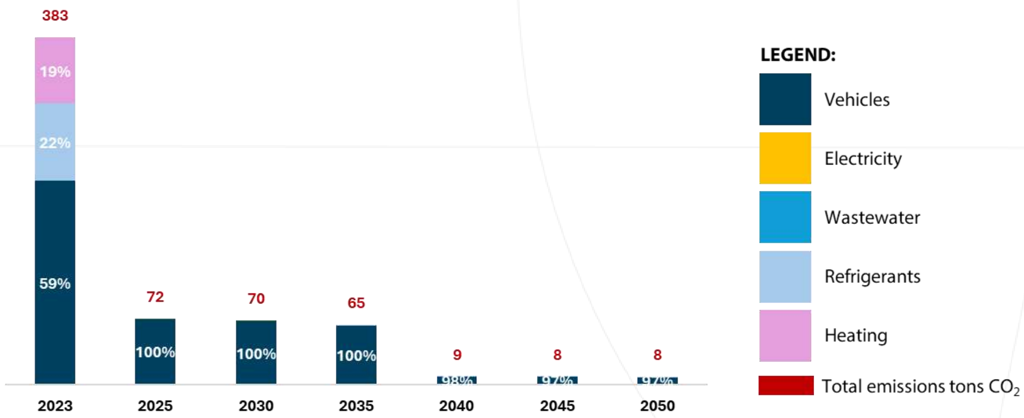

Figure 14: Distribution of emissions by categories

This graph shows a dramatic reduction in total emissions from 2023 to 2050, with emissions dropping from 383 tons to as low as 8 tons of CO_2. In 2023, emissions come mainly from vehicles (59%), refrigerants (22%), and heating (19%). By 2025 and beyond, vehicles become the significant source of emissions, making up 98 up to 100% of the total. From 2040 onwards, vehicle emissions remain dominant while still reducing due to the transition of HVO for the non-electric fleet, with a small contribution (2%) from refrigerants reappearing, while heating and other categories are eliminated.

Scope 1 – Insights

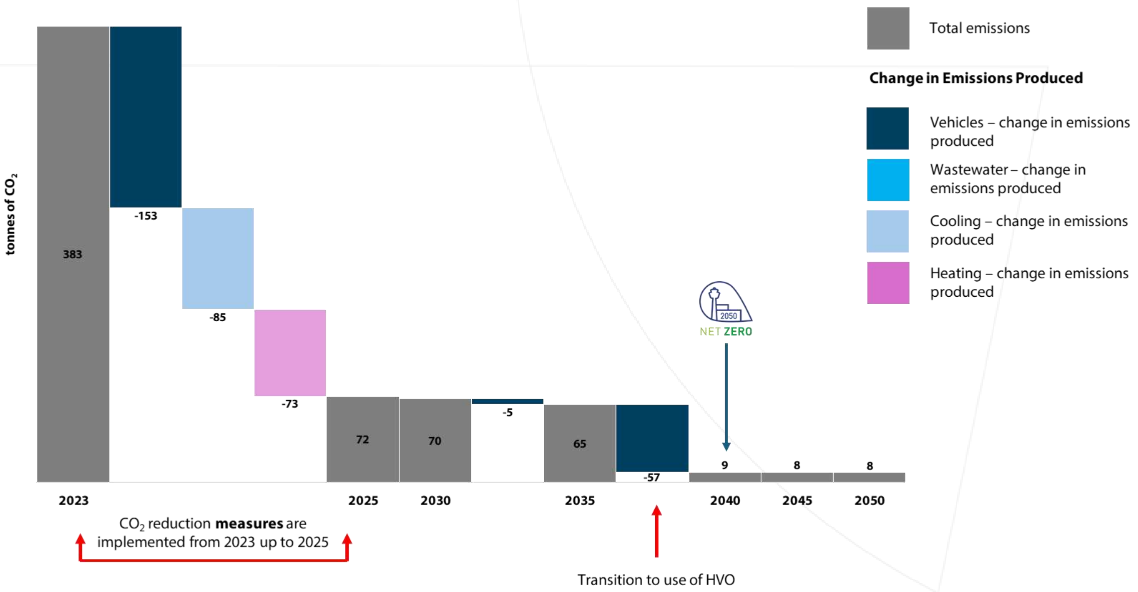

Figure 15: Scope 1 - Categories Change in Emissions 2023-2050

The figure above provides a comprehensive, year-by-year visualization of CO_2 emissions reductions achieved through targeted decarbonization measures for Scope 1 emissions. Each reduction is distinctly attributed to specific interventions and is categorized by source—namely, vehicles, wastewater, cooling, and heating. This segmented approach enables a clear understanding of the cumulative and individual impacts of each action over the timeline.

The color-coded format highlights the relative contribution of each emission source to the overall reduction. Vehicles (dark blue) emerge as the dominant factor, especially as the fleet transitions to electric power. Heating (purple) and cooling systems (light blue) also play crucial roles, particularly in the early years, as outdated technologies are replaced with more efficient alternatives. Wastewater management (blue), while a smaller contributor, remains relatively stable across the period.

11 Key Performance Indicators (KPI's)

KPIs are crucial for effectively monitoring progress and should be aligned with financial instruments to ensure consistency between sustainability goals and financing strategies. The following section provides an overview of global sector-specific KPI definitions.

11.1 Global sector-specific KPI's

Published in June 2020, the Sustainability-Linked Bond Principles (SLBP) provide guidelines that recommend structuring features, disclosure, and reporting practices for sustainability-linked bonds. To support implementation, the SLB Working Group released an Illustrative KPIs Registry[9], developed based on a materiality matrix that identifies the most material sustainability themes for each sector. Building on this framework, the following table presents selected KPIs for the aviation sector, specifically for the airport subsector. In addition to sector-specific KPIs, some cross-sector KPIs were also included to better reflect RAC's decarbonisation measures. The KPI Registry ensures that KPIs are aligned with key sustainability themes and the United Nations Sustainable Development Goals (SDGs). Moreover, global benchmarks for KPI definition highlight initiatives and frameworks that provide content and guidance to support the definition and implementation of these metrics.

Table 15 - KPI's derived from the 2023 SLBP Illustrative KPI Registry

Category	KPIs	SDGs	Global Benchmarks for KPI Definition
GHG Emissions and Energy	Absolute energy consumption (GWh/year)	7 Affordable and clean energy; 12 Responsible consumption and production; 13 Climate action	GRI 302
GHG Emissions and Energy	Proportion of renewable energy used against total energy consumption (%)	7 Affordable and clean energy; 12 Responsible consumption and production; 13 Climate action	IEA World Energy Outlook IRENA RE100
GHG Emissions and Energy	Scope 1, 2, and 3 GHG emissions (intensity or absolute) (tCO_2, $kgCO_2e$/pax)	9 Industry, innovation and infrastructure; 13 Climate action	-
Waste	Percentage of waste recycled or otherwise recovered in an environmentally sustainable way (%)	12 Responsible consumption and production	GRI (306-4)
Waste	Total weight of waste generated (t/year)	12 Responsible consumption and production	GRI (306-4)
Water	Proportion of reused/recovered/recycled water	6 Clean water and sanitation; 14 Life below water	CDP Water Security GRI (303-3)

[9] Sustainability-Linked Bond Principles (SLBP) » ICMA

12 COST CONSIDERATIONS

In this chapter, the operative costs (OPEX, Operational Expenditure) and the ones related to the investments planned (CAPEX, Capital Expenditure) are presented.

12.1 Operational Expenditure (OPEX)

In order to project and develop the OPEX trends for the future, all the costs related to the day-by-day expenses are needed. Some of them are extremely difficult to estimated due to their uncertainty in the future and, for this reason, several assumptions must be imposed. From this viewpoint, it follows that:

- **Vehicles:** the OPEX for vehicles is calculated by adding the maintenance costs to the product of annual consumption (for GSE and Personnel), the number of vehicles, and the current fuel price. For electric vehicles, only the maintenance cost is included under the vehicles category, while the electricity consumption and its corresponding cost (in place of fuel) are accounted for in the electricity category.
- **Heating:** OPEX in this category is only applicable to the baseline forecast, where it is calculated by multiplying the number of Liters of diesel consumed by the current diesel price. As with vehicles, the OPEX related to energy consumption for heat pumps is included in the electricity category.
- **Refrigerants:** the annual amount of coolant used in the forecast is determined as a ratio between the amount used in the baseline year and the surface of the building in the baseline year and current year. A price factor in €/kg based on Italy current prices for refrigerants is used to determine the OPEX.
- **Waste Water:** the annual OPEX is calculated as the total amount of wastewater in Liters produced multiplied by the a factor = 0.2€/L[10].
- **Electricity:** the OPEX is an estimation based on the forecasted demand of electricity in kWh and a factor of 0.016€/W[11].

12.1.1 Pathway 1 – OLB Planned Interventions

The graph bellow shows the projected evolution of the airport's operating expenses (OPEX) from 2023 to 2050, segmented by Scope 1 and Scope 2 emissions. Over time, total OPEX decreases from €1.1 million in 2023 to €0.96 million in 2050. The composition of these expenses shifts as well: while Scope 2 (primarily related to purchased electricity) consistently represents the majority of costs, because of the generation of electricity on-site through solar panels.

This trend reflects a gradual transition in energy sourcing and operational practices, with the airport reducing its reliance on external energy and increasing efforts to manage direct emissions, ultimately leading to a more balanced and efficient cost structure by mid-century.

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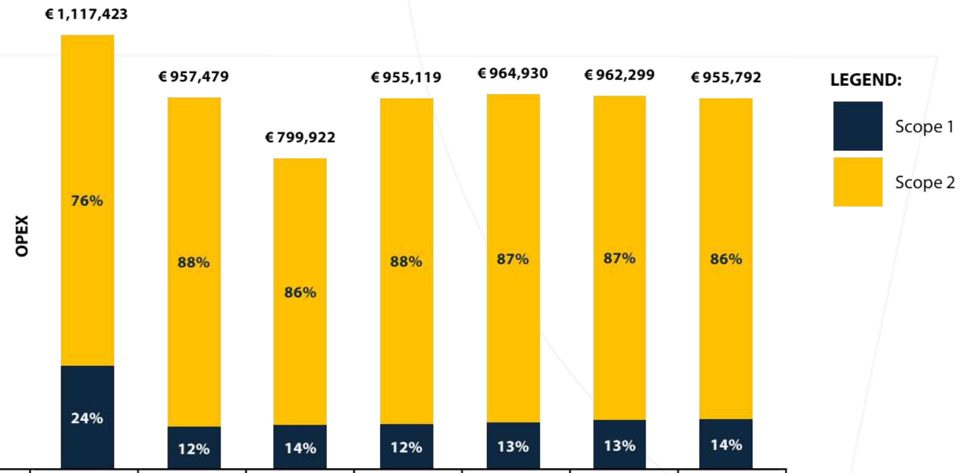
[10] Cost of Urban Wastewater Treatment and Ecotaxes: Evidence from Municipalities in Southern Europe

[11] U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2023

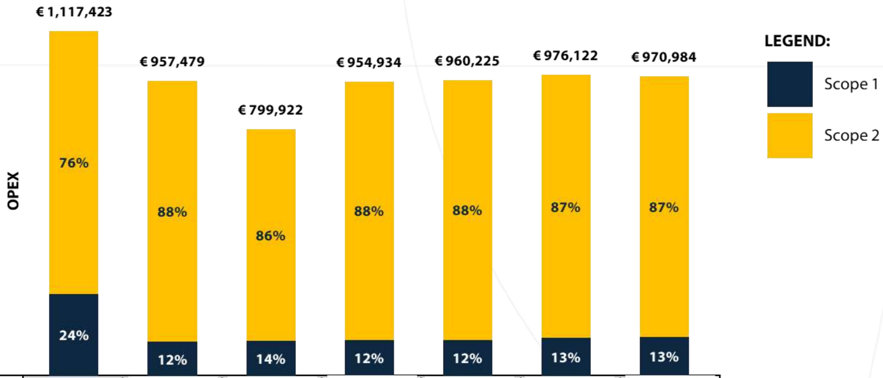


Category	2023	2025	2030	2035	2040	2045	2050
Fuel and vehicle maintenance	€ 208,028	€ 98,726	€ 99,764	€ 100,005	€ 101,567	€ 104,588	€ 104,909
Diesel heating	€ 48,035	-	-	-	-	-	-
Refrigerants	€ 1,519	-	€ 375	€ 375	€ 375	€ 375	€ 375
Green electricity buildings	€ 743,330	€ 571,376	€ 394,365	€ 503,453	€ 500,570	€ 478,701	€ 457,423
Green electricity vehicles	€ 68,903	€ 141,062	€ 151,073	€ 166,034	€ 174,668	€ 188,285	€ 200,217
Green electricity heat pumps	€ 37,290	€ 133,182	€ 129,586	€ 157,535	€ 157,535	€ 157,535	€ 157,535
Totale	**€ 1.11 mln**	**€0.95 mln**	**€ 0.79 mln**	**€ 0.95 mln**	**€ 0.96 mln**	**€ 0.97 mln**	**€ 0.96 mln**

Figure 16: OPEX - Pathway 1

12.1.2 Pathway 2 – Earliest Net Zero

The graph bellow presents a detailed projection of the airport's operating expenses (OPEX) from 2023 through 2050 under Pathway 2, which represents an accelerated decarbonization strategy. OPEX is segmented into Scope 1 (direct emissions from airport-controlled sources) and Scope 2 (indirect emissions from purchased electricity), allowing a clear view of how cost structures evolve alongside emissions reductions.



Category	2023	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
Fuel and maintenance vehicles	€ 208,028	€ 98,726	€ 99,764	€ 100,005	€ 97,595	€ 100,758	€ 102,449
Diesel heating	€ 48,035	-	-	-	-	-	-
Refrigerants	€ 1,519	-	€ 375	€ 375	€ 375	€ 375	€ 375
Green electricity buildings	€ 743,330	€ 571,376	€ 394,365	€ 503,453	€ 500,570	€ 478,701	€ 457,423
Green electricity vehicles	€ 68,903	€ 141,062	€ 151,073	€ 166,034	€ 174,668	€ 188,285	€ 200,217
Green electricity heatpumps	€ 37,290	€ 133,182	€ 129,586	€ 157,535	€ 157,535	€ 157,535	€ 157,535
Total	**€ 1.11 mln**	**€0.95 mln**	**€ 0.79 mln**	**€ 0.95 mln**	**€ 0.96 mln**	**€ 0.97 mln**	**€ 0.97 mln**

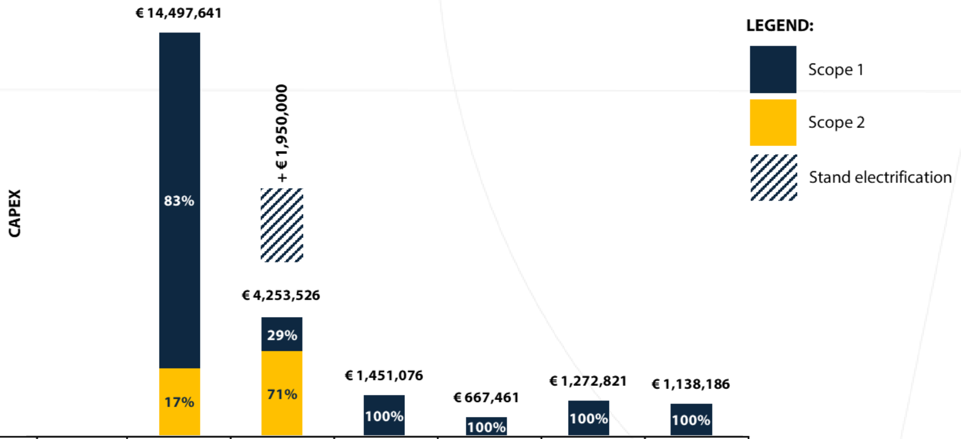
Figure 17: OPEX - Pathway 2

12.2 Capital Expenditure (CAPEX)

The values presented in the following figure serve as reference points for CAPEX estimates. These costs are informed by a combination of benchmarking studies and internal technical analyses, resulting in preliminary CAPEX estimations.

As the Baseline pathway serves as a reference point without any new measures implemented, the CAPEX remains at zero throughout all years. This constant zero CAPEX in the Baseline scenario provides a benchmarking against which the financial impacts of other pathways can be compared.

12.2.1 Pathway 1 – OLB Implemented Measures



Measures	2023	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
Electric GSE	-	€ 10.62 mln	€ 1.22 mln	€ 1.45 mln	€ 0.67 mln	€ 1.27 mln	€ 1.14 mln
Solar panel	-	€ 2.43 mln	€ 3.03 mln	-	-	-	-
Heat pumps	-	€ 1.45 mln	-	-	-	-	-
Stand electrification	-	-	€ 1.95 mln	-	-	-	-
Total	**-**	**€ 14.49 mln**	**€ 6.2 mln**	**€ 1.45 mln**	**€ 0.67 mln**	**€ 1.27 mln**	**€ 1.14 mln**

Figure 18: CAPEX - Pathway 1

In Pathway 1, capital expenditures (CAPEX) associated with Scope 2 emissions are limited and highly focused. The only notable Scope 2 CAPEX arises from the implementation of a photovoltaic park in 2025 and 2030.

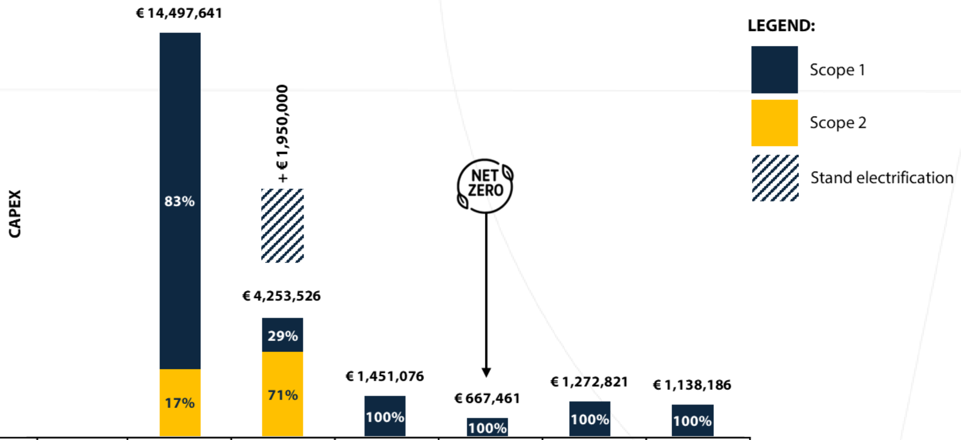
For the year 2025, Scope 1 accounts for 83% of the total CAPEX, amounting to aproximately €12 million. This significant investment is allocated as follows:

- for electric Ground Support Equipment (GSE): In 2024, expenditures for electric vehicles amounted to €2,423,311 (self-financed) and €7,652,641 (publicly funded by ENAC).
- For Heat Pumps: investments related to the installation of heat pumps totaled €1,451,202.

As operational activity grows, the airport must acquire additional electric vehicles to ensure efficient ground handling and passenger service. Consequently, the incremental CAPEX for Scope 1 is solely attributed to the purchase and deployment of new electric GSE units, reflecting the direct relationship between fleet size and service demand.

No other significant Scope 2 capital investments are planned under this scenario. The strategy prioritizes cost-effective decarbonization, relying on existing infrastructure for electricity supply and limiting new expenditures to those strictly required by operational growth.

12.2.2 Pathway 2- Earliest Net Zero



Measures	2023	2023-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
Electric GSE	-	€ 10.62 mln	€ 1.22 mln	€ 1.45 mln	€ 0.67 mln	€ 1.27 mln	€ 1.14 mln
Solar panel	-	€ 2.43 mln	€ 3.03 mln	-	-	-	-
Heat pumps	-	€ 1.45 mln	-	-	-	-	-
Stand electrification	-	-	€ 1.95 mln	-	-	-	-
Total	**-**	**€ 14.49 mln**	**€ 6.2 mln**	**€ 1.45 mln**	**€ 0.67 mln**	**€ 1.27 mln**	**€ 1.14 mln**

Figure 19: CAPEX – Pathway 2

In Pathway 2, capital expenditures (CAPEX) related to Scope 2 emissions are more pronounced and strategically timed, reflecting the airport's accelerated decarbonization approach. The most significant Scope 2 investments occur in 2025 and 2045, corresponding to major upgrades in the airport's electricity supply and supporting infrastructure.

For the year 2025, Scope 1 accounts for 83% of the total CAPEX, amounting to aproximately €12 million. This significant investment is allocated as follows:

- for electric Ground Support Equipment (GSE): In 2024, expenditures for electric vehicles amounted to €2,423,311 (self-financed) and €7,652,641 (publicly funded by ENAC).
- For Heat Pumps: investments related to the installation of heat pumps totaled €1,451,202.

The initial CAPEX peak in 2025 is driven by the large-scale deployment of renewable energy systems and the expansion of electric ground support equipment (GSE) to accommodate anticipated growth in airport movements and passenger numbers. During this period, Scope 2 CAPEX accounts for 17% of the total investment, with the remainder focused on Scope 1 measures. This allocation underscores the airport's commitment to rapidly increasing its share of clean, externally sourced electricity and electrifying operational assets.

Overall, both Pathway 1 and 2 have the same CAPEX investments over the years which demonstrates proactive, front-loaded investment in Scope 2 measures, enabling a swift and comprehensive shift toward renewable electricity and electrified operations. This strategy positions the airport to achieve deep decarbonization and meet ambitious climate objectives well ahead of 2050, while maintaining financial prudence through targeted, high-impact capital investments.

13 OFFSETTING

The described decarbonisation measures will have a large impact in achieving a net-zero for Olbia Airport. However, there are certain emissions that are not possible to be mitigated through normal measures and will therefore have to compensated through offsetting measures.

Table 16 - CO_2e Abatement Required per Pathway

Pathway/ Year	2025	2030	2035	2040	2045	2050
CO_2e abatement required (t) to achieve **carbon neutrality** / **net-zero**						
Pathway 1	**72**	**70**	**82**	**81**	**80**	**76**
Pathway 2	**72**	**70**	**65**	**9**	**8**	**8**

Only the most established and credible offset programmes that meet strict methodological and quality criteria are eligible under Airport Carbon Accreditation. A list of eligible offsetting programmes can be found in the programme's Offset Guidance Document[12]. These include the Verified Carbon Standard, Gold Standard, Climate Action Reserve, and others. In order to ensure that offsets are of high quality they should meet the following criteria:

- **Real:** Reductions/removals must have already occurred and be proven.
- **Additional:** Reductions/removals wouldn't have occurred without the project and offset revenue.
- **Measurable:** Reductions/removals must be quantifiable with minimal error.
- **Verifiable:** Third-party auditor must verify reductions/removals under set standards.
- **Permanent:** Measures must prevent reversal of reductions; safeguards needed for high-risk projects.
- **Unique:** Reductions/removals can't be claimed or registered more than once.

Direct Air Capture (DAC) and Bio sequestration were identified as potential offsetting measures. DAC is an example of an engineered offset removal method, meaning it is a human-developed process to capture and store ambient GHG emissions. Bio-sequestration is an ecosystem-based method, meaning it makes use of naturally occurring processes to increase the uptake and storage of GHG emissions in carbon sinks, generally those based on land but also including oceans.

While both approaches show strong potential for long-term carbon removal, it is important to acknowledge the risk of reversals, particularly with nature-based solutions. Reversals refer to the potential re-release of sequestered carbon due to factors such as land-use change, environmental degradation, or extreme weather events. To mitigate this risk, the selection of specific projects should include a thorough evaluation of the implementer's risk mitigation strategy to ensure the permanence of carbon sequestration.

13.1 Direct Air Capture (DAC)

DAC is a technology that removes CO_2 from the atmosphere. It works by using large fans to pull ambient air into the system, where chemical filters, such as amine-based or solid sorbents, bind with the CO_2 molecules.

[12] Offset Guidance Document

The captured CO_2 is then heated and released, allowing it to be either stored underground through carbon sequestration or used to create Sustainable Aviation Fuel (SAF). The cost of DAC typically ranges between 100$[13] to 1000$[14] per ton of CO_2 captured.

For OLB, the emergence of Direct Air Capture technologies offers a promising pathway for offsetting residual emissions on the journey to Net Zero. While DAC is still in the early stages of deployment in Italy, several national and European initiatives are advancing the technology. For example, Italian energy companies[15] and research institutions are collaborating on pilot DAC facilities[16] capable of capturing several tons of CO_2 per year directly from the atmosphere. These efforts are supported by EU funding[17] and align with Italy's broader climate strategy to scale up carbon removal solutions. As DAC technology matures and becomes more widely available.

13.2 Bio sequestration

Bio sequestration is a nature-based offsetting measure that involves capturing and storing atmospheric carbon dioxide through biological processes such as afforestation, reforestation, soil carbon sequestration, and wetland restoration.

Bio sequestration projects offer a credible and effective way to compensate for residual emissions that cannot be eliminated through direct operational improvements. By investing in high-quality, certified bio sequestration initiatives, such as forest restoration or soil carbon enhancement, the airport can contribute to long-term carbon removals, support biodiversity, and deliver co-benefits for local communities. This approach aligns with the requirements and recommendations of Airport Carbon Accreditation[18], which encourages airports to prioritize robust, permanent, and transparent offset removals as part of their Net Zero strategies.

[13] DOE Explains...Direct Air Capture | Department of Energy

[14] A comparative look at Direct Air Capture and CO2 capture from biogas upgrading - Nordsol

[15] Eni & Snam Launch Italy's First Carbon Capture & Storage for Gas Plant | EnergyTech

[16] Climeworks direct air capture plant in Italy

[17] CarpeCarbon Direct Air Capture Plant Design Receives $1.9M Funding - Carbon Herald

[18] Environmental Policy

14 SCOPE 3 EMISSIONS

Scope 3 emissions are indirect greenhouse gas (GHG) emissions that occur as a consequence of an organization's activities but arise from sources not owned or directly controlled by the organization. For airports, Scope 3 emissions are particularly significant, as they encompass a broad range of activities across the aviation value chain, including those associated with passengers, staff, and third-party operations.

14.1 ACA Levels of Influence, Guide, and Control in Scope 3 Emission Reduction

The Airport Carbon Accreditation (ACA) framework provides a structured approach for airports to address emissions based on their varying levels of authority over different emission sources. Emissions are categorized according to whether the airport can control, guide, or influence them. [19]

- **"Control"** applies to emissions from activities the airport directly manages, such as its own vehicle fleet or on-site energy use.
- **"Guide"** refers to emissions from operations where the airport can set standards or provide direction, such as ground handling services or certain tenant activities.
- **"Influence"** covers emission sources where the airport's role is primarily to encourage or facilitate change, for example, emissions from airline operations or passenger travel to and from the airport.

Understanding and applying these levels is essential for effective Scope 3 emission reduction. By distinguishing between what can be controlled, guided, or influenced, airports can develop targeted strategies, ranging from implementing operational mandates to fostering partnerships and advocacy efforts. This tiered approach ensures that all relevant emission sources are addressed appropriately, allowing airports to maximize their contribution to Scope 3 reductions and support their overall net zero ambitions.[20]

14.2 Scope 3 Decarbonisation Measures

14.2.1 Fixed Ground Power Units (GPU) and Pre-conditioned Air (PCA)

Many large aircraft rely on an auxiliary power unit (APU) to supply onboard lighting, electronics, and air conditioning while parked at the gate. This eliminates the need to start the main engines during passenger boarding and preparation. However, APUs consume approximately 150 litres of aviation fuel per hour, generating substantial CO_2e and particulate emissions, along with noise and air quality impacts.

To reduce reliance on APUs, Fixed Electrical Ground Power and Pre-Conditioned Air systems allow aircraft to connect directly to the local grid or airport-based renewable energy sources (see initiatives on onsite solar PV, battery energy storage, and purchasing renewable energy).

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[19] Short-Guide-to-Airport-Carbon-Accreditation-November-2020.pdf

[20] 7 levels of accreditation - Airport Carbon Accreditation

Table 17 - Fixed Ground Power Units (GPU) and Pre-conditioned Air (PCA) - Key Performance Indicators

Location in airport: **Airside**	Emissions impact: **Reductions of up to 50% in APU emissions**	Stakeholder to involve: **Ground Handlers** **Airlines**
Industry benchmark example: • Hong Kong International Airport invested $7.8 million to provide fixed electrical ground power (FEGP) and pre-conditioned air (PCA) at all stands and enforced a ban on APU use at frontal stands, leading to a 20% reduction in NOx emissions between 2017 and 2018[21]. • Heathrow Airport invested $36.5 million by 2018 to implement FEGP and PCA, fitting over 90% of its stands with FEGP to reduce APU use[22].		

Table 18 - Fixed Ground Power Units (GPU) and Pre-conditioned Air (PCA) - Advantages and Considerations

Advantages	Considerations
• Enhanced local air quality and lower noise levels compared to APU usage. • Decreased aircraft fuel consumption and related emissions. • Greater control for OLB over energy usage. • Opportunity to further reduce Scope 2 emissions when powered by renewable energy sources.	• Upgrading airport electrical infrastructure may be necessary. • Less practical for aircraft with short turnaround times. • If powered by on-site renewables, battery storage may be needed to manage peak electricity demand and ensure availability during low-generation periods. • Collaboration with stakeholders is essential, as airlines may prefer APU use.

Planning recommendations

- Determine the need for pre-conditioned air at each bay based on typical aircraft usage and turnaround times.
- Evaluate space availability for installation and integration with centralized power unit (if applicable) to enhance system efficiency.
- Analyse the impact of increased electrical demand on existing infrastructure.

[21] Carbon Reduction Programme, Environment - Hong Kong International Airport

[22] 2023_FY_HAHL_ARA_Final.pdf

Role of airport:

To enforce adoption, the airport must collaborate with airlines and ground handling service providers, implement usage polices, and potentially introduce incentives or regulations to encourage compliance.

ACA Level:

For fixed GPU and PCA systems, the airport typically achieves the **"guide"** level of authority under the ACA framework. While airports may not directly operate all aircraft or ground handling equipment, they can set requirements or provide infrastructure for airlines and service providers to use fixed electrical ground power and pre-conditioned air instead of aircraft auxiliary power units. By mandating or incentivizing the use of these systems, airports play a guiding role, establishing standards and facilitating adoption to reduce emissions during aircraft turnaround.

14.2.2 Sustainable Aviation Fuels (SAF)

SAF is produced from various organic materials such as sugarcane bagasse, molasses, wood waste, animal fats, vegetable oils, and agave. OLB can support the transition to biofuels by ensuring its fuel delivery infrastructure is compatible. In many cases, SAF can be integrated into existing fuel pipelines, including blended with conventional jet fuel as an interim solution. By establishing the necessary infrastructure, OLB can further encourage biofuel adoption by eliminating internal or contractual barriers to its use.

Table 19 - Sustainable Aviation Fuel (SAF) - Key Performance Indicators

Location in airport: **Airside**	Emissions impact: **Reduction of up to 80% per gallon**	Stakeholder to involve: **Fuel Provider** **Airlines** **Ground Handlers** **Civil Aviation Authority (ENAC)**
Industry benchmark example: • Royal Schiphol Group allocated €15 million for SAF promotion from 2022 to 2024, offering subsidies of €500 per tonne of SAF and €1,000 per tonne of synthetic fuels[23]. • SEA Milano has committed €500 per tonne of SAF blended with fossil fuel for airlines at Linate and Malpensa airports, with €450,000 allocated for 2023 and €500,000 committed for 2024[24].		

[23] Schiphol announces rise in airport charges as an incentive for use of SAF

[24] Sustainable Aviation Fuels (SAF) and other Alternative Fuels Used for Aviation | European Alternative Fuels Observatory

Table 20 - Sustainable Aviation Fuel (SAF) - Advantages and Considerations

Advantages	Considerations
• Potential for substantial reductions in Scope 3 emissions by decreasing reliance on fossil fuels. • Compatibility with existing pipelines and fuel infrastructure enables easier integration. • Opportunity to utilise organic waste as a feedstock, including materials from on-site airport waste management processes, reducing the need for virgin resources.	• SAF costs remain higher than conventional jet fuel and can vary significantly based on the feedstock used. • The sustainability impact of SAF differ: Some production methods generate high greenhouse gas emissions or contribute to environmental issues like deforestation. • Clear governance and ownership responsibilities must be established for delivering biofuel through existing fuel hydrant infrastructure.

Planning recommendations

- Assess the necessary infrastructure to support SAF usage, including integrating SAF into existing pipelines or developing new ones.
- Explore opportunities to encourage SAF adoption through contractual agreements and consider renegotiating aviation fuel supply contracts to include biofuel options.

Role of airport

The airport plays a key role in providing the necessary infrastructure for SAF, such as dedicated storage tanks and fuelling systems. To enforce adoption, the airport must work closely with airlines, fuel suppliers, and ground services to ensure SAF availability at the airport, while also collaborating with regulators to implement incentives, such as discounted landing fees or preferential treatment for airlines that commit to using SAF.

ReFuelEU Aviation:

The EU ReFuelEU Aviation incentive is a cornerstone policy in the European Union's net zero roadmap, designed to accelerate the decarbonization of the aviation sector. As part of the broader Fit for 55 package, this regulation mandates a progressively increasing share of sustainable aviation fuels (SAF) in aviation fuel supplied at EU airports, starting at 2% in 2025 and rising to 70% by 2050. [25]

The initiative aims to create a level playing field for air transport across Europe, stimulate innovation and investment in SAF production, and drive down costs through economies of scale. By harmonizing SAF mandates across all member states, the ReFuelEU Aviation regulation provides market certainty and reduces compliance complexity for airlines and fuel suppliers. Additional incentives include direct financial support through EU Emissions Trading System allowances, preferential tax treatment for SAF, and support for research and development. Collectively, these measures are expected to deliver substantial reductions

[25] ReFuelEU Aviation - European Commission

in aviation emissions, foster job creation, and ensure that sustainable fuels become widely available, supporting the EU's ambition to achieve net zero emissions by 2050.[26]

ACA Level:

The airport's role in promoting Sustainable Aviation Fuel (SAF) adoption is primarily at the **"influence"** level. Airports do not control the fuel choices of airlines but can encourage SAF uptake by facilitating supply, supporting fuel infrastructure, and engaging with airlines and fuel providers. Their ability to influence is crucial: through partnerships, incentives, and advocacy, airports can foster a market for SAF and help drive industry-wide change toward net zero goals.

14.2.3 Aircraft Upgrades

Aircraft design continually evolves to enhance fuel efficiency, reduce emissions, and lower operating costs. Advancements include more efficient engines, lightweight materials, and improved aerodynamics. OLB can support these innovations by ensuring that its runways, taxiways, support services, and terminals are equipped to accommodate both current and next-generation aircraft.

Table 21 - Aircraft Upgrades - Key Performance Indicators

Location in airport: **Airside**	Emissions impact: **Fuel consumption of new aircraft designs can be reduced by approximately 15-25%**	Stakeholder to involve: **Airlines** **Ground Handlers**
Industry benchmark example: • Brisbane Airport's 2020 Master Plan recognises changes in designs of aircraft that are currently being manufactured and the demands these aircraft will place on the airside infrastructure[27].		

[26] RefuelEU Aviation Regulation

[27] Airport Master Plan | Brisbane Airport

Table 22 - Aircraft Upgrades Advantages and Considerations

Advantages	Considerations
• Airport master planning provides an opportunity to anticipate future aircraft needs, helping to minimize emissions and avoid the costs associated with retrofitting infrastructure.	• Uncertainty in predicting future aircraft trends and requirements. • Airports have limited influence over the embodied energy, design, and operation of aircraft.

Planning recommendations

- Work closely with airlines to align airport infrastructure with their future fleet plans and sustainability commitments.
- Offer reduced landing fees, preferential slots, or other benefits for airlines that operate newer, low-emission aircraft or retrofit existing fleets with greener technology.
- Collaborate with airlines, manufacturers, and government bodies to promote tax benefits, grants, or rebates for aircraft upgrades and the adoption of cleaner technologies.

Role of airport

The airport plays an important role in ensuring that its runway, taxiways, support services, aprons, and terminals are designed and maintained to accommodate both current and next-gen aircrafts. Examples of these include enhancing taxiway layouts, future-proofing terminal facilities for emerging aircraft types, or integrating new fuelling systems. The airport must collaborate with airlines, aircraft manufacturers, ground handlers, and aviation regulators to ensure these upgrades are made in line with evolving aircraft designs, safety standards, and operational efficiency goals.

ACA Level:

When it comes to aircraft upgrades, such as the adoption of newer, more efficient aircraft or retrofitting existing fleets, the airport's authority is at the **"influence"** level. Airlines retain full control over their fleets, but airports can support upgrades by offering incentives, preferential slots, or collaborating on environmental initiatives. By influencing airline decisions through policy, collaboration, and recognition programs, airports contribute indirectly to emission reductions.

14.2.4 Surface access improvements

Airport surface access refers to the non-aviation travel to and from the airport by passengers, visitors, and staff. Enhancing airport surface access and promoting low-emission transport options can help reduce emissions and ease congestion. Potential improvements include public transport hubs, dedicated electric vehicle parking and charging stations, and road redesigns such as express lanes for electric vehicles.

Table 23 - Surface Access Improvements - Key Performance Indicators

Location in airport:	Emissions impact:	Stakeholder to involve:
Landside	**For example, the electric metro reduces emissions by approximately 85% per vehicle kilometre compared to a petrol car**	**Public Transport providers** **Local governments**
Industry benchmark example: • In 2018, Perth Airport began construction on infrastructure for a new train station near Terminal 1, including the Skybridge, a 280m elevated walkway with travellators, to promote greater public transport use[28]. • Manchester Airport's Sustainable Development Plan 2016 includes a Surface Access Plan. The Plan recognises the importance of partnerships to influence surface access improvements[29].		

Table 24 - Surface Access Improvements - Advantages and Considerations

Advantages	Considerations
• Reduced local traffic congestion, leading to lower emissions. • Enhanced safety by minimising transportation conflicts. • Broader benefits for local and regional communities. • Opportunity to promote electric vehicle adoption through charging infrastructure powered by renewable energy. • Potential to integrate with future transport infrastructure developments.	• Implementation may require coordination and approval from government and transport authorities. • Funding agreements between airports, government, and transport authorities may be necessary.

Planning recommendations

- Assess passenger travel patterns to and from the airport, identifying carbon emissions by transport mode.
- Integrate surface access enhancements into broader transport master plan.
- Collaborate with transport authorities to coordinate necessary infrastructure upgrades.

Role of airport

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[28] Perth Airport

[29] Sustainable Development Plan

The airport is responsible for providing infrastructure that supports low-emission transportation. For that, the airport must initiate conversations with local governments and transport providers to establish specific initiatives.

ACA Level

Improvements to surface access (such as public transport links, cycling infrastructure, or electric vehicle charging), airports generally operate at both the **"guide"** and **"influence"** levels. Airports can guide by investing in on-site infrastructure, setting access policies, and collaborating with local authorities and transport providers. Their influence extends to encouraging passengers and staff to use low-carbon transport options through incentives, awareness campaigns, and partnerships. Achieving net zero requires airports to leverage both guidance and influence to transform how people access the airport, reducing associated Scope 3 emissions.

14.3 Scope 3 Decarbonization Scenarios

In order to provide an overall overview of the actual implementation of the mitigation measures described in the previous chapters, two evolutionary scenarios have been developed and analysed. Each scenario represents a possible decarbonization pathway, constructed through the progressive combination of different technological and operational solutions belonging to GHG Category 11 with regard to aircraft-related emissions, excluding APU emissions.

The two scenarios have been defined on the basis of realistic assumptions concerning implementation timelines, technology maturity levels, and the potential impact in terms of emission reductions.

14.3.1 Scenario 1

Scenario 1 represents a conservative decarbonization pathway based on the progressive renewal of the aircraft fleet, the mandatory uptake of Sustainable Aviation Fuel (SAF) in line with EU targets, and the implementation of operational efficiency improvements as estimated on average by Eurocontrol and SESAR. This scenario relies exclusively on technologies and practices that are already available or close to market maturity, achieving gradual emission reductions over time while remaining strongly aligned with current regulatory frameworks and realistic deployment timelines.

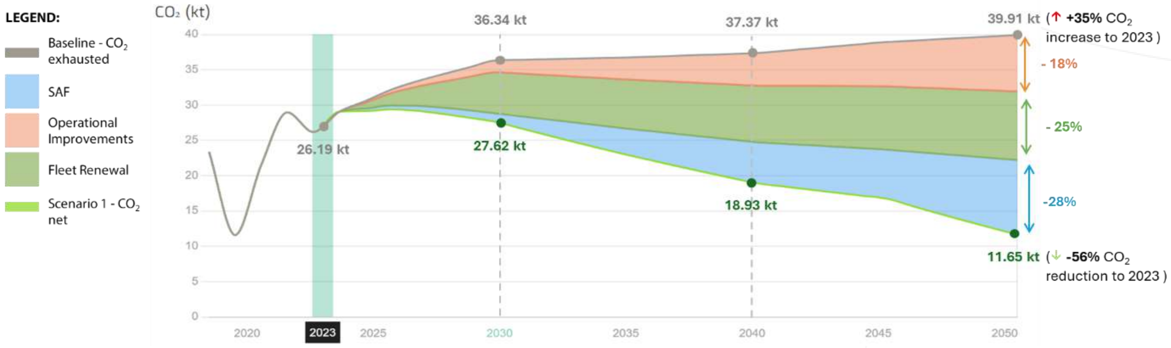

Figure 20: Scope 3 - Scenario 1 Forecast

14.3.2 Scenario 2

Scenario 2 depicts a more ambitious decarbonization trajectory that builds on fleet renewal and higher-than-mandated SAF adoption, while further enhancing operational efficiency. In addition, this scenario assumes the introduction of disruptive aircraft technologies, with electric aircraft entering operations around 2035 and hydrogen-powered aircraft from 2040 onwards. As a result, Scenario 2 delivers a 90% reduction in CO_2 emissions by 2050, reflecting a faster transition enabled by technological breakthroughs and higher system-level transformation.

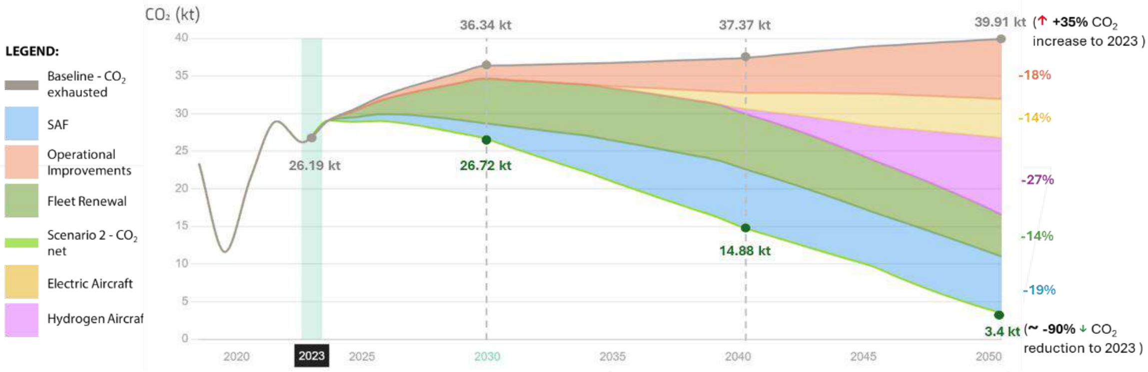

Figure 21: Scope 3 - Scenario 2 Forecast

15 NET ZERO ROADMAP

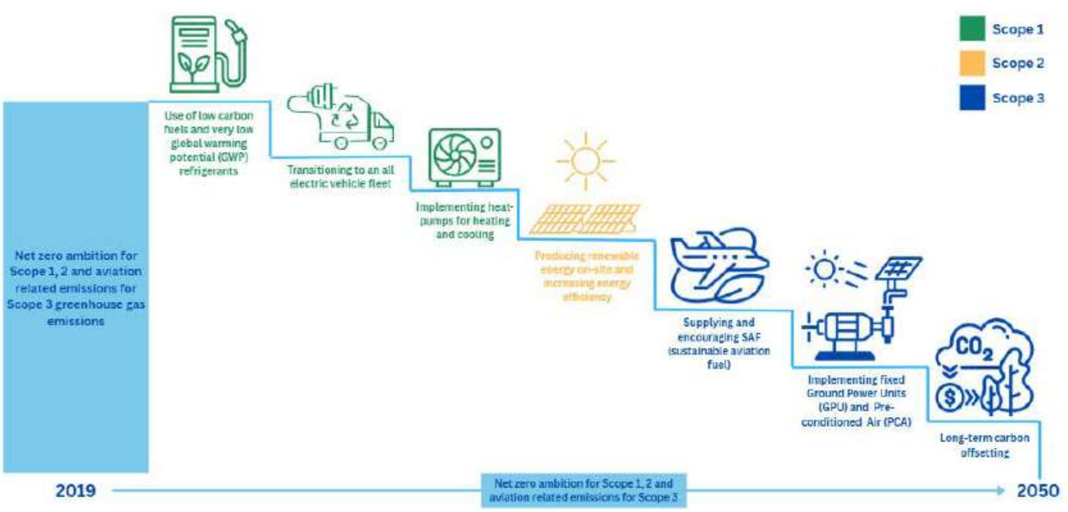

Figure 22: Net Zero Roadmap Measures

The roadmap culminates with long-term carbon offsetting strategies to address any residual emissions that cannot be eliminated through operational changes or technological upgrades. This comprehensive, phased approach demonstrates a commitment to continuous improvement and innovation, aligning with international climate goals and ensuring a significant reduction in environmental impact across all emission sources.

Scope Coverage

- **Scope 1 (Direct Emissions):** Actions such as fleet electrification and refrigerant management directly reduce on-site emissions.
- **Scope 2 (Indirect Emissions):** Energy efficiency and renewable energy initiatives target emissions from purchased electricity and heat.
- **Scope 3 (Other Indirect Emissions):** Efforts like sustainable aviation fuel adoption and carbon offsetting address broader value chain emissions, including those related to air travel.

This roadmap serves as a strategic guide for organizations aiming to align with international climate goals and demonstrates a clear commitment to reducing environmental impact across all major emission sources.

15.1 NET ZERO ROADMAP SCOPE 1 & 2

This report demonstrates that Olbia Airport has the capacity to fulfil both requirements of achieving zero carbon emissions under the direct control of airport operators (Scope 1 and 2) by 2050, in line with the directives set forth by ACI EUROPE, and aligning with the IPCC Special Report's 1.5 degrees Celsius trajectory by adhering to the various recommendations outlined herein. Specifically, by 2030, it will achieve a comprehensive 50% reduction in CO_2 emissions compared to 2011, ultimately attaining a Net Zero status by 2040.

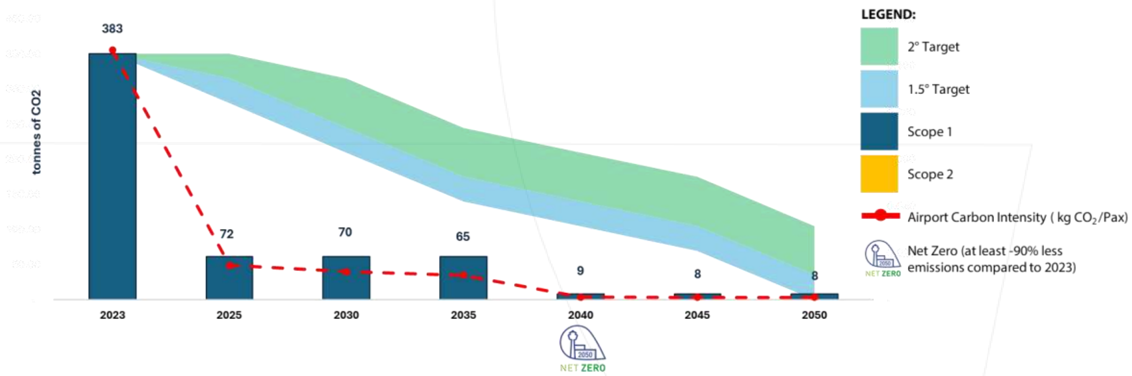

Figure 23: Net Zero Roadmap - Scope 1&2 Emissions

The final net zero road map, represented as Pathway 2 in this graph, outlines a clear trajectory toward achieving a 98% reduction in emissions by 2050 compared to 2023 levels. The pathway demonstrates a steep decline in total CO_2 emissions, dropping from 383 tonnes in 2023 to 8 tonnes by 2050. This ambitious reduction aligns with international climate targets, with the shaded areas in the graph indicating the 2°C and 1.5°C global warming limits. The road map also highlights interim milestones, such as reducing emissions to 72 tonnes by 2025 and further to 9 tonnes by 2040, emphasizing a sustained and aggressive approach to decarbonization.

Throughout this journey, the graph tracks both Scope 1 and Scope 2 emissions, reflecting direct and indirect sources, respectively. The red dashed line illustrates the reduction in airport carbon intensity (measured in kg CO_2 per passenger), which steadily declines in parallel with total emissions. The pathway's progression is marked by the achievement of net zero, defined here as at least a 90% decrease in emissions from the 2023 baseline. This road map underscores the necessity of continuous improvement and innovation in operational practices, energy sourcing, and efficiency measures to meet stringent climate goals while maintaining essential airport functions.

16 RISK ANALYSIS

Analysing the risks associated with a Net Zero Roadmap is crucial for effective planning and implementation. Achieving a net-zero carbon footprint involves significant changes in energy systems, industries, and societal behaviour. There are several factors that should be considered, below a framework about it:

Regulatory and Policy risk:
Changes in government policies and regulations can impact the feasibility and cost-effectiveness of the roadmap. Even political instability and shifts in leadership may lead to policy reversals or delays in implementation.

Technological risk:
Dependence on emerging and unproven technologies can pose risks, including delays in development or unexpected technical challenges. The Olbia Airport roadmap prioritizes a realistic approach, aiming to align objectives with practical feasibility.

Economic risk:
The costs associated with transitioning to net zero may be higher than anticipated, potentially straining budgets and financial resources. Also, economic downturns or fluctuations in energy prices can impact the financial viability of projects.

Infrastructure and Implementation risk:
The need for new infrastructure (e.g., renewable energy plants, electric vehicle charging stations) introduces risks related to construction delays, cost overruns, and technical issues. Also, Delays in project implementation can result from factors such as permitting issues, community opposition, or unforeseen technical challenges.

Supply Chain risk:
Reliance on specific suppliers for critical poses supply chain vulnerabilities and geopolitical factors affecting the availability of materials can disrupt the supply chain.

Stakeholder involvement risk:
Possibility of encountering resistance, lack of support, or conflicting interests from stakeholders, which could impede progress or lead to the Net Zero roadmap failure.

Measurement and Reporting risk:
Accurate measurement and reporting of carbon emissions reductions may be challenging, leading to potential inaccuracies in assessing progress and lack of standardized reporting frameworks may result in inconsistent data.

A comprehensive risk management plan should address these factors, incorporating contingency plans, monitoring mechanisms, and regular reviews to adapt to evolving conditions. Additionally, engaging stakeholders, fostering innovation, and building flexibility into the roadmap can enhance resilience to these risks.