DES HE SESAR solution 0515 concept outline

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Abstract

This document presents the Concept Outline of the PRIAM Solution (SESAR Solution 0515), a TRL1 analytical and modelling toolset designed to enable the passenger-centric integration of Innovative Air Mobility (IAM) into Europe's regional multimodal transport network, addressing accessibility gaps in remote, island, and mountainous territories. The solution is composed by five core analytical components, validated across case studies in the Catalan Pyrenees and the Tenerife–La Gomera corridor. The case study findings fed into a strategic Social Cost-Benefit Analysis (SCBA) evaluating the long-term societal impact of regional IAM deployment. Finally, drawing on the insights from the technical toolset and the SCBA, the document outlines an IAM implementation roadmap and policy recommendations across three key pillars: market targeting for structural accessibility gaps, streamlined governance and U-space regulation, and public-private partnerships alongside unified multimodal ticketing.

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PRIAM

PLANNING REGIONAL-SCALE MULTIMODAL OPERATIONS FOR INNOVATIVE AIR MOBILITY SERVICES

PRIAM

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1 Executive summary

This document presents the Concept Outline of the PRIAM Solution (SESAR *Solution 0515*), a data analytics and modelling toolset developed to enable the passenger-centric integration of Innovative Air Mobility (IAM) into Europe's regional multimodal transport network, addressing a critical gap in European transport policy: extending seamless, regional-scale accessibility beyond urban centres to remote, mountainous, and island territories.

The development of the solution began with a foundational phase to establish the conceptual and analytical basis for the PRIAM Solution. This phase focused on understanding the regional mobility landscape, defining challenges and opportunities for IAM, and setting high-level requirements. This led directly to the creation of an Impact Assessment Framework covering 6 Key Performance Areas (KPAs): Passenger Experience, Demand, Cost Efficiency, Environment, Operational Efficiency, and Capacity.

This conceptual framework laid the ground for the technical development of the PRIAM Solution, which was validated across two real-world regional case studies with distinct geographic typologies:

- **Catalan Pyrenees (Mountainous Connectivity).** Addresses severe terrain barriers, single-rail line limitations, and seasonal tourist congestion by evaluating intra-mountain links alongside regional connections to Lleida and Barcelona.
- **Tenerife–La Gomera (Inter-Island Connectivity).** Evaluates alternatives to maritime ferries (which hold a 98.9% baseline market share) and regional air links, addressing island isolation, healthcare connectivity, and tourism access.

The PRIAM Solution is composed of five interconnected analytical components, each validated through the regional case studies:

- **Component 1: IAM Adoption Models.** Uses unsupervised machine learning (K-means clustering) on stated-preference survey data to detect key behavioural drivers and segment prospective users into distinct adoption archetypes. The analysis reveals that a user's likelihood to adopt IAM is not dictated by sociodemographic factors alone, but is heavily shaped by travel behaviour, environmental awareness, price sensitivity, and privacy concerns.

- **Component 2: Potential Demand Monitoring Tools.** Establishes data fusion algorithms that combine Mobile Network Data (MND) with land-use and sociodemographic datasets to monitor regional mobility patterns and infer potential IAM demand. By integrating a high-accuracy trip-purpose classifier and a road modal-detection algorithm, these tools generate consistent, real-world mobility indicators across both island and mountain environments—an essential step for tailoring IAM services to true user needs.

- **Component 3: IAM Demand Models.** Estimates potential traffic for IAM by combining hybrid multinomial logit models for modal shift (*captured demand*) with an exponential gravity model for newly generated trips (*induced demand*). The models demonstrate that between 70% and 97% of captured IAM demand is shifted directly from private cars, while induced demand remains marginal and concentrated almost entirely among short-distance leisure travellers.

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- **Component 4: IAM Network Planning Tools.** Optimizes the placement, capacity, and overall scale of vertiport networks by integrating MND demand estimates, discrete choice behaviour, infrastructure costs, and localized weather availability constraints. The tool identifies that network demand exhibits diminishing returns beyond 7 to 8 vertiports and confirms that affordable pricing structures (around €4–€5/km) are an essential prerequisite for financial and operational viability.

- **Component 5: IAM Service Optimization Tools.** Provides a dual-optimization framework—combining exact Mixed-Integer Linear Programming (MILP) with fast heuristic algorithms—to jointly schedule eVTOL flight dispatches and passenger itineraries alongside existing public transit schedules. By introducing a locality-based graph sparsification method that reduces massive transit networks by approximately 80% without altering mobility structures, it proves the computational feasibility of managing integrated multimodal regional traffic in real time.

The case study findings fed into a strategic Social Cost-Benefit Analysis (SCBA) evaluating the long-term societal impact (2034–2074) of regional IAM deployment. The SCBA compared the IAM rollout against reference scenarios across 7 resource-cost levels (€4–€20/pax-km) and 3 macroeconomic demand growth paths, incorporating direct user welfare gains, infrastructure/operational costs, air traffic management expenses, public financing burdens, and external transport costs.

The key takeaway is that while IAM generates clear passenger time savings (€536M NPV in Tenerife–La Gomera and €1,372M NPV in the Catalan Pyrenees), high fleet and vertiport resource costs result in a net social deficit in almost all evaluated scenarios:

- Tenerife–La Gomera: Yields a negative net social benefit across all cost scenarios (ranging from -€321M to -€4,558M), even under optimistic cost reductions or higher demand growth assumptions.
- Catalan Pyrenees: Yields a positive net social benefit (+€170M NPV) strictly under the lowest, most optimistic cost scenario (€4/pax-km). Under all higher-cost scenarios, net social benefits remain negative (ranging from -€849M to -€5,731M), although removing long-distance feeder routes (Barcelona/Lleida) slightly improves efficiency, as 99.4% of user welfare is generated directly within intra-mountain routes.

Quantified environmental changes in air pollution, noise, and safety are minor relative to primary resource costs, though IAM achieves physical cumulative CO_2 reductions of 121.6 kilotonnes in the Canary Islands and 8.2 kilotonnes in Catalonia. Overall, IAM generates a net positive societal return only under the most optimistic cost assumption in specific mountain corridors, underscoring that these findings apply to the specific networks studied rather than serving as a blanket evaluation for all IAM deployments.

Drawing on the insights from the technical toolset and the SCBA, PRIAM defines an IAM implementation roadmap for Europe structured around three core policy pillars:

- **Pillar I: Market Strategy & Network Targeting.** Prioritize IAM deployment strictly in corridors with severe structural accessibility gaps where ground transit options are unviable. Mandate quantitative SCBAs and data-driven demand modelling prior to allocating public funding.
- **Pillar II: Governance & Regulatory Frameworks.** Streamline municipal permitting and land-use zoning for vertiport infrastructure. Harmonize EU-wide regulations for eVTOL certifications

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and U-space Level 4 traffic management. Enforce open-data protocols to enable real-time multimodal schedule coordination.

- **Pillar III: Infrastructure, Economics & Acceptance.** Incentivize Public-Private Partnerships (PPPs) to absorb heavy upfront power grid connection and vertiport buildout costs. Implement unified multimodal ticketing to position IAM as a seamless last-mile feeder. Maintain continuous public consultation frameworks to foster long-term societal trust.

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2 Introduction

2.1 Purpose of the document

The purpose of this document is to present a detailed concept outline of the PRIAM Solution. This concept outline is crafted to systematically document the development and insights of the PRIAM Solution at TRL1. It includes the problem areas the project addresses, the innovative solutions proposed, operational scenarios envisioned, and the expected outcomes of implementing these solutions within the context of ATM.

Specifically, the document delineates how the PRIAM Solution has developed a set of case studies, scenarios, methods, and tools for the comprehensive and rigorous assessment of the impact of IAM operations in the regional context.

2.2 Intended readership

This document is intended for a diverse audience engaged in the development of regional IAM. It is particularly relevant to the SESAR3 Joint Undertaking and regional authorities, who can use its insights to guide strategic decisions and support IAM implementation. Potential end users such as drone operators, vertiport operators, and U-space service providers (USSPs) may benefit from the project's demand monitoring and planning tools, helping advance IAM solutions toward higher readiness levels. Policy makers and regulatory bodies can draw on PRIAM's findings to shape supportive legislation, while other SESAR projects may benefit from methodological synergies. The scientific community, especially those researching IAM and U-space, can leverage the results for further innovation

2.3 Background

PRIAM builds on the research outputs of previous and ongoing R&I initiatives and will establish cross-fertilisation links with parallel SESAR 3 projects, with particular emphasis on passenger experience, multimodality and U-space research. The PRIAM Consortium includes partners from SESAR multimodality projects (**MAIA**, **MultiModX** and **SIGN-AIR**) and from many SESAR U-space initiatives (e.g., **MUSE**, **EUREKA**, **SPATIO**, **USEPE** and **Metropolis 2**).

The following table outlines the main links to other SESAR multimodality and U-space projects.

Table 1. Main links the main links to other SESAR multimodality and U-space projects

SESAR Project	Description and link to PRIAM	PRIAM partners involved
MultiModX	PRIAM will build upon the multimodal evaluation framework developed in MultiModX, extending it to IAM use cases. It will also leverage MultiModX's regional archetypes to upscale case study results for the European-level social cost-benefit analysis.	Nommon, ARC

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MAIA	The algorithms for modelling IAM demand and estimating the induced demand effects of IAM services have been developed using the demand modelling framework developed under the MAIA project. In PRIAM, the methodologies, insights, and modelling tools from MAIA have served as the foundation for building the IAM induced demand models. These established components have been adapted and extended to suit the regional-scale IAM use cases addressed in PRIAM, ensuring methodological consistency and leveraging the proven capabilities of the MAIA framework.	Nommon (coordinator), TML
SIGN-AIR	PRIAM has considered the smart contract frameworks developed by SIGN-AIR as an enabling technology for the coordination mechanisms proposed by the multimodal optimisation models.	ENAC
TRANSIT	PRIAM has used and evolved TRANSIT's set of multimodal KPIs, data analysis methods and transport simulation tools for analysing IAM services.	Nommon (coordinator), ENAC
MODUS	PRIAM builds on MODUS' passenger archetypes (updated within MultiModX) to segment IAM demand.	ENAC
X-TEAM D2D	X-TEAM D2D developed a concept of operations for the seamless integration of ATM into a transport intermodal network to enable the D2D connectivity, including UAM services. Its outputs will be incorporated to PRIAM's conceptual framework.	-
EUREKA	EUREKA develops complete arrival, departure and turnaround processes for vertiports. EUREKA solutions have informed the IAM and vertiport operation constraints to be considered in PRIAM.	ENAC, Deep Blue, Bluenest
MUSE	PRIAM has built on the KPIs and evaluation methods developed in MUSE for understanding the impact of UAM, and will adapt it to IAM regional use cases.	Nommon (coordinator)
ImAFUSA	PRIAM has considered the "Impact and capacity Assessment Framework for U-space Societal Acceptance" developed in ImAFUSA and will extend this framework to regional-scale IAM use cases	-
OperA	PRIAM has considered the operating conditions outlined by OperA in the definition of the addressed IAM services.	-
CORUS-XUAM	PRIAM has considered the most recent U-space ConOps from this project and its continuation when defining the service models and requisites for IAM operations.	-
EALU-AER	PRIAM has leveraged the human factors and social acceptance research expected within the demonstration to inform its IAM adoption models.	Deep Blue

Additionally, the dynamic analysis of population required to estimate IAM demand has been carried out using Nommon's Mobility Insights tool, which leverages MND for monitoring mobility patterns and travel behaviour. As part of PRIAM, this tool has be further enhanced to identify key characteristics

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relevant to assess the potential adoption of IAM services. This solution has been successfully applied and continuously improved in several previous SESAR ER projects such as **BigData4ATM**, **TRANSIT**, **IMHOTEP**, and **MultiModX**.

Beyond the SESAR programme, the algorithm for optimal vertiport location developed in the **Engage Vertiport Location** project (coordinated by Nommon) has been reused and enhanced in PRIAM. This, together with the leading position of Deep Blue in **Engage 2**, has helped PRIAM incorporate the most recent relevant research.

2.4 Structure of the document

Chapter 1 presents the executive summary of the document. Chapter 2 presents information about the purpose of the document, the related stakeholders, structure of the document and glossary of terms and acronyms. Chapter 3 is the core of the document, where the concept outline of PRIAM is presented. Firstly, the problem to address is presented, then the concept description of the PRIAM solution is introduced. Then, the technical aspects of PRIAM are discussed and finally the expected outcome of PRIAM, its assumptions and limitations are outlined. Chapter 4 presents the description of the SESAR Solution and its maturity level and Chapter 5 gives a description of future work.

2.5 Glossary of terms

Table 2. Glossary of terms

Term	Definition	Source of the definition
OD matrix	Data table that quantifies the number of trips (or flow of people, vehicles, or goods) between each origin zone and each destination zone in a study area.	Own elaboration

2.6 List of acronyms

Table 3. List of acronyms

Term	Definition
ATC	Air traffic control
ATM	Air traffic management
CO_2	Carbon dioxide
CS	Consumer surplus
DES	Digital European Sky
D2D	Door-to-door
EC	European Commission
ERR	Exploratory research report

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ETS	Emissions Trading System
EU	European Union
eVTOL	Electric Vertical Take-Off and Landing
GA	Grant agreement
GDP	Gross domestic product
GDPR	General data protection regulation
GHG	Greenhouse gas
HE	Horizon Europe
HF	Human Factors
HICP	Harmonised Index of Consumer Prices
HSR	High Speed Rail
IAM	Innovative Air Mobility
ID	Identifier
LS	Logsum
MaaS	Mobility as a Service
MCPF	Marginal Cost of Public Funds
MND	Mobile Network Data
ML	Machine Learning
NPV	Net Present Value
OD	Origin Destination
OEM	Original Equipment Manufacturer
SCBA	Social Cost-Benefit Analysis
SESAR	Single European sky ATM research
SESAR 3 JU	SESAR 3 Joint Undertaking
TRL	Technology readiness level
UAM	Urban Air Mobility
USSP	U-Space Service Provider

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3 Concept outline

3.1 Problem statement

The European transport policy seeks to connect 90% of travellers within 4 hours, employing a multimodal strategy combining high-speed rail (HSR) and air transport [1] [2]. This approach works well for cutting inter-city travel times while reducing transport emissions, but it faces challenges in ensuring the desired levels of accessibility beyond urban areas [3] [4]. Investments in HSR lines entail significant costs and environmental impacts, particularly in mountain territories, and it is not always possible in inter-island connections. This sets a high threshold for demand that low density areas cannot meet [5]. On-demand (autonomous) road shuttles show promise as an efficient public transport alternative in such areas, but their contribution to accessibility is dependent on road network improvements that also face sustainability challenges [6]. Insular territories also cannot benefit from the advantages of HSR options, further complicating connectivity. An inclusive progress towards the 4-hours door-to-door (D2D) target calls for new approaches to regional mobility.

Concurrently, the potential role of novel aircraft types in short-haul distances is gaining attention [7] [8]. Some of the so-called new entrants are equipped with electric, hybrid or hydrogen propulsion systems, short or vertical take-off and landing approaches (STOL, VTOL) and advanced automation technologies that question some of the most established hypotheses when evaluating the environmental impact of air transport. The discussion on new use cases for aviation enabled by these aircraft types initially focused on city environments, under the concept of Urban Air Mobility (UAM). However, this idea is evolving into Innovative Air Mobility (IAM) to include suburban and rural use cases [9]. IAM services may enhance the connectivity of multimodal transport networks (by providing swift links between rural areas, cities, airports and HSR stations), foster the resilience of regional mobility systems (by utilising available airspace capacity as an alternative to ground transport) and mitigate the environmental impact of regional travel (by offering zero-emission operations with less Infrastructure footprint) [10] [11] [12]. In a policy context where air transportation seems relegated to long-distance travel, regional-scale IAM concepts could unlock new roles for aviation in the European Mobility-as-a-Service (MaaS) ecosystem, creating sustainable value for the sector.

Despite these opportunities, it is still unclear to what extent IAM can stand out as a breakthrough solution for regional mobility: questions such as the coordination mechanisms with other modes, the ability to satisfy the expectations of different passenger groups, the induced demand effects and the service reliability against different weather conditions deserve further research [13] [14] [15] [16], calling for a multicriteria approach [17] [18]. IAM network studies have mainly focused on the USA and China [19], with most of the scarce European research focused on single regions (e.g., SmartFly project in Saxony) or use cases (e.g., SESAR MAIA project for airport access). Leveraging this opportunity for the aviation sector requires supporting tools for an evidence-based implementation of regional-scale IAM across Europe. The PRIAM project aims to fulfil this need.

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3.2 Concept description and operational scenarios

PRIAM is a data analytics and modelling toolset that supports a passenger-centric integration of IAM into multimodal regional transport networks across Europe. The development of the PRIAM Solution, has entailed the of 6 interconnected exercises.

The first exercise was focused on defining an impact assessment framework, clarifying the concept for regional-scale IAM services and defining the high-level requirements that guide the technical design of the solution and ensure it addresses regional mobility needs, while aligning with SESAR and EASA performance goals.

The next 5 exercises were focused on validating the 5 components of the solution:

- **IAM adoption models**. Algorithms to understand the factors that may affect IAM acceptance by different groups of target users.
- **Potential demand monitoring algorithms**. Algorithms to fuse MND and other data sources to derive mobility indicators and demand behaviour, and monitor potential IAM demand.
- **IAM demand models**. Advanced discrete choice models, developed using stated preference surveys and MND, to estimate the modal shift and the induced demand of IAM.
- **IAM network planning**. A multicriteria evaluation framework for optimising the IAM network and infrastructure locations.
- **IAM service optimisation**. Optimisation to strategically coordinate IAM services with other transport modes (such as buses and trains).

All the components have successfully been developed and validated through a series of carefully selected regional case studies, assessing the relevance, robustness, and practical applicability of the analytical toolset in diverse geographic and socio-economic contexts—such as mountainous, insular, and sparsely populated regions. These case studies not only supply the data needed to validate individual models and algorithms but also simulate realistic IAM deployment scenarios. This ensures that the PRIAM Solution responds effectively to the specific needs and constraints of regional mobility systems across Europe. Further information about the operational and geographical context of the case studies is presented in Section 3.2.1.

The full results are available in the deliverable D4.2 PRIAM Exploratory Research Report. The main results and insights are briefly described in the net subsections.

Problem definition

This exercise is not part of the technical solution itself but it lay the ground to the work performed afterwards. It establishes the conceptual and analytical basis for the PRIAM Solution, and focuses on understanding the regional mobility landscape, defining the challenges and opportunities for IAM, and identifying the key performance areas that the solution must address.

A four-stage process has been performed, starting from a literature review process, which led to a set of semi-structured interviews with the EEAB. The main insights were then discussed in the 1st PRIAM Stakeholder Workshop, where the final outcomes were refined and validated.

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The main results achieved were the following:

- 8 challenges for regional connectivity across Europe were identified: geographical barriers, limited public transport infrastructure, sparse population density, cross-border connectivity issues, outdated infrastructure, environmental/sustainability concerns, emergency medical services, economic barriers to infrastructure development.
- 4 regional scenarios, crossing two time horizons (2035 and 2050) with two geographic contexts were defined: the Catalan Pyrenees (mountainous connectivity) and La Gomera–Tenerife (inter-island connectivity).
- An Impact Assessment Framework (see Table 4) was defined. It addresses 6 Key Performance Areas (KPAs): passenger experience, demand, cost efficiency, environment, operational efficiency, and capacity.
- High-level requirements to serve as the foundation for future solution development were identified, covering 4 areas (vehicular concept, business model, connectivity, passenger needs).

Table 4. PRIAM impact assessment framework

KPA	KPI	Unit	Description	Source
Environment	CO_2 per passenger-km	gCO_2/ pax km	Grams of CO_2 per passenger and per km	TRANSIT
	KPIs developed in MUSE to measure noise	-	Examples: area based people exposure to noise, area based people exposure to day-evening-night noise level, trajectory based people exposure to noise, etc.	MUSE
	KPIs developed in MUSE to measure visual impact	-	Examples: trajectory-based people exposed, trajectory-based people exposed by concentration threshold, trajectory based visual exposure, etc.	MUSE
Demand	Total demand per OD pair	pax	Passenger demand per OD pair in all available modes	Own creation
	Demand per mode per OD pair	pax	Passenger demand per OD pair per mode	Own creation
	IAM captured demand per OD pair	pax	Number of passengers in IAM modes captured from other modes	Own creation
	IAM induced demand per OD pair	pax	Number of passengers in IAM modes generated by the inclusion of a new transport	Own creation

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			mode i.e. new demand not considered previously	
	Mode shift	pax	IAM demand captured from each pre-existing mode	Own creation
	Vertiport catchment area	Area	Geographical area from which the vertiport demand originate or finalise their access/egress trip to/from the vertiport	Similar to MultiModX (with airports)
	Population-based potential demand	person	Population within the vertiport catchment area Population within a 30-minute travel radius of a vertiport by car Population within a 15-minute travel radius of a vertiport by foot	Literature
Capacity	IAM passenger route capacity	pax/ hour	Maximum number of passengers that each IAM route (OD pair) can allocate	TRANSIT
	IAM vehicle route capacity	vehicle/ hour	Maximum number of vehicles per route	Own creation
	IAM passenger vertiport capacity	pax/ hour	Maximum number of passengers that each vertiport can allocate	Own creation
	IAM vehicle vertiport capacity	vehicle/ hour	Maximum number of vehicles a vertiport can allocate	Own creation
Passenger experience	Average travel time per OD pair	time unit (min, hour, etc.)	Average travel time of the passengers per OD pair	TRANSIT & MultiModX
	Average travel time per itinerary per OD pair	time unit (min, hour, etc.)	Average travel time of the passengers per OD pair per itinerary i.e., combination of modes	TRANSIT & MultiModX
	IAM Average access/egress travel time to vertiport	time unit (min, hour, etc.)	Average access and egress travel time of the passengers using IAM modes	TRANSIT & MultiModX
	IAM in-flight travel time ratio	%	Ratio between access/egress travel time and total travel time	TRANSIT

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	IAM access/ egress travel time ratio	%	Ratio between in-flight travel time and total travel time	TRANSIT
Cost efficiency	Average passenger-kilometer cost per OD Pair	Price (€) /passenger *km	Average cost per passenger and kilometer per OD pair	Literature and stakeholder consultation
	Average passenger-kilometer cost per OD and Itinerary	Price (€) /passenger *km	Average cost per passenger and kilometer per OD pair and itinerary	Literature and stakeholder consultation
Capacity	Waiting time between modes	time unit (min, hour, etc.)	Time spent from one leg to another in a multimodal itinerary	TRANSIT and MultiModX
	Waiting time ratio	%	Ratio between the total time and the waiting time	TRANSIT and MultiModX

IAM adoption models

The purpose of this component is to develop AI algorithms for estimating IAM adoption levels based on human factors, identified through unsupervised machine learning techniques.

For that purpose, a stated preference survey was used to gather the public opinion respect IAM. The survey was composed by 48 question's survey across 4 sections (socio-demographics, current travel behaviour, awareness/perception of air taxis and stated preferences under concrete service configurations) using realistic choice scenarios drawn from the project's two case studies: La Gomera–Tenerife and Catalan Pyrenees.

The responses were translated into two composite indicators:

- User propensity level: combining the willingness to travel, willingness to make new trips, willingness to pay, and expected frequency of use.
- Adoption level: combining the likelihood of future use and attitude toward immediate service availability.

A clustering (K-means) process was then applied to the 211 survey responses received based on 18 features (selected via feature importance analysis) were used across a sample of 211 respondents to segment users in an unsupervised manner. The results showed two main clusters: Cluster 1 groups individuals more open to IAM adoption, more flexible in their travel choices, less concerned about privacy, and more responsive to environmental and cost factors; while Cluster 0 reflects more conservative habits and greater caution toward the new technology. Although the quantitative differences between clusters are moderate, the analysis confirms that adoption cannot be explained by socio-demographics alone, but is also shaped by travel behaviour, privacy perception, and environmental awareness. The results are presented in the following table.

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Table 5. Identified clusters

Feature	Cluster 1 (Higher Adoption & Propensity)	Cluster 0 (Lower Adoption & Propensity)
Propensity	6.94	6.86
Adoption	5.82	5.69
Transport mode used	Multimodal (driver, passenger, taxi)	Private car only
Privacy concerns	Slightly concerned	Moderately concerned
Frequency of regional trips	Monthly	Every two weeks
Environmental concerns	Very important	Moderately important
Cost concerns	Extremely important	Very important

The results are constrained by a small sample size (211 respondents), which limits the statistical robustness and representativeness of the clusters, and by the fact that they rely entirely on stated preferences for a transport mode not yet commercially available, meaning actual future behaviour may differ. As such, this should be treated as an initial proof of concept rather than a definitive assessment of market adoption.

That said, the exercise confirms the technical and conceptual feasibility of combining stated preference surveys with unsupervised learning to characterise IAM adoption, through a workflow that is replicable and scalable to other geographic contexts. Clustering quality metrics (SSE, Silhouette) further support the reliability of the approach as a tool.

IAM demand monitoring tools

This component has developed algorithms for monitoring potential IAM demand through the fusion of MND with other data sources, and confirmed that the resulting mobility indicators are consistent with expected mobility behaviour.

For that purpose, a two-phase approach was followed:

1. Extraction of mobility patterns from MND using anonymised mobile phone records, land use, and sociodemographic data to derive trip flows, passenger attributes, and journey characteristics between regions.

2. Enhanced passenger profile characterisation, adding layers of information not directly observable in MND, but that are key for understanding IAM adoption:
    - Trip purpose identification (business vs leisure), via a machine learning classifier trained on population survey data and applied to MND-derived trips.
    - Road transport mode identification, via a novel algorithm distinguishing bus trips from private-vehicle trips on shared road infrastructure (based on proximity to bus stops/routes and schedule consistency), applied only to the Catalonia case study.

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- Travel time and cost estimation, combining OpenStreetMap (OSM)-based road calculations with official fares/schedules for other modes.

The application of the methodology to the Tenerife–La Gomera connection showed that trip volumes are stable year-round, peaking in summer (>230,000 trips in August) and dipping in November (~152,000). Ferry dominates (98.9% of trips) over air (1.1%), with clear spatial patterns tied to port/airport locations. Sociodemographics are strongly local/national (90–96% residents), with German and British visitors leading the foreign segment.

In the Catalan Pyrenees, the demand shows two peak seasons: summer (August, >6M trips) and the ski season (Dec–Mar). 92.5% of demand originates within Catalonia, mainly from Barcelona and Lleida; Huesca, Madrid, and Zaragoza are the main sources from the rest of Spain. Rail use is concentrated on the single R3 line (Barcelona–Puigcerdà).

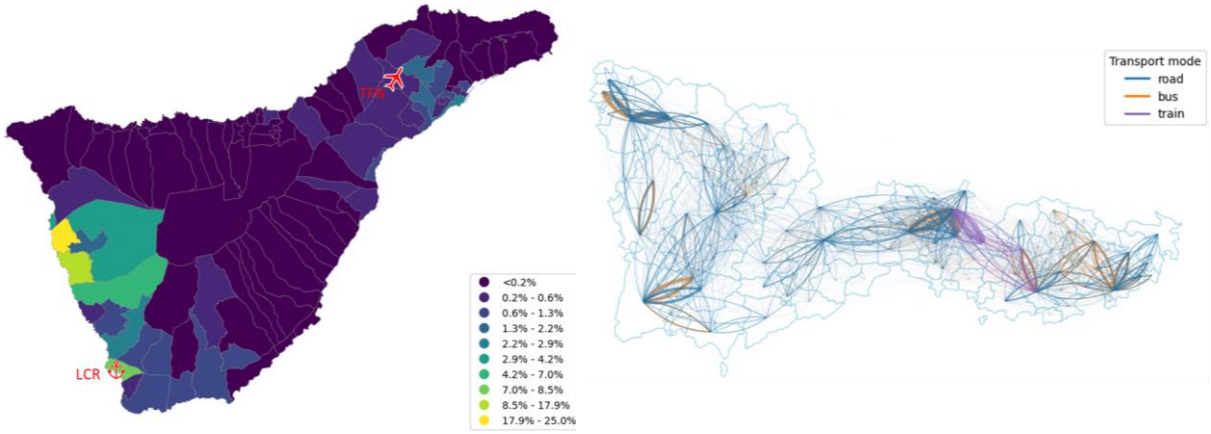

Figure 1. Example of mobility patterns derived from MND. Origin of the ferry trips from Tenerife to La Gomera (left), and flow of passengers within the Catalan Pyrenees segmented by mode (right).

The trip-purpose classifier achieved strong, consistent performance across both case studies (0.97 accuracy and 0.92 macro-averaged F-score) reliably distinguishing business from leisure trips. Business travel was correctly detected as concentrated on weekdays, within the working-age population, and negligible among the youngest and over-65 groups. Results were independently validated against the EMQ APA 2025 survey, with detected patterns (weekday concentration, weekend collapse, higher business share on longer external corridors) consistent with survey references.

The bus-detection algorithm produced modal shares comparable in order of magnitude to survey data (e.g., ~23% intra-Pyrenees bus share from MND vs. 18% from the survey; 2–3.8% on external corridors vs. a combined 5.4% survey figure), despite the absence of ground-truth occupancy data.

Travel times and costs were estimated for all detected trips, combining OSM-based road calculations (with a standardised cost of €0.21/km) with official fares and schedules for ferry, plane, bus, and rail. For Tenerife–La Gomera, results captured the effect of the 75% resident subsidy on inter-island fares, producing clearly divergent cost distributions between resident and non-resident passengers.

The exercise successfully demonstrates that MND, enriched with trip-purpose and modal-detection layers, produces mobility indicators consistent with expected behaviour and independent references.

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This confirms the technical feasibility and transferability of the developed methods across different territorial contexts (island and mountain regions), establishing a credible foundation for the subsequent IAM demand and market-potential analysis — particularly relevant given that business and leisure segments differ substantially in value of time and willingness to pay, both key drivers of potential shift to IAM services.

IAM demand models

This component estimates IAM demand by calibrating models able to forecast IAM captured demand (modal shift from existing modes) and induced demand (net new trips generated by IAM's improved accessibility).

Captured demand is estimated using a hybrid modelling framework that combines the stated preference surveys and MND-derived demand. The survey is used to estimate multinomial logit models that capture travellers' sensitivity to IAM travel time, cost, and user characteristics, while also deriving the Value of Time. MND is used to calibrate the alternative-specific constants of existing transport modes, ensuring the model reproduces observed modal shares. This calibrated generalised cost framework is then used to introduce IAM as a future transport option.

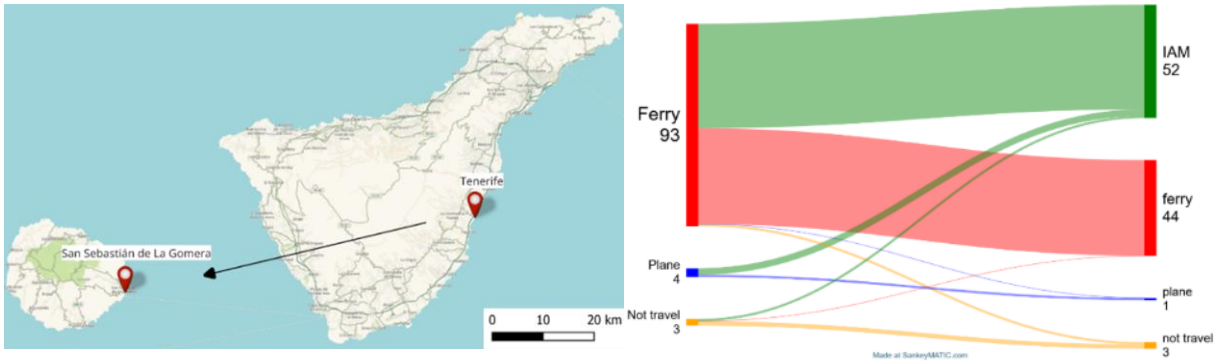

Figure 2. Potential demand captured by IAM in the 'South of Tenerife to San Sebastián de la Gomera' scenario according to the stated preference surveys.

Induced demand is estimated independently from captured demand using a gravity-style exponential model calibrated with MND. The model relates trip frequency to changes in generalised travel cost, allowing the estimation of additional trips generated when IAM reduces travel time and cost. This approach distinguishes newly generated travel demand from modal shift, which only reallocates existing trips between transport modes.

The application to the case studies shows that:

- IAM users are predominantly former car/road users (70–97% of shifted trips depending on the corridor), with ferry and taxi also contributing significantly in the Canary Islands, and bus/train in Catalonia.
- IAM is more competitive on shorter, geographically constrained trips (e.g. intra-Pyrenees, intra-Gomera) than on longer-distance corridors (e.g. Puigcerdà–Barcelona), where higher total IAM cost reduces attractiveness.

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- Induced demand is minimal overall and concentrated among leisure travellers in the Canary Islands; no induced demand was detected in Catalonia under any tested fare, due to longer distances driving up total IAM cost.
- Survey-based results additionally show that willingness to adopt IAM correlates most strongly with income, age (highest among 25–54), and familiarity with IAM.

The results are subject to several limitations. Since IAM is not yet commercially available, all modal shift and induced demand estimates rely on scenario-based assumptions regarding fares, travel times, and vertiport locations, with no revealed-preference data available for validation. Furthermore, the induced demand model is an aggregate cost-sensitivity approximation that does not explicitly account for destination choice or activity generation. The generalised cost formulation also excludes potentially influential factors such as parking costs, waiting and transfer times, service reliability, and schedule-delay penalties. Finally, the stated preference survey, based on 211 respondents, is suitable for exploratory analysis but may not fully represent the diversity of future IAM users.

Despite this, the exercise confirms that IAM is not a mass-transport mode but a complementary mobility option, most valuable in corridors with slow, indirect, or geographically constrained existing connections, particularly islands and mountainous regions. The bulk of IAM demand comes from modal shift (mainly from private car), while induced demand remains marginal, meaning IAM largely redistributes existing travel rather than generating substantial new trips. This has direct implications for infrastructure planning: vertiport investment should be prioritised based on realistic modal-shift potential rather than assumptions of large newly-generated demand.

IAM network optimisation

This component consists on a vertiport location optimisation tool, a decision-support framework designed to identify economically viable and operationally feasible IAM infrastructure networks. The tool integrates the MND-derived demand and the discrete choice models developed previously in the other components, along with infrastructure costs and weather constraints, and perform and optimisation process to determine the optimal location and configuration of vertiports while maximising operator profitability or captured demand.

The application of the tool to the case studies consistently show that network performance is highly sensitive to IAM pricing and the number of vertiports. In both case studies, demand increases rapidly as the network expands but exhibits diminishing returns beyond seven to eight vertiports, where additional infrastructure contributes little additional demand while increasing costs. Affordable IAM fares (around €4/km in the Catalan Pyrenees and up to €5/km in the Canary Islands) are identified as a prerequisite for financial viability, highlighting the potential need for public support during the early deployment phases.

The optimisation results closely reflect the underlying mobility patterns extracted from MND. In the Catalan Pyrenees, the selected vertiports concentrate around the main mobility corridors linking urban centres with tourist destinations, while peripheral locations capture limited demand and often become economically unattractive. In the Canary Islands, most profitable vertiports are located within La Gomera, where intra-island demand exceeds inter-island travel and IAM provides greater relation between cost and travel time savings compared with existing transport alternatives. Across both case studies, the selected networks demonstrate internally consistent relationships between demand, revenues, costs, and operational constraints, including weather-related availability.

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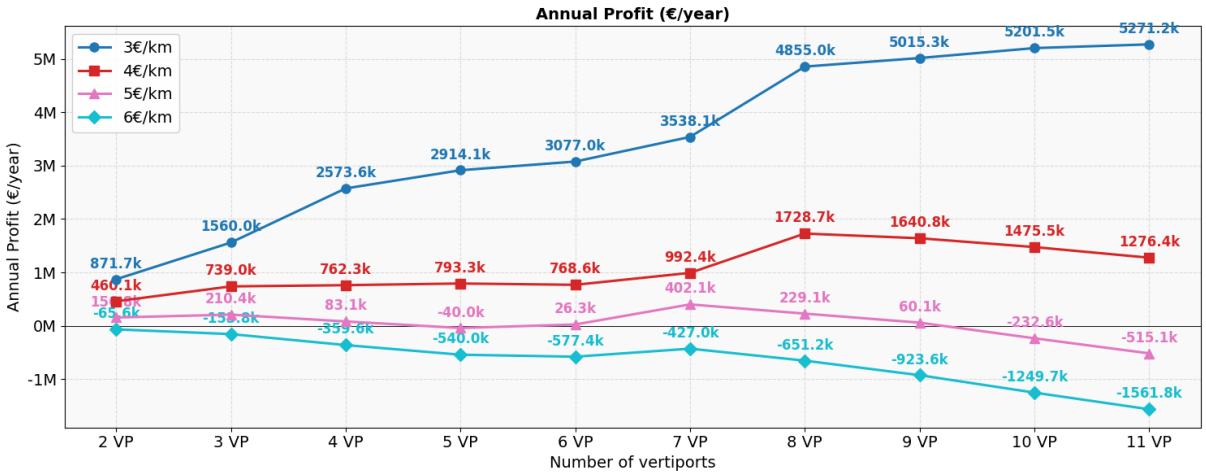

Figure 3. Vertiport network profits per IAM price and number of vertiports dor the Catalan Pyrenees

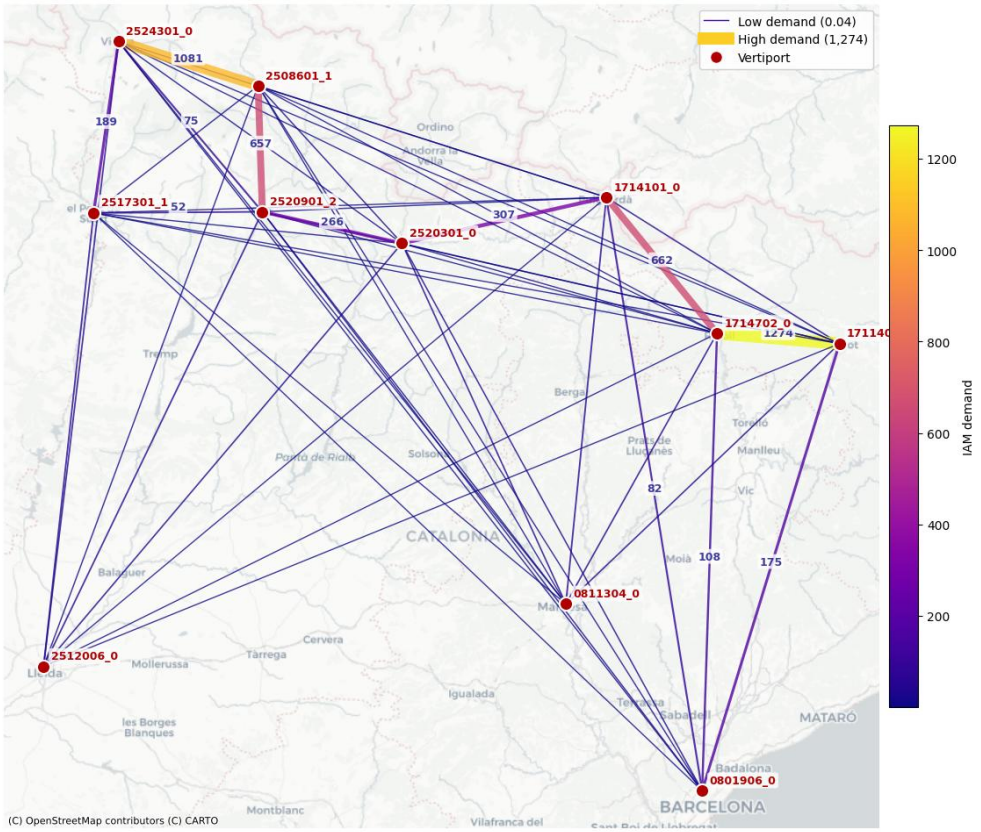

Figure 4. Yearly IAM demand across the routes connecting the selected vertiports for the Catala Pyrenees, assuming a IAM cost of 4€/km

Overall, the validation demonstrates that the proposed methodology constitutes a robust proof of concept. The integrated framework successfully combines mobility demand estimation, behavioural modelling, and optimisation into an operational tool capable of supporting strategic IAM infrastructure planning. While the absolute results remain dependent on scenario assumptions and input data quality, the methodology provides reliable comparative insights into network design, pricing

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strategies, and infrastructure investment decisions. Expert validation confirmed the realism of the modelling assumptions and reinforced confidence in the tool's outputs.

IAM service optimisation

This component consists on an optimisation framework for regional IAM operations that jointly optimises passenger journeys and IAM vehicle dispatch while integrating existing public transport services.

Two complementary optimisation approaches were developed: a heuristic algorithm capable of producing high-quality solutions within operationally acceptable computation times, and an exact Mixed-Integer Linear Programming (MILP) formulation that provides globally optimal solutions for smaller problem instances. Together, these methods establish a flexible framework capable of supporting both strategic planning and operational decision-making for future IAM services.

A key outcome of the work is the demonstration that integrated optimisation of passenger demand and vehicle scheduling is computationally feasible, although solving the complete problem exactly rapidly becomes intractable for realistic regional networks. The original MILP formulation exceeds 570 million decision variables for the considered case studies, confirming the need for scalable solution techniques. To address this challenge, a locality-based sparsification approach was introduced, reducing the optimisation problem by approximately 80% while preserving the essential network structure and significantly improving computational tractability.

The framework was validated through the Catalan Pyrenees case study, where a multimodal transport network was constructed from GTFS public transport data, existing heliports, and representative candidate vertiport locations. Successive graph simplification techniques, including node merging and Leiden community detection, reduced more than 8,700 transport stations to a representative network of only 105 nodes without compromising the regional mobility structure.

Overall, the results demonstrate that the proposed framework can efficiently model multimodal passenger flows and optimise IAM operations at regional scale while maintaining computational efficiency. The combination of heuristic optimisation for large-scale applications and exact optimisation for benchmarking provides a robust basis for future IAM traffic management systems. The proposed network abstraction and sparsification techniques are shown to be essential enablers for scaling optimisation to realistic transport networks and constitute a significant step towards the practical implementation of IAM operational planning tools.

3.2.1 Operational/Technical context

The PRIAM project is set within a dynamic European mobility landscape focused on sustainability, multimodality, and passenger-centric solutions. It targets the integration of regional-scale IAM services—powered by emerging aircraft technologies such as electric VTOL—as a complement to existing transport modes, especially in areas with limited infrastructure due to geographic or environmental constraints.

Technically, PRIAM is developing a TRL1 SESAR toolset that leverages AI and big data to support IAM planning, demand forecasting, and multimodal coordination. It is designed to interface with mobility data spaces and existing transport infrastructure, including airports, vertiports, high-speed rail, and on-demand ground transport.

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The PRIAM Solution is designed to operate within a dynamic and evolving ecosystem. As such, several working hypotheses have been formulated and a set of requirements defined (see Section 3.2) to guide its development and ensure its validity under diverse and future operational scenarios.

To assess the capabilities of the PRIAM Solution, two case studies with different operational and geographical context have been selected: The Catalan Pyrenees and the Tenerife–La Gomera corridor. These regions were chosen for their distinctive mobility challenges and strategic relevance to regional IAM deployment. The Catalan Pyrenees represent a mountainous and sparsely populated area with limited transport infrastructure and significant seasonal tourism flows, making it an ideal setting to explore how IAM can enhance connectivity in complex terrains. The Tenerife–La Gomera case focuses on inter-island mobility within an insular territory, where current transport options are constrained by geography and travel time. This scenario allows the project to assess the potential of IAM services to improve accessibility between islands and within remote communities. Together, these cases provide diverse and complementary conditions to evaluate the flexibility and impact of the PRIAM Solution.

3.2.1.1 Case study 1 – Catalan Pyrenees: IAM for mountainous regions

The Catalan Pyrenees offer a valuable example of the accessibility challenges faced by mountainous areas. Geographical barriers limit the ability to provide high-quality road infrastructure and HSR links. While predominantly rural, the region attracts large tourist flows (particularly in the winter season) and acts as the door to the country of Andorra (80k inhab.). Andorra has no airport due to lack of space and the complicated orography, but the existing heliports could be upgraded to vertiports in order to enable IAM connectivity with Spain and France. Aeroports de Catalunya (AdC) manages the single commercial airport in the area (Andorra–La Seu d'Urgell, ICAO code: LESU), with a single 1,267-meters runway and 11.2k annual passengers in 2022. Besides another aerodrome managed by AdC without commercial traffic (La Cerdanya, ICAO code: LECD, 1,250-meters runway), the area has several heliports for emergency purposes

Connecting the Catalan Pyrenees with nearby population centres is complicated due to orography. The closest major urban area is Lleida, located approximately 120 kilometers away, depending on the specific location within the Pyrenees. Lleida offers further connectivity through its airport (Lleida–Alguaire Airport, ICAO code: LEDA), with regular flights to the Balearic Islands, and through HSR links to other major Spanish cities. Although more distant, cities such as Barcelona and Girona could also serve as important nodes within a future IAM network.

Table 6 presents the specification of the Catalan Pyrenees case study. These specifications will be further refined in the next phases of the project.

Table 6. Catalan Pyrenees case study specification

Category	Information
Scope	IAM for mountainous regions
Geographical scope	Catalan Pyrenees
Service type	Passenger transportation
Context scenario	Simulation of passenger transportation with eVTOLs.

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PRIAM components	Passenger behaviour modelling to estimate the demand for a new IAM service: • Identify passenger characteristics that influence IAM adoption • Extract the current passenger demand data through mobile data • Develop models to estimate the demand captured by new IAM services IAM service characterisation based on the estimated IAM demand: • Identify the optimal vertiport locations to maximise the demand that can be allocated • Define key service operation characteristics (e.g., on-demand service, scheduled routes, etc.)
Data sources	• Orange mobile data • Stated preference surveys
Benefits	• Improved connectivity within the rural area • Improved time saving for passengers • Positive environmental impact due to eVTOLs technologies and less use of private cars • Positive impact on the eVTOL business through rate of rides

Figure 5 graphically represents the concept related to IAM for the Catalan Pyrenees. The image is intended for illustrative purposes only. The image shows the main populations and multimodal transport hubs located in the area.

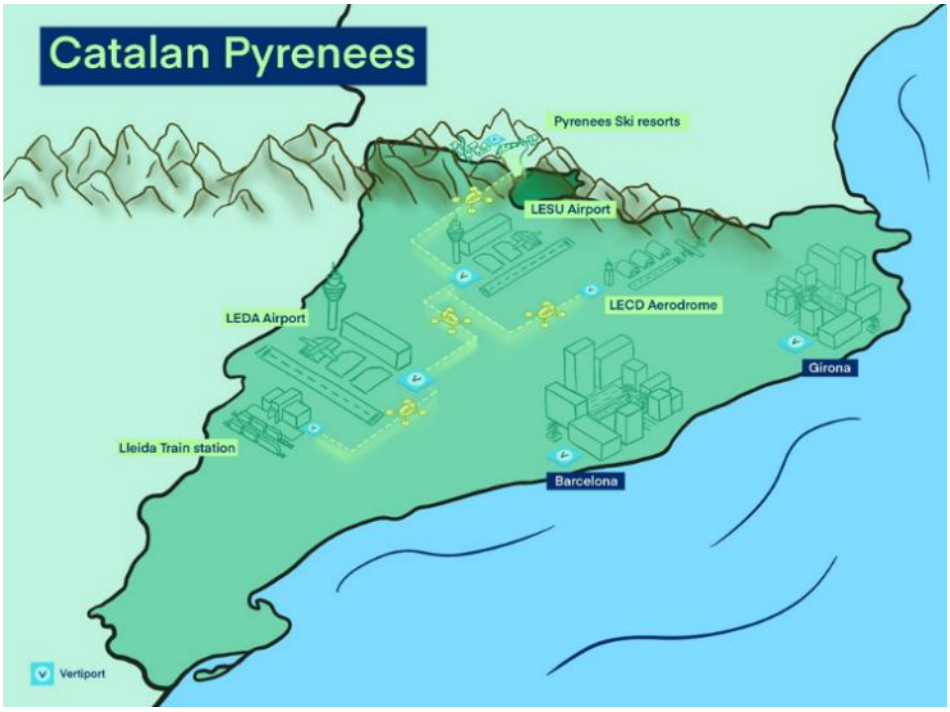

Figure 5. Graphical representation of Case Study 1 – Catalan Pyrenees: IAM for mountainous regions

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3.2.1.2 Case study 2 – La Gomera-Tenerife connection: IAM for inter-island connectivity

The EU has over 60 islands with populations exceeding 5k, often clustered in archipelagos that follow a hierarchical structure. Smaller islands require seamless connections to cities and transport hubs in larger islands in order to foster citizens' well-being and socioeconomic development. La Gomera (22k inhab.) and Tenerife (950k inhab.), two of the Canary Islands, provide a challenging case study for inter-island mobility. La Gomera is connected to Tenerife by sea (from Tenerife southern port of Los Cristianos to La Gomera's largest town) and by air (from Tenerife Norte airport to La Gomera airport, IATA code: GMZ, 1,500-meters runway) with 2 flights per day (morning and evening) by Binter airline using ATR-72 (limited to 70 seats). Bluenest has initiated cargo eVTOL trials for the transportation of medical goods within and between the islands.

Table 7 presents the specifications of the La Gomera-Tenerife case study. These specifications will be further refined in the next phases of the project.

Table 7. La Gomera-Tenerife case study specification

Category	Information
Scope	IAM for intra/inter-island connectivity
Geographical scope	Canary Islands (La Gomera and Tenerife)
Service type	Passenger transportation
Context scenario	• Simulation of passenger transportation between La Gomera Airport and the capital. • Simulation of passenger transportation between La Gomera and Tenerife.
PRIAM components	Passenger behaviour modelling to estimate the demand of a new IAM service • Identify passenger characteristics that influence IAM adoption • Extract the current passenger demand data through mobile data • Develop models to estimate the demand captured by new IAM services IAM service characterisation based on the estimated IAM demand: • Identify the optimal vertiport locations to maximise the demand that can be allocated • Define key service operation characteristics (e.g., on-demand service, scheduled routes, etc.)
Data sources	• Orange mobile data • Stated preference surveys • Trial tests performed with cargo eVTOLs since 2025
Benefits	• Improved connectivity within and between the islands • Improved time saving for passengers • Positive environmental impact due to eVTOL technologies and less use of private cars

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	• Expected positive impact on tourism, making travel between the Canary Islands easier

Figure 6 graphically represents the concept related to IAM for the La Gomera – Tenerife case study. The image is intended for illustrative purposes only. The image shows the main populations and multimodal transport hubs shown located in that area.

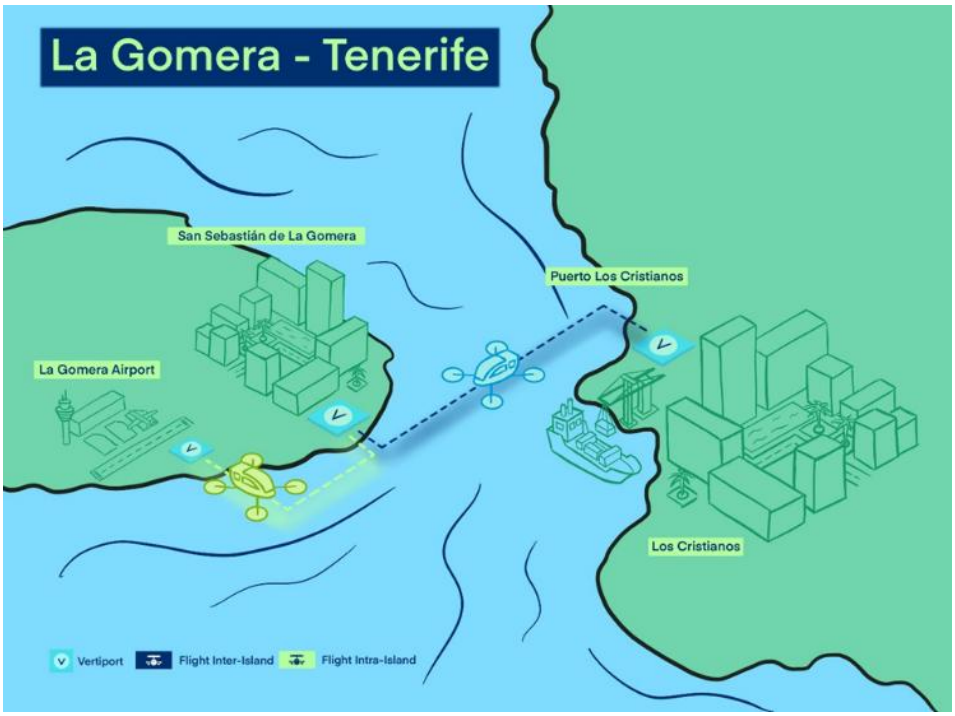

Figure 6. Graphical representation of Case study 2 – La Gomera-Tenerife connection: IAM for inter-island connectivity

3.2.2 Stakeholders

The PRIAM advisory board is composed by 8 representatives of relevant fields, such as eVTOL operators, aircraft manufacturers, regional authorities, and other European organisations. The following table present a detailed list of the stakeholder involved in the PRIAM advisory board.

Table 8. PRIAM Advisory Board members

Category	Organisation	Role
eVTOL manufacturer	Volocopter*	Airspace Specialist
	Lilium*	Senior Manager
	Pipistrel*	Technology and Production Engineer
eVTOL operator	AEROS	Chief Executive Officer
Regional authorities	Cluster Aeronáutico de Canarias (CAAC)	President

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	Govern d'Andorra	Civil Aviation Adviser
European organisations	ERTICO	Senior Manager Innovation & Deployment
	POLIS	Project Manager
		Director Policy and Projects

*Despite several eVTOL compagnies having financial issues during the duration of the PRIAM project, the individuals forming part of the advisory board have remained in touch with members of the project and have participated in the stakeholder involvement activities providing the PRIAM project with valuable and actionable insights.

Stakeholders have been consulted in several ways during the PRIAM project:

1. A series of semi-structured interviews with 5 members of the advisory board (Lilium, AEROS, CAAC, Andorra Government and ERTICO) were conducted, with the objective of contrast their insights to the preliminary desk research developed by the project as well as identify potential gaps in the desk research and the state-of-the-art.

   The feedback received was highly helpful and allowed the project team to confirm most of the topics identified during the desk research phase. Most of the interviewed stakeholders had similar points of view on the future of IAM, and their insights were essential for confirming and refining several key assumptions to be considered in the project. These included, for example, the definition of a realistic timeline for the deployment of IAM services—taking into account technological maturity, automation levels, and regulatory developments—which anticipates manned operations by 2035 and fully autonomous operations by 2050; or the identification of the importance of various factors that could affect the social acceptance of IAM services, such as environmental impacts, affordability, or safety.

2. The PRIAM first stakeholder workshop took place in Brussels on March 18th, 2025. The workshop gathered members from the Advisory Board and the SJU, achieving a total attendance of 9 experts external to the project team, 6 in-person (Volocopter, Andorra Government. AEROS, ERTICO, POLIS and the SJU) and 3 online (Pipistrel, Lilium and CAAC). The workshop focused on presenting the initial version of the impact assessment framework, the case studies and the scenarios developed within the project, aiming at collecting the feedback of the different stakeholders.

3. The PRIAM second stakeholder workshop took place in Madrid on the April 15th, 2026. The workshop gathered more than 20 participants including project members, members of the advisory board and stakeholders from diverse backgrounds. During the workshop, the members of the PRIAM project presented and validated the results of the relevant PRIAM tools and gathered feedback for the final round of experiments. Additionally, the project members gathered important information regarding the SCBA and the final policy recommendations.

4. After the PRIAM second stakeholder workshop, a series of one-to-one conversation with different members of the advisory board took place. These conversations were key establishing the final simulation parameters and assumptions.

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The feedback received during both workshops was highly valuable for refining the selected scenarios and identifying all relevant actors involved. In the first stakeholder workshop, the discussion contributed to the improvement of several PIs defined in the impact assessment framework. This included clarifying the specification of capacity (e.g., per vehicle/per person or per vertiport/airspace), highlighting the importance of segmenting PIs based on passenger characteristics (e.g., business vs leisure travel) as the impact can be significantly different, and ensuring alignment with the SESAR performance framework. In the second stakeholder workshop, the conversations helped identify policies, additional modelling assumptions and validating the different tools of the PRIAM toolset.

A more detailed summary of the feedback gathered from the various stakeholders engaged in the project through the stakeholder involvement activities will be included in the deliverables D3.2 and D4.2.

3.2.3 Key scenarios

This section presents a structured overview of the PRIAM project's two core scenarios, each analysed across two time horizons - 2035 and 2050. These scenarios have been developed in alignment with the project's regional case studies (see 3.2.1) and serve to explore the evolution of IAM under varying operational, regulatory, and technological conditions. Each scenario will guide the iterative development and validation of the PRIAM solution, contributing to a deeper understanding of IAM's potential to transform regional mobility. This section will be further refined in the final version of the document, accordingly to project developments and achievements.

The year 2035, based on the desk research output, is selected as a plausible timeframe for the initial deployment of piloted eVTOL operations within regulated airspace. The year 2050 envisions the potential for a fully mature IAM ecosystem, including autonomous eVTOL operations, facilitated by advanced regulatory frameworks and U-space Level 4 services.

Table 9 summarises the key scenarios for the PRIAM project.

Table 9. PRIAM scenarios

Scenario	2035	2050
Mountainous regions	IAM in mountainous regions in 2035	IAM in mountainous regions in 2050
Intra/Inter-Island connectivity	IAM in intra/inter-island connectivity in 2035	IAM in intra/inter-island connectivity in 2050

3.2.3.1 Scenario 1: Integrating IAM in mountainous regions

This scenario investigates IAM deployment in regions where terrain-related constraints significantly hinder regional connectivity and airport access. Mountainous terrains often present significant challenges to regional connectivity and airport access due to natural barriers and limited surface transport options.

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IAM, enabled through eVTOL services, is envisioned to bridge connectivity gaps for both residents and tourists. The PRIAM solution will support these efforts by modelling passenger demand, identifying optimal vertiport locations, and simulating modal shift.

The goal is to improve passenger experience, enhance environmental sustainability, alleviate airport congestion, and optimise network performance.

Scenario 1A: IAM in mountainous regions – 2035

Identifier: PRIAM-S1A-2035	
Objectives	• Establishment of certified piloted eVTOL operations to enhance connectivity in mountainous areas. • Utilisation of existing heliport infrastructure to minimise initial investment. • Addressing the mobility needs of residents, tourists, and businesses.
Airspace structure	• Operations within controlled airspace, primarily in low-density mountainous regions. • Integration with existing ATM systems to ensure safety.
Traffic characteristics	• Low volume of piloted eVTOL flights. • Predominantly short-haul flights connecting remote areas to urban centres.

In 2035, the focus is on the initial deployment of certified, piloted eVTOL services, leveraging existing heliports where possible. For example, Andorra already possesses suitable infrastructure. These services are primarily targeted at residents, tourists, and business travellers, recognising the high early-stage costs and limited range of vehicles.

eVTOLs intended for this phase should be adequately certified and sized to support safe, comfortable passenger transport. Key technical needs include advancements in battery performance, ensuring low weight, high durability, and safety, along with robust design considerations for extreme weather conditions.

From an infrastructure perspective, existing heliports should be adapted for eVTOL compatibility, supported by vertiport management systems and flight “booking” functionalities. Importantly, these operations must coexist with conventional airport activities without disrupting runway use. This requires the establishment of safe and economically viable operational standards and high levels of digitalisation for air traffic communication.

On the regulatory front, approval for piloted eVTOL services should be in place by 2035, alongside commercial certification for vehicles and a demonstrated technical proof of concept. Operators must account for both direct and indirect costs, including insurance, storage, maintenance, administration, and marketing.

Business models must identify and train eVTOL pilots and maintenance personnel, while infrastructure must be upgraded to accommodate vehicle storage and operational needs. To align services with real

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demand, mobility data (e.g., mobile tracking, surveys) should inform service frequency and network planning.

Connectivity goals include linking remote mountainous areas to cities or regional hubs. Over-water and high-altitude regulations must be developed accordingly. Services should meet mobility expectations around travel time, comfort (including storage for leisure travel), frequency, and perceived safety. Accessibility for diverse user groups and overall ease of use should be prioritised, supported by efforts to enhance user trust and acceptance, and mitigate noise and visual pollution.

Scenario 1B: IAM in mountainous regions – 2050

Identifier: PRIAM-S1B-2050	
Objectives	• Transitioning to autonomous eVTOL operations to enhance service frequency and reduce costs. • Implementing U-space Level 4 services for efficient and safe airspace management. • Expanding accessibility to underserved communities.
Airspace structure	• Operations in both controlled and uncontrolled airspace, requiring dynamic airspace management. • Full integration with U-space Level 4 services for autonomous operations.
Traffic characteristics	• Operations in both controlled and uncontrolled airspace, requiring dynamic airspace management. • Full integration with U-space Level 4 services for autonomous operations.

By 2050, a mature IAM ecosystem is envisaged, centred around autonomous eVTOL operations supported by U-space Level 4 services. Services are expected to be more affordable and widespread, including underserved communities and difficult-to-reach areas.

Vehicles must be designed explicitly for autonomous passenger transport, with remote piloting serving as a transitional capability. Regulation should authorise such autonomous operations, including complex scenarios like night-time or over-water flights, while the integration of U-space Level 4 must support automation across vehicle, environment, and operational dimensions.

Vertiport development should balance operational needs with minimal disruption to people and ecosystems. Urban integration requires special attention to second landing zones and safe access. Environmental and logistical constraints, including proximity to the sea, weather stability, traffic density, and airport locations, must be assessed.

OEMs should secure certification for autonomous vehicles by 2050, addressing direct investment and operational costs. With reduced piloting costs and greater demand, prices should be adjusted to ensure affordability and generate sufficient profit margins. Passenger uptake will be further encouraged by this affordability shift, in line with broader IAM objectives for inclusive and resilient mobility.

Stakeholders in scenarios PRIAM-1A-2035 and PRIAM-1B-2050 include:

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Stakeholder	Role	Interaction	Scenario
Regional and airport authorities	They have the regulatory oversight and are responsible for the establishment and enforcement of regulations to ensure safe and efficient IAM operations. From an infrastructure planning perspective, they also facilitate the development and integration of vertiports and other necessary infrastructure. Lastly, regional and airport authorities could address public concerns and promote social acceptance of IAM services.	In these scenarios, regional and airport authorities collaborate with vertiport operators and eVTOL service providers to ensure infrastructure meets operational requirements, as well as engage with passengers and ground transport providers to integrate IAM services into the existing transport network.	PRIAM-1A-2035 PRIAM-1B-2050
Vertiport operators	They oversee the operation and maintenance of vertiports, ensuring readiness for eVTOL operations, as well as implementing safety protocols in line with regulatory standards.	In these scenarios, vertiport operators work with regional authorities for compliance and infrastructure development, as well as coordinate with eVTOL operators to schedule and manage flight operations efficiently.	PRIAM-1A-2035 PRIAM-1B-2050
Air Navigation Service Providers	They manage the airspace by controlling and monitoring air traffic to ensure safe separation of IAM vehicles from other airspace users, as well as integrating U-space services in advanced traffic management systems to accommodate high-density IAM operations	In these scenarios, ANSPs coordinate with eVTOL operators for flight planning and real-time air traffic management, as well as collaborate with regulatory authorities to develop and implement airspace policies specific to IAM.	PRIAM-1A-2035 PRIAM-1B-2050
eVTOL operators	They provide service by offering air mobility services to passengers, ensuring adherence to safety and operational standards, as well as managing and maintaining the eVTOL fleet, ensuring operational readiness and compliance.	In this scenario, eVTOL operators work closely with vertiport operators for scheduling and ground operations, as well as coordinate with ANSPs for flight approvals and adherence to airspace regulations, and engage with ground transport providers to offer seamless multimodal transport options.	PRIAM-1A-2035 PRIAM-1B-2050

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eVTOL pilot	They have direct control over the aircraft, typically from within the cockpit (or remote piloting).	In this scenario, pilots coordinate closely with airport and vertiport authorities, and ANSPs to ensure safe, integrated operations, while also contributing to service refinement through real-time feedback and direct passenger interaction.	PRIAM-1A-2035
Ground transport providers	They collaborate with IAM services to provide integrated multimodal transport solutions, offering transportation services that connect passengers to and from vertiports.	In these scenarios, ground transport providers coordinate with eVTOL operators and vertiport operators to synchronise schedules and facilitate smooth passenger transfers, as well as engage with regional authorities to ensure transport policies support multimodal integration.	PRIAM-1A-2035 PRIAM-1B-2050
Passengers	They utilise the IAM services for transportation.	In these scenarios, they interact with eVTOL operators and vertiport staff during their travel experience.	PRIAM-1A-2035 PRIAM-1B-2050

Other stakeholders that are indirectly impacted by these scenarios are:

- Civil society: IAM services would offer more accessible and reliable transportation options, addressing the mobility challenges that many residents face in areas with limited infrastructure. This improved connectivity would help bridge the gap between isolated communities and larger urban centres, making it easier for people to access essential services, education, and employment opportunities.
- Tourist agencies: The improved accessibility given by IAM services would likely lead to a higher demand from tourists, as they will have the option to explore less accessible areas, knowing they can rely on a well-coordinated transport system

3.2.3.2 Scenario 2: Enhancing connectivity for insular territories

This scenario addresses connectivity gaps in insular territories, where geographic isolation leads to extended travel times, limited transport frequencies, and vulnerability to weather-related disruptions. IAM solutions, especially via eVTOL, are considered strategic alternatives to existing ground, air and ferry services.

IAM, enabled through eVTOL services, is envisioned to bridge connectivity gaps for both insular residents and tourists. The PRIAM solution will support these efforts by modelling passenger demand, identifying optimal vertiport locations, and simulating modal shift.

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The goal is to improve passenger experience (e.g., reduced travel times and increased transport frequency), enhance operational resilience, and improve environmental sustainability.

Table 10. Scenario 2A: IAM for intra/inter-island connectivity – 2035

Identifier: PRIAM-S2A-2035	
Objectives	• Introducing piloted eVTOL services to improve connectivity within and between islands. • Utilising existing airfields and upgraded heliports to establish initial routes. • Addressing critical transport gaps for residents, tourism, and healthcare.
Airspace structure	• Operations primarily in controlled airspace over water and coastal regions. • Coordination with maritime authorities for over-water flights.
Traffic characteristics	• Low volume of piloted eVTOL flights. • Predominantly short-haul flights connecting islands.

In 2035, the priority is to launch piloted eVTOL services using upgraded heliports and existing airfields. These services offer an essential alternative to ferry and regional air services, especially where weather or infrastructure limitations hinder reliable mobility. The focus includes critical transport segments, such as healthcare access and tourism.

Piloted eVTOLs should be certified and tailored for passenger operations, offering comfort, manoeuvrability, and size appropriate for short to medium trips. Battery improvements are necessary to support longer missions and durability. As with mountainous regions, vehicle resilience to weather extremes must be built into their design, and multi-engine configurations are recommended for safety.

Operations should integrate with existing heliport networks through booking and scheduling platforms. Communication must be digitalised for efficient interaction with ATC and other airspace users, ensuring safe, seamless integration into controlled airspace.

By 2035, commercial certification and technical validation should be achieved, with a solid cost structure addressing both direct (e.g., vertiports, insurance) and indirect (e.g., marketing, reservations) expenditures. High ticket costs may initially be necessary to balance the investment unless offset by public support.

The business model must include trained pilots, identified operators for ground activities, and upgraded storage infrastructure. Demand mapping, based on empirical data, will support appropriate service frequency planning.

Connectivity should focus on linking isolated islands with mainlands or neighbouring islands, ensuring that regulations for over-water flights are well-established. Mobility needs include reduced travel time, reliability, and comfort (including baggage accommodation for leisure users). Accessibility for various user categories, user-friendly service design, and enhanced public trust must also be built into the offering, alongside noise and visual impact mitigation.

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Table 11. Scenario 2B: IAM for intra/inter-island connectivity – 2050

Identifier: PRIAM-S2B-2050	
Objectives	• Transitioning to autonomous eVTOL operations to enhance service frequency between islands and reduce costs. • Implementing U-space Level 4 services for efficient and safe airspace management. • Provide affordable and reliable transportation options for residents and tourists in insular regions.
Airspace structure	• Operations primarily in controlled airspace over water and coastal regions. • Full integration with U-space Level 4 services for autonomous operations.
Traffic characteristics	• Increased volume of autonomous eVTOL flights. • Diverse flight profiles and hauls, including night-time and over-water operations.

In 2050, IAM in insular regions evolves into an autonomous, affordable, and resilient transport system with U-space Level 4 integration. Operations will be scalable, frequent, and adaptable to challenging conditions, such as over-water routes or nighttime flights.

eVTOLs will be fully automated and designed specifically for passenger use, with a possible transitional phase using remote piloting. Autonomous operations will require harmonised regulation for complex operating scenarios, fully embedded within U-space and ATM frameworks. These elements must converge across vehicle functionality, operational modes (flight procedures), and digital environment infrastructure.

New vertiport infrastructure will be constructed with attention to environmental sustainability and spatial efficiency, particularly in constrained or sensitive urban settings. Multiple landing zones and safety access must be ensured. Environmental, geographic, and operational variables—like sea proximity or air traffic—will shape location strategies.

OEMs should pursue commercial certification of autonomous eVTOLs, aiming for efficiency in cost structure and operations. Cost reductions through autonomy should allow for lower ticket prices, boosting uptake and enhancing regional mobility equity. Overall, pricing strategies must be designed to ensure accessibility for a broader segment of the population.

Stakeholders in scenarios PRIAM-2A-2035 and PRIAM-2B-2050 include:

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Stakeholder	Role	Interaction	Scenario
Regional and airport authorities	They have the regulatory oversight and are responsible for the establishment and enforcement of regulations to ensure safe and efficient IAM operations. From an infrastructure planning perspective, they also facilitate the development and integration of vertiports and other necessary infrastructure. Lastly, regional and airport authorities could address public concerns and promote social acceptance of IAM services.	In these scenarios, regional and airport authorities collaborate with vertiport operators and eVTOL service providers to ensure infrastructure meets operational requirements, as well as engage with passengers and ground transport providers to integrate IAM services into the existing transport network.	PRIAM-2A-2035 PRIAM-2B-2050
Vertiport operators	They oversee the operation and maintenance of vertiports, ensuring readiness for eVTOL operations, as well as implementing safety protocols in line with regulatory standards.	In these scenarios, vertiport operators work with regional authorities for compliance and infrastructure development, as well as coordinate with eVTOL operators to schedule and manage flight operations efficiently.	PRIAM-2A-2035 PRIAM-2B-2050
Air Navigation Service Providers	They manage the airspace by controlling and monitoring air traffic to ensure safe separation of IAM vehicles from other airspace users, as well as integrating U-space services in advanced traffic management systems to accommodate high-density IAM operations	In these scenarios, ANSPs coordinate with eVTOL operators for flight planning and real-time air traffic management, as well as collaborate with regulatory authorities to develop and implement airspace policies specific to IAM.	PRIAM-2A-2035 PRIAM-2B-2050
eVTOL operators	They provide service by offering air mobility services to passengers, ensuring adherence to safety and operational standards, as well as managing and maintaining the eVTOL fleet, ensuring operational readiness and compliance.	In these scenarios, eVTOL operators work closely with vertiport operators for scheduling and ground operations, as well as coordinate with ANSPs for flight approvals and adherence to airspace regulations, and engage with ground transport providers to offer seamless multimodal transport options.	PRIAM-2A-2035 PRIAM-2B-2050

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Stakeholder	Role	Interaction	Scenario
eVTOL pilot	They have direct control over the aircraft, typically from within the cockpit (or remote piloting).	In this scenario, pilots coordinate closely with airport and vertiport authorities, and ANSPs to ensure safe, integrated operations, while also contributing to service refinement through real-time feedback and direct passenger interaction.	PRIAM-2A-2035
Ground transport providers	They collaborate with IAM services to provide integrated multimodal transport solutions, offering transportation services that connect passengers to and from vertiports.	In these scenarios, ground transport providers coordinate with eVTOL operators and vertiport operators to synchronise schedules and facilitate smooth passenger transfers, as well as engage with regional authorities to ensure transport policies support multimodal integration.	PRIAM-2A-2035 PRIAM-2B-2050
Passengers	They utilise the IAM services for transportation.	In these scenarios, they interact with eVTOL operators and vertiport staff during their travel experience.	PRIAM-2A-2035 PRIAM-2B-2050

Other stakeholders that are indirectly impacted by these scenarios are:

- Maritime and port authority: The implementation of IAM services would require careful consideration of responsibilities, particularly in terms of overwater operations. If incidents or disruptions occur on the seaside, the responsibility for managing those situations would likely fall to maritime and port authorities. This would require ensuring rigorous safety protocols, effective risk management, and seamless coordination with other transport modes.
- Civil society: IAM services would offer more accessible and reliable transportation options, addressing the mobility challenges that many residents face in areas with limited infrastructure. This improved connectivity would help bridge the gap between isolated insular communities and larger urban centres, making it easier for people to access essential services, education, and employment opportunities.
- Tourist agencies: The improved accessibility given by IAM services would likely lead to a higher demand from tourists, as they will have the option to explore less accessible areas, knowing they can rely on a well-coordinated transport system.

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3.2.4 Potential limitations, weaknesses and constraints

The main limitations identified during the project are thoroughly detailed in the deliverable D4.2 PRIAM Exploratory Research Report, which details the inherent limitations across the project's validation exercises. A summary of these key limitations is presented below:

- Exercise #01 Problem definition: Focused strictly on a high-level strategic scope, omitting tactical/operational KPIs as well as direct measurements of visual and noise pollution due to early TRL modelling constraints. Additionally, the expert interview panel was relatively small, though findings were cross-validated against desk research.

- Exercise #02 IAM adoption modelling: Relied on a small sample size (211 respondents), which reduced clustering robustness. The use of a Random Forest Classifier to filter the top 18 features prior to re-clustering introduces potential overfitting risks, and the visual Elbow Method remains vulnerable to random noise on small datasets.

- Exercise #03 Potential demand monitoring tools: Suffered from a lack of ground-truth operational data (such as actual bus ticketing or occupancy records) to directly validate trip-purpose classification and bus detection algorithms. Furthermore, OpenStreetMap-based travel time calculations did not account for traffic congestion or time-of-day/day-of-week variations.

- Exercise #04 IAM demand models: All estimated modal shifts and induced demand figures depend on scenario-based assumptions for an uncommercialised technology. The generalised cost formula omitted key real-world factors (e.g., parking fees, waiting/transfer times, schedule-delay penalties, and reliability), while the induced demand model relies on an aggregate exponential impedance function rather than explicit destination or activity choices.

- Exercise #05 IAM network optimisation: Used generic urban land prices, sparse weather data, simplified operational templates (e.g., fixed gate counts and 12-hour operational days), and focused solely on vertiport operator profitability without modelling aircraft operator fleet economics.

- Exercise #06 IAM service optimisation: Relied on a limited set of representative scenarios with predefined parameters and partial stochastic variability, restricting the direct generalisability of the outcomes across different operational environments.

These limitations are fully consistent with the expected maturity of a TRL1 exploratory research project and do not undermine the conceptual validity of the conclusions.

A detailed more detailed explanation of these limitations can be found in deliverable D4.2 PRIAM Exploratory Research Report.

3.3 Expected performance outcome

The technical insights and findings of the application of the PRIAM Solution to the case studies, have been translated into actionable guidance for decision-makers. Based on the results of the regional case studies and a comprehensive cost-benefit analysis, this component identifies key enablers, barriers,

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and strategic measures to support the effective deployment of regional IAM services across Europe. It aims to inform policy development at local, national, and EU levels, ensuring that regulatory frameworks, funding strategies, and governance models are aligned with the requirements of sustainable, inclusive, and resilient air mobility.

The following subsections present the results of the SCBA derived from the case studies, together with the IAM implementation roadmap and the policy recommendations developed based on the findings from both the SCBA and the case studies.

3.3.1 Social Cost Benefit Analysis

3.3.1.1 Introduction

This section assesses whether the introduction of IAM generates net benefits for society in the two PRIAM case studies: Tenerife-La Gomera and the Catalan Pyrenees. We compare a reference scenario without IAM with a scenario in which the IAM services and vertiport networks developed in PRIAM Deliverable 4.2 (Nommon et al. 2026) become operational from 2035.

We assess the impacts on transport users, IAM and vertiport service provision, air traffic management, the public budget and the external costs of transport. Because future IAM resource costs and long-term transport demand are uncertain, we report results for seven IAM cost scenarios and three demand scenarios. The analysis is strategic. It supports an initial assessment of the proposed configurations but does not replace a project-level appraisal based on detailed engineering, operating and environmental information.

3.3.1.2 Methodology

What is a social cost-benefit analysis?

The underlying principle of a SCBA is that it identifies all welfare effects – both costs and benefits – of an alternative scenario (in this case the IAM scenario) in comparison with a reference scenario. The term “social” indicates that the costs and benefits are analysed from the perspective of society as a whole. The effects of a scenario in a SCBA include not only economic impacts, but also impacts on people’s well-being, such as effects on the environment or transport safety. The PRIAM SCBA follows the guidelines for cost-benefit analysis of the European Commission (EC), as formulated in EC DG REGIO (2014).

Some of these effects are already expressed in monetary terms, such as transport costs and investment costs. Other effects, however, do not have a market price, including environmental impacts or travel time. To make the different effects comparable, these impacts are valued in monetary terms where possible. Consequently, an SCBA is not limited to financial and economic effects. This distinguishes it from a financial analysis, which focuses exclusively on cash flows – expenditure and revenues – and assesses whether an investment is financially viable from the perspective of the infrastructure manager or operator.

In this PRIAM study, the analysis takes the form of a strategic SCBA. It follows the conventional method but reflects the information available at the current stage of IAM development. Several inputs remain uncertain, particularly IAM resource costs and the future evolution of some external effects. We therefore test alternative assumptions through sensitivity analysis.

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The result of an SCBA is an overview of the different effects over time. These effects are converted, or "discounted", to their present value. This makes it possible to compare effects occurring at different points in time and to calculate the net benefits to society. With a positive net benefit, it can be concluded that the IAM scenario is beneficial from the perspective of society as a whole, while it is not in case of a negative net benefit. In PRIAM only one IAM scenario is considered for each case study. No variants are considered for the number of vertiports or their location. Therefore, the conclusions apply to the configurations and assumptions assessed in this report. The SCBA in this project does not allow to make a comparison between different IAM scenarios, to see which one is the most beneficial one. This could be a topic for further research.

Impacts included in the SCBA

An SCBA identifies the potential differences between the reference scenario and the IAM scenario. These differences constitute the effects of the IAM introduction to be quantified and valued. In general, the effects can be divided into four groups, as illustrated in Figure 7: direct effects, indirect effects, external effects and societal effects related to impacts on the government budget.

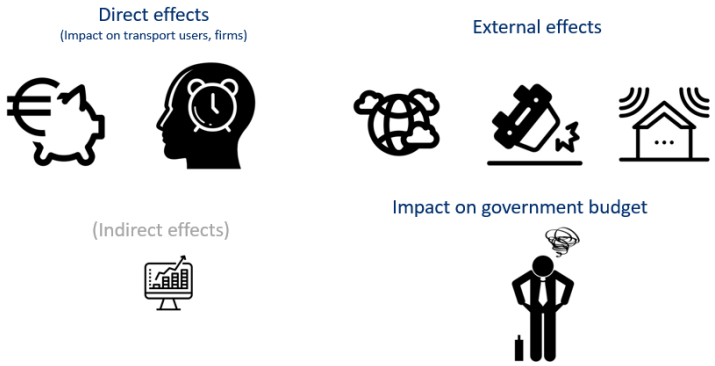

Figure 7. Main impact types of IAM introduction

Direct effects

The introduction of IAM changes the set of transport options, generalised travel costs and transport flows. The direct effects included in the SCBA comprise changes in transport-user welfare, and the impacts on the vertiport and IAM operators and the providers of air traffic management (ATM) services.

The direct effects could also include any impacts on the operators of the other transport modes. However, in this strategic SCBA these impacts are not considered.

- **Impact on the transport users**

We measure the transport-user effects through the change in consumer surplus due to the introduction of IAM. The consumer surplus measures the welfare that the transport users derive from the available transport alternatives after accounting for the monetary and time costs included in the generalized costs.

For each of the transport sub-markets PRIAM has estimated a mode-choice model (see Deliverable 4.2), using a random utility model based on data collected in a stated preference survey. Based on the

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model estimations, the change in consumer surplus for each individual *n* can be calculated as follows, for the case where no additional trips are generated in the IAM scenario:

$$\Delta CS_n = \frac{1}{-\beta_C}\left[ln\left(\sum_i exp(V_{ni}^{scIAM})\right) - ln\left(\sum_i exp(V_{ni}^{scREF})\right)\right] = \frac{(LS_n^{scIAM} - LS_n^{scREF})}{-\beta_C}$$

With *i* = 1, … , *I* denoting the transport modes, V_{ni} the observed utility of mode *i* for transport user *n*, the superscripts *scIAM* denoting the scenario with IAM and *scREF* the reference scenario. The symbol *LS* denotes the logsum or inclusive value for the transport user. β_C is the estimated coefficient for the generalized cost in the utility function. A positive value of ΔCS_n means that the IAM scenario improves the choice situation for the transport user. The PRIAM model does not only model modal choice, but also trip generation. In the case where the IAM scenario leads to additional trips (induced demand), the change in consumer surplus is computed as follows:

$$\Delta CS_n = \frac{(LS_n^{scIAM} - LS_n^{scREF})}{-\beta_C} . \frac{(Q_{scIAM} + Q_{scREF})}{2}$$

With trip demand denoted by *Q* and $Q^{scIAM} = Q^{scREF}$ + induced demand.

We sum the resulting change in consumer surplus across all transport users and origin-destination markets. The calculation includes induced trips in Tenerife-La Gomera, as described in 3.3.1.3.

- **Impact on vertiport operators, IAM operators and ATM operators**

The impact on the vertiport operators and IAM operators is calculated based on their capital costs and operating costs, and the revenues they receive from the users of their services. The IAM operator revenues are transfers from IAM users to IAM providers. They matter for distribution and financial viability but cancel in the consolidated social total. Similarly, if landing fees are paid by the IAM operator to the vertiport operators, they are a transfer between providers. We report such transfers separately and include only the underlying resource costs in the net social benefit.

We also include the additional air traffic management investment and operating costs associated with IAM. The report assigns these costs to the public sector as a simplifying assumption.

We take the vertiport costs from the optimisation exercise reported in PRIAM Deliverable 4.2. Because future IAM capital and operating costs remain uncertain, we assess seven resource-cost scenarios.

Indirect effects

Wider economic effects include changes in gross domestic product and employment. Such effects can overlap with direct benefits already measured through consumer surplus and provider impacts. EC DG REGIO (2014) therefore requires careful treatment to avoid double counting.

As the projected scale of IAM introduction in the PRIAM case studies is still relatively small, the wider economic impact can be expected to be small, and it is reasonable to assume the main economic impacts are already captured to a large extent in the direct effects.

- **Societal effects related to impacts on the government budget**

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If subsidies are required for the IAM introduction, such subsidies are a transfer from the government to the IAM providers/travellers. They do not enter the consolidated social total as a cost by themselves. The report presents subsidy amounts separately to show their distributional and budgetary implications.

Still, the social total does include the welfare cost associated with financing the subsidies where financing relies on distortionary taxation. This extra cost is reflected in the marginal cost of public funds.

Any indirect public budget impacts due to the change in the trips for the non-IAM modes are outside the scope of this strategic SCBA.

External effects

External effects have two defining characteristics:

- There is no market for them and therefore no market price. As a result, those causing negative effects, or costs, do not have to pay for them, while those creating positive effects, or benefits, do not receive compensation.
- They affect people other than those who cause them.

The SCBA includes the part of these effects that is not borne by transport users or providers. Potential external effects concern infrastructure changes and changes in transport flows, as listed below:

- the external effects of infrastructure changes, such as land take, visual intrusion and loss of natural areas where this is not subject to mandatory compensation, as well as possible gains in architectural value, amenity, recreation and related benefits;
- the impact on the external effects of transport flows, including:
    - emissions affecting air quality and climate change;
    - noise nuisance;
    - road safety.

Available information is insufficient to quantify or monetise the infrastructure-related effects of vertiports, including land take, visual intrusion and effects on natural areas. We therefore exclude these effects from the quantified SCBA. Their exclusion does not demonstrate that they are negligible.

The SCBA quantifies changes in air pollution, noise and accident costs. It also reports physical changes in tank-to-wheel carbon dioxide (CO_2) emissions. Maritime and aviation emissions fall under the European Union's Emission Trading System (EU ETS), road transport falls under the EU ETS2, and electricity generation under the EU ETS. The SCBA therefore treats changes in covered emissions as changes in compliance costs under the emissions cap rather than as additional climate-damage benefits. To prevent double counting, no separate climate value is added where allowance costs are already included in user prices or operator costs (as is taken to be the case).

Depending on the flight characteristics aviation also causes non-CO_2 related climate costs. In the PRIAM case studies aviation is available as a transport mode only in the Tenerife-La Gomera case study. The flights between Tenerife and La Gomera are short flights. Therefore, their non-CO_2 climate impact is zero as the flights do not attain the altitudes at which these effects manifest themselves.

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EASA (2021) also identifies possible effects of IAM on visual amenity and privacy. Based on the available information these could not be monetized. They are mentioned *pro memoria*.

Summary

Overall, the quantified SCBA includes transport-user welfare, IAM and vertiport resource costs, air traffic management costs, the excess burden of public financing, and changes in air-pollution, noise and accident costs. It excludes wider economic effects, impacts on incumbent operators, indirect public-budget effects for non-IAM modes and a number of external effects. These exclusions should be considered when interpreting the results.

General assumptions for the strategic SCBA

We apply the following general assumptions in both case studies.

Time horizon

We assume that the construction of the first set of vertiports takes place in 2034, and that operations run from 2035 to 2074. This is consistent with the vertiport lifetime of 40 years used in the vertiport optimization calculations in PRIAM Deliverable 4.2 (Nommon et al., 2026). In the Catalan Pyrenees three additional vertiports are constructed in 2050 and start operating in 2051. We include a residual value in 2075 for these vertiports after 24 years of operation, following the guidelines set by EC DG REGIO (2014).

Price level 2025

We express all prices and costs in constant 2025 euros. Where relevant, we convert values from older studies using the harmonized index of consumption prices (HICP) for Spain, published by Eurostat (2026).

Base year for discounting

The base year for discounting is 2034. All costs and benefits for the period 2034-2074 are discounted to this year.

Social discount rate

We calculate the net present value (NPV) of all costs and benefits over 2034-2074. We express future amounts in constant 2025 prices and discount them to 2034. Discounting gives less weight to effects that occur later and makes costs and benefits at different points in time comparable.

We apply a social discount rate of 3%, following EC DG REGIO (2014).

Study area

The SCBA covers two case studies for which the geographical scope is summarised in Figure 5 and Figure 6.

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3.3.1.3 Reference scenario and IAM scenario

The SCBA compares the IAM scenario with a reference scenario without IAM. This section defines both scenarios and the assumptions that determine demand, modal shares, costs and external effects.

Reference scenario

The reference scenario represents the most likely evolution in the absence of the introduction of IAM, taking into account as much as possible transport policies that have already been formally adopted. This is in accordance with the guidelines of EC DG REGIO (2014).

It specifies the future evolution of the total number of trips, the modal choice, and the external effects of transport.

We consider three paths for the future evolution of the total number of trips:

- D1: Constant demand: the total number of trips remains constant at the level of 2025, the most recent year for which data are available.
- D2: Intermediate demand growth: the total number of trips increases over time in line with the outlook for population growth and growth of gross domestic product (GDP) per capita in Spain. In this scenario the elasticity of trip demand with respect to GDP per capita is assumed to be equal to 0.5.
- D3: High demand growth: the total number of trips increases over time in line with the outlook for population growth and growth of GDP per capita in Spain. In this scenario the elasticity of trip demand with respect to GDP per capita is assumed to be equal to 1.

We derive the three demand paths from the population and GDP-per-capita projections for Spain in the European Commission's 2024 Ageing Report (EC, 2024). Table 1 presents the underlying indices and the resulting trip-demand indices.

The analysis applies national projections to the two case-study areas. This is a simplifying scenario assumption, not a case-specific demographic or tourism forecast. Both the Canary Islands and the Catalan Pyrenees have strong tourism activity, so trip demand could increase more than the national average, especially during peak seasons. In addition, the areas around Barcelona are expected to experience stronger demographic and economic growth than the national average. In the SCBA the consequences of higher trip demand growth are explored by considering three demand scenarios, one of which assumes a strong growth in demand.

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Table 12 Demographic and economic outlook for Spain, and three scenarios for the evolution of the total number of trips (index; 2025 = 1) (2035-2075)

	2035	2040	2045	2050	2055	2060	2065	2070	2075
Population (2025 = 1)	1.02	1.03	1.04	1.03	1.02	1.01	0.99	0.98	0.98
GDP per capita (2025 = 1)	1.08	1.13	1.22	1.30	1.40	1.51	1.64	1.75	1.85
Total number of trips (2025 = 1)									
D1: Constant demand	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
D2: Intermediate demand growth	1.06	1.10	1.15	1.19	1.23	1.27	1.31	1.35	1.39
D3: High demand growth	1.11	1.17	1.27	1.35	1.43	1.53	1.63	1.71	1.81

Source: Outlook population and GDP per capita: EC (2024). Demand scenarios: own calculations based on EC (2024)

We derive the reference modal shares from the PRIAM modal choice model, using the generalised travel cost in the current situation. We hold the generalised travel cost constant in real terms throughout the assessment period and apply the same modal shares to the three demand scenarios. The Tenerife-La Gomera reference scenario includes road, ferry and commercial aviation. The Catalan Pyrenees reference scenario includes road, bus and rail. The relevant alternatives vary by origin-destination pair. Holding real generalised costs and modal shares constant and applying the same national demographic and economic outlook to the two case studies is a simplifying assumption, given the strategic nature of this SCBA.

For the external transport costs the following assumptions are made:

- GHG emissions:
  - For cars and buses account is taken of the future electrification of cars and buses, in line with the European climate policies for road transport. As a result of this the exhaust emissions of GHG from these vehicles gradually decrease over time, reaching zero from 2050 onwards. For cars the basis is formed by the average emission factor in 2024, which is calculated by dividing the GHG emissions from car transport in 2024 (EEA, 2026) by the number of car km in Spain (approximated by data for 2023) (EC DG MOVE, 2025). The share of electric cars is assumed to increase up to 7.25% in 2030 (in line with the outlook of Díaz-Díaz et al. (2026) for Spain and then is taken to increase linearly to 100% by 2050. For buses the share of electric buses is also assumed to increase linearly to 100% by 2050.
  - For ferries we use the verified emission factor published by Fred. Olsen Express (n.d.) for the Tenerife–La Gomera connection. For air trips between the Canary Islands we use the short-haul passenger-flight value from EC (2019). While the EU has also put in place climate policies for these sectors, it is assumed that the emission factors remain constant over time. If the IAM scenario reduces the demand for these modes, this means that the impact on the CO_2 emissions will be overestimated (ceteris paribus).
  - For trains the exhaust emission factors are taken to be zero, given that the trains are fully electrified.
- Air pollution costs:

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- For cars, buses, rail and short-haul aviation the air pollution costs per passenger-km are based on the values of EC (2019). These values are converted into the price level of 2025 by considering the change in the HICP for Spain between 2016 and 2025 (Eurostat, 2026). For ferries the air pollution costs are approximated by applying the ratio between air pollutant emissions and CO2 emissions from Doundoulakis et al. (2022) to the CO2 emissions reported by Fred. Olsen Express (n.d.) and by applying the air pollution costs per kg reported for Spain in EC (2019), converted from €2016 to €2025 based on the HICP for Spain.
- Because of the electrification of road transport, the air pollution costs per passenger-km of cars and buses decrease over time until 2050. They are not reduced to zero, as the non-exhaust emissions from brake, tyre and road wear remain. It is assumed that the PM2.5 emissions are reduced by 80% because of electrification, based on OECD (2022).
- We hold the air pollution costs for the other modes constant over time. If their environmental performance improves, the model overstates the air pollution benefit of a modal shift away from these modes.

- Noise costs
  - The noise costs per passenger-km of the modes used in the reference scenario are taken from EC (2019). These values are converted into the price level of 2025 by considering the change in the HICP for Spain between 2016 and 2025 (Eurostat, 2026). The electrification of cars and buses is assumed not to have an impact on their noise costs, as this mainly affects the noise levels produced by these vehicles at low speed.
  - No information could be found for the noise costs of ferries. The quantified results therefore omit any noise benefit from a reduction in ferry trips.
- Accident costs
  - We take the accident costs per passenger-km for the reference modes from EC (2019). For ferries we use the accident costs per passenger for passenger ships from the same publication. We convert the values into the price level of 2025 by using the Spanish HICP and hold them constant over the assessment period. This assumption does not reflect possible future safety improvements in existing modes. If accident risks decline, the model overstates the accident benefit of modal shift away from those modes

Table 13 summarises the external cost assumptions for the modes used in the reference scenario.

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Table 13 Elements for the external cost calculations for the modes used in the reference scenario

	CO_2 emission factors (tank-to-wheel)			Air pollution costs			Noise costs	Accident costs
	Unit: Road, rail: g/passenger-km, Aviation, ferry: kg/trip			Unit: Road, rail, aviation: €cent/passenger-km Ferry: €/trip			Unit: €cent/passenger-km	Unit: Road, rail, aviation: €cent/passenger-km Ferry: €/trip
	2035	…	2050-2074	2035	…	2050-2074	2035-2074	2035-2074
Car	92.66		0	0.27		0.07	0.76	5.72
Bus	47.00		0	0.77		0.20	0.51	1.27
Rail (electric)	0		0	0.01		0.01	1.02	0.64
Aviation (short haul)	14		14	0.38		0.38	0.58	0.05
Ferry (Canary Islands)	28		28	6.00		6.00	na	0.05

Source: own calculations based on Díaz-Díaz et al. (2026), Doundoulakis et al. (2022), EC (2019), EC DG MOVE (2025), EEA (2026), Eurostat (2026), Fred. Olsen Express (n.d.) and OECD (2022)

IAM scenario

The IAM scenario adds IAM as a new mode. The vertiport optimisation exercise reported in PRIAM Deliverable 4.2 (Nommon et al., 2026), opens eight vertiports in Tenerife-La Gomera, from 2035 onwards. In the Catalan-Pyrenees the vertiports are opened in two stages. First, in 2035 eight vertiports open to serve the Catalan Intra-Pyrenees market, followed in 2050 by three additional vertiports for the IAM connections between the Pyrenees and Barcelona/Lleida. The optimisation exercise selected these configurations at an IAM user price of €4 per passenger-kilometre.

We use the IAM-scenario modal shares that were derived in PRIAM Deliverable 4.2, from the generalised costs of IAM and the existing modes. The generalised cost of the existing modes remain equal to those in the reference scenario. IAM users pay €4/passenger-km and the IAM travel time costs depend on the IAM travel time and the value of time by travel purpose and income group. We apply the modal shares to each of the three demand scenarios (see Section 0). The Tenerife-La Gomera demand model also produces induced trips, which we include when calculating the change in the consumer surplus.

Future IAM resource costs remain highly uncertain, both in terms of its initial level and its evolution over time. We therefore assess seven cost scenarios rather than relying on a single estimate. The scenarios cover constant average resource costs of €4, €10, €15 and €20 per passenger-kilometre, as well as three cases in which costs fall after 2049. The €4 scenario represents the case in which the resource cost is equal to the assumed user price and no operating subsidy is required. The higher constant-cost scenarios show the consequences if the gap between the user price and the cost of providing the service persists throughout the assessment period. The declining-cost scenarios represent intermediate cases in which IAM initially remains relatively expensive but becomes less

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costly from 2050 onwards. Together, the scenarios allow us to assess how strongly the SCBA results depend on the uncertain cost of IAM provision and whether future cost reductions would be sufficient to make the service socially beneficial.

Table 14. IAM cost scenarios

Cost scenario	Description
C1: €4	Constant average resource cost of €4/passenger-km
C2: €10	Constant average resource cost of €10/passenger-km
C3: €15	Constant average resource cost of €15/passenger-km
C4: €20	Constant average resource cost of €20/passenger-km
C5: €20 → €15	Average resource cost of €20/passenger-km through 2049, then €15/passenger-km
C6: €15 → €10	Average resource cost of €15/passenger-km through 2049, then €10/passenger-km
C7: €10 → €4	Average resource cost of €10/passenger-km through 2049, then €4/passenger-km

Users pay €4 per passenger-kilometre in every cost scenario. Scenarios above €4 therefore require a subsidy equal to the difference between resource cost and fare revenue. The subsidy is a transfer and does not enter the social total by itself. We include the additional welfare cost of raising the required public revenue. The marginal cost of public funds (MCPF) measures the social cost of raising one additional euro of government revenue. Taxes change behaviour (for example, by reducing labour supply, investment or consumption). Because of this, raising €1 may impose a welfare cost greater than €1. To our knowledge there is no official value for the MCPF to be used in SCBAs for Spain. The central calculation applies an MCPF of 1.25, so the excess burden equals 0.25 times the additional net public expenditure. A sensitivity analysis applies a MCPF of 1.

The average resource costs listed above for the different cost scenarios include the vertiport construction and land costs, the vertiport operation costs and the IAM operating costs. The vertiport costs are taken from the vertiport optimisation exercise reported in PRIAM Deliverable 4.2 (Nommon et al. 2026). Table 15 reports their value.

Table 15. Vertiport costs (€2025 million), and years in which these costs are made

	Construction cost	Land cost	Operational cost (annual)
Catalan Pyrenees	2034: 5.38	2034: €6.60	2035-2049: 2.26
	2049: 2.02	2049: €4.81	2050-2074: 3.10
Tenerife-La Gomera	2034: 5.38	2034: 6.84	2035-2074: 2.26

Source: Vertiport optimisation exercise reported in PRIAM D4.2 (Nommon et al., 2026)

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We take the ATM costs from the EUREKA assessment (Bluenest by Globalvia et al., 2026)[2]. We assume one ATM unit in each case study, with an investment cost of €3.42 million, and annual operating costs of €1.13 million.

For the external costs of IAM the following assumptions are made:

- As designated by their name, the eVTOL (electrical vertical take-off and landing aircraft) are electric. We therefore set their exhaust greenhouse gas (GHG) emissions and emissions of air pollutants to zero.
- The external noise costs of eVTOL are still uncertain. EASA (2021) mentions Urban Air Mobility (UAM) "aircraft have a variety of noise profiles that differ from those of traditional aircraft. Characteristics of their noise signature such as tonality could potentially increase annoyance. Other health impacts associated with introducing this entirely new sound source into urban and suburban environments are not widely known. UAM aircraft pose another layer of complexity since, compared with other types of aircraft, they will fly closer to where people live and work." (p. 56). A noise perception lab test with a limited number of participants indicated a high level of noise annoyance mostly similar to that of aircraft and helicopters, except for one air taxi position. (EASA, 2021). The literature consulted for the SCBA does not provide an established monetary value. We therefore apply an illustrative central value equal to twice the car noise cost per passenger-kilometre and test a value equal to the current car noise cost in the sensitivity analysis.
- The external IAM accident costs are also still uncertain. EASA (2021) mentions that "safety ranks high among the risks of UAM mentioned in the reviewed literature, as an unsafe system could have widespread implications for public acceptance." (p. 32). Participants in the PRIAM stakeholder workshop of April 2026 indicated that IAM uptake would require a safety level comparable to commercial aviation. We therefore use the short-haul aviation accident cost per passenger-kilometre in the central case and test the current car value in a sensitivity analysis.

3.3.1.4 Results of the SCBA – Tenerife-La Gomera

SCBA for demand scenario D2 (intermediate demand growth)

Table 16 presents the results of the SCBA for the case study Tenerife-La Gomera in the case of intermediate growth of demand in the reference scenario (demand scenario D2).

[2] In the EUREKA project the costs are split between different stakeholders. In the PRIAM strategic SCBA all costs are assigned to the public sector, as a simplifying assumption. Given the fact that these costs are small relative to other SCBA components, this does not affect the main outcome of the PRIAM SCBA.

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Table 16. SCBA IAM scenario Tenerife-La Gomera – Demand scenario D2 (intermediate demand growth) - €2025 million, Net Present Value in 2034

	C1: €4	C2: €10	C3: €15	C4: €20	C5: €20 → €15	C6: €15 → €10	C7: €10 → €4
Change in consumer surplus	536	536	536	536	536	536	536
Resource costs vertiports & IAM operators	-847	-2 119	-3 178	-4 237	-3 497	-2 438	-1 231
ATM costs public sector	-30	-30	-30	-30	-30	-30	-30
Welfare change due to need for additional distortionary taxes	-7	-325	-590	-855	-670	-405	-103
Change in air pollution costs	23	23	23	23	23	23	23
Change in noise pollution costs	-2	-2	-2	-2	-2	-2	-2
Change in transport accident costs	7	7	7	7	7	7	7
Pro memoria: Impact on privacy and on costs of visual intrusion, impact on noise pollution from ferries, external costs of vertiport infrastructure							
Net social benefits = social benefits - social costs	**-321**	**-1 910**	**-3 234**	**-4 558**	**-3 633**	**-2 309**	**-800**

Note: Negative value = cost
Source: calculations PRIAM consortium

Under demand scenario D2, IAM in Tenerife-La Gomera leads to an increase in welfare for the transport users. The NPV of this benefit equals €536 million. The undiscounted annual benefit ranges from €17.5 million in 2035 to €30.8 million in 2074. In every cost scenario, the combined IAM, vertiport and air traffic management resource costs however exceed the transport-user benefit. Public financing adds a further welfare cost where the government finances air traffic management and the subsidies required to maintain the €4 user price.

The quantified external-cost effects are small relative to the change in consumer surplus and resource costs. Three limitations affect their interpretation:

- The analysis may overstate the air pollution benefits as no account is taken yet in the reference scenario of the likely future improvement in the environmental performance of ferries and aviation.
- Similarly, the analysis may overstate the accident benefits because the reference scenario does not yet incorporate any improvement in accident risks for the existing modes.
- The calculation omits any noise benefit from a reduction in ferry trips because no information is available on the noise costs from ferries.

However, given the relative magnitude of the impact on the external transport costs, these elements will not influence the final result of the SCBA for IAM in Tenerife-La Gomera.

The overall outcome is that the introduction of IAM in Tenerife-La Gomera is not beneficial in this demand scenario. The social benefits are negative in all seven cost scenarios. They range from -€321 million in C1 to -€4 558 million in C4. This is also illustrated in the next figure.

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To be noted is that some external costs from IAM could not be quantified: the costs related to privacy, visual intrusion and the external costs of the vertiport infrastructure. Including these costs would make the net IAM impact even more negative.

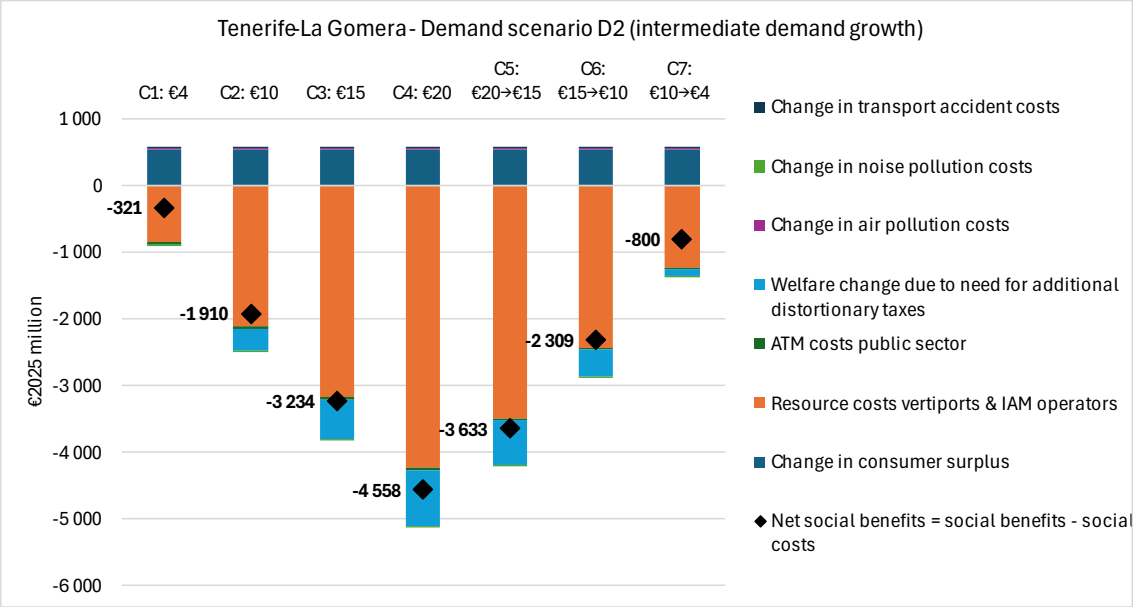

Figure 8. SCBA IAM scenario Tenerife-La Gomera – Demand scenario D2 (intermediate demand growth) - €2025 million, Net Present Value in 2034 (Source: calculations PRIAM consortium, Note: Negative value = cost)

Table 17 reports the transfers between IAM users, IAM providers, vertiport operators and the public authorities. These payments cancel in the consolidated social total but remain relevant for distribution and financial viability.

Table 17. Tenerife-La Gomera: Transfers paid in IAM scenario - Demand scenario D2 (intermediate demand growth) - €2025 million, NPV in 2034

	C1: €4	C2: €10	C3: €15	C4: €20	C5: €20 → €15	C6: €15 → €10	C7: €10 → €4
IAM fares paid (transfer from IAM travellers to IAM companies)	847						
Revenues from vertiport operation (transfer from IAM companies to vertiport operators)	74						
Subsidies (transfers from public sector to private sector)	0	1271	2330	3390	2650	1590	383

Source: calculations PRIAM consortium

Table 18 reports a cumulative reduction of 121.6 kilotonnes of tank-to-wheel CO_2 emissions over 2035-2074. We report this as a physical indicator. We do not add a separate climate-damage value for

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emissions assumed to be covered by the EU ETS or EU ETS2 where allowance costs are included in transport or energy costs.

Table 18. Tenerife-La Gomera: Impact of IAM scenario on cumulative tank-to-wheel CO_2 emissions – Demand scenario D2 (intermediate demand growth) – 2035-2074 (ktonnes CO_2)

	Ktonnes CO_2
Road	-3.5
Ferry	-116.8
Aviation	-1.3
IAM	0.00
TOTAL	-121.6

Notes: (i) a negative value corresponds to a reduction in emissions. (ii) the emissions reductions for ferries and aviation are likely to be an overestimate because the reference scenario does not yet include the future improvement in their environmental performance.
Source: calculations PRIAM consortium

Sensitivity analyses

With a number of sensitivity analyses we test the robustness of the SCBA outcome reported above:

- Two different scenarios for the future evolution of the total number of trips in the reference scenario: D1 (constant demand) and D3 (high demand growth) compared to D2 (intermediate demand growth)
- Extra public budget can be raised in a non-distortionary way (MCPF = 1 instead of MCPF = 1.25)

We also test two alternative external cost assumptions:

- IAM creates a lower noise cost
- IAM is associated with a high accident risk

Comparison of three demand scenarios

Figure 9 compares the net social benefits under constant, intermediate and high demand growth.

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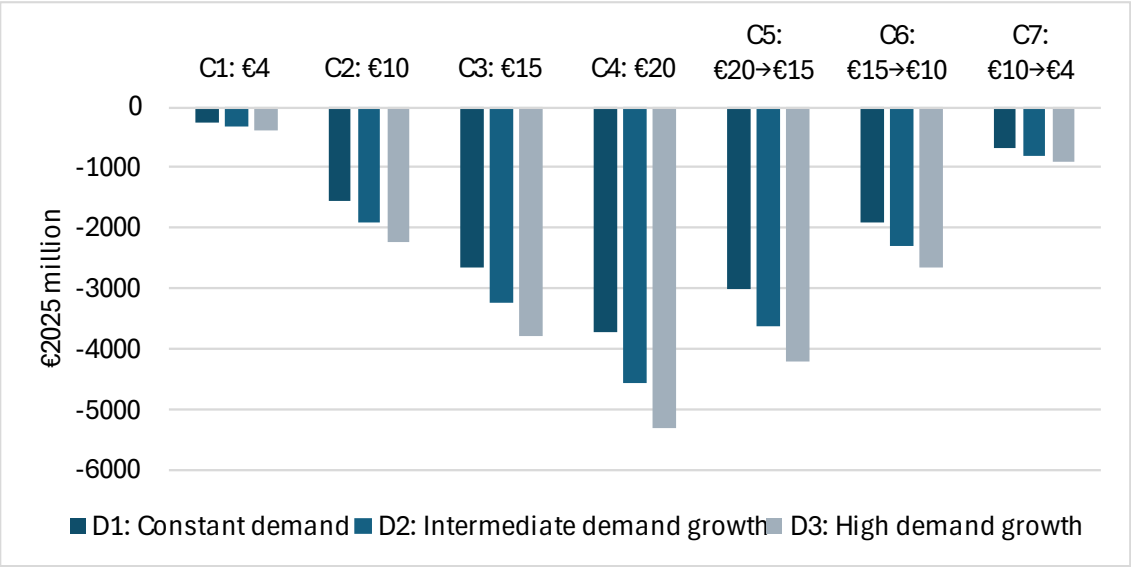

Figure 9. SCBA IAM scenario Tenerife-La Gomera – Comparison of demand scenarios D1, D2 and D3 - €2025 million, Net Present Value in 2034 (Source: calculations PRIAM consortium)

The different demand and cost scenarios change the size of the net social cost but not its sign. For the Tenerife-La Gomera case study the introduction of IAM is not beneficial from the point of view of society.

Comparison of MCPF=1 and MCPF = 1.25

Setting the MCPF to 1 reduces the net social cost because it removes the assumed excess burden of public financing. It does not produce a positive net social benefit in any cost scenario.

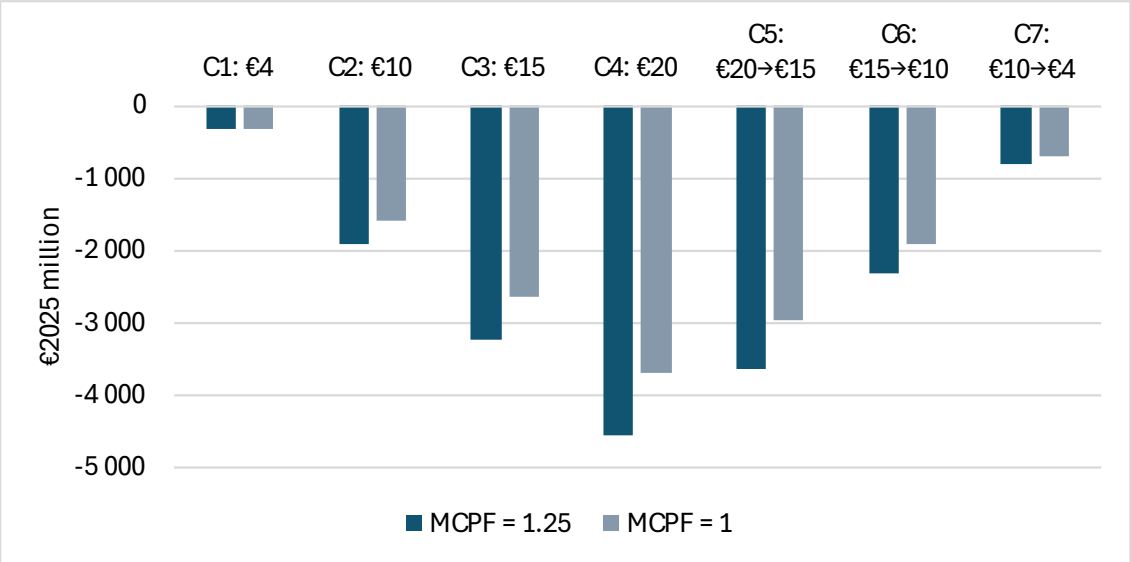

Figure 10. SCBA IAM scenario Tenerife-La Gomera – Comparison of results with MCPF=1 and MCPF=1.25 – Demand scenario D2 (intermediate demand growth) – €2025 million, Net Present Value in 2034 (Source: calculations PRIAM consortium)

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Impact of different external cost assumptions

Reducing the IAM noise value from twice the car value to the car value improves the net present value by €1-2 million, depending on the cost scenario. This change does not alter the conclusion.

Applying the car accident-cost value instead of the short-haul aviation value reduces the net present value by €12 million in every cost scenario. The net social benefit remains negative throughout.

Table 19 Tenerife-La Gomera – Effect of sensitivity analysis noise and accident cost assumptions – Demand scenario D2 (intermediate demand growth) – €2025 million, NPV in 2034 and % change

	C1: €4	C2: €10	C3: €15	C4: €20	C5: €20 → €15	C6: €15 → €10	C7: €10 → €4
Total net social benefit in central case	-321	-1 910	-3 234	-4 558	-3 633	-2 309	-800
Total net social benefit with lower IAM noise costs	-319	-1 908	-3 232	-4 557	-3 632	-2 307	-798
(% change w.r.t. central case)	(-0.5%)	(-0.1%)	(0.0%)	(0.0%)	(0.0%)	(-0.1%)	(-0.2%)
Total net social benefit with higher IAM accident costs	-333	-1 922	-3 246	-4 570	-3 645	-2 321	-812
(% change w.r.t. central case)	(3.7%)	(0.6%)	(0.4%)	(0.3%)	(0.3%)	(0.5%)	(1.5%)

Source: calculations PRIAM consortium

Summary SCBA Tenerife-La Gomera

The assessed Tenerife-La Gomera IAM configuration has a negative net social benefit in every resource-cost and demand scenario. The conclusion also remains unchanged when the MCPF is set to 1 and when alternative IAM noise and accident-cost assumptions are applied. Quantified external-cost effects are small relative to consumer surplus and IAM resource costs. The conclusions apply to the configuration and exclusions described in Sections 3.3.1.2

3.3.1.5 Results of the SCBA - Catalan Pyrenees

SCBA for demand scenario D2 (intermediate demand growth)

Table 20 presents the results of the SCBA for the Catalan Pyrenees case study in the case of intermediate growth of demand in the reference scenario (demand scenario D2).

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Table 20 SCBA IAM scenario Catalan Pyrenees – Demand scenario D2 (intermediate demand growth) - €2025 million, Net Present Value in 2034

	C1: €4	C2: €10	C3: €15	C4: €20	C5: €20 → €15	C6: €15 → €10	C7: €10 → €4
Change in consumer surplus	1 372	1 372	1 372	1 372	1 372	1 372	1 372
Intra-Pyrenees	*1363*	*1363*	*1363*	*1363*	*1363*	*1363*	*1363*
Barcelona-Pyrenees	*7*	*7*	*7*	*7*	*7*	*7*	*7*
Lleida-Pyrenees	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Resource costs vertiports & IAM operators	-1 180	-2 950	-4 425	-5 901	-5 105	-3 630	-1 995
ATM costs public sector	-30	-30	-30	-30	-30	-30	-30
Welfare change due to need for additional distortionary taxes	-7	-450	-819	-1 188	-989	-620	-211
Change in air pollution costs	1	1	1	1	1	1	1
Change in noise pollution costs	-2	-2	-2	-2	-2	-2	-2
Change in transport accident costs	16	16	16	16	16	16	16
Pro memoria: Impact on privacy and on costs of visual intrusion, external costs of vertiport infrastructure,							
Net social benefits = social benefits - social costs	**170**	**-2 043**	**-3 887**	**-5 731**	**-4 736**	**-2 892**	**-849**

Note: Negative value = cost
Source: calculations PRIAM consortium

Under demand scenario D2 the introduction of IAM in Catalan Pyrenees increases transport-user by €1 372 million. The undiscounted annual benefit ranges from €52.1 million in 2035 to €69.9 million in 2074. This is substantially larger than in the Tenerife-La Gomera case study. When considering the different subregions for the Catalan Pyrenees it is clear that the trips in the Intra-Pyrenees subregion account for most of this benefit, namely 99.4%.

In all cost scenarios except C1, the NPV of the resource costs for vertiport operators, IAM operators and the ATM provision exceeds the transport-user benefits. The excess burden of public financing increases the net social cost where subsidies are required. In cost scenario C1, the net welfare impact of the IAM introduction is positive, even before considering the impacts on the external transport costs. It should be noted however, that cost scenario C1 is optimistic and unlikely to materialise.

The quantified external-cost impacts are relatively small compared to the change in consumer surplus and the resource costs. The assumption of constant accident costs for existing modes may overstate the accident benefit of modal shift. This limitation does not change the sign of the result in any cost scenario. The exclusion of the external privacy, visual intrusion and vertiport infrastructure costs would increase the net social cost in cost scenarios C2 to C7, is unlikely to change the sign of the SCBA outcome in scenario C1.

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Under demand scenario D2, the Catalan Pyrenees IAM configuration has a positive net social benefit only in C1 (€170 million). Net social benefits in C2-C7 range from -€849 million to -€5 731 million. This is also illustrated in Figure 11.

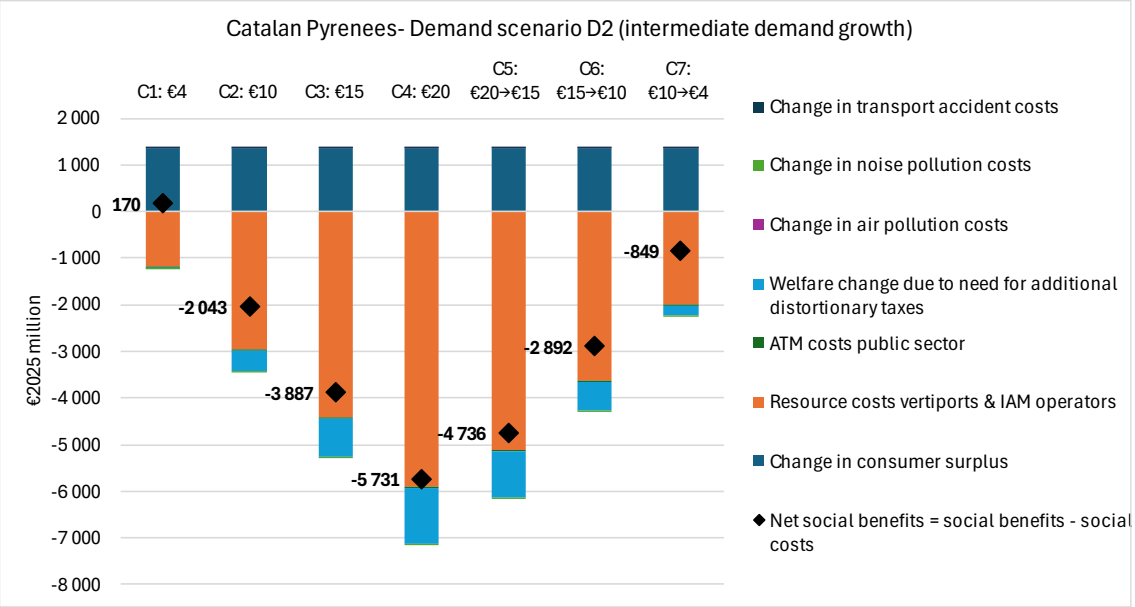

Figure 11. SCBA IAM scenario Catalan Pyrenees – Demand scenario D2 (intermediate demand growth) - €2025 million, Net Present Value in 2034 (Source: calculations PRIAM consortium)

Table 21 reports the transfers between the IAM users, the IAM operators, the vertiport operators and the public sector. These payments cancel in the consolidated social total but remain relevant for distribution and financial viability.

Table 21 Catalan Pyrenees: Transfers paid in IAM scenario - Demand scenario D2 (intermediate demand growth) - €2025 million, NPV in 2034

	C1: €4	C2: €10	C3: €15	C4: €20	C5: €20 → €15	C6: €15 → €10	C7: €10 → €4
IAM fares paid (transfer from IAM travellers to IAM companies)	1180						
Revenues from vertiport operation (transfer from IAM companies to vertiport operators)	107						
Subsidies (transfers from public sector to private sector)	0	1770	3245	4721	3925	2450	815

Source: calculations PRIAM consortium

The cumulative impact on the tank-to-wheel CO_2 emissions in the period 2035-2074 is a reduction by 8.2 kilotonnes. We report this as a physical indicator and do not add a separate climate-damage value for emissions assumed to be covered by the EU ETS or EU ETS2 where allowance costs are included in transport or energy costs.

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Table 22 Catalan Pyrenees: Impact of IAM scenario on cumulative tank-to-wheel CO_2 emissions – Demand scenario D2 (intermediate demand growth) – 2035-2074 (ktonnes CO_2)

	Ktonnes CO_2
Car	-7.1
Bus	-1.0
Rail	0.00
IAM	0.00
TOTAL	-8.2

Note: a negative value corresponds with a reduction in emissions.
Source: calculations PRIAM consortium

Sensitivity analyses

We apply the same demand, public-financing, noise and accident-cost sensitivities as in Tenerife-La Gomera. We also test a network without the Barcelona-Pyrenees and Lleida-Pyrenees IAM services.

Comparison of three demand scenarios

Figure 12 compares net social benefits under constant, intermediate and high demand growth.

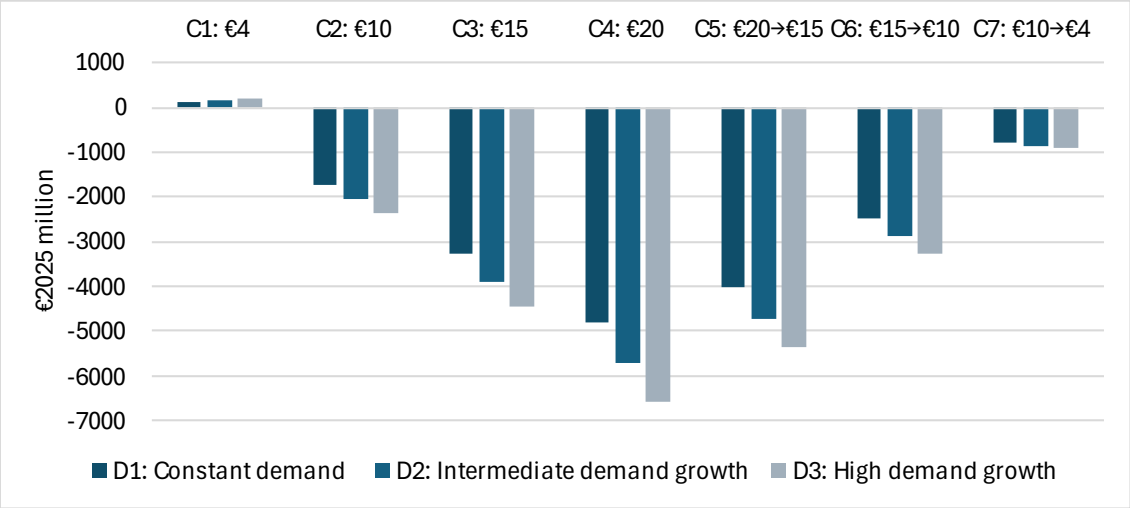

Figure 12 SCBA IAM scenario Catalan Pyrenees – Comparison of demand scenarios D1, D2 and D3 - €2025 million, Net Present Value in 2034 (Source: calculations PRIAM consortium)

Demand growth changes the size of the result but not the overall pattern. IAM in the Catalan Pyrenees is positive only in C1 under each reported demand scenario. However, that cost scenario is unlikely to materialise.

Comparison of MCPF=1 and MCPF = 1.25

Setting the MCPF to 1 reduces the net social cost in C2-C7. It does not make any of these scenarios positive. The SCBA outcome in C1 is positive under both MCPF assumptions.

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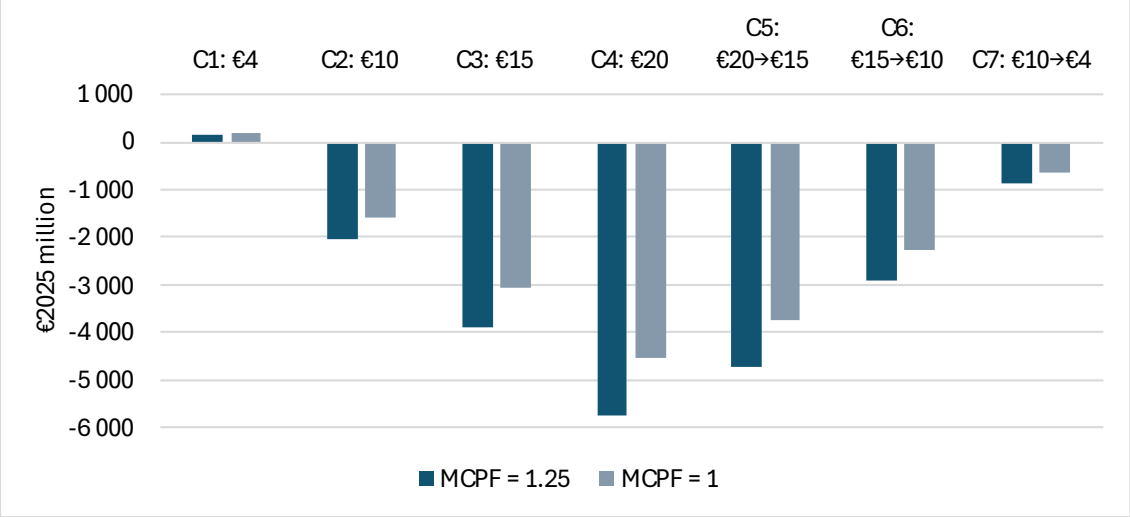

Figure 13 SCBA IAM scenario Catalan Pyrenees – Comparison of results with MCPF=1 and MCPF=1.25 – Demand scenario D2 (intermediate demand growth) – €2025 million, Net Present Value in 2034 (Source: calculations PRIAM consortium)

Impact of different external cost assumptions

Table 23 reports the effect of the alternative IAM noise and accident-cost assumptions.

Reducing the IAM noise value from twice the car value to the car value improves the net present value by €2 million in every cost scenario. This change does not alter which scenarios are positive or negative.

Applying the car accident-cost value instead of the short-haul aviation value reduces the net present value by €17 million in every cost scenario. C1 remains positive at €153 million which is lower than in the central case, and C2-C7 become more negative.

Table 23 Catalan-Pyrenees – Effect of sensitivity analysis noise and accident cost assumptions – Demand scenario D2 (intermediate demand growth) – €2025million, NPV in 2034 and % change

	C1: €4	C2: €10	C3: €15	C4: €20	C5: €20 → €15	C6: €15 → €10	C7: €10 → €4
Total net social benefit in central case	170	-2 043	-3 887	-5 731	-4 736	-2 892	-849
Total net social benefit with lower IAM noise costs	172	-2 041	-3 885	-5 729	-4 734	-2 890	-847
(% change w.r.t. central case)	(1.3%)	(-0.1%)	(-0.1%)	(0.0%)	(0.0%)	(-0.1%)	(-0.3%)
Total net social benefit with higher IAM accident costs	153	-2 060	-3 904	-5 748	-4 753	-2 909	-866
(% change w.r.t. central case)	(-9.9%)	(0.8%)	(0.4%)	(0.3%)	(0.4%)	(0.6%)	(2.0%)

Source: calculations PRIAM consortium

No deployment of IAM services between the Pyrenees and Barcelona/Lleida

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The Intrapyrenees market accounts for more than 99% of the transport-user benefit. In this sensitivity analysis, the Barcelona-Pyrenees and Lleida-Pyrenees services are not introduced and the associated vertiports are not opened. Figure 14 shows the impact for demand scenario D2.

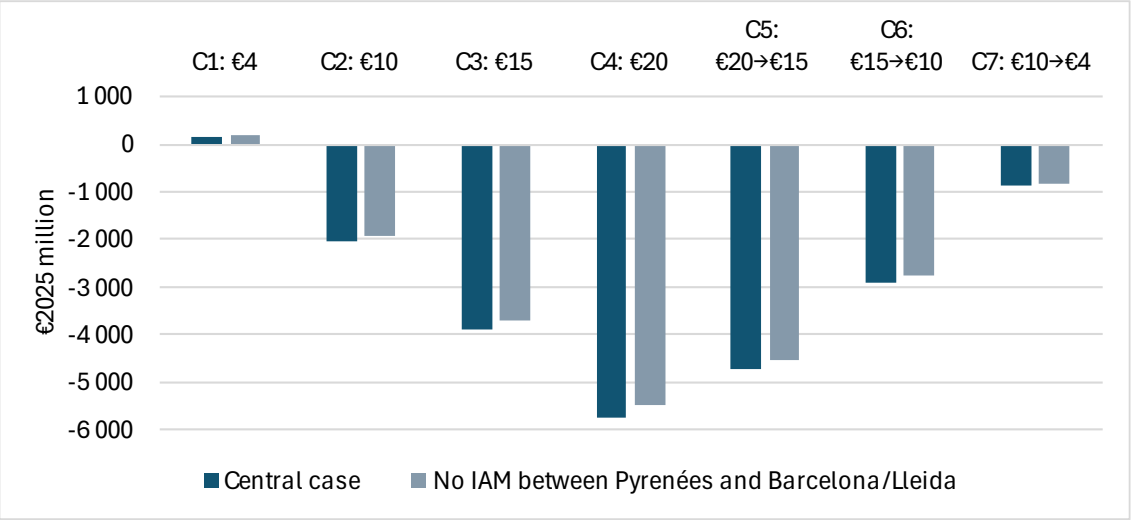

Figure 14. ***Catalan-Pyrenees – Sensitivity analysis: no IAM connections between the Pyrenees and Barcelona or Lleida – Demand scenario D2 (intermediate demand growth) – €2025million, NPV in 2034 and % change (Source: calculations PRIAM consortium)***

Removing these IAM connections leads to a higher net benefit in cost scenario C1 (+20%) and reduces the net social costs in the other cost scenarios by 4 to 6%, depending on the cost scenario. The network change improves the result but does not alter which cost scenarios are positive or negative.

Summary SCBA Catalan Pyrenees

The assessed Catalan Pyrenees configuration has a positive net social benefit only if the average IAM resource cost remains at €4 per passenger-kilometre from the start of operations. This cost scenario is however unlikely to materialise, based on the stakeholder consultation during the PRIAM project. The results of the SCBA are robust to changes in the background scenarios for the development of total trip demand, for the different cost scenarios and assumptions on the welfare cost of public funds. Removing the Barcelona and Lleida connections improves the result but does not make cost scenarios C2-C7 positive. Quantified external-cost effects are small relative to consumer surplus and IAM resource costs. The conclusions apply to the configuration and exclusions described in 3.3.1.2 and 3.3.1.3.

3.3.1.6 Conclusions

We assessed the social costs and benefits of introducing IAM in Tenerife-La Gomera and the Catalan Pyrenees. The analysis compares the IAM configurations developed in PRIAM Deliverable 4.2 with a reference scenario without IAM, under different demand scenarios. It covers transport-user welfare, IAM and vertiport resource costs, the costs for additional air traffic management, public financing costs and selected external transport costs.

IAM improves the transport choices available to users in both case studies. Under the intermediate demand growth scenario, the net present value of the consumer-surplus benefit is €536 million in

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Tenerife-La Gomera and €1 372 million in the Catalan Pyrenees. In the Catalan case study, 99.4% of this benefit arises from the Intra-Pyrenees market.

However, these user benefits are not sufficiently high to offset resource costs in most scenarios. IAM in Tenerife-La Gomera has a negative net social benefit in all seven cost scenarios, including a value of -€321 million when the average resource cost would be €4 per passenger-kilometre throughout 2035-2074. The Catalan Pyrenees has a positive net social benefit of €170 million only in the €4 cost scenario and is negative in all other scenarios.

The alternative demand scenarios and the MCPF, noise and accident-cost sensitivities affect the size of the results but not the main conclusions. IAM resource costs are the dominant source of variation across scenarios.

The quantified air-pollution, noise and accident effects are small relative to the change in consumer surplus and IAM resource costs. The analysis also reports reductions in tank-to-wheel CO_2 emissions. It does not add separate climate-damage values for emissions assumed to be covered by the EU ETS or EU ETS2 with allowance costs included in transport or energy costs.

A number of effects remain outside the monetary assessment, including the external costs related to vertiport infrastructure, costs of visual intrusion, potential privacy problems for people living under the IAM routes and impacts on incumbent transport operators. Their exclusion reflects the information available for this strategic analysis. A full project-level appraisal should assess these effects in greater detail. Give the still small scale of IAM introduction that is assessed here, the main economic impacts of the PRIAM IAM scenarios are to a large extent captured by the direct effects that have been quantified and the wider economic benefits are likely to be limited.

The conclusions apply to the specific networks, user price, demand model and cost assumptions assessed in PRIAM. They do not constitute a general assessment of every possible IAM application. On the evidence reported here, the Tenerife-La Gomera configuration does not generate a positive net social benefit, while the Catalan Pyrenees configuration is positive only under the lowest and most optimistic resource-cost scenario. Further work could examine alternative network designs, calculate the break-even IAM resource cost and expand the strategic SCBA to a full SCBA at project level.

3.3.2 Policy recommendations

3.3.2.1 Initial activities

As part of the PRIAM project, a list of actions regarding IAM development and deployment for regional connectivity was designed by the different project partners. The actions were classified in five categories: economic, integration, operating, infrastructure and regulation. The preliminary list of actions is:

- **Action 1 (infrastructure). Prioritise IAM deployment in corridors with clear accessibility gaps**. Focus IAM deployment on regions where geography creates structural accessibility constraints (e.g., islands and mountainous areas). Require corridor-level assessment of accessibility gains and modal shift before investing

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- **Action 2 (economic)**. **Require IAM services to demonstrate clear door-to-door performance advantages.** IAM pricing and deployment should be linked to measurable performance (travel time savings, reliability, integration)

- **Action 3 (integration)**. **Ensure IAM services are integrated with existing transport systems.** IAM should be designed as part of a multimodal transport system, with seamless connections and coordinated schedules to maximise usability and demand.

- **Action 4 (integration)**. **Develop robust IAM service optimisation to handle operational uncertainty.** IAM services should be designed to remain reliable under uncertainty (delays, disruptions), ensuring smooth passenger connections between modes.

- **Action 5 (operating)**. **Use AI to identify and target key IAM user segments.** Apply AI and data-driven methods to segment users based on travel behaviour, purpose, and value of time, ensuring IAM services are tailored to mobility needs.

- **Action 6 (integration)**. **Mandate real-time data sharing for multimodal coordination.** Require IAM operators to integrate with public transport to enable synchronised scheduling, booking, and real-time passenger information.

- **Action 7 (infrastructure)**. **Prioritise vertiport locations based on accessibility and social impact.** Locate vertiports where they improve access to essential services and support regional cohesion, not where demand is at is highest.

- **Action 8 (economic). Create funding mechanisms for IAM pilot deployments.** Support early IAM services through targeted public funding to test feasibility and reduced investment risk.

- **Action 9 (regulation). Clarify regulatory framework for IAM deployment.** Define roles, responsibilities, and approval processes across aviation, mobility and land-use authorities.

- **Action 10 (economic). Support to IAM.** IAM should be supported where it provides real net societal benefits.

- **Action 11 (economic). Support economically viable IAM services in low-density and peripheral regions.** Public service obligation schemes ensuring connectivity in remote areas; co-funding for vertiports in strategic low-demand locations; performance-based incentives for underserved areas.

As part of the PRIAM second stakeholder workshop, stakeholders were asked to vote on the actions they considered highest priority. The ranking reflects the actions from highest to lowest priority

1. **Action 1: Prioritise IAM deployment in corridors with clear accessibility gaps**: (*4 votes*).
2. **Action 9: Clarify regulatory framework for IAM deployment:** (*3 votes*).
3. **Action 7: Prioritise vertiport locations based on accessibility and social impact**: (*2 votes*).
4. **Action 3: Ensure IAM services are integrated with existing transport systems**: (*1 vote*).
5. **Action 8: Create funding mechanisms for IAM pilot deployments**: (*1 vote*).

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6. **Action 10: Support to IAM:** (*1 vote*).

The prioritisation clearly indicates that stakeholders place the greatest emphasis on strategic deployment driven by accessibility needs rather than purely technological or market-driven considerations. Overall, the results reflect a policy-oriented perspective, with stakeholders prioritising impact, equity, and feasibility over rapid or demand-led expansion.

3.3.2.2 IAM implementation roadmap

We present here the IAM implementation roadmap developed within the PRIAM project. This roadmap is based on the technical activities undertaken in the project, the numerous discussions with stakeholders, the preliminary activities detailed above, and the SCBA. It presents the three main pillars that enable regional IAM mobility, along with specific policy examples.

Pillar I. Market strategy and network targeting, focusing on demand and accessibility

Policy A. Prioritise corridors in regions with greater accessibility gaps and/or severe terrain constraints that make other public transport alternatives unviable.

As seen in the SCBA and in the technical activities, even in remote areas with scarce public transport and accessibility, IAM may not result in a competitive or social advantage. However, for certain corridors, IAM represents a clear net mobility gain. Therefore, extensive planning activities should be undertaken before IAM deployment, targeting key corridors and aiming at maximising overall societal benefit.

Policy B. Mandate extensive demand modelling and economic and social viability studies comparing IAM to existing and planned alternatives.

Following up from Policy A, the planning phase should encompass the most up-to-date quantitative methodologies. As a new and potentially disruptive technology, planning should be data and technology driven and not rely on static assumptions. Planning frameworks should use integrated decision-support tools such as the PRIAM toolset to cover the complete planning lifecycle from quantifying today's mobility patterns, assessing IAM predisposition for today's and tomorrow's population, analysing modal shift and induced demand, selecting the most suitable places for infrastructure placement, and integrating IAM with existing transport options. Additionally, social viability studies in the form of SCBA should be part of the preliminary activities to ensure that distortionary taxation does not yield a net negative social return.

Pillar II. Governance and Regulatory Frameworks, focusing on Policy and integration

Policy A. Establish streamlined municipal permitting and land-use zoning for IAM infrastructure building.

As standard aviation, IAM requires highly specialised take-off and landing infrastructure in the form of vertiports or vertihubs. Vertiports require high power grid connection, their own weather monitoring system, security, passenger waiting, and boarding areas, and control areas among others. Building the Infrastructure may lead to high up-front costs, additionally to construction delays; especially in remote areas. Clear municipal permitting and land use zoning can alleviate part of the up-front costs and potential delays. Other measures in this direction could include terrain leasing, and grid connection facilities and subsidies.

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Policy B. Adopt standardised regulatory frameworks for eVTOL certifications and U-Space management.

In a safety-critical field, certification is paramount. However excessive rules and bureaucracy can hinder eVTOL deployment and drive costs up significantly. Additionally, certification processes have huge geographical variability. Finally, being certified to fly is only the first half of the story, as U-space needs to be in place for operations to safely take place. During all the stakeholder's involvement activities, the need for a straight-forward and fast eVTOL certification process and U-Space management has appeared time and time again. Hence, we call for the standardisation and simplification of regulatory frameworks across the EU for eVTOL certification and U-Space management.

Policy C. Incentivise open-data protocols for public transport integration and real-time scheduling and routing.

One of the results of the PRIAM Project is that, when IAM is integrated with current public transport options, connectivity can rise significantly. Yet, one of the greatest challenges of mode integration is that it requires constant information streams between different actors and stakeholders. Therefore, to facilitate multimodal integration, data standards and sharing protocols must be established.

Pillar III. Infrastructure, economics and acceptance, focusing on deployment enablers

Policy A. Incentivise Public-Private Partnerships for vertiport construction and grid connexion.

As stated previously, infrastructure building, especially grid connection, are necessary for IAM operations, but represent one of the biggest up-front costs. Public-Private Partnership arise as one of the greatest opportunities to overcome this initial challenge. On the one side, public authorities usually own the land, are in touch with the electricity providers and can accelerate permitting. Private companies on the other side operate the eVTOLs, maintain vertiport infrastructures, and with the right business model, can enhance the economic activities along the IAM corridors. Both the consulted experts from the private and the public sector agree that facilitating collaboration between public bodies and private companies may be one of the key leverages to jumpstarting widespread IAM operations.

Policy B. Incentivised, unified and accessible ticketing for multimodal trips.

Policies targeting data sharing often fall short of improving passenger experience unless paired with other multimodal policies. Integrated ticketing ensures a seamless buying experience and protects passengers right in case of disruption, making multimodal alternatives a real competitive option with respect to unimodal trips. IAM rollout will start with short trips. Integrated with other transportation options, the service can function as a last-mile leg, opening the doors to a wider audience.

Policy C. Implement continuous consultation and social participation frameworks.

The PRIAM passenger survey provided further evidence that acceptance of IAM services can vary substantially from individual to individual. Communication between IAM experts and the global population can be mutually beneficial. On the one side, it can help IAM professional to align the service with the expectations of the global public. On the other side, communication campaigns can help gaining trust on the technology and the potential benefits it provides.

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The PRIAM IAM roadmap represents the high-level lines of actions to ensure an accessible, fair and save rollout of IAM services for passengers in a regional context. The recommendations written above are only valid in this context and are not representative of other use cases such as the use of eVTOLs for medical emergencies and parcel delivery.

3.4 Key assumptions

The following table reports key assumptions applicable to the PRIAM solution concept and to advancements in IAM that may have a significant impact on the scope and performance of the project.

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Table 24. Key assumptions

Category	ID	Title	Description	Justification	Impact Assessment
Technological advancements in IAM	AS-01	Vehicle propulsion	Electric, hybrid, and/or hydrogen propulsion systems will mature and become viable for short-haul and long-haul IAM.	Current advances on propulsion systems are on track for this	Delay on the development of this technology could affect the proposed timeline (2035 & 2050)
	AS-02	Certification of eVTOLs	Development and certification of novel aircraft types with short or vertical take-off and landing capabilities (STOL, VTOL) suitable for regional passenger transport will be achieved by 2035.	Several companies are already in the process of certification	Delay or difficulties in the completion of the certification process could affect the proposed timeline (2035 & 2050)
	AS-03	IAM operations	Development of reliable sensor technology will enable IAM operations in diverse environmental conditions, including night-time and adverse weather.	Technology advancement points in this direction	Delay on the development of this technology could affect the proposed timeline (2035 & 2050)
	AS-04	Battery and charging	Enhancements in battery range, charging time, and safety will support viable regional IAM operations by 2035, with further advancements by 2050. Battery swapping may emerge as an alternative solution.	Battery performance is an active area of research and is improving year by year	Delay on the development of this technology could affect the proposed timeline (2035 & 2050)

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Category	ID	Title	Description	Justification	Impact Assessment
	AS-05	Automation of eVTOLs	Advanced automation technologies enabling autonomous eVTOL operations will be available by 2050, contingent on regulatory approval and robust safety features.	Both the desk research and the interview performed assured us that this timeline is realistic	Delay on the development of this technology could affect the proposed timeline (2035 & 2050)
Development of supporting infrastructure and services	AS-06	Vertiport availability	Establishment of vertiports in regional areas, potentially upgrading existing infrastructure like heliports, by 2035. This includes the development of vertiport design and management tools.	Both the desk research and the interview performed assured us that this timeline is realistic	Lagging development of vertiport technologies poses a risk to meeting the proposed milestones set for 2035 and 2050.
	AS-07	U-space	U-space will be implemented by 2035 when the first passenger drone operations take place.	The successful implementation of U-space services, integrated with existing ATM, is crucial for managing IAM operations, particularly in very low-level airspace.	Delay on the implementation of U-Space could affect the proposed timeline (2035 & 2050)
	AS-08	Data availability	Establishment of data spaces and AI tools to support IAM decision-making, including demand prediction, network planning, and service optimisation.	This assumption aligns with the desk research and the latest SESAR master plan	The unavailability of the data required by the PRIAM solution could affect the implementation of the solution in specific cases.

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Category	ID	Title	Description	Justification	Impact Assessment
	AS-09	Data sharing	Evolution of data sharing and passenger information systems to facilitate seamless integration of IAM with other transport modes.	This assumption aligns with the desk research and the latest SESAR master plan	Delay on the development of this technology or unwillingness to the different actors to share data could difficult the integration between modes of transport in the future.
Economic and business viability	AS-10	Business models	Development of business models for regional IAM services that balance operating costs with fares and potential subsidies, achieving competitive pricing compared to existing transportation methods.	This assumption aligns with the desk research and the interviews	The lack of viable and effective business models could significantly hinder the deployment of IAM services.
	AS-11	IAM recognition	The aviation sector will recognise IAM's potential to create sustainable value, offering new business opportunities for airlines and infrastructure providers.	This is needed for IAM integration in airports	The lack of recognition of IAM's potential could limit industry engagement, leading to reduced investment and delayed deployment of services.
Societal acceptance	AS-12	Societal acceptance	Societal acceptance of IAM services will grow as passengers gain confidence in the safety and reliability of new technologies. Factors like accessibility and connectivity are expected to positively influence acceptance.	This assumption aligns with the desk research and the stakeholder interviews	Social reluctancy to IAM may result in a reduced demand.

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Category	ID	Title	Description	Justification	Impact Assessment
Regulatory framework	AS-13	Regulatory framework	Regulatory frameworks will evolve to enable safe and efficient IAM operations, covering aspects like vehicle certification, airspace management (including U-space), and vertiport standards.	This assumption is necessary to ensure eVTOLs can operate	Delay on the establishment of a regulatory framework could affect the proposed timeline (2035 & 2050)
Multimodal integration	AS-14	IAM coordination with traditional modes	There is willingness between the relevant stakeholders to enable effective integration of novel IAM services with existing ground transport modes within regional multimodal transport networks, leveraging mechanisms such as data sharing.	This assumption aligns with the desk research and the stakeholder interviews	A lack of interest in intermodal coordination would hinder the seamless integration of IAM services into regional transport networks.
PRIAM toolset	AS-15	Data availability	Data required for the proper work of the PRIAM solution (demand data to provide the current mobility patterns in the region of study, and IAM adoption surveys to model the level of adoption of these services) will be in place for the implementation of the solution in different contexts.	Demand data is widely used in Europe to analyse mobility patterns. If MND is not available, travel surveys, commonly conducted across European countries, can serve as an alternative. In the absence of IAM adoption surveys, they can be conducted or estimated using heuristic approaches.	The unavailability of this data can limit the application of the solution to other geographical contexts.

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Category	ID	Title	Description	Justification	Impact Assessment
	AS-16	Data quality	The quality of the data is sufficient to ensure that the outputs of the PRIAM solution are reliable.	Quality of data can be good enough to accurately represent the current mobility patterns and the IAM adoption trends.	Bad quality data can lead to non-reliable results.
	AS-17	Data representati-veness	The data sample is representative of the behaviour of the total population, and is sufficient to ensure that the outputs of the PRIAM solution are reliable.	Data should be representative, ensuring that all the passenger segments are equally represented.	Non-representative data can lead to biases and to achieving non-reliable results.
	AS-18	Models' accuracy	The accuracy of the different models used in the solution is sufficient to ensure that the outputs of the PRIAM solution are reliable	Accuracy of the models will be tested to ensure they are accurate and precise.	Non-accurate models can lead to wrong results.

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4 Proposed SESAR solutions

Table 25. Proposed applications

Proposed solution title	Passenger-Centric Multimodal Planning and Optimisation for Regional Innovative Air Mobility
Proposed solution definition	The PRIAM Solution is a data analytics and modelling toolset that supports a passenger-centric integration of Innovative Air Mobility (IAM) into multimodal regional transport networks across Europe. PRIAM helps understand the passenger needs for regional travel, anticipate IAM adoption and use patterns, plan resilient IAM infrastructure networks that are seamlessly connected with other transport modes and optimise IAM service performance taking advantage of multimodal data sharing and passenger information systems. PRIAM comprises five components that combine advanced data analysis and modelling techniques: 1. IAM adoption models based on AI techniques able to identify the factors influencing the acceptance of IAM and its perception across different prospective user groups. 2. Potential demand monitoring methods that leverage geolocation big data sources to analyse regional mobility patterns and identify emerging opportunities for IAM deployment. 3. IAM demand models for estimating modal shifts towards IAM and quantifying induced demand effects. 4. Multicriteria optimisation tools that support IAM network planning by identifying optimal locations for operational infrastructure, such as vertiports. 5. IAM service optimisation tools that enhance operational performance and efficiency of IAM services within integrated multimodal transport systems.
Proposed solution description	RESHAPING REGIONAL CONNECTIVITY THROUGH INNOVATIVE AIR MOBILITY The PRIAM Solution is a digital platform designed to support regions across Europe explore how Innovative Air Mobility (IAM), such as air taxis, can enhance connectivity in areas where traditional transport infrastructure faces significant challenges. This is particularly valuable for mountainous and insular regions, where sustainable and efficient travel alternatives such as high-speed rail are often unfeasible or too costly to develop. PRIAM focuses on creating a passenger-oriented transport system by analysing mobility patterns and understanding passenger behaviour and needs. It supports local authorities and planners identify where IAM could bring the greatest benefits,

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	such as improving access to remote communities, supporting tourism, and connecting people to essential services. Using data-driven insights, PRIAM supports decisions on where to locate key infrastructure like vertiports, how to integrate air mobility with existing transport networks, and how to optimise services to make regional travel faster, greener, and more reliable. In essence, PRIAM empowers regional communities to embrace sustainable air mobility, helping them build a more connected, resilient, and environmentally friendly transport system.
Maturity at project start	TRL0
Maturity at project end	TRL1

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5 Plan for next R&I phase

Building on the methodological foundation established by PRIAM, future R&I activity should be structured in three phases, each building on the outputs of the previous one.

Phase 1: Consolidate the methodology and its underlying data and evidence base

- **Extending methodological validation.** Apply the full PRIAM pipeline to additional case studies and territorial contexts. This would allow the methodology to be tested under more diverse geographic, demographic, and infrastructural conditions, improving its transferability and strengthening the robustness and validity of the results across a broader range of environments and conditions.
- **Strengthening the behavioural evidence base.** Apply the methodology to larger and more geographically targeted stated preference surveys. While the current sample was sufficient for exploratory model development, a larger sample would improve representation across user groups, trip purposes, income levels, and regional contexts, strengthening behavioural robustness and supporting more detailed policy conclusions on IAM adoption, modal shift, and induced demand.

Phase 2: Increase model sophistication using the outputs of Phase 1

- **Enriching MND-derived mobility data.** Enhance the attributes extracted from MND to better support IAM shift assessment, including finer segmentation by traveller and trip profile to provide a more informative basis for estimating willingness to pay and modal-shift potential. The road-mode detection algorithm should also be improved to identify additional modes, particularly taxi, given that taxi users represent one of the segments most likely to shift to IAM.
- **Forecasting demand evolution.** Forecast demand growth and structural changes in passenger behaviour over the medium and long term, rather than relying solely on current mobility patterns as a baseline.
- **Enhancing travel time and reliability modelling.** Include road congestion and travel time variability by day of week and time of day. Reliability could also be captured by representing travel time as a probability distribution rather than a fixed value, with variance calibrated to these temporal factors.
- **Refining the generalised cost formulation.** Incorporate additional cost and service-quality components such as parking costs, transfer time, schedule-delay penalties, reliability, and comfort, since IAM competitiveness depends on the full door-to-door travel experience, not only in-vehicle travel time.
- **Improving vertiport micro-location.** The current tool identifies vertiport locations based on aggregated demand zones. Future work should extend this capability to a two-stage hierarchical approach: a first stage operating on aggregated demand zones to identify high-potential areas, followed by a second stage that zooms into those selected areas to fine-tune exact vertiport locations and resolve detailed site-specific costs (land availability, surface access, electrical-grid connection capacity and lead time, construction, obstacle environment, airspace/procedural compatibility, emergency access and local permitting). This requires more refined siting models, including fine-grained weather modelling (particularly wind effects,

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since wind exposure and turbulence are critical constraints on vertiport feasibility and safety) together with more granular land and construction cost data to better capture site-specific economic viability.

Phase 3: Extend the strategic-level approach toward operational application and prepare the tool for broader, non-technical use

- **Adding an operational layer.** Complement the current strategic-level perspective with a more operational view capable of analysing day-to-day service performance and operational constraints, requiring more detailed, higher-resolution models. This layer should explicitly represent the time-dependent capacity of FATOs/pads, stands, chargers, passenger-processing resources and available electrical power, together with turnaround, queueing, staffing and curfew/noise constraints. Such modelling is needed to test whether the demand identified annually can be served within the operational window of each infrastructure configuration.
- **Improving tool usability and accessibility.** Reduce computational times through more efficient algorithms or solvers, and improve the user interface to allow non-technical users to configure scenarios, run simulations, and visualise results independently

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6 References

6.1 Applicable documents

This concept outline complies with the requirements set out in the following documents:

Project and programme management

[1] 101167262 PRIAM Grant Agreement, 25/06/2024

[2] SESAR 3 JU Project Handbook – Programme Execution Framework, 11/04/2022 01.00

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