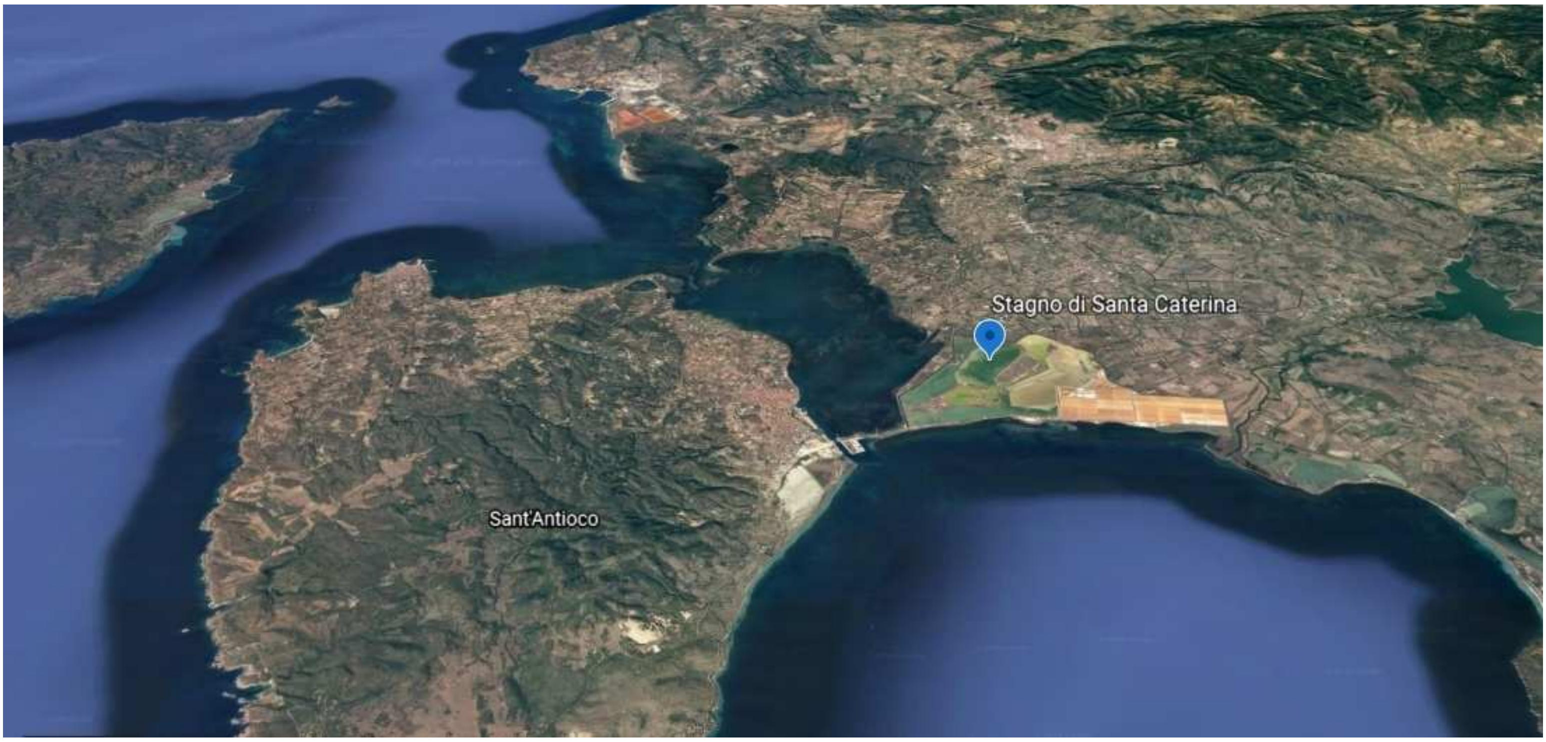
REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

DESTI-SMART
Interreg Europe

European Union
European Regional Development Fund

# Feasibility Study

*Sustainable mobility model towards naturalistic areas:*
*The case of Santa Caterina—Sant'Antioco*
*Regione Sardegna*




*Andrea Zara*

**May 2020**

## DOCUMENT CONTENT AND REFERENCES

This document represents one of the outputs of the project "Delivering Efficient Sustainable Tourism with Low-Carbon Transport Innovations: Sustainable Mobility, Accessibility and Responsible Travel" – DESTI-SMART, funded by the Interreg Europe 2014/2020 European Territorial Cooperation Programme and of which the Region of Sardinia is one of the 10 partners.

This study was carried out with regard to Activity 8, which requires "Feasibility Studies for Low-Carbon Mobility Options & Transport Systems, Accessibility provision, Intermodality improvements and Cycling/Walking facilities at partner destinations".

The study was carried out by Andrea Zara, external expert of Autonomous Region of Sardinia in charge to develop the study, in a close collaboration with the project staff of the Region of Sardinia and in the context of  DESTI-SMART Project and.

Therefore, all the contents of this document refer exclusively to the objectives and activities of the DESTI-SMART Project. Any different use and the total or partial citation of the contents by third parties must explicitly quote the source and relieve the author and the Region of Sardinia from any possible consequences.

Delivering Efficient Sustainable Tourism with low-carbon transport Innovations:
Sustainable Mobility, Accessibility and Responsible Travel

DESTI-SMART
Interreg Europe

European Union
European Regional Development Fund

Lead Partner

Advisory Partner

**https://www.interregeurope.eu/desti-smart/**


**Prepared by**
Andrea Zara
Via Giudice Guglielmo, 19
09131 Cagliari (Italy)
e-mail: zara.andrea@hotmail.it
phone: +39 392 8340155
p.iva 03889430926

## SUMMARY

# 1. Executive Summary

## 1.1 Case and objectives

This study analyses the proposal received from the municipality of Sant'Antioco (south-west Sardinia) for using a regional contribution to purchase electric vehicles with low environmental impact, which would be useful to reach the SCI "Stagno di Santa Caterina (Pond of Santa Caterina) naturalistic area (cod.ITB042223 Rete Natura 2000)".

The implementing entity's proposed intervention involves purchasing and installing the following means and equipment:

- Six charging stations and/or columns for pedal-assisted bicycles
- Four electric motor boats
- Four two-seat microcars with electric motors
- Purchase of four two-seat cars with electric motors
- Thirty-four pedal-assisted bicycles
- Six electric motor scooters
- Eleven car and scooter charging points

The intervention, which is the subject of this study, is intended to achieve the following objectives simultaneously:

1. Enhancing a naturalistic resource that can function as an additional tourist attraction to attract visitors and bring economic and employment benefits to the area;
2. Promoting the use of renewable energy sources instead of fossil fuels;
3. Helping protect and safeguard natural resources by providing mobility solutions with low environmental impact for residents and tourists and reduce, in particular, pollutant emissions linked to traditional vehicles;
4. Contributing to residents and tourists' active mobility in the use of the territory;
5. Contributing to the adoption of intermodality solutions in the use of the territory
6. Improving accessibility for people with reduced mobility

## 1.2 Study approach

In the context of the DESTI-SMART project and in relation to its role as a programmer, the region of Sardinia conducts this study to draw an overall picture within which the intervention of the actuator is inserted and thus to identify guidelines regarding:

- General coherence with regional energy, mobility and tourism strategies;
- Preconditions necessary for the intervention's concrete development;
- The methodology of the analysis;

- Possible intervention scenarios, environmental impacts different modulations of the fleet of electric vehicles;
- Conditions, competences and minimum requirements for the implementation of the intervention according to the various scenarios

The purpose of the study, therefore, is not to formulate a detailed business plan. That is the responsibility of the organization that will implement the intervention.

## 1.3 Consistency with regional strategies

The programming framework of the Region of Sardinia, of which the intervention analysed in this document is part, comprises various policy instruments. The analysis reveals that the purchase and implementation of low-emission electric vehicles, regardless of the scenarios proposed, represents an intervention consistent with regional strategies concerning mobility, energy production and management, emission reduction, sustainable development, tourism development and the enhancement of environmental tourism attractors.

## 1.4 Preconditions

All the scenarios analysed in the study can be implemented effectively only if certain preconditions are satisfied. In particular, these include the implementation of interventions that are part of previously financed in-progress projects: the “Vie del Sale” project will provide for the physical redevelopment of the Stagno di Santa Caterina through the renovation of the tracks to make them accessible by bicycles and the construction of equipment to support its use (e.g., watchtowers, information centres, toilets), and the Regional Cycling Mobility Plan of Sardinia will complete the cycle paths leading to the area from the three main access hubs.

## 1.5 Potential demand and traffic flows

The first step for all scenarios is to estimate the number of users who will use the mobility services to reach the naturalistic area from each municipality and access hub. The potential demand for the mobility services includes two components: the residential demand from the population living in the area under consideration and the fluctuating demand linked to annual tourist flows.

Based on the estimates, the mobility services offered can be used by 13,000 to16,000 users per year, depending on whether the estimate is conservative or optimistic.

Three hubs from which potential visitors can reach the area have been identified:

1. South-West, from the municipalities of Calasetta and Sant’Antioco
2. North, from the municipality of Carbonia’s intermodal centre
3. South-East, from other municipalities

Of 100 potential visitors, approximately 89–92 come from the first two hubs. In light of this figure and the amount of funding available, the analysis and, therefore, this feasibility study are focused on solutions that ensure sustainable connections from these two routes.

## 1.6 Scenario analysis

Five scenarios were analysed and compared. For all scenarios, movement from the place of stay or residence to the reference hub is considered invariant and it won't be included in the analysis. Instead, solutions for movement from each hub to the area will be considered and analysed.

To identify the optimal solution, the scenarios were assessed and compared based on certain parameters related to their economic and environmental sustainability.

- **Scenario 0**

  This scenario provides no interventions. People interested in visiting the area reach it in the typical way according to their normal travel habits. This scenario represents a common basis of comparison, particularly with respect to the environmental impacts resulting from traditional traffic flows that which be generated by the creation of a new tourist attraction.

- **Scenario 1**

  Scenario 1 provides for a complete replacement of the usual means of visitor transport by means with low environmental impact, as proposed by the Municipality of Sant'Antioco. The vehicles selected be determined based on the visitor flows associated with each hub. This scenario is useful for understanding how environmental impacts would vary if the entire demand only used electric vehicles.

The other scenarios involve hybrid solutions regarding the quantity, type and configuration of the fleet of electric vehicles.

- **Scenario 2**

  Scenario 2, as well the following scenarios, assumes that some consumers who currently use their own vehicles and public transportation users may be encouraged to use pedal-assisted bicycles and electric scooters. Currently, the use of bicycles, motorcycles and scooters is decidedly marginal compared to the use of public transport and, in particular, high-emission private vehicles.

- **Scenario 3**

  Scenario 3 considers the same distribution of demand as Scenario 2 but provides a change in the vehicle fleet: an electric minibus will be introduced to accommodate part of the demand that typically uses traditional high-emission public transport and provide a means of mobility that can also accommodate people with limited mobility.

- **Scenario 4**

  Scenario 4 provides the introduction two electric minibuses.

Regarding the estimated demand and current travel habits, a disparity exists regarding the means of transportation currently in use and those proposed for purchase. In particular, bicycles and scooters would be almost completely unused. Given the intervention's objectives, which include promoting active mobility and use of the territory, all Scenarios include recommendations that appropriate information, communication and promotion activities be adopted to persuade some individuals who generally use private cars and traditional public transport to use bicycles and scooters. This clearly implies the availability of adequate communication and marketing skills on the part of the operator. This element should be taken into proper consideration when selecting the actual management for the activity, whether it is internal or external to the implementing entity.

When considering the utilisation rates of the various vehicle types, the fleet composition envisaged in Scenario 3 appears the most balanced and consistent with the composition of the demand.

### Environmental impact

Any scenario that provides an intervention guarantees a lower level of impact on the environment and the community than Scenario 0, which does not provide any intervention.

The transition from the use of traditional petrol and diesel vehicles to electric vehicles entails the following:

- A slight reduction in external environmental impacts (e.g., road congestion, accidents, polluting emissions, noise pollution, global warming). When moving from Scenario 0 to Scenario 4, the change in monetary terms is −11%.
- A sharp reduction in operating costs, equal to a −47% change from Scenario 0 to Scenario 4. These costs are calculated with reference to the community. In other words, they are the total costs incurred by a community to maintain a specific fleet.
- A −33% difference in overall costs. When moving from Scenario 0 to Scenario 4, the monetised overall costs are reduced by one-third.
- A reduction of $CO_2$production to zero. Moving from Scenario 0 to Scenario 4, the $CO_2$produced decreases from about 9.2 tonnes to none.

### Management costs

In terms of fleet management costs, the differences between the scenarios are negligible: estimated total annual costs range from a maximum of 95.5 thousand euros in Scenario 2 to 91.5 thousand euros in Scenario 4.

### Break-even point

In the light of the vehicle fleets' composition, the current modal distribution of demand and vehicle occupancy rates and estimates made regarding the tariffs to be applied to cover costs, returns for Scenario 3's tariff system are more balanced and, overall, more appropriate to the market tariffs applied by other car sharing operators than those proposed in the other scenarios.

### Marketing management requirements

In relation to commercial activity, Scenario 4 requires a greater availability of management and marketing skills necessary for good management, particularly because of the need to manage the sale of the 2 minibuses in an efficient and cost effective way. However, because the fleet contains no minibuses Scenario requires a lower level of expertise. Because Scenario 3 entails the purchase of only one minibus, it appears to be the best compromise between the need to make the mobility system accessible to all and the quantity and quality of necessary managements kills.

### Environmental constraints

In terms of environmental constraints, the scenarios do not exhibit any particular critical differences. None of the scenarios assumes particular landscape alterations, as they all provide the use of vehicles with low environmental impact, as well as mostly removable, minimally invasive systems.

## 1.7 Conclusions

Ultimately, regarding the objectives of the intervention proposal received from the Municipality of Sant'Antioco and the recommendations of DESTI-SMART project and in light of the elements considered in the study, Scenario 3 returns the most balanced framework of sustainability and feasibility. In addition, it is best able to pursue the objectives and ensure the most efficient management. This result is obviously linked to the whole series of assumptions made in the analysis.

To select the best solution, we recommend additional in-depth analysis by the managing entity to evaluate the following aspects:

1. Effective coordination with the Le Vie del Sale project and the Regional Cycling Mobility Plan, as well as certain definitions related to the conclusion of the planned interventions.
2. At least for the first period, the opportunity to purchase other means in place of electric boats, the later purchase of which could be facilitated, using other funds, during a more advanced phase when demand for their use will be more consolidated.
3. The opportunity to purchase of an electric minibus to allow greater and better accessibility of mobility services.
4. An in-depth assessment of the reference market (mobility services, car sharing, etc.) to verify the following:
    a. Necessary management and marketing skills;
    b. Effective availability of these skills and, therefore, the choice of internal or external management on the part of the implementing entity;
5. In the case of external management, careful evaluation of the characteristics of the service to be entrusted and the degree of attractiveness of the contract by possible market players.

# 2. Introduction

This document represents one of the outputs of the project "Delivering Efficient Sustainable Tourism with Low-Carbon Transport Innovations: Sustainable Mobility, Accessibility and Responsible Travel" – DESTI-SMART, funded by the Interreg Europe 2014/2020 European Territorial Cooperation Programme and of which the Region of Sardinia is one of the 10 partners.

### DESTI-SMART PROJECT

The overall objective of DESTI-SMART is to improve the transport and tourism policies of EU destination regions, by integrating strategies for sustainable mobility, accessibility and responsible travel with sustainable tourism development. This development will be in support of the transition to a low-carbon economy through sustainable mobility, multimodality, novel low-carbon transport systems, accessibility, cycling and walking in tourism destinations, with implementation innovations, policy learning and capacity building.

Main issues are as follows:

- investments in low-carbon transport systems for mode shift to sustainable tourism mobility, including electric mobility;
- intermodality facilities for visitors, including ICT, Mobile Aps and MaaS;
- accessible tourism for all;
- cycling and walking facilities and promotions for visitors.

Main outputs are as follows:

- policy learning and capacity building for public authorities and their stakeholders;
- improved policy instruments and action plans in nine destinations, with close involvement of stakeholders;
- advances in EU2020 objectives;
- communication and dissemination of learning materials.

Overall, there are 12 activities, and this study was carried out with regard to Activity 8, which requires "Feasibility Studies for Low-Carbon Mobility Options & Transport Systems, Accessibility provision, Intermodality improvements and Cycling/Walking facilities at partner destinations".

### OBJECTIVE

This study analyses the proposal, received from the municipality of Sant'Antioco, for the use of a regional contribution for the purchase of electric vehicles with low environmental impact useful for the achievement and use of the SCI Stagno di Santa Caterina (Pond of Santa Caterina) naturalistic area (cod, ITB042223 Rete Natura 2000).

The study adopts the point of view of the subject in charge of programming (i.e. the region of Sardinia) to verify (i) to what extent the proposed intervention respects the regional and national strategies on the environment, energy, transport and general sustainability; (ii) what are the preconditions for the intervention to be effectively feasible; (iii) what analysis methodology is useful to adopt; (iv) what may be the different scenarios of intervention and the impacts on the environment; and (v) what skills and prerequisites the intervention requires to be feasible and sustainable from an economic and management point of view.

The purpose of the study, therefore, is not to formulate a detailed business plan. This is the responsibility of the subject who will implement the intervention.

# 3. Proposed Intervention and Context

## 3.1 Reasons for and brief description of the intervention

The purpose of this feasibility study is to identify a model of sustainable mobility through which to ensure the achievement and enjoyment of recreational nature of the naturalistic area called Stagno di Santa Caterina (Pond of Santa Caterina) located on the south-west coast of Sardinia, in the territory of the municipality of Sant'Antioco.

The area in question, in turn, is the subject of redevelopment in the context of the project, funded in 2018 and under construction, called the "Salt Roads", which affects six coastal municipalities of Sulcis Iglesiente (Teulada, Sant'Anna Arresi, Masainas, Giba, San Giovanni Suergiu and Sant'Antioco) and in which fall wetlands and environmental attractions of great importance. In particular, four sites of community interest are included in the Natura 2000 Network:

1. ITB040025 Promontorio, dune e zona umida di Porto Pino.
2. ITB042226 Stagno di Porto Botte.
3. ITB042223 Stagno di Santa Caterina.
4. ITB042210 Punta Giunchera..

Once the interventions, better described in section4.2.1, have been carried out, the area of the Stagno di Santa Caterina will be an attraction for flows of visitors, whether residents or tourists. In light of the attraction's characteristics as a naturalistic area with a strong environmental value, it is therefore necessary to identify mobility solutions that guarantee access to the area from the surrounding municipalities, thus allowing an economic exploitation of the resource but, at the same time, does not compromise the delicate balance of the existing ecosystem in these wetlands.

This study intends to analyse the feasibility of making low environmental impact means of transport available to visitors and thus promoting the replacement of traditional means of transport that have high pollutant emissions.

The area of intervention and the reference territory are mainly characterised by the following:

- a strong value and high environmental and naturalistic quality, recognised at the community level through the establishment of SCI areas;
- the presence of an entrepreneurial activity linked to the extraction and production of salt;
- current tourist flows of a certain consistency;
- a high tourist potential linked to the presence of numerous historical, archaeological, cultural and naturalistic resources;
- high unemployment rates.

The analyses carried out within the management plans of the SCI areas highlight the lack, within these areas, of adequate services necessary to guarantee a better usability of the lagoon and stagnant areas and the entire territory. In particular, as an area with a prevalent environmental character, it is intended to connect in a more "sustainable" way the areas within the SCI "Stagno di Santa Caterina" [Natura 2000 Code: ITB042223], which has an area equal to about 614 hectares and is located in the south-western coastal strip of Sardinia, in the new province of South Sardinia, in the municipal territories of Sant'Antioco and San Giovanni Suergiu. The physical limits of the SCI are the countryside of San Giovanni Suergiu and its urban agglomeration to the north. The south is separated from the Gulf of Palmas by the peninsula of "Corru Longu" .The salt pans of Sant'Antioco are to the east; and to the north-west, the area is limited by the SS 126 which reaches, through an isthmus built in 1939, the peninsula of Sant'Antioco and the homonymous municipality.

The intervention, which is the subject of this study, intends to pursue the following objectives at the same time:

1. contribute to the enhancement of a naturalistic resource that can represent a further tourist attraction able to attract flows of visitors and, therefore, bring economic and employment benefits in the area;
2. promote the use of renewable energy sources instead of fossil fuels;
3. help to protect and safeguard the natural resource by providing mobility solutions for residents and tourists with low environmental impacts and reducing, in particular, pollutant emissions linked to traditional vehicles;
4. contribute to the active mobility of residents and tourists in the use of the territory;
5. contribute to the adoption of intermodality models in the use of the territory;
6. promote accessibility for people with reduced mobility.

The creation of adequate structures that allow a differentiated use of the area through the promotion of social, cultural and educational initiatives in its generality and aims to ensure the usability by a more attentive users and the involvement of qualified operators.

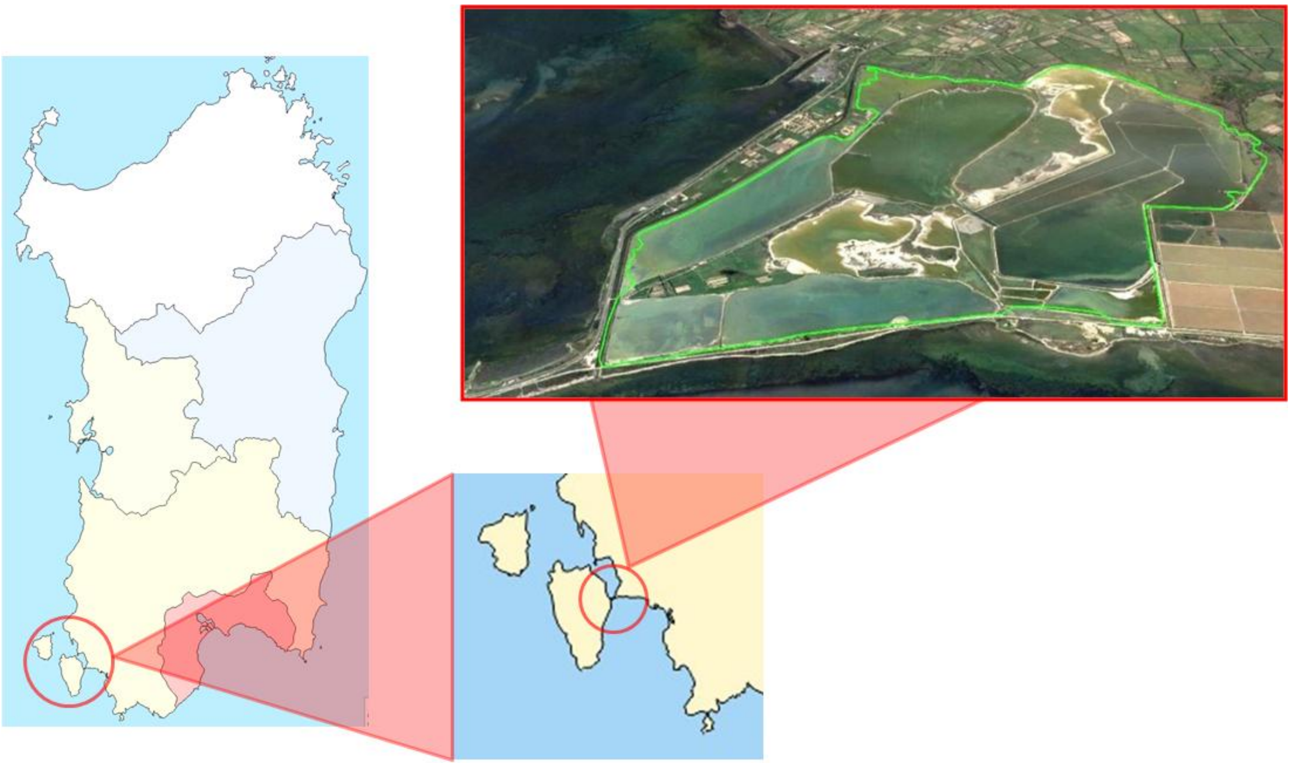
In addition to the benefits set out above, the proposed intervention is also to be considered as a de facto driving force for existing production activities, as it will create the need to maintain the new vehicles.

## 3.2 The intervention territory and area

The interest territory of this study is located in the western part of the province of South Sardinia, in the region historically called Sulcis. Sulcis includes an archipelago made up of two islands: the island of San Pietro, in the municipality of Carloforte, and the island of Sant'Antioco, where the homonymous municipality of Sant'Antioco and the municipality of Calasetta are located.

From a geographical and geomorphological point of view, the territory under examination has quite varied aspects. Long sandy shores and low cliffs (especially in the municipalities of Teulada, Sant'Anna Arresi and Masainas) alternate along the coastal strip with jagged coastlines overlooking the sea, in addition to the presence of one of the largest islands of Sardinia (Sant'Antioco). The coastal system is characterised by the significant presence of sites of community interest (SCI) centred on lake environmental systems. The Sulcis-Iglesiente area is, in the panorama of the island, a much-defined reality in its geographical and geomorphological connotations and environmental components. Moreover, in the Sulcis territory, there are 24 areas between the SCIs and SPAs, which are balanced and integrated and are divided between sea, mountains, lagoons, suggestive coasts, islands and islets, pinewoods, holm oaks and sand dunes. The area is a unique mix of environmental and territorial components currently undervalued in their tourism component.

**Figure 1 – Area of intervention**

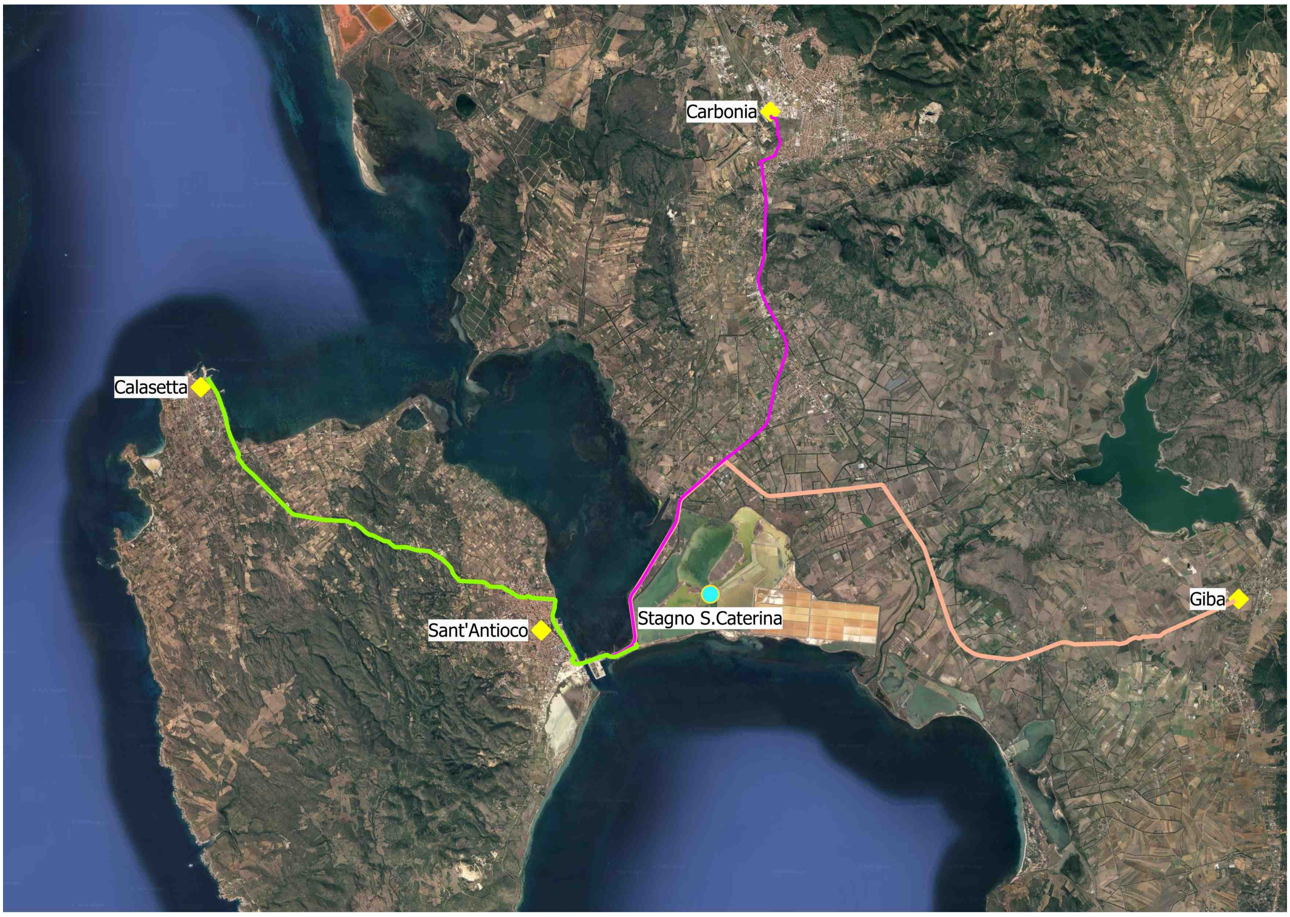


# 4. Study Approach

This study collects and analyses the proposal submitted to the region of Sardinia by the municipality of Sant'Antioco for the use of a contribution of 600,000 euros allocated to it and related to the financing of an experimental intervention for the purchase of vehicles and equipment with power supplies. The contribution is part of the general allocation of Action 1.2.2. of the Development and Cohesion Fund 2014/2020, in implementation of the programme Integration of Electric Mobility with Smart Cities (Guideline Resolution no. 63/8 of 15 December 2015).

The proposal of the municipality of Sant'Antioco consists in the purchase of vehicles with low $CO_2$ emissions and related equipment to ensure connections between the main towns of the territory (Calasetta, Sant'Antioco and Carbonia) and the naturalistic area of Santa Caterina.

**Figure 2 – Area view**




More precisely, the proposal consists of the purchase and installation of certain vehicles:

- electric motor boats type Picnic 18;
- microcar with electric motor, two seats;
- electric motor car, two seats;

- pedal-assisted bicycles;
- electric motor scooter, two seats;
- stations and/or charging columns for pedal-assisted bicycles;
- charging columns for electric vehicles.

Following this proposal, the municipality of Sant'Antioco, as the implementing entity of the intervention, will draw up an executive project that will identify in detail the individual interventions, the costs and benefits, the administrative and authorisation aspects and the general economic and environmental sustainability of the intervention.

In the context of the DESTI-SMART project and in relation to its role as a programmer, the region of Sardinia conducts this study to draw an overall picture within which the intervention of the actuator is inserted and thus to identify guidelines regarding:

- general coherence with regional energy and mobility strategies (Section4.1 );
- preconditions necessary for the concrete development of the intervention (Section4.2 );
- methodology of analysis (Section 4.3 );
- possible intervention scenarios, environmental impacts and different modulations of the fleet of electric vehicles (Section 6);
- conditions, competences and minimum requirements for the implementation of the intervention according to the different scenarios (Section 9).

## 4.1 Consistency with regional strategies

The programming framework of the region of Sardinia, within which the intervention analysed in this document is part, is made up of various policy instruments.

Specifically, these instruments are:

- Regional Operational Programme Sardinia ERDF 2014-2020
- Sardinia Smart Specialisation Strategy (RIS3)
- Sardinia Region Environmental Energy Plan 2015 – 2030
- Regional Energy Efficiency Action Plan 2013 – 2020

At the national level, however, the main reference is:

- Integrated National Energy and Climate Plan 2030.

### Regional Operational Programme Sardinia ERDF 2014–2020

The programme is dedicated to the theme of energy and mobility as a Priority Axis through "Axis IV—Sustainable energy and quality of life", which is linked to the Thematic Objective OT 4 "Support the transition to a low-carbon economy in all sectors".

The strategy adopted is intended to contribute to the objectives identified in the strategic documents PEARS (Sardinia Regional Environmental Energy Plan) and PAEER 2013–2020 (Regional Energy Efficiency Action Plan - excerpt of PEARS) based on three priorities:

- increase energy autonomy by diversifying energy sources, promoting widespread generation and implementation of distribution networks;
- increase the efficiency of the energy system in the electric and thermal sectors with energy saving and efficiency actions, to develop technologies with reduced environmental impact and in the transport sector with the diffusion of electric mobility and the reduction of private transport in favour of public transport;
- increase local benefits by promoting the sustainable use of local energy resources for the environment and the spread of integrated and hybrid plants and provide for research and innovation actions, with the further aim of reducing energy costs.

The general strategy to be adopted consists of measures to promote sustainable forms of mobility as an alternative to the private car, by means of measures to reduce private traffic in favour of the development of collective transport and low-impact modes of travel, encouraging the use of intermodality.

In relation to the themes of the DESTI-SMART Project and the object of intervention in this analysed document, the Operational Programme dedicates Action 4.6.4. "Development of the infrastructures necessary for the use of the low environmental impact vehicle also through charginghub initiatives".

This action includes actionssuch as the following:

- the upgrade, deployment and safety of pedestrian and cycle networks;
- the promotion of sustainable urban mobility through the use of electric traction in public transport and the implementation of interventions to support the use of electric mobility (bike sharing systems, car sharing, public charging infrastructure for electric vehicles to be installed in used areas, suchas depots, bus stations, interchange nodes, stations and public car parks).

### SARDINIA SMART SPECIALISATION STRATEGY (RIS3)

The Sardinia region's Smart Specialisation Strategy dedicates to the theme of energy production, distribution, management and savings the "Investment Priority 2, Intelligent Networks for Efficient Energy Management". This priority is also linked to the theme of electric mobility and, therefore, the promotion of the use of low-impact electric vehicles. However, the theme remains marginal overall and is mostly related to the issue of integration with the management of energy distribution networks.

Investment Priority 6, on the other hand, provides Tourism, Culture and Environment as a specific area of specialisation. The choice of this field comes from the need to consider tourism in relation to the enhancement of natural and cultural attractions to develop new holiday themes and new tourism products. In terms of this study, these could include naturalistic, cultural and active tourism. The need made explicit by the strategy is expanding the range of tourism products the island offers its tourists, multiplying opportunities for holidays in Sardinia even beyond the summer and even in inland areas. There is in fact an excessive dependence of Sardinian tourism on the sea-balnear sector concentrated in the summer months and along the coast.

The proposed intervention concerns the enhancement of a naturalistic attraction and therefore appears to align perfectly with the provisions of Strategy S3. In fact, the intervention pursues all the general objectives of Investment Priority 6:

- Strengthening the medium-long term competitiveness of the Sardinian tourism system in terms of the sustainability of the tourist activity;
- Increasing tourist arrivals and presence in inland areas;
- Consolidating the summer tourist flows and increasing non-summer tourist flows;
- Increasing flows of "qualified visitors" sensitive to the principles of sustainability, with a greater propensity to spend and more inclined to discover the territory and the authenticity of the tourist experience;
- Including culture and environment in tourist values through a unified organisation at the regional level to provide real support to the tourism sector.

Among the mechanisms provided for by the strategy, two appear perfectly aligned with the intervention in the Pond of Santa Caterina:

- Differentiating the services and amenities offered in order to expand product ranges and attract additional customer segments in coastal areas even in the non-summer months;
- Intervening in the recovery and enhancement of environmental and cultural heritage and infrastructure to improve the accessibility and usability of attractors.

### PEARS – Sardinia Region Environmental Energy Plan 2015–2030

The Regional Environmental Energy Plan represents a framework document, which includes the already approved excerpt documents consisting of the "Policy Document to Improve Energy Efficiency in Sardinia 2013–2020" and the "Study on the Energy Potential of Biomass in Sardinia".

The general objective of the plan is to improve, at regional level, the target set by the European Union by setting a 50% reduction, compared to the estimated values in 1990, by 2030 of CO2 emissions associated with the final energy consumption of the users living in Sardinia.

To achieve this objective, the plan provides for targeted intervention strategies in the various sectors of energy production and distribution within the thermal and transport sectors.

In the case of land transport, the plan identifies the strategic line "TT PU3 Infrastructure and charging networks for electric mobility" which, among other actions, provides for the following:

- projects and actions aimed at the integration between renewable energy sources and the spread of electric mobility to match the supply of unprogrammable energy with the energy demand of cars, and the aim of achieving a form of distributed storage of electricity from a renewable energy source;

- special economic and fiscal facilitations and authorisations for the installation of recharging stations, with particular regard to the sites affected by large-scale distribution centres;
- collaboration with the electricity distribution network operator and fuel distribution agencies for the creation of electric vehicle corridors designed to provide connections to major urban centres for intercity travel;
- infrastructure bolstering throughout the region to encourage interaction and coordination between the various types of electric and sustainable mobility (e.g. light rail, trolley buses, buses, car sharing, cycle paths, bike sharing, etc.), taking care to set up "sustainable mobility points" equipped with "Ebike" recharging and parking areas, with possible sharing for bicycles, near the electric recharging stations located in stations and metro stops with high commuter frequency or in urban centres;
- model implementation in tourist areas and integration with the regional transport system, where there is a strong need for conservation and management of natural, historical and cultural heritage (e.g., small islands).

### PAEER – Regional Energy Efficiency Action Plan 2013–2020

The Regional Energy Efficiency Action Plan is an integral part of the Regional Environmental Energy Plan and identifies a series of interventions to pursue its objectives. With regard to transport, the intervention "TRA01—Electric Mobility" aims to promote the diffusion and use of electric vehicles, including two-wheeled vehicles, in urban agglomerations with advantages in terms of improving air quality and reducing noise pollution. Therefore, the interventions concern the realisation of infrastructural recharging networks at the service of the latest generation electric vehicles. A second intervention, "TRA02—Integrated and sustainable urban mobility pilot project (MUIS)" focuses on electric mobility, cycling, car sharing and collective public transport, specifically for large urban agglomerations.

### PNIEC – Integrated National Energy and Climate Plan

At the national level, the Integrated National Energy and Climate Plan represents the strategic framework. The inspiring principle of the plan is the wide transformation of the economy, in which decarbonisation, the circular economy, efficiency and the rational and fair use of natural resources represent objectives and tools for a more respectful economy of people and the environment. Among the general objectives, one in particular aims to promote the electrification of consumption, specifically in the civil and transport sectors, as a means of improving air and environmental quality.

## Table 1 – Consistency framework

| | | Riferimenti Policy instrument | | | | | |
|---|---|---|---|---|---|---|---|
| Sant'Antioco intervention objectives | | Regional Operational Programme Sardinia ERDF 2014-2020 | Sardinia Smart Specialisation Strategy (RIS3) | Sardinia Region Environmental Energy Plan 2015 - 2030 | Regional Energy Efficiency Action Plan 2013 - 2020 | Integrated National Energy and Climate Plan | DESTI - SMART Issues |
| Contribute to the enhancement of a naturalistic resource that can represent a further tourist attraction able to attract flows of visitors and therefore bring economic and employment benefits in the area | General intervention | All instruments promote sustainable economic development based on renewable energy and low-emission transport. | | | | | |
| Promote the use of renewable energy sources instead of fossil fuels | Installation of solar-powered columns for recharging bicycles | Act. 4.6.4: Promotion of sustainable urban mobility by encouraging the use of electric traction in public transport and the implementation of measures to support the use of forms of electric mobility (bike sharing systems, car sharing, public charging infrastructure for electric vehicles to be installed in areas used for depots, bus stations, interchange nodes, stations and public car parks) | Investment Priority 2 “Smart networks for efficient energy management” | | | | Investments in low-carbon transport systems for mode shift to sustainable tourism mobility, including electric mobility |
| Help to protect and safeguard natural resources by providing mobility solutions for residents and tourists with low environmental impacts and reducing, in particular, pollutant emissions linked to traditional vehicles | Purchase and rental of electric vehicles | Developing technologies with reduced environmental impact and in the transport sector with the spread of electric mobility<br><br>Act. 4.6.4: promotion of sustainable urban mobility by encouraging the use of electric traction in public transport and the implementation of measures to support the use of forms of electric mobility (bike sharing systems, car sharing, public charging infrastructure for electric vehicles to be installed in areas used for depots, bus stations, interchange nodes, stations and public car parks) | Investment Priority 2 “Smart networks for efficient energy management”<br><br>Priority 6 “Tourism, Culture e Environment” | TT PU3 Infrastructure and charging networks for electric mobility:<br><br>implement the model in tourist areas and integrate it with the regional transport system where there is a strong need for conservation and management of natural, historical and cultural heritage (e.g., small islands) | “TRA01 – Electric Mobility”<br><br>to promote the spread and use of electric vehicles, including two-wheeled vehicles, in conurbations with benefits in terms of improved air quality and reduced noise pollution | General objective:<br><br>promoting the electrification of consumption, in particular in the civil and transport sectors, as a means of also improving air and environmental quality | Investments in low-carbon transport systems for mode shift to sustainable tourism mobility, including electric mobility |

| | | Riferimenti Policy instrument | | | | | |
|---|---|---|---|---|---|---|---|
| Sant'Antioco intervention objectives | | Regional Operational Programme Sardinia ERDF 2014-2020 | Sardinia Smart Specialisation Strategy (RIS3) | Sardinia Region Environmental Energy Plan 2015 - 2030 | Regional Energy Efficiency Action Plan 2013 - 2020 | Integrated National Energy and Climate Plan | DESTI - SMART Issues |
| Contribute to the active mobility of residents and tourists in the use of the territory | Purchase and rental of electric bikes and equipment for parking and recharging with renewable energy | | | TT PU3 Infrastructure and charging networks for electric mobility:<br><br>projects and actions aimed at the integration of renewable energy sources and the spread of electric mobility | | | Cycling and walking facilities and promotion for visitors |
| Contribute to the adoption of intermodality models in the use of the territory | Positioning of vehicles in the Intermodal Centre of Carbonia | Promoting sustainable forms of mobility as an alternative to the private car by encouraging the use of intermodality | | TT PU3 Infrastructure and charging networks for electric mobility:<br><br>encourage interaction and coordination between the various types of electric and sustainable mobility (light rail, trolleybuses, buses, car sharing, cycle paths, bike sharing, etc.), taking care to set up “sustainable mobility points” equipped with “e-bike” recharging and parking areas, with possible sharing for bicycles, near the electric recharging stations located in stations and subway stops with high commuter frequency or in urban centres | | | Intermodality facilities for visitors, including ICT, Mobile Aps and MaaS |
| Promote accessibility for people with reduced mobility | Purchase of minibuses for the transportation of disabled people | | | | | | Accessible tourism for all |

## 4.2 Preconditions and integrations with other projects

As anticipated, the intervention analysed in this study is linked to the implementation of other interventions foreseen in other projects already financed and in progress.

The first project, the Vie del Sale, will provide for the physical redevelopment of the Stagno di Santa Caterina, through the arrangement of the tracks to make them passable by bicycles and the arrangement of equipment to support use (watchtowers, information centres, toilets, etc.).

The second project, the Regional Cycling Mobility Plan of Sardinia, will instead complete the cycle paths leading to the area from the three main access hubs.

### *4.2.1. Redevelopment of the naturalistic area of Santa Caterina*

The first is the project that will make Stagno di Santa Caterina a tourist and recreational attraction, which will determine the development of the visitor flow to the area and, therefore, represents the first precondition that justifies the intervention object of this study.

The project "Le Vie del sale" was born from the will of the administrators of six municipalities of the historical region of Sulcis (Sant'Antioco, San Giovanni Suergiu, Giba, Masainas, Sant'Anna Arresi and Teulada) to enhance a fundamental part of the naturalistic and environmental context of lower Sulcis: the wetlands. The Stagno of Santa Caterina is part of the wetlands and the salt pans, which are still in production, are adjacent to the pond.

In fact, the Le Vie del Sale project was created in agreement with the company ATI sale, which owns most of the areas involved in the project and intends to make the areas where salt extraction is practiced accessible. As part of the development of the naturalistic area, a cultural economy has been linked to the tradition of salt extraction.

Le Vie del Sale is a route of about 59 km that starts in the territory of Teulada, extends to Sant'Antioco and will allow those who cross it to experience slow tourism while discovering a unique landscape. It is, therefore, a real geographical route but also, and above all, a journey of discovery for places, avifauna and uncontaminated landscapes and cultural elements.

The "Development and Cohesion Fund 2014–2020" finances the project "Pact for the Region of Sardinia Development—Action line 2.6.1 Wetlands protection and enhancement".

In general, the project provides for the enhancement of specific ecological and environmental wetlands, including the Pond of Santa Caterina and lagoons of Sulcis, through the redevelopment of routes of tourist interest, including the provision of spaces and facilities for sustainable use of the sites.

In particular, the following interventions are planned:

- redevelopment of existing pedestrian–cycle paths;
- construction of watchtowers for the avifauna;
- construction of reception and information points;
- installation of toilets;

- construction of charging stations and/or charging columns for pedal bikes;
- construction of parking areas with fountain and integrated drinking water tank;
- installation of equipment to support the playful use of the site and creation of a workout path;
- appropriate signage and exhibition panels for tourist information and protected sites.

The project is scheduled to end in July 2021.

These interventions will make the area a place of recreational, tourist, educational, naturalistic and cultural enjoyment for residents and tourists.

### *4.2.2. Realisation of cycle–pedestrian tracks*

The second project, the Regional Cycling Mobility Plan (approved in December 2018), provides for the completion of cycle paths leading to the intervention area from the access hubs described in the following sections.

The regional plan recognises the importance of sustainable mobility as a development model for the island, promoting cycle paths "not only as places of sport impact but as real infrastructures of mobility with low environmental impact". In this perspective, the region has provided for the establishment of a regional network of paths and cycle paths, with the aim of making the island passable on foot and by bicycle, promoting new processes of territorial integration and the establishment of an eco-sustainable economic model.

The plan identifies and plans approximately 1,900 km of cycle routes, which form part of the regional level network, intended as short-, medium- and long-distance corridors. To complete the regional cycle system, the routes included in the extraordinary plan for Sulcis are identified (a total of approximately 110 km) and those integrating with the railway network (bike and train routes, approximately 550 km). In addition, a proposal has been formulated for a network at the European level (EuroVelo, approximately 1,090 km) and two networks at the national level (Bicitalia and SNCT, approximately 1,500 and 1,207 km, respectively), as well as an in-depth study on the theme of integration with the local level networks, distributed in the territories crossed by the network through the cycling parks (itineraries of the smaller islands, paths, thematic itineraries, etc.).

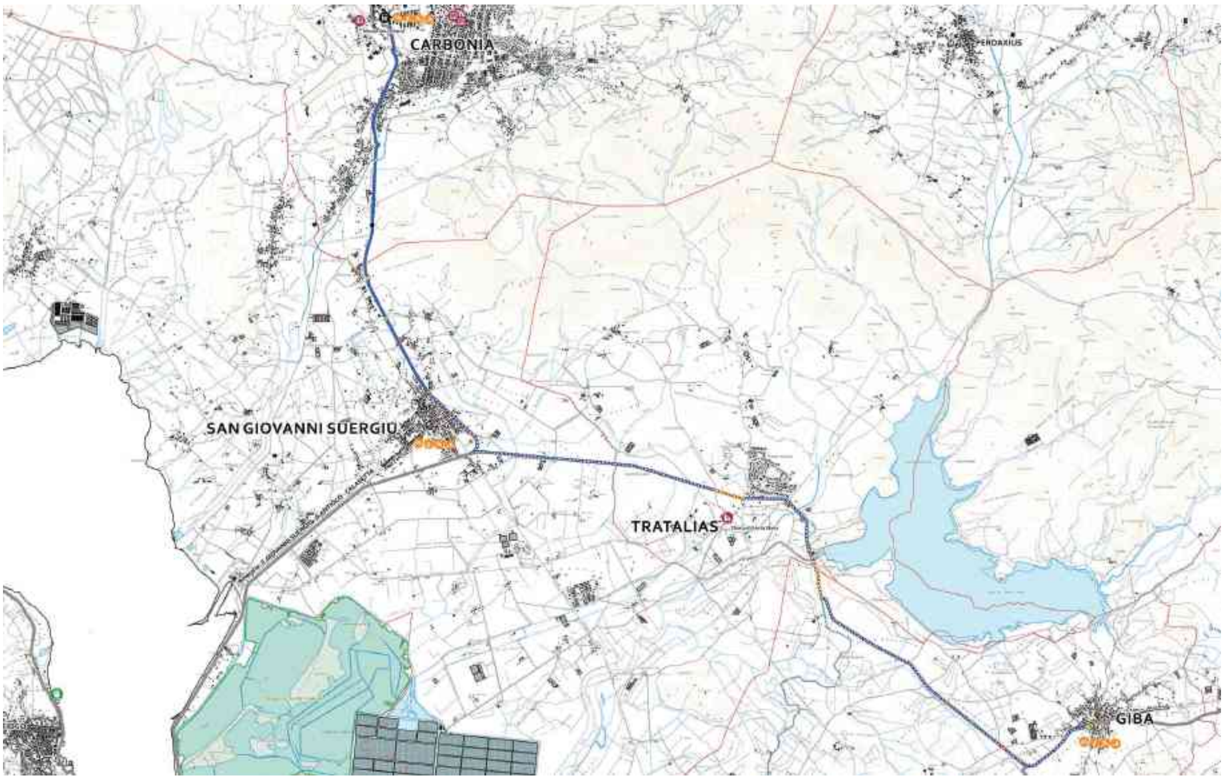
The itineraries of interest for this study are listed in this section.

**S1) Giba–San Giovanni Suergiu–Carbonia**

The 18.52 km route connects the urban centre of Giba with the city of Carbonia, crossing the urban centres of Tratalias and San Giovanni Suergiu. In Carbonia, the presence of the railway station allows for connection with the city of Cagliari and the main railway line of the island Porto Torres–Cagliari, configuring this centre as an intermodal node reachable using combined transport modes. This intervention will allow bicycle access to the area of interest by starting from Hub 3 (section 4.3.2).

To date, 8.56 km, or 46% of the total 18.52 km route, have already been built/designed.

**Figure 3 – View of the S1 - Giba–San Giovanni Suergiu–Carbonia route**




*Source: Sardinia's Regional Cycling Mobility Plan*

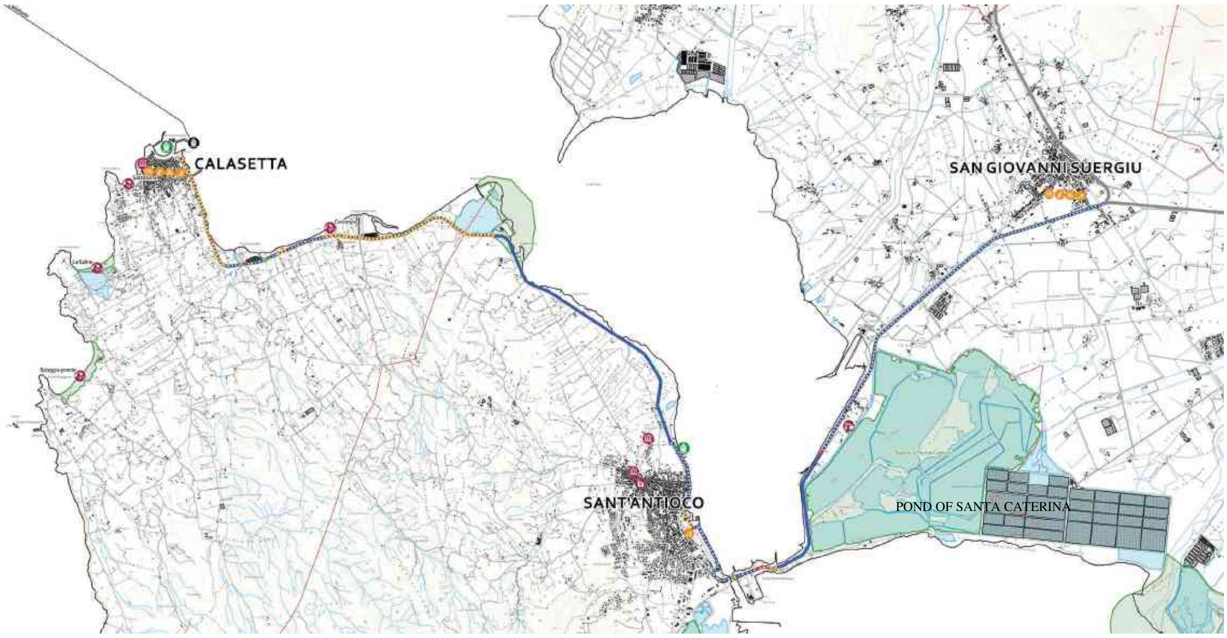
**S2) San Giovanni Suergiu–Sant'Antioco–Calasetta**

The itinerary, 21.26 km long, connects the urban centre of San Giovanni Suergiu with the Sulcitan island of Sant'Antioco, crosses the homonymous municipality, travels along the north-eastern coast of the island of Sant'Antioco and reaches the municipality of Calasetta. From the port of Calasetta, it is then possible to reach, through a maritime connection, the island of San Pietro and then the municipality of Carloforte.

The layout of this route allows bicycle access from Hubs 1.a and 1.b (Section 4.3.2).

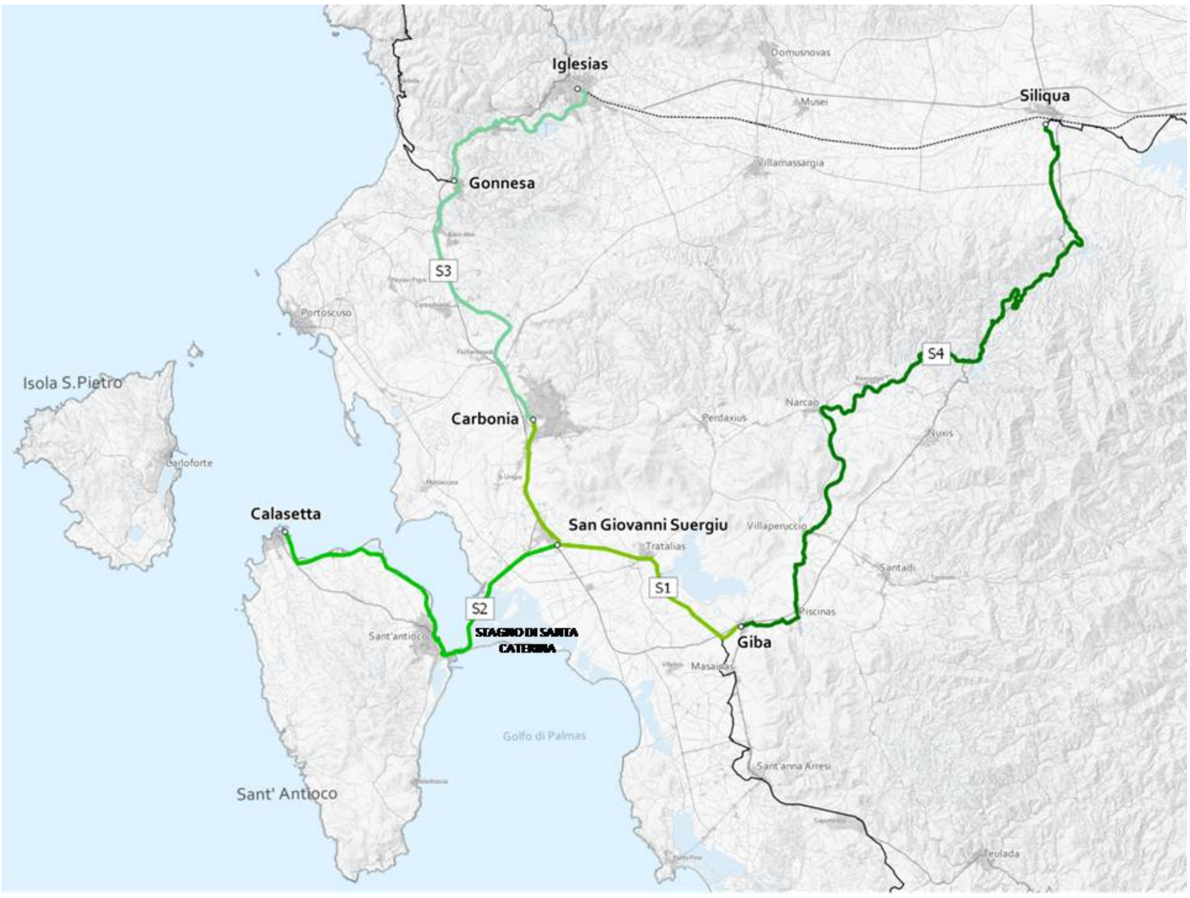
To date, 12.07 km, or 57% of the total 21.26 km route, have already been built/designed.

**Figure 4 – View of S2 - San Giovanni Suergiu–Sant'Antioco–Calasetta route**




*Source: Sardinia's Regional Cycling Mobility Plan*

**Figure 5 – General view of the cycle paths leading to the Stagno of Santa Caterina area**




*Source: Sardinia's Regional Cycling Mobility Plan*

The financing for the completion of the two routes derives from the so-called Extraordinary Plan for Sulcis.

The Sulcis plan is an instrument for the guidance, planning and coordination of interventions aimed at safeguarding the productive fabric, research and technological development, infrastructural interventions and environmental restorations, as well as training and financial commitments aimed at promoting the relaunch and development of the entire Sulcis Iglesiente area. This articulated strategy aims to tackle the economic and employment crisis that has long affected the Sulcis area. It involves initiatives already planned and in progress and initiatives and projects to be planned and integrated at different times. It brings together various regional programming tools within a unified and integrated vision and has a total budget of public resources from European, national, regional and provincial funds of around 800 million euros.

## 4.3 Methodology of analysis

As the area currently has not yet been redeveloped, the first step is to estimate the demand of those potentially interested in visiting what will become an attraction.

Once the potential demand has been determined, it is distributed based on the main access routes to the area (Access Hub) and the usual ways of getting to the area.

The third step is to assess the impacts, costs and benefits of what is called Scenario 0, which is characterised by not providing any solutions and, therefore, not supporting any investments. According to this scenario, people interested in the use of the area would reach the same according to their own travel habits.

The alternative scenarios presented in this study will then be compared with each other and with Scenario 0.

### *4.3.1. Demand estimation*

The reference application (Section 5) for attractiveness is tourists staying annually in the surrounding territory and the population living in the same territory.

In the analysis of the tourism component (Section 5.2  of the potential catchment area of the services offered, reference is made to the tourist arrivals recorded in the territory of the municipalities whose distance from the area of intervention (i.e., Stagno di Santa Caterina) is less than one hour by car.

In the analysis of potential users from the area's population, all municipalities within less than 1.5 hours by car from the naturalistic area have been included.

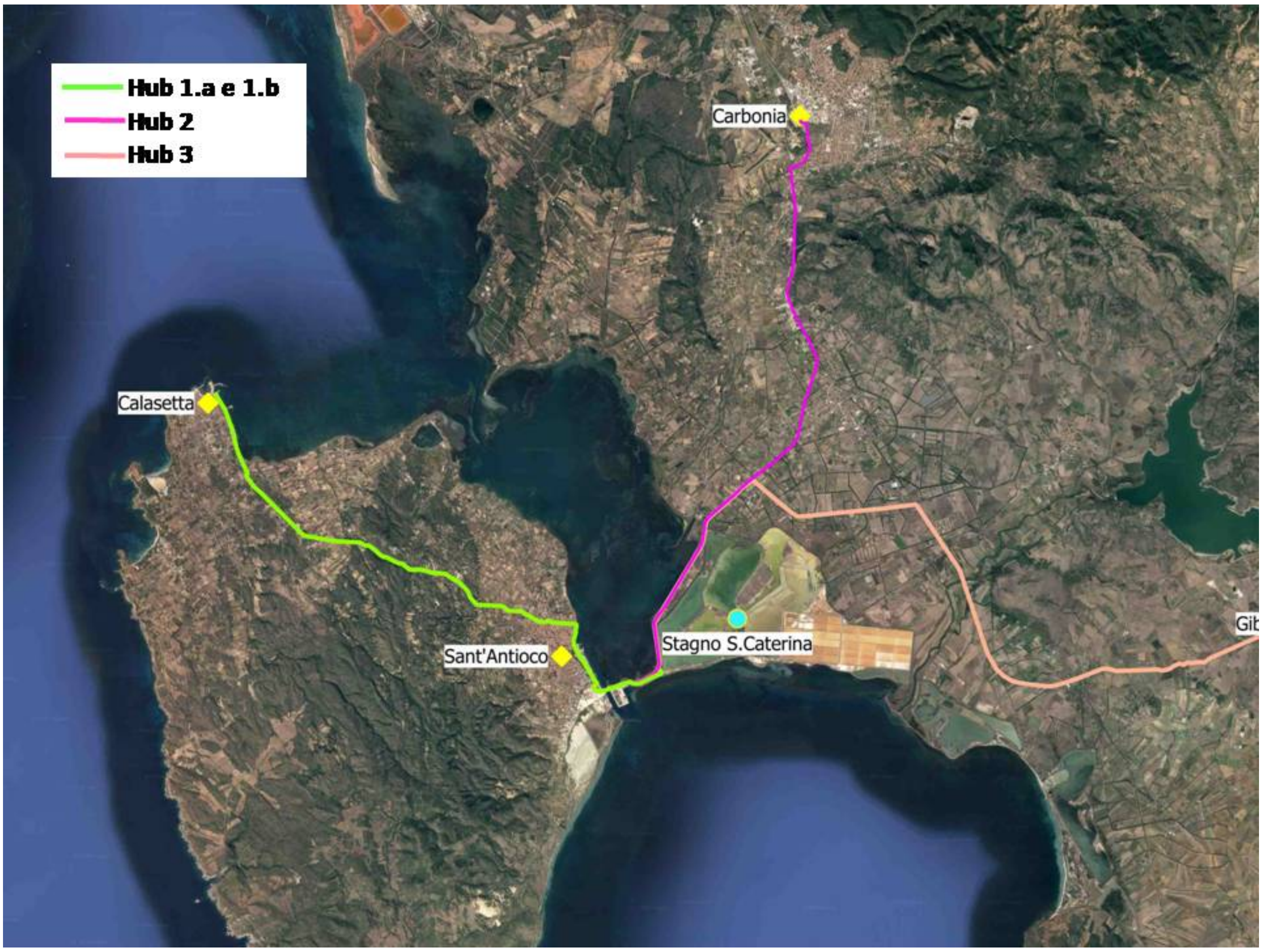
### *4.3.2. Gravitation area and access hub*

Given the geographical location of the area, there are three access gates (Section 6.1 coinciding with the main arteries connecting to and from the island of Sant'Antioco:

### Hub 1—Southwest–Calasetta (1.a)–Sant'Antioco (1.b)

The main road (SS) 126, in the direction of Cagliari, represents the first access to the west of the interest area. Through this entry, tourists and residents coming from the island of Sant'Antioco, mainly from the towns of Calasetta and Sant'Antioco, enter the area. As both municipalities are important tourist destinations, it is more appropriate to consider them separately and in light of the evaluations that will be made regarding the possible dislocations of the transport means proposed for purchase. Therefore, the distance from the municipality of Calasetta will be indicated as Hub 1.a, while the distance from Sant'Antioco will be indicated as 1.b. Hub 1.a will also include the flows coming from the island of San Pietro (municipality of Carloforte). To reach the island, in fact, it is possible to use the maritime connections from the municipalities of Calasetta and Portoscuso (Portovesme). Given the location of the interest area, it is assumed in this circumstance that the choice of landing is preferably the sea port of Calasetta.

**Figure 6 – Access hubs to the intervention area**




### Hub 2—North–Carbonia

The second access point, from the north, coincides with the SS 126 road in the direction of Sant'Antioco. In this case, the visitor flows come mainly from the municipalities located north and north-east of the area, therefore coming from the SS 126; the SS 130, which connects Cagliari to Iglesias; and the provincial road 2.

### Hub 3 – Southeast – Giba

The third door, from the south, coincides with the SS 195 that, from the south and southeast of Sardinia, leads to the area of interest. From this door, the flows of visitors coming from municipalities to the south of the area enter the area, therefore from the SS 195 and/or the SS 293.

As better described in Section 6.1 most flows come from hubs 1 and 2. Out of 100 potential visitors, approximately 89–92 come from the first two hubs. In light of this figure and considering the amount of funding, the analysis and therefore this feasibility study focuses on possible solutions to ensure sustainable connections in relation to these two routes.

More specifically, the possible connections from the towns of Sant'Antioco (Hub 1.b), the City of Calasetta (hub 1.a), which are on the same Island of Sant'Antioco, and the City of Carbonia (hub 2) will be considered.

As far as hub 2 is concerned, almost all visitor flows must necessarily travel along the SS 126, which crosses the territory of the Municipality of Carbonia, regardless of the means used: bus, private car or motorbike or bicycle. Therefore, with respect to these flows, possible connections from the Intermodal Centre of Carbonia will be considered (i.e., the interchange station between trains, buses and private vehicles to which this intervention would add electric vehicles such as cars, scooters and bicycles).

### The Intermodal Centre of Carbonia

The station of Carbonia Serbariu, also known as the Intermodal Centre of Carbonia, is an active train and bus station in the city of Carbonia, the terminus of the railway to Villamassargia. Designed and built between the second half of the 2000s and the beginning of the 2010s to facilitate the interchange between road and rail and to bring the railway terminal closer to the centre of the city of Carbonia, the station was inaugurated on 23 July 2011. The railway infrastructure manager of the plant is Rete Ferroviaria Italiana.

In the early 2000s, thanks to funding from the Autonomous Region of Sardinia with CIPE funds, the Municipality of Carbonia started the design of a new intermodal structure, where trains could be certified and the terminus of urban and suburban bus lines could be created, facilitating interchange between the two carriers.

The intermodal centre of Carbonia Serbariu is a two-storey building, one of which is at road level, which mainly includes the bus terminal and the facilities connected to it (10 bus stables, dedicated waiting room, toilets and two commercial premises). At the same height, the station car park extends over an area of one hectare and has a capacity of about 200 parking spaces, dimensioned to solve one of the critical points of the Carbonia Stato plant linked to the scarcity of parking spaces.

The station is structured to guarantee accessibility for people with motor or visual disabilities, and it is equipped with a video surveillance system for both the railway passenger area and the bus area.

### *4.3.1. Scenario analysis*

Once the reference demand and visitor flows have been identified based on the access door to the area, different connection models are evaluated and compared on the basis of specific intervention scenarios (Section 6).

Based on data provided by the ISTAT 2011 census, relating to the travel habits of residents between the territories located in the gravitation area of the Stagno di Santa Caterina, it is possible to estimate the annual visitor flow based on the medium they generally use and in relation to each hub identified.

Five scenarios will be analyzed and compared. For all scenarios, the movements from the place of stay/residence to the reference hub (1.a, 1.b and 2) will be considered unchanged, while the movement solutions from each hub to the area of interest will vary.

To identify the optimal solution, the scenarios will be assessed and compared based on certain parameters related to their economic and environmental sustainability:

- road congestion
- incidents
- polluting emissions
- noise pollution
- global warming
- $CO_2$ production
- operating costs
- management costs
- revenues

#### SCENARIO 0

As mentioned, Scenario 0 does not provide for any intervention. Therefore, people interested in visiting the area reach it in the typical way of their normal travel habits. Drawing this scenario is useful as a common basis of comparison, in particular with respect to the environmental impacts resulting from traffic flows, through traditional means, which would be generated by the creation of a new tourist attraction.

### Scenario 1

Scenario 1 provides for a complete replacement of the usual means of transport for visitors with means of low environmental impact, as proposed by the Municipality of Sant'Antioco. The location of these vehicles will be carried out respecting the weights of the visitor flows related to each hub; for example, if 71% of the visitors who habitually use cars to reach the area come from hub 2, then it is assumed to place in this hub 71% of the electric car fleet). This scenario is useful to understand how environmental impacts would vary if the entire demand were to use only electric vehicles. Given that the proposed purchase of the vehicles does not include public transport, in this scenario the trips made by local public transport in normal operation will be considered the same as in scenario 0.

### Scenarios 2, 3 and 4

The other scenarios involve hybrid solutions between the first two. They are hybrids with respect to the quantity and type, and therefore the configuration of the fleet of electric vehicles.

# 5. Estimation of potential demand

## 5.1 Methodology

The potential demand for the services covered by this study consists of two components: the residential demand, relative to the population living in the gravitation area considered, and the fluctuating demand linked to the tourist flows that visit the area annually.

In both cases, the methodology for estimating the number of potential users follows a common line.

### Gravitation area

The first step is to determine the reference universe (i.e., all the individuals who reasonably, in terms of the time taken to reach the area, want to access the area and then use the relevant mobility services). Then, in the case of tourists, an interest on the part of those staying in places whose distance from the area does not exceed one hour by car is assumed. In the case of residents, a slightly greater distance is considered and therefore within an hour and a half by car.

### Participation rate

Since not all individuals, whether tourists or residents, are necessarily interested in the type of attractor under consideration and the services offered there, the second step is to estimate how many individuals making up the reference universe might be interested in using the area. The following paragraphs set out in detail the assumptions underlying this estimate. For example, a tourist who chooses the area for a seaside holiday will certainly be less interested than a tourist who has chosen a naturalistic or cultural holiday.

### Usage rate

The third step is to estimate how many potentially interested people will actually use the services offered. We will then estimate the so-called usage rate. For example, 10 tourists who have chosen the destination because of their interest in discovering the area and its natural resources can all be considered potentially interested, but not necessarily all 10 will want to visit the Stagno of Santa Caterina or actually use the mobility services offered.

## 5.2 The tourist demand

In the analysis of the tourist component of the overall potential catchment area of the services offered, reference is made to the tourist arrivals recorded in the territory of the municipalities whose distance from the area of intervention (i.e., Stagno di Santa Caterina) is equal to or less than one hour of travel by car. The offer, in fact, consists of a proposal to visit the naturalistic area in half a day or at most one day through the services provided. Therefore, it is not possible to consider a time needed to reach the area and return to your place of stay excessively unbalanced compared to the time needed to visit the area (presumably three to four hours).

Table 2 shows the official tourist flows data collected by Sired of the Autonomous Region of Sardinia for the year 2019[1].

**Table 2 – Official tourist arrivals in municipalities less than an hour's drive from the Stagno of Santa Caterina – 2019**

| Municipality | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BUGGERRU | 5 | 0 | 26 | 445 | 511 | 1,025 | 1,383 | 1,647 | 1,295 | 404 | 57 | 19 | 6,817 |
| CALASETTA | 28 | 23 | 31 | 571 | 1,129 | 1,737 | 2,041 | 2,329 | 1,617 | 546 | 74 | 39 | 10,165 |
| CARBONIA | 689 | 550 | 833 | 946 | 1,237 | 1,238 | 1,427 | 1,578 | 1,255 | 1,003 | 769 | 641 | 12,166 |
| CARLOFORTE | 20 | 42 | 98 | 1,321 | 1,551 | 2,398 | 3,072 | 3,614 | 1,954 | 810 | 97 | 81 | 15,058 |
| DOMUSNOVAS | 0 | 0 | 3 | 15 | 10 | 7 | 12 | 53 | 5 | 3 | 4 | 0 | 112 |
| GIBA | 0 | 0 | 0 | 2 | 3 | 21 | 48 | 78 | 36 | 31 | 0 | 0 | 219 |
| GONNESA | 39 | 49 | 45 | 119 | 195 | 281 | 258 | 391 | 150 | 52 | 0 | 1 | 1,581 |
| IGLESIAS | 391 | 311 | 492 | 1,041 | 1,252 | 1,572 | 1,582 | 2,340 | 1,586 | 1,068 | 445 | 812 | 12,892 |
| MASAINAS | 0 | 0 | 0 | 2 | 18 | 58 | 58 | 82 | 50 | 2 | 0 | 0 | 272 |
| NARCAO | 2 | 2 | 3 | 72 | 70 | 113 | 107 | 124 | 114 | 12 | 3 | 3 | 626 |
| PISCINAS | 2 | 1 | 2 | 9 | 14 | 25 | 29 | 36 | 25 | 9 | 2 | 2 | 158 |
| PORTOSCUSO | 63 | 52 | 95 | 404 | 948 | 1,303 | 939 | 1,667 | 1,373 | 427 | 135 | 53 | 7,459 |
| SAN GIOVANNI SUERGIU | 0 | 28 | 38 | 62 | 45 | 156 | 187 | 328 | 147 | 98 | 21 | 22 | 1,131 |
| SANTADI | 1 | 1 | 1 | 4 | 18 | 23 | 97 | 207 | 114 | 4 | 1 | 1 | 472 |
| SANT'ANNA ARRESI | 0 | 0 | 46 | 92 | 244 | 2,354 | 2,750 | 3,373 | 2,283 | 548 | 13 | 11 | 11,714 |
| SANT'ANTIOCO | 44 | 89 | 144 | 1,771 | 3,297 | 4,554 | 5,158 | 6,647 | 4,714 | 1,246 | 177 | 253 | 28,094 |
| SILIQUA | 1 | 1 | 1 | 6 | 9 | 15 | 17 | 22 | 15 | 5 | 1 | 1 | 95 |
| TEULADA | 10 | 30 | 51 | 475 | 919 | 3,099 | 3,818 | 4,174 | 2,931 | 889 | 26 | 21 | 16,443 |
| TRATALIAS | 1 | 1 | 1 | 4 | 6 | 94 | 176 | 294 | 143 | 4 | 1 | 1 | 725 |
| VILLAMASSARGIA | 0 | 0 | 1 | 2 | 28 | 26 | 93 | 106 | 29 | 31 | 1 | 1 | 318 |
| VILLAPERUCCIO | 0 | 0 | 0 | 1 | 2 | 4 | 4 | 5 | 4 | 1 | 0 | 0 | 23 |
| **Grand total** | **1,297** | **1,181** | **1,912** | **7,364** | **11,506** | **20,103** | **23,257** | **29,096** | **19,838** | **7,193** | **1,828** | **1,963** | **126,540** |

*Source: RAS – Sired*

Among the municipalities considered in the analysis is Carloforte, although the distance is slightly longer than the hour of travel, in light of its importance in the Sulcis archipelago in terms of visibility and attractiveness of tourist flows.

Official arrivals refer to tourists who have stayed at least one night in a classified accommodation facility, be it a hotel or extra-hotel. However, it is known that the statistics on official tourist flows, including the one used in this context (Sired Sardegna), do not capture a

[1]The data taken from the source, RAS – Sired,include the category "others", in which, for some municipalities, the data on arrivals that could not be associated to any month are attributed. In this analysis, to reconstruct the complete time series, these residual data have been distributed over the various months according to the weight of the flows recorded in all of the municipalities considered for each month.

relevant phenomenon, particularly for tourist destinations such as Sardinia, concerning the submerged flows related to the tourist flows in second homes owned, to the tourist flows in the homes of relatives and friends, for which there is no obligation to report to the statistical offices, to that part of the flows not reported by the classified accomodations (official statistical submerged) and to flows in abusive accommodation facilities (Renoldi, 2012).

To take into account the analysis of the potential catchment area related to the tourism component, estimates can be made based on data collected from two sample surveys. The first refers to Italian tourists and is issued annually by Istat ("Travel and Holidays of Italians"), the second is produced, again annually, by the Bank of Italy ("International Tourism of Italy") and refers to foreign tourists. In both cases, the tourists interviewed are asked to indicate the main accommodation chosen for their holiday, regardless of whether it is classified or not.

Here, regardless of the absolute value detected by the two surveys on arrivals, the value of the multiplier given by the ratio between total arrivals (i.e., in classified and non-classified facilities) and arrivals in classified facilities was calculated. Applying this multiplier to the official arrivals recorded by Sired Sardegna, an estimate of the total arrivals is then obtained.

Before proceeding with the calculation, some clarifications are necessary:

- At the time of writing this study, the most recently published Istat "Travel and Holidays" survey reports data were for 2018. Therefore, for consistency in data comparison, the data for 2018 are also taken as reference in the case of the survey provided by the Bank of Italy.
- The Bank of Italy survey provides data on arrivals by type of accommodation disaggregated by region of destination, while the ISTAT survey provides these data only at the national level. Therefore, in the first case, concerning the foreign component, it is possible to calculate the value of the multiplier at the regional level, while in the second case, concerning the Italian component, the multiplier is calculated on a national basis. In all probability, the estimate of the value of the multiplier relative to Italian arrivals is therefore underestimated, since, as is well known, the propensity to use second homes (personally owned and owned by friends and relatives) is generally higher for tourists staying in destinations in southern Italy.
- With respect to the survey conducted by the Bank of Italy, the following types of accommodation were included in the macro category of "classified" accommodation: farm holidays, hotel-tourist villages, other communities, bed & breakfasts, houses for rent, communities run by religious organisations, motorhomes, camper vans, youth hostels and tented-caravan. The following typologies were included in the "not classified" category: other, one's own house, ship (on cruise) and guest of relatives/friends.
- With respect to the survey conducted by ISTAT, the following types of accommodation were included in the macro-category of "classified" accommodation: hotel, specialised collective structure, other type of collective structure, private accommodation and residential/rental accommodation. The following types of accommodation were included

in the “not classified” category,: owner-occupied dwelling or timeshare, relative or friend’s dwelling and other private accommodation.

Table 3 shows the proportions between arrivals in classified and unclassified accommodation. In the case of Italians, it emerges that out of 100 tourists, 57 stay in classified accommodations and 43 in unclassified accommodations. By comparing the total to the number of tourists who have chosen the classified accommodations, we obtain the multiplier useful to calculate the total arrivals, which is equal to 1.7. This means that for 100 tourists staying in a classified facility, another 70 stay in unclassified facilities. Applying the same procedure to the foreign component gives a multiplier of 1.2.

**Table 3 – Multipliers for the estimate of total tourist arrivals (in classified and unclassified facilities)**

| | Italians | |
|---|---|---|
| A | Classified accommodation | 57.3 |
| B | Unclassified accommodation | 42.7 |
| C=A+B | Total | 100.0 |
| D=C/A | Multiplier | 1.7 |
| | Foreigners | |
| E | Classified accommodation | 80.2 |
| F | Unclassified accommodation | 19.8 |
| G=E+F | Total | 100.0 |
| H=G/E | Multiplier | 1.2 |

*Source: Adapted from Istat (2018b) and Bank of Italy (2018) data*

Once the multipliers are obtained, the official arrivals of Italians and foreigners, the sum of which is shown in Table 2, the overall arrivals are obtained, representing the potential pool of users who could use the services that are the object of investment.

Table 4 shows the results of this calculation. Compared to 127,000 official arrivals, it is estimated that in the territory considered the total number of arrivals is about 198,000.

**Table 4 – Total tourist arrivals (official and unofficial) in municipalities with a distance of less than one hour by car from the Stagno of Santa Caterina – 2019**

| Municipality | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BUGGERRU | 8 | 0 | 45 | 705 | 738 | 1,585 | 2,186 | 2,714 | 1,938 | 561 | 90 | 33 | 10,603 |
| CALASETTA | 46 | 39 | 53 | 921 | 1,742 | 2,726 | 3,228 | 3,814 | 2,442 | 789 | 128 | 64 | 15,991 |
| CARBONIA | 1,155 | 935 | 1,413 | 1,454 | 1,944 | 1,896 | 2,072 | 2,367 | 1,859 | 1,521 | 1,292 | 1,084 | 18,991 |
| CARLOFORTE | 35 | 72 | 164 | 2,200 | 2,535 | 3,934 | 5,042 | 6,044 | 3,190 | 1,309 | 167 | 137 | 24,827 |
| DOMUSNOVAS | 0 | 0 | 4 | 24 | 13 | 9 | 17 | 79 | 8 | 5 | 7 | 0 | 166 |
| GIBA | 0 | 0 | 1 | 2 | 4 | 27 | 70 | 121 | 49 | 43 | 1 | 1 | 318 |
| GONNESA | 68 | 85 | 71 | 183 | 304 | 435 | 404 | 639 | 236 | 86 | 1 | 1 | 2,511 |
| IGLESIAS | 665 | 531 | 838 | 1,651 | 1,912 | 2,475 | 2,373 | 3,601 | 2,394 | 1,632 | 746 | 1,368 | 20,187 |
| MASAINAS | 0 | 0 | 1 | 2 | 23 | 89 | 89 | 136 | 78 | 2 | 1 | 1 | 423 |
| NARCAO | 4 | 3 | 6 | 126 | 122 | 198 | 183 | 215 | 195 | 21 | 5 | 6 | 1,082 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PISCINAS | 3 | 2 | 4 | 15 | 23 | 40 | 47 | 58 | 40 | 14 | 4 | 4 | 254 |
| PORTOSCUSO | 99 | 84 | 150 | 642 | 1,383 | 1,975 | 1,391 | 2,605 | 2,056 | 633 | 213 | 86 | 11,319 |
| SAN GIOVANNI SUERGIU | 1 | 46 | 65 | 95 | 74 | 253 | 284 | 527 | 238 | 144 | 33 | 38 | 1,797 |
| SANTADI | 1 | 1 | 2 | 7 | 26 | 36 | 142 | 309 | 160 | 6 | 2 | 2 | 693 |
| SANT'ANNA ARRESI | 0 | 0 | 80 | 145 | 352 | 3,922 | 4,581 | 5,646 | 3,631 | 867 | 18 | 16 | 19,258 |
| SANT'ANTIOCO | 75 | 145 | 235 | 2,671 | 4,792 | 6,816 | 7,859 | 10,497 | 6,885 | 1,768 | 282 | 411 | 42,435 |
| SILIQUA | 2 | 1 | 2 | 9 | 13 | 24 | 27 | 34 | 23 | 8 | 2 | 2 | 148 |
| TEULADA | 15 | 45 | 83 | 695 | 1,255 | 4,796 | 6,033 | 6,728 | 4,411 | 1,199 | 43 | 32 | 25,337 |
| TRATALIAS | 1 | 1 | 2 | 6 | 9 | 146 | 276 | 480 | 208 | 6 | 1 | 2 | 1,137 |
| VILLAMASSARGIA | 1 | 1 | 1 | 4 | 46 | 39 | 139 | 170 | 41 | 49 | 1 | 1 | 492 |
| VILLAPERUCCIO | 0 | 0 | 1 | 2 | 3 | 6 | 7 | 8 | 6 | 2 | 1 | 1 | 37 |
| **Grand total** | **2,179** | **1,992** | **3,218** | **11,556** | **17,315** | **31,426** | **36,449** | **46,793** | **30,087** | **10,666** | **3,035** | **3,289** | **198,005** |

*Source: Adapted from RAS – Sired (2019), Istat (2018b) and Bank of Italy (2018) data.*

### DISTANCE-WEIGHTING FACTOR

The probability that a tourist may be interested in using the services offered in the area of intervention decreases as the distance, calculated in terms of minutes of travel by car, from their place of stay or residence increases. In other words, the attractiveness of the proposal is certainly less for an individual who takes one hour by car to reach the area and more for an individual who takes 15 minutes.

To take this into account, the potential tourist catchment area identified is recalculated based on a weighting factor attributed to each municipality on the basis of distance, as shown in Table 5. It is assumed that users staying in municipalities within 30 minutes may be affected in their entirety and therefore a weighting factor equal to the unit is considered. Municipalities between 31 minutes and 45 minutes are given a factor of 0.8, while those further than 45 minutes away are given a factor of 0.6.

The basin of potential tourist users is shown in Table 5. The difference is not excessively large, given that 15 of the 21 municipalities considered are less than half an hour's drive from the Santa Caterina Pond. From 198,000, potential users are now about 175,000, of whom 71% are Italian and 29% foreign.

**Table 5 – Total tourist arrivals, weighted by distance, in municipalities with a distance of less than one hour by car from the Stagno of Santa Caterina - 2019**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Grand total** | 2,026 | 1,848 | 2,949 | 9,919 | 15,367 | 27,758 | 31,867 | 41,201 | 26,669 | 9,349 | 2,773 | 2,940 | **174,665** |
| | | | | | | **Of whom:** | | | | | | | |
| **Italians** | 1,827 | 1,687 | 2,676 | 7,018 | 9,104 | 19,537 | 22,607 | 32,235 | 16,433 | 5,177 | 2,414 | 2,631 | **123,346** |
| **Foreigners** | **198** | **161** | **272** | **2,901** | **6,264** | **8,221** | **9,260** | **8,966** | **10,236** | **4,172** | **358** | **309** | **51,319** |

*Source: Adapted from RAS – Sired (2019), Istat (2018 b), Bank of Italy (2018) and Google Maps data*

### PARTICIPATION RATE

The next step is to determine the rate of participation (i.e., to estimate how many of the total number of tourists might actually be interested in the visit and thus in purchasing the services to be invested). To do this, it is necessary to distinguish the total number of tourists according to the type of holiday they spend in the area and therefore the type of tourist product purchased, since the interest in certain attractions and certain services varies according to the different holiday interests of each tourist. For example, services are more likely to be of interest to a tourist travelling for cultural interests than to a tourist choosing a destination to spend a classic seaside holiday.

To make a distinction between tourists according to the tourist product purchased, the results of the Crenos (2015) sample survey are used. Table 6 shows the relative distribution of tourists who have stayed in Sardinia based on the (main) tourist product purchased.

**Table 6 – Relative distribution of arrivals in Sardinia according to the type of tourist product chosen**

| Tourist product | Italians | Foreigners | Total |
|---|---|---|---|
| Beach tourism | 80.6% | 69.9% | 76.4% |
| Naturalistic tourism | 7.1% | 13.1% | 9.5% |
| Active/sports tourism | 4.2% | 5.2% | 4.6% |
| Other | 2.9% | 2.8% | 2.9% |
| Cultural/archaeological tourism | 1.5% | 2.4% | 1.8% |
| Food and wine tourism | 0.9% | 2.4% | 1.5% |
| Events | 1.6% | 1.2% | 1.4% |
| Short break | 0.6% | 1.7% | 1.0% |
| Rural tourism | 0.3% | 1.2% | 0.7% |
| Religious tourism | 0.2% | 0.0% | 0.1% |
| Total | 100% | 100% | 100% |

*Source: Crenos (2015)*

Given the nature of the services and the place where they are provided, a naturalistic-cultural area, the most similar and potentially interested types of tourism are naturalistic, active/sports, cultural/archaeological, rural and enogastronomic tourism. The other typologies are collected in a last category called "other".

Table 7 shows a breakdown of the tourists who have stayed in the gravitation area in question.

For each type of tourist, it is a question of assuming a participation rate and therefore determining how many tourists could actually use the services during their holiday. Although reasoned, in this case it is still a hypothesis, since there are no estimates so detailed as to return such information.

The following considerations must be borne in mind. Regardless of the type of holiday, foreign tourists, unlike Italian tourists, show a greater interest in discovering local cultures and traditions and this generally translates into a greater propensity for excursions and visits to cultural and naturalistic attractions. For this reason, for each type of holiday, a relatively higher participation rate is assumed for the foreign component than for the Italian one.

### Table 7 – Arrivals in the municipalities concerned according to the type of tourist product chosen

| Tourist product | Italians | Foreigners | Total |
|---|---|---|---|
| Naturalistic tourism | 8,800 | 6,748 | 16,618 |
| Active/sports tourism | 5,169 | 2,664 | 8,010 |
| Cultural/archaeological tourism | 1,816 | 1,243 | 3,228 |
| Rural tourism | 419 | 622 | 1,196 |
| Food and wine tourism | 1,118 | 1,243 | 2,630 |
| Other | 106,025 | 38,800 | 142,984 |
| **Total** | **123,346** | **51,319** | **174,665** |

*Source: Adapted from Crenos data (2015)*

The guide is represented by tourists who buy a naturalistic holiday. Regardless of whether they actually visit the area they are visiting, it is certain that the area can be an attraction of interest to them. In this case, therefore, it can be said that 100% of naturalistic tourists are potentially interested.

### Table 8 – Rate of participation

| Tourist product | Italians | Foreigners |
|---|---|---|
| Naturalistic tourism | 100% | 100% |
| Active/sports tourism | 60% | 70% |
| Cultural/archaeological tourism | 70% | 80% |
| Rural tourism | 40% | 50% |
| Food and wine tourism | 10% | 20% |
| Other | 6% | 12% |

*Source: Our estimates*

The second type of tourism of potential interest is undoubtedly cultural, since cultural interests linked to the production of salt flank the naturalistic aspects. In this case, a participation rate of 70% for Italian tourists and 80% for foreign tourists is assumed. In other words, it is reasonable to imagine that out of 100 tourists who travel for cultural reasons, 70–80 may be interested in visiting a naturalistic-cultural area and the remaining part is exclusively interested in other types of attractors (museums, exhibitions, shows, etc.).

Moreover, for active/sports and rural tourism, the area can represent an attraction of interest, even if relatively less than the two previous types.

Those who travel for food and wine interests might be interested, but in this case, the audience would be very small. The attraction in question could in fact represent the occasion for an excursion, but is marginal with respect to one’s interests that are more linked to culinary traditions. The audience is even smaller in the case of seaside tourism, included in the “other” category, which represents the main segment of all arrivals in the area and, in general, for the whole of Sardinia. It is well known that the seaside tourist has a low propensity to make excursions beyond the coast.

Applying the participation rate to the different segments, we arrive at an estimate of potential user-tourists of almost 35,000 individuals.

### Table 9 – Tourist potential users

| Tourist product | Italians | Foreigners | Total |
|---|---|---|---|
| Naturalistic tourism | 8,800 | 6,748 | 15,548 |
| Active/sports tourism | 3,101 | 1,865 | 4,966 |
| Cultural/archaeological tourism | 1,271 | 994 | 2,266 |
| Rural tourism | 168 | 311 | 478 |
| Food and wine tourism | 112 | 249 | 360 |
| Other | 6,361 | 4,656 | 11,017 |
| **Total** | **19,814** | **14,822** | **34,636** |

*Source: Our estimates*

### USAGE RATE

The last step is to try to estimate how many tourists from this audience will actually buy the services offered. In this case, we are talking about a wise use, for which we are thinking in hypothetical terms. To compensate for the possible margin of error, two estimates are proposed below: a prudent one and a more optimistic one.

Always starting from the naturalistic segment (i.e., the one potentially more interested in a naturalistic attraction and more sensitive to environmental issues, and therefore in the use of low-impact services), the reasoning is as follow: If out of 100 naturalistic tourists we imagine that all 100 were interested in the visit (participation rate), how many could actually use the services?

### Table 10 – Conservative estimate of the actual number of user-tourists

| | Italians | | Foreigners | | Total |
|---|---|---|---|---|---|
| Tourist product | Usage rate | No. of users | Usage rate | No. of users | No. of users |
| Naturalistic tourism | 15.0% | 1,320 | 15.0% | 1,012 | 2,332 |
| Active/sports tourism | 7.0% | 217 | 7.0% | 131 | 348 |
| Cultural/archaeological tourism | 10.0% | 127 | 10.0% | 99 | 227 |
| Rural tourism | 5.0% | 8 | 5.0% | 16 | 24 |
| Food and wine tourism | 2.0% | 2 | 2.0% | 5 | 7 |
| Other | 1.0% | 64 | 2.0% | 93 | 157 |
| **Total** | | **1,738** | | **1,356** | **3,094** |

*Source: Our estimates*

Consider that the area offers many naturalistic attractions and that, during a holiday, the number of visits and excursions in these areas is five on average. If a tourist has to choose between three naturalistic attractions, the probability that one of these is carried out in the area of interest would be around 33%. If a tourist has to choose between six attractions, the probability of one of them being carried out in the area of interest would be around 15%. Based on these hypotheses, a utilisation rate of between 15% (conservative estimate) and 30% (optimistic estimate) is identified.In the case of active/sports tourists, the range of excursion possibilities is wider and more varied, therefore a lower utilisation rate between 7% and 14% is assumed.

The cultural tourist will be able to decide between a number of attractors and therefore excursion proposals, which are less numerous than those of interest to the active/sporting tourist but more than that available to the naturalist tourist. Therefore, the value of the use rate is estimated to be between that of the two previous types of tourists (10–20%).

**Table 11 – Optimistic estimate of the actual number of user-tourists**

| | Italians | | Foreigners | | Total |
|---|---|---|---|---|---|
| Tourist product | Usage rate | No. of users | Usage rate | No. of users | No. of users |
| Naturalistic tourism | 30.0% | 2,640 | 30.0% | 2,024 | 4,664 |
| Active/sports tourism | 14.0% | 434 | 14.0% | 261 | 695 |
| Cultural/archaeological tourism | 20.0% | 254 | 20.0% | 199 | 453 |
| Rural tourism | 10.0% | 17 | 10.0% | 31 | 48 |
| Food and wine tourism | 5.0% | 6 | 5.0% | 12 | 18 |
| Other | 2.0% | 127 | 3.0% | 140 | 267 |
| **Total** | | **3,478** | | **2,667** | **6,146** |

*Source: Our estimates*

Finally, for the remaining types of tourism, it is assumed that they will be used between a minimum of 1% and a maximum of 10%.

As Tables 10 and 11 show, the estimate of the number of actual users of the services to be invested in the tourism component ranges from a minimum of about 3,000 users per year to a maximum of about 6,000 users per year. The number of actual users of the services offered will obviously also depend on the goodness, quantity and effectiveness of the promotional actions that will be implemented and, therefore, on the ability to communicate the possibilities offered, to arouse interest and make the area as a whole attractive.

## 5.3 Residential demand

In the analysis of potential users from the population living in the area, all municipalities whose distance from the naturalistic area does not exceed 1.5 hours by car have been included. The decision to extend the distance is motivated by the fact that a resident has a greater availability of days and time to decide to visit the area, compared to a tourist whose days of stay are clearly more limited.

The population is therefore considered to be resident in 51 municipalities, which also include the 17 municipalities belonging to the Metropolitan City of Cagliari in which just over a quarter of the entire population of Sardinia resides. The population under 6 years of age is excluded from the total count[2]. Therefore, the overall population in the gravitation area in 2019 was about 596,000 individuals.

In this case, too, each municipality is assigned a weighting factor linked to the distance measured in terms of time to reach the area by car: 1 for municipalities within half an hour, 0.8 for those between half an hour and an hour, and 0.6 for municipalities beyond an hour by car. Similar to the analysis conducted on the tourism component, it is believed that the probability a resident will visit the area is inversely proportional to the necessary distance. The application of the weighting factor returns a total audience of about 400,000 residents.

**Table 12 – Resident population and weighted population (6 years or older) in municipalities with a distance of less than 1.5 hours by car from Stagno di Santa Caterina – 2019**

| Municipality | Population | Weighting factor | Weighted population |
|---|---|---|---|
| Assemini | 25,493 | 0.6 | 15,296 |
| Buggerru | 1,007 | 0.6 | 604 |
| Cagliari | 149,110 | 0.6 | 89,466 |
| Calasetta | 2,756 | 1 | 2,756 |
| Capoterra | 22,495 | 0.6 | 13,497 |
| Carbonia | 27,143 | 1 | 27,143 |
| Carloforte | 5,948 | 0.6 | 3,569 |
| Decimomannu | 7,886 | 0.6 | 4,732 |
| Decimoputzu | 4,127 | 0.8 | 3,302 |
| Domus de Maria | 1,612 | 0.6 | 967 |
| Domusnovas | 5,885 | 0.8 | 4,708 |
| Elmas | 9,139 | 0.6 | 5,483 |
| Fluminimaggiore | 2,861 | 0.6 | 1,717 |
| Giba | 1,957 | 1 | 1,957 |
| Gonnesa | 4,772 | 1 | 4,772 |
| Gonnosfanadiga | 6,226 | 0.6 | 3,736 |
| Iglesias | 25,655 | 0.8 | 20,524 |
| Maracalagonis | 7,614 | 0.6 | 4,568 |
| Masainas | 1,242 | 1 | 1,242 |
| Monastir | 4,414 | 0.6 | 2,648 |
| Monserrato | 19,041 | 0.6 | 11,425 |
| Musei | 1,469 | 0.8 | 1,175 |
| Narcao | 3,077 | 1 | 3,077 |
| Nuxis | 1,502 | 1 | 1,502 |
| Perdaxius | 1,352 | 1 | 1,352 |
| Piscinas | 809 | 1 | 809 |
| Portoscuso | 4,884 | 1 | 4,884 |
| Pula | 7,019 | 0.6 | 4,211 |
| Quartu Sant'Elena | 67,770 | 0.6 | 40,662 |
| Quartucciu | 12,575 | 0.6 | 7,545 |
| San Giovanni Suergiu | 5,770 | 1 | 5,770 |
| San Sperate | 7,919 | 0.8 | 6,335 |
| Santadi | 3,226 | 1 | 3,226 |
| Sant'Anna Arresi | 2,631 | 1 | 2,631 |
| Sant'Antioco | 10,711 | 1 | 10,711 |
| Sarroch | 5,057 | 0.6 | 3,034 |
| Selargius | 27,404 | 0.6 | 16,442 |
| Serramanna | 8,686 | 0.6 | 5,212 |
| Sestu | 19,890 | 0.6 | 11,934 |

[2] Pre-school children are unlikely to be accompanied (e.g., on school trips) to such sites. They are more likely to visit the area with their families, but in any case, they would not pay for services.

| | | | |
|---|---|---|---|
| Settimo San Pietro | 6,446 | 0.6 | 3,868 |
| Siliqua | 3,650 | 0.8 | 2,920 |
| Sinnai | 16,770 | 0.6 | 10,062 |
| Teulada | 3,401 | 0.8 | 2,721 |
| Tratalias | 1,029 | 1 | 1,029 |
| Uta | 8,194 | 0.6 | 4,916 |
| Vallermosa | 1,849 | 0.8 | 1,479 |
| Villa San Pietro | 2,046 | 0.6 | 1,228 |
| Villacidro | 13,291 | 0.8 | 10,633 |
| Villamassargia | 3,409 | 1 | 3,409 |
| Villaperuccio | 1,046 | 1 | 1,046 |
| Villasor | 6,628 | 0.8 | 5,302 |
| Total | 595,893 | | 403,237 |

*Source: Adapted from Istat (2019 a)*

### PARTICIPATION RATE

The next step is to estimate how many of these residents may actually be interested in visiting the area, using the participation rate.

In the case of the resident population, the data collected by Istat through the Aspects of Daily Life (Istat, 2018c) survey on the participation of the resident population in shows is used. Since interest varies according to a person's age, data broken down by age group are considered. This disaggregation is not provided on a regional basis, so data at the Italian level are considered, assuming that the propensity to participate in performances of residents in Sardinia is equal to the national average.

Table 13 shows the participation rate according to the age group and the value of the population potentially interested in visiting the area, for each municipality. Altogether, it is estimated to be about 96,000 people.

**Table 13 – Participation rate by age group of residents and population potentially concerned**

| Age | 6–10 | 11–14 | 15–17 | 18–19 | 20–24 | 25–34 | 35–44 | 45–54 | 55–59 | 60–64 | 65–74 | 75 and more | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Participation rate | 33.2% | 41.3% | 36.3% | 36.1% | 32.7% | 31.2% | 28.7% | 31.1% | 27.9% | 28.6% | 21.8% | 8.1% | |
| **Total potential participants** | **4,817** | **4,838** | **3,282** | **2,274** | **5,226** | **12,183** | **15,119** | **19,179** | **8,146** | **7,818** | **10,088** | **3,347** | **96,318** |

*Source: Adapted from Istat data – demo.istat (2019 a) and Aspects of Daily Life (2018 c)*

### USAGE RATE

Once the potentially interested population has been determined, it is necessary to estimate how much of it can actually buy the proposed mobility services at least once in a year. This is therefore a question of identifying the usage rate. There are no supporting data, so we remain in the field of hypotheses.

The guide may reasonably be, again, the participants' age. The mobility services offered consist in the rental of motor vehicles (cars and scooters) and bicycles. In the case of motor vehicles, it is possible to exclude the population under 18 years of age. These are certainly individuals who might visit the area, but do not use motor vehicles as they require a driving licence. Minors between 15 and 17 years old could use the bicycle rental service. It is reasonable to imagine that people older than 75 are not inclined to use bicycles, but rather to rent motor vehicles.

Based on these considerations, the table 14 assumes the usage, bicycle and motor vehicle usage rate for each age group. It is assumed that, overall, the usage rate for both types of vehicles is higher for the central age groups, from 25 to 54 years old.

### Table 14 – Rate of use of services by age group of resident population

| Age | 6–10 | 11–14 | 15–17 | 18–19 | 20–24 | 25–34 | 35–44 | 45–54 | 55–59 | 60–64 | 65–74 | 75 and more |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rate of use | | | | | | | | | | | | |
| Bicycles | 0.0% | 0.0% | 0.5% | 2.0% | 2.0% | 3.5% | 3.5% | 3.5% | 2.0% | 1.0% | 1.0% | 0.0% |
| Motor vehicles | 0.0% | 0.0% | 0.0% | 1.0% | 2.0% | 3.5% | 3.5% | 3.5% | 3.5% | 2.0% | 2.0% | 1.0% |

*Source: Hypothesis*

The usage rates were thus multiplied by the potentially affected resident population to estimate the number of residents who will use the services. The calculations were made separately for bicycles and motor vehicles. For the sake of brevity, only the total sum is given in Table 15.

Overall, the estimated demand for the services offered by the population living in the municipalities within the gravitation area is about 5,200.

### Table 15 – Estimate of actual users among residents

| Age | 6–10 | 11–14 | 15–17 | 18–19 | 20–24 | 25–34 | 35–44 | 45–54 | 55–59 | 60–64 | 65–74 | 75 and more | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total potential participants | 0 | 0 | 19 | 78 | 238 | 969 | 1.205 | 1.531 | 509 | 265 | 341 | 38 | 5.192 |

*Source: Hypotheses based on Istat (2019 a)*

For the resident population, however, a distinction must be made with respect to the tourist population. Residents are likely to use the services more than once per year (even for trips other than to the area of interest), as is the case for a tourist who, during his stay, may not use the services more than once.

Therefore, it is necessary to consider the frequency of use among residents. Again, this is obviously a hypothesis but starting from one assumption: the residents of the municipalities where the services will operate will likely use the services more than once a year. These municipalities are Calasetta, Carbonia, San Giovanni Suergiu and Sant'Antioco. For these municipalities a frequency of use is assumed as indicated in the following table.

### Table 16 – Frequency of use and estimation of actual users among residents

| | Frequency of use | Resident users |
|---|---|---|
| Calasetta | 10 | 333 |
| Carbonia | 8 | 2,686 |
| San Giovanni Suergiu | 10 | 715 |
| Sant'Antioco | 12 | 1,580 |
| Other municipalities | 1 | 4,620 |
| Total resident users | | 9,934 |

*Source: Hypotheses based on Istat (2019 a)*

Ultimately, an estimated 9,300 residents would use mobility services.

## 5.4 Overall demand

In conclusion, based on the estimates, it is assumed that the mobility services offered can be used by between 13,000 and 16,000 users per year.

**Table 17 – Estimation of actual service users over one year**

| | Users | Media users/day |
|---|---|---|
| *Residents* | *9,934* | *27* |
| *Tourists (conservative estimate)* | *3,094* | *8* |
| **Total (conservative estimate)** | **13,029** | **36** |
| *Tourists (optimistic estimate)* | *6,146* | *17* |
| **Total (optimistic estimate)** | **16,080** | **44** |

The average number of users per day will therefore be between 36 and 44. This is obviously an average figure and will fluctuate depending on the time of year. In particular, tourists have increased presence in the territory during the spring and summer months.

# 6. Scenario Analyses

The proposed intervention includes the implementation of some actions foreseen in the SCIs' management plans - "Stagno di Santa Caterina" (ITB042223), "Stagno di Porto Botte" (SIC ITB042226) and "Promontorio, Dune e Zona Umida di Porto Pino" (ITB040025) – aimed at guaranteeing the achievement, fruition, protection and valorisation of ecological and environmental specificities through resource management. This will be consistent with the traditional uses of the site as a whole and the functional connections to the Intermodal Centre of Carbonia, the town of Calasetta and the urban centre of Sant'Antioco, through the use of alternative and sustainable means of transport, using not only traditional but also alternative routes and paths such as existing routes and cycle paths.

The purpose of the intervention, taking into account the itinerary's important environmental tourist value, is to optimise and adapt the support equipment for tourist use, by creating adequate connections that guarantee the use of environmentally friendly means, thus linking this project to what is already being done with the "Vie del Sale" project. The intervention will involve purchasing alternative means of locomotion such as pedal-assisted bicycles, electric cars and microcar and electric motorcycles, as well as building charging stations and/or columns.

The following analyses of five scenarios are proposed to assess the sustainability of the possible solutions and the possible configurations of the above mentioned low-environmental-impact vehicles.

## 6.1 Hubs and traffic flows

The first step for all of the scenarios is to estimate the users of the mobility services to reach the naturalistic area, divided by the municipality of stay/residence and by access hub (see Figure 6).

### Table 18 – Visitor flows by municipality and access hub

| Municipality | Access door | Total demand (prudential) | Total demand (optimistic) |
|---|---|---|---|
| Calasetta | 1.a | 612 | 888 |
| Carloforte | 1.a | 280 | 514 |
| Sant'Antioco | 1.b | 2,381 | 3,168 |
| Assemini | 2 | 207 | 207 |
| Buggerru | 2 | 121 | 233 |
| Cagliari | 2 | 1,113 | 1,113 |
| Capoterra | 2 | 179 | 179 |
| Carbonia | 2 | 3,022 | 3,354 |
| Decimomannu | 2 | 64 | 64 |
| Decimoputzu | 2 | 43 | 43 |
| Domusnovas | 2 | 64 | 66 |
| Elmas | 2 | 74 | 74 |
| Fluminimaggiore | 2 | 22 | 22 |
| Gonnesa | 2 | 103 | 146 |
| Gonnosfanadiga | 2 | 47 | 47 |
| Iglesias | 2 | 547 | 828 |
| Maracalagonis | 2 | 62 | 62 |
| Monastir | 2 | 34 | 34 |
| Monserrato | 2 | 147 | 147 |
| Musei | 2 | 16 | 16 |

| | | | |
|---|---|---|---|
| Narcao | 2 | 54 | 70 |
| Perdaxius | 2 | 17 | 17 |
| Portoscuso | 2 | 273 | 481 |
| Quartu Sant'Elena | 2 | 541 | 541 |
| Quartucciu | 2 | 102 | 102 |
| San Giovanni Suergiu | 2 | 746 | 776 |
| San Sperate | 2 | 85 | 85 |
| Sarroch | 2 | 39 | 39 |
| Selargius | 2 | 218 | 218 |
| Serramanna | 2 | 67 | 67 |
| Sestu | 2 | 168 | 168 |
| Settimo San Pietro | 2 | 53 | 53 |
| Siliqua | 2 | 39 | 41 |
| Sinnai | 2 | 136 | 136 |
| Uta | 2 | 69 | 69 |
| Vallermosa | 2 | 18 | 18 |
| Villacidro | 2 | 136 | 136 |
| Villamassargia | 2 | 52 | 61 |
| Villaperuccio | 2 | 14 | 14 |
| Villasor | 2 | 68 | 68 |
| Domus de Maria | 3 | 12 | 12 |
| Giba | 3 | 31 | 37 |
| Masainas | 3 | 23 | 30 |
| Nuxis | 3 | 18 | 18 |
| Piscinas | 3 | 14 | 18 |
| Pula | 3 | 54 | 54 |
| Santadi | 3 | 53 | 67 |
| Sant'Anna Arresi | 3 | 341 | 646 |
| Teulada | 3 | 402 | 765 |
| Tratalias | 3 | 33 | 52 |
| Villa San Pietro | 3 | 16 | 16 |
| **Total** | | **13,029** | **16,080** |

*Source: Our estimates*

In Table 19, the demand is aggregated by access hub.

Most of the potential visitor flows access the area via Hubs 1 and 2. Depending on the estimate (conservative or optimistic), the percentages of visitors from the first two hubs comprise 89–92% of the total. Therefore, the analysis will focus on possible mobility patterns with reference to the first two hubs while considering the third hub unchanged. The distances covered refer to the round trip from the selected hubs to the destination.The reference demand to be included will thus range from 12,000 to 14,000.

## Table 19 – Visitor flows Access Hubs

| Hub | Distance (km) | Total demand (prudential) | Total demand (optimistic) | % | % |
|---|---|---|---|---|---|
| 1,a Southwest – Calasetta | 31,6 | 892 | 1,402 | 7% | 9% |
| 1,b Southwest – Sant'Antioco | 11,6 | 2,381 | 3,168 | 18% | 20% |
| 2 North – Carbonia Intermodal Centre | 23,0 | 8,758 | 9,793 | 67% | 61% |
| **Total** | | **12,031** | **14,363** | **100%** | **100%** |

*Source: Our estimates*

On the basis of data provided by the 2011 ISTAT census relating to residents' travel habits between the territories in the gravitation area of the Stagno di Santa Caterina, we estimated the annual visitors flows based on the medium they generally use and in relation to each identified hub. With respect to the tourism component of the demand, no data exist on travel habits, especially in such a limited area. Therefore, it is assumed that tourists can choose their travel mode in the same way as residents can. This is likely to be the case because tourists will also have the same options as residents in that particular location.

The following table shows the weights of the means of transport generally used to reach the area of interest.

### Table 20 – Modal split of flows towards the reference area

| Hub | Distance (km) | Bicycle | Motorcycle/ scooter | Car | TPL | Total |
|---|---|---|---|---|---|---|
| 1.a Southwest – Calasetta | 31.6 | 0% | 1% | 55% | 45% | 100% |
| 1.b Southwest – Sant'Antioco | 11.6 | 2% | 3% | 93% | 1% | 100% |
| 2 North – Carbonia Intermodal Centre | 23.0 | 0% | 0% | 82% | 18% | 100% |

*Source: Our estimates*

There is a clear propensity to use private cars. Equally clear is the general low propensity to use bicycles. On the basis of these weights, the reference demand was distributed in relation to the access hub and the means of transportation used.

### Table 21 – Visitor demand per hub and means of transportation used

| | Total demand (prudential) | | | | Total demand (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|
| Hub | Bicycle | Motorcycle/ scooter | Car | TPL | Bicycle | Motorcycle/ scooter | Car | TPL |
| 1.a Southwest – Calasetta | 0 | 7 | 486 | 398 | 0 | 12 | 765 | 626 |
| 1.b Southwest – Sant'Antioco | 48 | 82 | 2,219 | 33 | 64 | 109 | 2,952 | 44 |
| 2 North – Carbonia Intermodal Centre | 0 | 0 | 7,156 | 1,602 | 0 | 0 | 8,002 | 1,791 |
| **Total** | **48** | **89** | **9,861** | **2,033** | **64** | **120** | **11,719** | **2,460** |

*Source: Our estimates*

Except for bicycles, the various means of transport can be used by more than one person. Therefore, the number of vehicles that can reach the area of interest annually was calculated by dividing the visitors' demand by the vehicles' occupancy coefficient in TTable 22.

### Table 22 – Occupancy rate by means of transportation

| | |
|---|---|
| Bicycle | 1 |
| Motorcycles/scooters | 1,2 |
| Car | 2 |
| TPL | 5 |

### Table 23 – Number of vehicles per hub

| Hub | Total vehicles (prudential) | | | | Total vehicles (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|
| | Bicycle | Motorcycle/ scooter | Car | TPL | Bicycle | Motorcycle/ scooter | Car | TPL |
| 1.a Southwest – Calasetta | 0 | 6 | 243 | 80 | 0 | 10 | 382 | 125 |
| 1.b Southwest – Sant'Antioco | 48 | 68 | 1,109 | 7 | 64 | 91 | 1,476 | 9 |
| 2 North – Carbonia Intermodal Centre | 0 | 0 | 3,578 | 320 | 0 | 0 | 4,001 | 358 |
| **Total means** | **48** | **74** | **4,931** | **407** | **64** | **100** | **5,859** | **492** |

*Source: Our estimates*

Thus, an estimated 55,000 to 65,000 vehicles can reach the area annually.

The last step was to calculate how many kilometres these vehicles travel annually to reach the area from the reference hub and, vice versa, from the area back to the hub. Table 24 shows the total kilometres travelled by all vehicles reaching the area, divided by type of vehicle and by hub.

### Table 24 – Total vehicle distance

| Hub | Total vehicles (prudential) | | | | Total vehicles (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|
| | Bicycle | Motorcycle/ scooter | Car | TPL | Bicycle | Motorcycle/ scooter | Car | TPL |
| 1.a Southwest – Calasetta | 0 | 180 | 7,096 | 2,351 | 0 | 281 | 11,068 | 3,682 |
| 1.b Southwest – Sant'Antioco | 555 | 797 | 12,933 | 77 | 739 | 1,062 | 17,174 | 103 |
| 2 North – Carbonia Intermodal Centre | 0 | 0 | 82,599 | 7,486 | 0 | 0 | 92,658 | 8,434 |
| **Total vehicles *km** | **555** | **976** | **102,628** | **9,914** | **739** | **1,343** | **120,900** | **12,219** |

*Source: Our estimates*

This figure represents the basis for the subsequent estimates of environmental and economic impacts presented in the following sections on the possible configurations of mobility services.

## 6.2 Description of the vehicle fleet and equipment

The intervention proposed by the implementing entity involves purchasing and installing the following means and equipment:

- A.1 Construction of six charging stations and/or columns for pedal-assisted bicycles;
- A.2 Purchase of four electric motor boats;
- A.3 Purchase of four microcar with electric motor, two seats;
- A.4 Purchase of four cars with electric motor, two seats;
- A.5 Purchase of 34 pedal-assisted bicycles;
- A.6 Purchase of six electric motor scooters;
- A.7 Purchase of 11 charging points for cars and scooters.

In light of the purchase cost for the four electric boats (about 120,000 euros) versus their possible use and therefore actual utility, another six electric cars (two electric motor cars and four microcars) will be purchased instead. The electric boats undoubtedly represent a sustainable and compatible fruition modality with the intervention area's typology,but given that no stable and consolidated demand exists for the area's fruition, any estimates about the effective use and therefore the possible return of the investment would be random. Additionally, the electric boats could be used exclusively for the area's internal use and not as a connection by sea. The Sulcis Archipelago is subjectto strong mistral winds for many days of the year, which makes navigation extremely difficult, even within the gulf, for boats of greater tonnage and draught. It seems more useful to purchase means that will allow people to reach the area, so that the investment will be more useful and more economically advantageous (particularly financially). Moreover, residents and tourists could also use these means for different mobility needs other than reaching the intervention area.

The vehicle fleet was therefore remodelled as follows:

- A.1 Construction of six charging stations and/or columns for pedal-assisted bicycles;
- A.3 Purchase of 8 (or 6 or 4) microcars with electric motors and two seats;
- A.4 Purchase of 6 (or 5 or 4) cars with electric motors and 2 two seats;
- A.5 Purchase of 34 pedal-assisted bicycles;
- A.6 Purchase of six electric motor scooters;
- A.7 Purchase of 11 charging points for cars and scooters
- A.8 Purchase of 1 (or 2) minivan with electric motor

### A.1 – Stations and/or charging columns for pedal-assisted bicycles

The system chosen was the EVO-BIKE type, or similar, which can accommodate almost all types of pedal-assisted bicycles.



These bicycles are recharged through electronic columns powered by a photovoltaic shelter and also track users via RFID card. A user-recognition and recharging kit will be installed on each bike.

The bicycles will be attached to the bar through the handlebars, which are blocked by special stainless steel stalls. In order to obtain the maximum performance for the batteries, the bicycle will be recharged through its own charger, which is integrated into the charging bar, avoiding the use of harmful and inefficient universal battery chargers.

The EVO-BIKE system does not require a management column, as each rental point operates independently, guaranteeing continuity of service if individual charging points break down.

In addition to the columns and/or charging stations, six lounge-type bicycle-charging benches will be installed, with over six 220-volt sockets for telephones, Wi-Fi and twilight lighting.

### A. 3 – Microcar with electric motor

The identified microcar model is called Icaro (two seats), which is an electric car suitable for all uses, both in the city and for stretches of areas with environmental value. This model, produced by GreenGo, was designed to be electric but also to be a car with all the expected comforts and safety equipment. The dimensions from Smart include two seats side by side and a small trunk, making the car large enough for a couple and also some suitcases (300 litres). The seats are ergonomic to withstand city stress as well as spacious.


It is also equipped with an automatic air-conditioning system and a touch screen that manages the basic functions and consumption information as well as provides infotainment, with radio, a 3.5 mm input, a CD/MP3 player, satellite navigation, USB, a DivX player and Bluetooth. The manufacturer also plans to offer TV and Web-browsing options. Icaro is fitted with a standard telephone module containing a data SIM card, which the car uses to communicate with the control centre and to monitor the parameters for assistance and remote control, as well as for any future satellite anti-theft and tracking services.

The Icaro's safety equipment is on par with that of larger or better known cars. It has four power disc brakes, all 221 mm in diameter. The braking is also used to power the energy-recovery system for the batteries. On the front is a McPherson suspension system, the daytime running lights are LED and the wheels are 13-inch alloy wheels with 165/55 tyres on the rear and 145/55 on the front.

The Icaro has a range of 165 km, a maximum speed of 75 km/h, a 6 kW motor with a torque of 20 Nm and a 72V battery pack.

### A.4 – ELECTRIC MOTOR CARS

The type of electric motor car to be purchased is a Smart car, with 150 km travel distance and two seats. The equipment includes a60 kW (82 hp) electric motor with 160 Nm of maximum torque. According to the manufacturer, it is able to go from 0 to 100 in 11.5 seconds and to drive at a maximum speed of 130 km/h (self-limited, to not weigh too heavily on the driver's autonomy). The battery has a capacity of 17.6 kWh and is placed between the two axes to keep the centre of gravity low. It comprises 96 cells produced by the Korean company LG but designed and assembled by the German subsidiary Accumotive.

The capacity is the same as the previous electric Smart car but with different densities, weight (which drops by 15 kg, for a total of 160 kg) and charging times (six hours for 80% from a domestic outlet against the previous seven, and 3.5 hours from a 20 A wall box). A faster and more powerful battery charger (22 kW) is also available, which can restore 80% of the battery's energy in less than 45 minutes. To save energy, the Smart electric drive has a pre-conditioning function, which allows the driver  to set the desired temperature in the passenger compartment while the car is still connected to the electrical outlet being charged, so that the car will already at the right temperature at the time of use. The Smart Control app also allows users to access certain information about the car via smartphone, tablet or computer, as well as to remotely operate the charging's start time. In addition to choosing the normal driving schedule, the driver can select Eco mode, which allows a more efficient driving style. This function limits the maximum speed and provides a different throttle pedal response and the highest level of kinetic energy recovery for the car when braking. The new Smart car also takes advantage of an advanced regeneration function, which uses a radar. A sensor in the front monitors the traffic and "controls" the road up to 200 metres away. It then selects the recovery level that best suits the situation. The system chooses between five degrees of recharge, depending on the distance from the vehicle in front, to optimise the effect of the engine brake and avoid wasted energy during braking.

Interestingly, to preserve the safety of pedestrians in the city, the car can be fitted with a horn with a cube-shaped speaker positioned to the right, behind the radiator grille. It produces a sound whose height and volume increase progressively with the speed of the car. Above 30 km/h, the sound is automatically switched off because rolling and aerodynamic noise prevails above this speed. The sound generator is activated by a switch to the left of the steering wheel.

### A.5 – PEDAL-ASSISTED BICYCLES

The type of pedal-assisted bicycles to be purchased is the Italmoto Cassia Lady and Man, which can travel 80 km with a recharge.

This e-bike was chosen due to the desire to offer a safe, high-quality bike produced in Italy, with highly innovative and unique details. The manufacturer, Italiana Veicoli S.r.l., has produced an alternative means of mobility with a maximum power of 250W at 36V, a brush less motor, a range of 50 km and capacity of 100kg. It is powered by Samsung-built36V/12 Ah lithium ion batteries. The recharge time is four hours, and the duration is 500 cycles. The bike has hydraulically activated disc brakes, an aluminium alloy fork and front trick suspension, and a Shimano six-speed gearbox and transmission.

### A.6 – ELECTRIC MOTOR SCOOTER

The electric motor scooters that will be purchased are the NIU two-seater model, with an 80-km travel distance on one recharge. NIU electric scooters are intelligent two-wheeled vehicles. They are high-quality models equipped with the latest technology and design.

The NIU n1s electric scooter model is equipped with a Panasonic NCR18650PF 60 V, 29 AH battery with  a charging time of six hours and a lithium-ion battery-management system. The motor is a Boschwith, a 2,400 Wfield-oriented control system, speed of 45 km/h and 120 Nm power. The braking system is electronic with energy recovery. The brakes are dual-piston hydraulic disc brakes with shock absorbers. The lighting system includes an LED headlamp, an LED rear light, an LCD display, and a USB input. Its battery weighs 8.3 kg. The NIU Scooter app, available for Android and iOS, allows users to monitor and manage diagnostics, view the charge level, synchronise route data, locate the nearest charging stations and receive notifications in case of malfunctions. The integrated GPS system also acts as an anti-theft device and alerts the owner in case of vehicle movements.

### A.7 – VEHICLE-CHARGING COLUMNS

The vehicle-charging columns will be 22kW Innogy columns with two charging sockets. The electric vehicles described above need special equipment for recharging. For this reason, several charging columns will be distributed throughout the various municipal areas, to recharge the vehicles that need it. The columns were chosen because of their innovation, as they are equipped with the most modern technologies for remote management. They are the ideal solution for fast and intelligent recharging in public parking areas, squares, streets, shopping centre areas, etc. The charging is provided in alternating current according to mode 3 (the only one allowed by national regulations for charging in public spaces). With this capacity, the latest generation of electric vehicles can recharge in just one hour. Two electric vehicles can be recharged at the same time. User safety is guaranteed by compliance with international standards and by devices such as the charging current control via a pilot signal according to IEC 61851/SAE J1772 as well as the automatic locking of the socket throughout the charging process.

The charging data is communicated to the control centre in real time via GSM, and the communication occurs with the vehicle via the charging cable, which constantly regulates the energy flow. The charging process can be activated in various ways: through plugging in and charging or by Internet, smartphone or RFID.

The possibility to customise the device with a company logo makes the charging station an excellent means of advertising and communication.

### A.8 – MINIVAN WITH ELECTRIC MOTOR

In this study, including a minivan in the fleet is tested to:

- intercept part of the demand from individuals who usually use local public transport and thus affect the environmental impacts of public transport;
- intercept part of the customer demand that needs or prefers to move in groups; and
- promote mobility and tourism that is also accessible to people with reduced mobility.

The model identified was the Nissan e-NV200 Evalia. The low floor of the Nissan e-NV200 Evalia, with a 100% power supply, is integrated in the rear of the vehicle and accommodates a wheelchair and its passenger while maintaining five comfortable seats. The low floor is accessible via a servo-assisted aluminium ramp covered in non-slip material, which can be foldable in the ECO version and can be short or full in the AIR version.




The AIR version can be fitted with pneumatic suspensions that improve travelling comfort and facilitate loading operations, by reducing the slope and length of the access ramp. The small Japanese van is the ideal vehicle for modern urban areas thanks to its fully electric propulsion, the exclusive CARWINGS system, its compact dimensions and its reduced steering diameter. The various vehicle options and the possible customisation of the equipment make it suitable for private use and ideal for professionals such as taxi drivers, renters and transport companies.

The capacity of the Nissan battery is 40 kWh, and with a recharge, the autonomy ranges from 200 km in the combined cycle to 301 km in city driving (60% more than the previous generation's battery).

## 6.3 Scenario Descriptions

The scenarios used for the analysis were as follows:

### Scenario 0

Scenario 0 represents the current situation, in which visitors visit the area by the means available to them, according to the current modal split (Table 21). This scenario does not involve any investment and is a comparison scenario between not intervening and intervening according to the different possible solutions illustrated in the following scenarios.

### Scenario 1

Scenario 1 is based on current demand, with the current modal split, assuming that all visitors use the vehicle fleet proposed by the intervention to reach the area. Because the proposal from the municipality of Sant'Antioco does not consider the purchase of public transport, the customer demand that generally uses public transport, in this scenario, will continue to use the current petrol and diesel vehicles.

**Table 25 – Vehicle use, scenario 1**

| | | Total vehicles (prudential) | | | | Total vehicles (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hub | Distance km | Bike | Motor scooter | Car | TPL | Bike | Motor scooter | Car | TPL |
| 1.a Southwest – Calasetta | 31.6 | 0 | 6 | 225 | 74 | 0 | 9 | 350 | 117 |
| 1.b Southwest – Sant'Antioco | 11.6 | 48 | 69 | 1,115 | 7 | 64 | 92 | 1,481 | 9 |
| 2 North – Carbonia Intermodal Centre | 23 | 0 | 0 | 3,591 | 325 | 0 | 0 | 4029 | 367 |
| | **Total vehicles** | **48** | **74** | **4,931** | **407** | **64** | **100** | **5,859** | **492** |
| | **Occupation over365 days** | **0.4%** | **3.4%** | **96.5%** | | **0.5%** | **4.6%** | **114.7%** | |
| | **Day vehicles** | **34** | **6** | **14** | | **34** | **6** | **14** | |

Scenario 1 assumes that the proposed fleet (34 bicycles, six scooters and 14 electric cars) will be used to meet current demand. In Table 25, the demand is broken down by mode of transportation, using the occupancy coefficients (Table 22). There is a clear disproportion between bicycles and scooters and the available fleet. Currently,48 bikes per year would be needed to meet demand, while 34 would be available per day. The occupancy rate is 0.4%.

On the contrary, the cars would barely be sufficient to meet current demand, when using all cars year-round, with an occupancy rate of 96.5% for prudential demand. In the case of optimistic demand, the cars would not be sufficient, even if all means were used 365 days a year.

The initial data show that the fleet's current composition would not meet the current demand (very few trips by bike and many trips by car), so the fleet should be rethought regarding the number and type of vehicles.

Having comparison terms would be useful for this scenario:

- compared to Scenario 0, to assess the difference in environmental impacts if all visitors to the area use only the proposed electrical means (section 6.5 );
- with respect to subsequent scenarios, in order to assess changes in relation to the vehicle fleet's composition and configuration.

Scenario 1 is therefore a reference scenario but is unrealistic because it assumes that 100% of the estimated demand (Section 5.4 ) will use only electrical means.

Starting with the second scenario, more realistic assumptions are made to subsequently verify their feasibility and economic sustainability (Section 7). It is therefore assumed that the fleet manager can intercept 60% of the total demand in the different scenarios.

### SCENARIO 2

The second scenario introduces some hypotheses for the changes, in relation to the distribution of demand and, in subsequent scenarios, also to the composition of the vehicle fleet.

Scenario 2 assumes that part of the consumer who are currently using their own car and public transportation may be stimulated to use pedal-assisted bicycles and electric scooters. Currently, the use of bicycles and motorcycles/scooters is decidedly marginal compared to the use of public transport and, in particular, of private cars with high emissions. The incentive to change habits should come from:

1. the possibility of using safe cycling routes, after the completion of the routes described in section 4.2.2;
2. the use of pedal-assisted bicycles being proposed, as a less tiring means of transport than the traditional bicycle from the point of view of physical effort;
3. the communication and awareness-raising actions that the implementing entity or fleet manager should implement to promote the use of mobility services.

In particular, that the following is assumed:

- Among car users, 10% will use bicycles and scooters. Of these users, 85% will use pedal-assisted bicycles and 15% electric scooters;
- Among public transport users, 60% will use bicycles and scooters. The distribution of these users will be the same as that of those who change mode from car (85% bicycle and 15% electric scooter).

- The remaining 40% of public transport users will continue to use existing means of transport (petrol or diesel).

The redistribution of demand leads to an improved vehicle redistribution: electric bicycles and scooters show an occupancy rate of around 10%, whereas it was virtually zero before. Cars will have an occupancy rate ranging from 50% to 60% depending on prudent versus optimistic demand.

### Table 26 – Vehicle use, scenario 2

| | | Total vehicles (prudential) | | | | Total vehicles (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hub | Distance km | Bike | Motor scooter | Car | TPL | Bike | Motor scooter | Car | TPL |
| 1.a Southwest – Calasetta | 31,6 | 231 | 69 | 533 | 18 | 278 | 85 | 633 | 28 |
| 1.b Southwest – Sant'Antioco | 11,6 | 692 | 71 | 799 | 2 | 833 | 88 | 949 | 2 |
| 2 North – Carbonia Intermodal Centre | 23 | 231 | 69 | 1,331 | 78 | 278 | 85 | 1,582 | 88 |
| | **Total vehicles** | 1,154 | 210 | 2,663 | 98 | 1,389 | 259 | 3,164 | 118 |
| | **Occupation over 365 days** | 9% | 10% | 52% | | 11% | 12% | 62% | |
| | **Day vehicles** | 34 | 6 | 14 | | 34 | 6 | 14 | |

### SCENARIO 3

Scenario 3 considers the same distribution of demand as Scenario 2 but, like Scenario 4, foresees a change in the vehicle fleet.

In particular, an electric minibus will be introduced to:

- collect part of the demand that usually uses traditional high-emission public transport in order to reduce environmental impacts
- provide a means of mobility that can also accommodate people with limited mobility.

It is also assumed that the availability of an electric minibus could intercept about half of the people who habitually use public transport. In order to be included in the total costs financed by the regional contribution, the purchase of three electric cars would be replaced with that of one electric minibus.

The occupancy rate for bicycles and scooters would remain unchanged at around 10%. The occupancy rate for cars, on the other hand, would increase, as a result of the reduction in the number of vehicles, ranging between 66% and 79%, depending on demand. The electric bus, on the other hand, will have an occupancy coefficient of between 38% and 46%.

### Table 27 – Vehicle use, scenario 3

| | | Total vehicles (prudential) | | | | Total vehicles (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hub | Distance km | Bike | Motor scooter | Car | TPL | Bike | Motor scooter | Car | TPL |
| 1.a Southwest – Calasetta | 31,6 | 231 | 69 | 533 | 26 | 278 | 85 | 633 | 40 |
| 1.b Southwest – Sant'Antioco | 11,6 | 692 | 71 | 799 | 2 | 833 | 88 | 949 | 3 |
| 2 North – Carbonia Intermodal Centre | 23 | 231 | 69 | 1,331 | 112 | 278 | 85 | 1,582 | 126 |
| | **Total vehicles** | **1,154** | **210** | **2,663** | **139** | **1,389** | **259** | **3,164** | **169** |
| | **Occupation over365 days** | 9% | 10% | 66% | 38% | 11% | 12% | 79% | 46% |
| | **Day vehicles** | **34** | **6** | **11** | **1** | **34** | **6** | **11** | **1** |

### Scenario 4

Scenario 4, as compared to Scenario 3, foresees an additional electric minibus being introduced, for a total of two minibuses. In this case, it is expected to serve the entire demand that generally uses public transport. In this scenario, it is necessary to forego six electric cars to allow the purchase of two minibuses.

Compared to scenarios 2 and 3, there are no variations for bikes and scooters, while the reduction in the number of cars (by eight) will mean that the occupancy coefficient is 91% with prudent demand and 108% with optimistic demand; that is, the cars available would not be sufficient to meet demand even if they were all used 365 days per year.

### Table 28 – Vehicle use, scenario 4

| | | Total vehicles (prudential) | | | | Total vehicles (optimistic) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hub | Distance km | Bike | Motor scoot er | Car | TPL | Bike | Motor scoot er | Car | TPL |
| 1.a Southwest – Calasetta | 31,6 | 231 | 69 | 533 | 26 | 278 | 85 | 633 | 40 |
| 1.b Southwest – Sant'Antioco | 11,6 | 692 | 71 | 799 | 2 | 833 | 88 | 949 | 3 |
| 2 North – Carbonia Intermodal Centre | 23 | 231 | 69 | 1,331 | 112 | 278 | 85 | 1,582 | 126 |
| | **Total vehicles** | 1,154 | 210 | 2,663 | 139 | 1,389 | 259 | 3,164 | 169 |
| | **Occupation over 365 days** | 9% | 10% | 91% | 19% | 11% | 12% | 108% | 23% |
| | **Day vehicles** | 34 | 6 | 8 | 2 | 34 | 6 | 8 | 2 |

## 6.4 Indicators used for environmental impact estimates

The indicators used were provided by the Guidelines for the Evaluation of Investments in Public Works in the Areas under the Responsibility of the Ministry of Infrastructure and Transport (Legislative Decree 228/2011), specifically the parameters for economic estimation of external impacts described in Appendix 4. For estimating external impacts, the guidelines refer to the *Handbook on External Costs of Transport*, prepared by DG Move of the European Commission. The impacts described below (road congestion, accidents, pollutant emissions, noise pollution and global warming) are all estimated on the basis of the number of vehicles per kilometre travelled (vehicles*km), the type of vehicle (including Euro class), the area (urban, suburban, etc.) and the type of road (urban, roadway, etc.). Each category, based on these factors, has a different marginal cost.

These indicators were calculated to "monetise" the impacts, to show the "environmental cost" of a given infrastructure or transport system, or, in the current case, to show how the environmental cost to the community varies with the fleet used. Therefore, note that these costs are borne by the community as a whole and not by the implementing or managing entity.

Below is a description of the indicators used:

**Table 29 – Environmental impact indicators**

| Indicator | Source | Description | Calculation |
|---|---|---|---|
| Road congestion | DG MOVE | Road congestion is understood as "traffic disutility". Marginal costs categorized according to vehicle type, territorial area, road type and V/C ratio (traffic volume / road capacity). | The marginal cost, applied to the type of vehicle and the type of infrastructure, is multiplied by the vehicles *km. |
| Incidentality | DG MOVE | Road accidents are estimated using the number of kilometres travelled, broken down by mode of transport and type of infrastructure. | The marginal cost, applied to the type of vehicle and the type of infrastructure, is multiplied by the vehicles* km. |
| Polluting emissions | DG MOVE | Pollutant emissions harmful to human health (e.g. $SO_2$, $NO_x$, PM10, PM2.5 and NMVOC) are produced during the combustion process. | The marginal cost applied to the type of vehicle, the Euro class and the type of infrastructure is multiplied by the vehicles * km. |
| Acoustic pollution | DG MOVE | Vehicle noise pollution is the introduction of noise into the external environment, causing annoyance or disturbance to people resting and activities, danger to human health and deterioration of ecosystems. | The marginal cost applied to the type of vehicle, the time of day, the traffic density is multiplied by the vehicles * km. |
| Global warming | DG MOVE | Global warming is caused by emissions of greenhouse gases (climate-altering gases), which have a negative effect on global warming. $CO_2$ produced by vehicles contributes strongly to this phenomenon. | The marginal cost applied to the type of vehicle, the Euro class and the type of infrastructure is multiplied by the vehicles * km. |

As will be seen below in the scenario analyses, the impacts related to road congestion and accidents produce the most significant monetised impacts, with few variations between scenarios. The remaining impacts (polluting emissions, noise pollution and global warming) produce rather limited effects in narrow areas such as the area under consideration. For this reason, further indicators we considered, unrelated to the considered external impacts, to provide additional assessment tools.

**Table 30 – Additional impact indicators**

| Indicator | Source | Description | Calculation |
|---|---|---|---|
| Operating costs | | The mileage cost of using a vehicle, which varies according to the type and brand of the vehicle, displacement and engine type. | The parametric cost per vehicle type is multiplied by the vehicles * km. |
| $CO_2$ production | | The amount of $CO_2$, expressed in kilograms, produced by the vehicles while driving. It is calculated by type of vehicle and indicated by car manufacturers. | The $CO_2$ value per vehicle type is multiplied by the kilometres travelled. |

The environmental impacts of the different scenarios are compared below. In the remainder of the analysis, given the marginality of demand in relation to the total, hub 3 (South East) will not be considered (Section 6.1 ). For the sake of brevity and clarity, only the total values of the various indicators are presented and compared in the following sections. Section 14 reports the full individual details per reference hub and therefore the details of the calculation procedures that led to the total values.

## 6.5 Scenario 0 (current situation) and 1: Differences in impact

This paragraph describes the differences between scenarios 0 (current situation) and 1, which foresees that the current users, with the current modal split, will use an electric vehicle to move to the area (with the exception of public transport). The following tables show the indicator values in relation to the estimates of prudent and optimistic demand.

**Table 31 – Comparison between scenario 0 and 1 (in euros), prudential demand**

| | | Scenario | | Difference |
|---|---|---|---|---|
| | | 0 | 1 | |
| **External impacts** | Road congestion | 25,483 | 25,483 | 0 |
| | Incidentality | 20,721 | 20,721 | 0 |
| | Polluting emissions | 856 | 545 | −311 |
| | Acoustic pollution | 29 | 18 | −10 |
| | Global warming | 205 | 108 | −97 |
| | Total impacts | **47,294** | **46,875** | **−419** |
| | | | | |
| **Operating costs** | | **78,148** | **66,654** | **−11,495** |
| | | | | |
| **TOTAL COSTS** | | **125,442** | **113,528** | **−11,914** |
| | | | | |
| **Production kg $CO_2$** | | 12,968 | 684 | **−12,284** |

The total difference in external impacts, with both conservative and optimistic demand, is quite small in both scenarios. The indicators with the greatest weight (road congestion and accidents) are invariant. The use of electric vehicles leads to savings, in terms of external impacts, of € 419 with prudent demand and €494 with optimistic demand.

However, the operating costs decrease considerably, with savings of between about €11,500 and €13,500, thanks to much lower operating costs of electric vehicles compared to those of petrol and diesel vehicles. The same considerable difference can be seen in terms of $CO_2$ production, which decreases drastically, from a value between about 13,000 kg and 15,300 kg for the current situation to a value between about 680 kg and 840 kg with the use of electric vehicles.

**Table 32 – Comparison between scenarios 0 and 1 (in euros), optimistic demand**

| | | Scenario | | Difference |
|---|---|---|---|---|
| | | 0 | 1 | |
| **External impacts** | Road congestion | 30,289 | 30,289 | 0 |
| | Incidentality | 24,448 | 24,448 | 0 |
| | Polluting emissions | 1,035 | 672 | −363 |
| | Acoustic pollution | 34 | 22 | −12 |
| | Global warming | 249 | 130 | −119 |
| | Total impacts | **56,056** | **55,562** | **−494** |
| | | | | |
| **Operating costs** | | **93,716** | **80,167** | **−13,548** |
| | | | | |
| **TOTAL COSTS** | | **149,772** | **135,730** | **−14,042** |
| | | | | |
| **Production kg $CO_2$** | | 15,328 | 843 | **−14,485** |

## 6.6 Impact differences among the scenarios

All of the scenarios are compared in this section. Because scenarios 2–4 capture 60% of current demand, the demand for scenarios 0 and 1has also been reduced accordingly, for consistent comparison between scenarios affected by the same demand.

In scenarios 2, 3 and 4, the demand presents a modal shift compared to the current state (scenario 0) and scenario 1; in fact, the assumption is that the fleet system and the fleet of electric vehicles will shift a share of the demand that currently uses cars and LPT towards the use of bicycles and pedal assistance. As explained above, an estimated 60% of LPT users will use electric bicycles and scooters, while 10% of car users will use the same vehicles. Of those users who will change modes of transportation, 8% will use pedal-assisted bicycles, while 15% will opt for electric scooters.

Tables 33 and 34 show the impact values for all scenarios, under the two assumptions of conservative and optimistic demand. In general, the impacts and costs decrease when switching from petrol/diesel vehicles to electric vehicles. Analysing the scenarios in relation to prudential demand, scenarios 0 and 1 show similar total external impacts (around €28,000), which decrease by more than 10% when switching to electric vehicles, with the different configurations foreseen in the scenarios, to around €25,000. Similarly, operating costs are almost halved in the comparison between scenario 0 (almost €47,000) and scenario 4 (just under €25,000). $CO_2$ production goes from almost 8,800 kg in scenario 0 to less than 170 kg in scenario 2 and to 0 kg in scenario 4.

### Table 33 – Comparison of scenarios (in euros), prudential demand

| | | Scenario 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| External impacts | Road congestion | 15,290 | 15,290 | 12,532 | 13,042 | 13,042 |
| | Incidentality | 12,433 | 12,433 | 12,265 | 12,265 | 12,265 |
| | Polluting emissions | 514 | 327 | 131 | 93 | 0 |
| | Acoustic pollution | 17 | 11 | 8 | 8 | 7 |
| | Global warming | 123 | 65 | 26 | 13 | 0 |
| | Total impacts | **28,376** | **28,125** | **24,962** | **25,422** | **25,314** |
| | | | | | | |
| **Operating costs** | | **46,889** | **39,992** | **28,662** | **28,322** | **24,923** |
| | | | | | | |
| **TOTAL COSTS** | | **75,265** | **68,117** | **53,624** | **53,744** | **50,237** |
| | | | | | | |
| **Production kg $CO_2$** | | 7,781 | 410 | 164 | 117 | 0 |

A similar argument can be made for optimistic demand, where costs are higher but with the same proportions described for prudential demand.

### Table 34 – Comparison of scenarios (in euros), optimistic demand

| | | Scenario 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| External impacts | Road congestion | 18,174 | 18,174 | 14,945 | 15,574 | 15,574 |
| | Incidentality | 14,669 | 14,669 | 14,616 | 14,616 | 14,616 |
| | Polluting emissions | 621 | 403 | 161 | 115 | 0 |
| | Acoustic pollution | 21 | 13 | 10 | 9 | 8 |
| | Global warming | 150 | 78 | 31 | 16 | 0 |
| | Total Impacts | **33,634** | **33,337** | **29,763** | **30,330** | **30,197** |
| | | | | | | |
| **Operating costs** | | **56,229** | **48,100** | **34,411** | **33,992** | **29,803** |
| | | | | | | |
| **TOTAL COSTS** | | **89,863** | **81,438** | **64,174** | **64,321** | **60,000** |
| | | | | | | |
| **Production kg $CO_2$** | | 9,197 | 506 | 164 | 117 | 0 |

In conclusion, the transition from the use of traditional petrol/diesel to electric vehicles entails:

- a slight reduction in external environmental impacts (road congestion, accidents, polluting emissions, noise pollution, global warming). Moving from scenario 0 to scenario 4, the change in monetary terms is −11%;
- a sharp reduction in operating costs, equal to a −47% change from scenario 0 to scenario 4. These costs are calculated with reference to the community. In other words, they are the total costs incurred by a particular community to maintain a particular fleet;
- a not insignificant difference in overall costs of −33%. Moving from scenario 0 to scenario 4, the monetized overhead costs are reduced to one-third;
- a reduction of $CO_2$production to zero. Moving from scenario 0 to scenario 4, the $CO_2$produced goes from about 9.2 tons to none.

In the Scenario 4, $CO_2$ production is eliminated in the reference territory because electric vehicles do not directly produce polluting emissions. On a global level, however, the whole process of producing the energy needed by electric vehicles should be verified. For pedal-assisted bicycles, $CO_2$ production is certainly zero even on a global level since these bicycles will be recharged using solar-powered columns. In the case of other vehicles, the $CO_2$ production would be zero even at the global level if the energy used to power them is produced exclusively from renewable sources.

Ultimately, this comparison therefore shows indisputable convenience for the general community of the investment, which will promote active and electric mobility.

## 6.7 Management costs: Comparison of scenarios 2–4

Fleet management involves costs relating to vehicles (variable costs) and more general items (fixed costs). This section compares scenarios 2, 3 and 4 in relation to management costs. Variable costs are taken into account.

**Table 35– Variable management costs**

| | | Values | | |
|---|---|---|---|---|
| **Cost item** | **Description** | **Vehicle** | **Value (€)** | **Unit of measurement** |
| Insurance | Vehicles on the road require insurance. Generally, costs for electric vehicles are lower than for diesel/petrol vehicles, as the former are less prone to mechanical problems. Third-party liability insurance will also be provided for pedal-assisted bicycles. | Smart<br>Microcar<br>Minibus<br>Scooter<br>Bicycles | 300<br>200<br>600<br>150<br>60 | Annual cost per vehicle |
| Battery rental | The battery has a major impact on the value of an electric vehicle, often reaching almost 50% of the vehicle's total purchase cost. For this reason, many dealerships offer annual rentals for batteries, which | Smart<br>Microcar<br>Minibus | 1,000<br>800<br>1,200 | Annual cost per vehicle |

| | | | | |
|---|---|---|---|---|
| | can be replaced in case of damage and loss of performance, without incurring additional costs beyond the annual rate. The following annual costs have been chosen, in line with current market prices. | | | |
| Maintenance | Electric vehicles have much lower annual maintenance costs than petrol vehicles do. | Smart<br>Microcar<br>Minibus<br>Scooter<br>Bicycles | 160<br>100<br>200<br>50<br>30 | Annual cost per vehicle |
| Electricity | The cost of recharging electric vehicles varies greatly, depending on the "packages" proposed by the operators, the type of charge chosen (slow, quick or fast) and other factors. A parametric cost of €0.05 per kilometre was adopted, based on the average charging costs, usually provided per kWh, and the average distance of a vehicle per kWh, when the battery is charged. | | 0.05 | Cost per km travelled |

In relation to the maintenance costs, the implementing entity declared that "with regard to the management and maintenance of all the structures and means subject to this intervention, these will be subject to ordinary and extraordinary maintenance by the Municipality of Sant'Antioco, guaranteeing the integrity and regular use of the works for a period of not less than 10 years from the date of final testing". Nevertheless, the maintenance costs are calculated in this analysis to draw as complete an overall economic picture as possible.

As for fixed costs, personnel costs and overhead were taken into account, for a total of 70,000 euros per year.

### Table 36– Fixed management costs

| | | **Values** | | |
|---|---|---|---|---|
| **Cost item** | **Description** | **Unit** | **Value (€)** | **Unit of measurement** |
| Staff | The personnel costs necessary to manage the fleet and the relationship with customers: vehicle booking, customer service, vehicle handling, administration and accounting management. | Two full-time employees | 50,000 | Annual cost |
| General costs | The management costs include rent for the local administrative and operational headquarters with adjoining parking area, expenses for office utilities (telephone, water, management software licenses, etc.), local cleaning, communication and promotional campaigns and other general costs. | Rent<br>Users<br>Promotional campaigns<br>Other costs<br>Total | 10,200<br>3,000<br>5,000<br>1,800<br>20,000 | Annual cost |

Tables 37 and 38 summarise the costs, broken down by item and scenario, with prudent and optimistic demand. Fixed costs account for over 70% of the total, while the rest of the costs are lower.

### Table 37– Costs(in euros) with prudent demand

| | Scenario | | |
|---|---|---|---|
| | 2 | 3 | 4 |
| Insurance | 6,340 | 6,240 | 6,140 |
| Battery rental | 12,400 | 11,000 | 9,600 |
| Maintenance | 3,080 | 2,920 | 2,760 |
| Energy | 3,066 | 3,126 | 3,185 |
| **Total variable costs** | **24,886** | **23,286** | **21,685** |
| Staff | 50,000 | 50,000 | 50,000 |
| General costs | 20,000 | 20,000 | 20,000 |
| **Total fixed costs** | **70,000** | **70,000** | **70,000** |
| | | | |
| **Total** | **94,886** | **93,286** | **91,685** |

Battery rental is the highest of the variable costs. In general, the total cost decreases as the vehicle fleet becomes smaller.

### Table 38– Costs (in euros) with optimistic demand

| | Scenario | | |
|---|---|---|---|
| | 2 | 3 | 4 |
| Insurance | 6,340 | 6,240 | 6,140 |
| Battery rental | 12,400 | 11,000 | 9,600 |
| Maintenance | 3,080 | 2,920 | 2,760 |
| Energy | 3,654 | 3,727 | 3,801 |
| **Total variable costs** | **25,474** | **23,887** | **22,301** |
| Staff | 50,000 | 50,000 | 50,000 |
| General costs | 20,000 | 20,000 | 20,000 |
| **Total fixed costs** | **70,000** | **70,000** | **70,000** |
| | | | |
| **Total** | **95,474** | **93,887** | **92,301** |

# 7. Economic Analysis

A cost- and revenue-analysis approach was used for the company's economic analysis of costs and revenues. The assumption is that the operator will capture 60% (section 6.3 ) of the total estimated demand (section 6.1 ). Based on the number of vehicles needed to meet that demand and the annual mileage of those vehicles (section 6.3 ), the fixed and variable costs (section 6.7 ) are broken down by type of vehicle considered (electric cars, minibuses, scooters and bicycles). The rates to include in the costs were calculated on the basis of the cost of each obtained vehicle. These tariffs were then compared with the tariffs currently applied by the main car/scooter/bike-sharing operators to verify how reliable the identified tariffs are from a market perspective.

## 7.1 Breakeven point estimate

Below is the analysis for each scenario. In light of section 6.3 , scenarios 2, 3 and 4 are considered.

The following were calculated for each scenario:

- Number of vehicles by type;
- Annual variable costs, broken down by incidence of each type of vehicle;
- Annual fixed costs, broken down by type of vehicle on the basis of the incidence of variable costs;
- Total annual costs by vehicle type;
- Annual demand for vehicles by vehicle type;
- Breakeven point by type of vehicle, intended as the rate applied to rent each vehicle to cover its annual cost;
- Time of use as an estimated average number of hours, including the average time of the return trip needed to reach the nature area from the reference hub and the time needed to use the area:
    - five hours for cars,
    - eight hours for minibuses (assuming that the vehicles are used by small groups, whose organization necessarily requires a longer time),
    - six hours for scooters, and
    - a full day (24 hours) for bicycles;
- The hourly rate and per-minute rates, calculated on the basis of the breakeven rate and time, which is useful for comparing rates with those currently applied by other operators.

For the sake of synthesis and clarity in presenting the results, only the breakeven tariff columns are presented, rather than the entire calculation table for each scenario. However, all of the tables are provided in section 14.

### SCENARIO 2

In relation to scenario 2, according to the estimated prudential demand, the following rates would have to be applied to reach the breakeven point: €36 to rent a Smart electric car (about €7/h), €25 for the microcar (€5/h), €26 for the scooter (€4.30/h) and €10 for the pedal-assisted bicycle (€0.4/h).

**Table 39– Breakeven scenario 2 – prudential demand estimate**

| Vehicles | Fleet | Breakeven (tariff in €/vehicle) | Time of use (h) | Rate (€)/h | Rate (€)/min |
|---|---|---|---|---|---|
| Smart | 6 | 36 | 5 | 7.10 | 0.12 |
| Microcar | 8 | 25 | 5 | 5.00 | 0.08 |
| Scooter | 6 | 26 | 5 | 4.30 | 0.07 |
| Bicycle | 34 | 10 | 24 | 0.40 | 0.01 |
| Totals | 54 | | | | |

As demand increases to the optimistic estimate, the rates can be reduced by 15% to 17%, depending on the type of vehicle, from a minimum of €8 for a bicycle to a maximum of €30 for the electric Smartcar.

**Table 40– Breakeven scenario 2 – optimistic demand estimate**

| Vehicles | Fleet | Breakeven (tariff in €/vehicle) | Time of use (h) | Rate (€)/h | Rate (€)/min |
|---|---|---|---|---|---|
| Smart | 6 | 30 | 5 | 6.00 | 0.10 |
| Microcar | 8 | 21 | 5 | 4.20 | 0.07 |
| Scooter | 6 | 21 | 5 | 3.60 | 0.06 |
| Bicycle | 34 | 8 | 24 | 0.30 | 0.01 |
| Totals | 54 | | | | |

### SCENARIO 3

In relation to Scenario 3, according to the estimated prudential demand, the breakeven rates should be as follows: €32 to rent an electric Smart car(about €6.50/h), €20 for the microcar (€4.10/h), €59 for the minibus (€7.40/h), €27 for the scooter (€4.50/h) and €11 for the pedal-assisted bicycle (€0.40/h).

Compared to scenario 2, in scenario 3, the fare for cars is lower, and the fares for scooters and electric bikes are higher. This is because in scenario 3, compared to scenario 2, a minibus is purchased, rather than three electric cars. The consequence is that the variable costs related to the car fleet are lower, which would decrease the variable costs of the entire vehicle fleet. However, because the demand for scooters and bikes – and therefore the annual mileage – remains the same as in the previous scenario, the variable costs related to these vehicles will remain the same, with greater weight on the overall variable costs and also on the fixed costs (because the fixed costs are allocated on the basis of the distribution of variable costs).

**Table 41– Breakeven scenario 3 – prudential demand estimate**

| Vehicles | Fleet | Breakeven (tariff in €/vehicle) | Time of use (h) | Rate (€)/h | Rate (€)/min |
|---|---|---|---|---|---|
| Smart | 5 | 32 | 5 | 6.50 | 0.11 |
| Microcar | 6 | 20 | 5 | 4.10 | 0.07 |
| Minibus | 1 | 59 | 8 | 7.40 | 0.12 |
| Scooter | 6 | 27 | 6 | 4.50 | 0.08 |
| Bicycle | 34 | 11 | 24 | 0.40 | 0.01 |
| Totals | 47 | | | | |

When drawing up the business plan, the operator will obviously have to review the tariffs to make the differences between the different types of vehicles acceptable.

As in scenario 2, as demand increases (optimistic estimate), rates can be reduced by14% to 19%.

**Table 42– Breakeven scenario 3 – optimistic demand estimate**

| Vehicles | Fleet | Breakeven (tariff in €/vehicle) | Time of use (h) | Rate (€)/h | Rate (€)/min |
|---|---|---|---|---|---|
| Smart | 5 | 27 | 5 | 5.50 | 0.09 |
| Microcar | 6 | 17 | 5 | 3.50 | 0.06 |
| Minibus | 1 | 48 | 8 | 6.00 | 0.10 |
| Scooter | 6 | 23 | 6 | 3.80 | 0.06 |
| Bicycle | 34 | 9 | 24 | 0.40 | 0.01 |
| Totals | 47 | | | | |

### SCENARIO 4

In relation to scenario 4,based on the estimated prudential demand, the breakeven rates should be €29 for the rental of an electric Smart car(about €5.80 per hour), €15 for the microcar (€3.10/h), €125 for the minibus (€15.60/h), €29 euros for the scooter (€4.80/h) and €11 for the pedal-assisted bicycle (€0.50/h).

**Table 43– Breakeven scenario 4 – prudential demand estimate**

| Vehicles | Fleet | Breakeven (tariff in €/vehicle) | Time of use (h) | Rate (€)/h | Rate (€)/min |
|---|---|---|---|---|---|
| Smart | 4 | 29 | 5 | 5.80 | 0.10 |
| Microcar | 4 | 15 | 5 | 3.10 | 0.05 |
| Minibus | 2 | 125 | 8 | 15.60 | 0.26 |
| Scooter | 6 | 29 | 6 | 4.80 | 0.08 |
| Bicycle | 34 | 11 | 24 | 0.50 | 0.01 |
| Totals | 46 | | | | |

In relation to scooters and bicycles and the increase in fares needed to cover costs, the considerations made in the previous scenario also apply here. The further growth in fares compared to those of scenario 3 is linked to the fact that two minibuses are included in this scenario, instead of three electric cars, with various consequences to the variable and fixed costs attributed to each type of vehicle. However, the most obvious figure is that of the minibus rental rate, which increases from €59 in scenario 3 to €125 in scenario 4. This is because, as described in section6.3 this scenario includes two minibuses, which serve an unchanged demand compared to that of scenario 3, so the occupancy rate of the vehicles halves from 38% to 19%.This translates into a lower use of the vehicles and therefore lower revenues for higher costs.

The suggestion that emerges from this is that, given the goodness of the estimated demand, the introduction of an additional bus in the fleet would not be economically viable without a different distribution of costs and therefore tariffs among the different types of vehicles.

**Table 44– Breakeven scenario 4 – optimistic demand estimate**

| Vehicles | Fleet | Breakeven (tariff in €/vehicle) | Time of use (h) | Rate (€)/h | Rate (€)/min |
|---|---|---|---|---|---|
| Smart | 4 | 25 | 5 | 4.90 | 0.08 |
| Microcar | 4 | 13 | 5 | 2.70 | 0.04 |
| Minibus | 2 | 102 | 8 | 12.70 | 0.21 |
| Scooter | 6 | 24 | 6 | 4.00 | 0.07 |
| Bicycle | 34 | 9 | 24 | 0.40 | 0.01 |
| Totals | 46 | | | | |

As in the previous scenario, rates could be reduced by 14–19% if the optimistic demand estimate is considered.

## 7.2 Benchmarking

In addition to comparisons between the different scenarios, it is necessary to make a comparison with some current market references to verify that the identified tariffs will be attractive to the market. For the sake of prudence, only the tariffs identified on the basis of the estimatedprudential demand were taken into account, bearing in mind that increased demand would allow for decreased tariffs. The parameter taken as the reference was the tariff per hour of use.

Evidently, the operators – as the fleet manager could do in this study – apply different pricing solutions depending on the type of customers and their needs. In order to facilitate comparison among the operators' pricing options, the tariffswere considered that do not include a subscription and, where possible, without the so-called "station-based" tariff that provides for pick-up and return of the vehicle at the same point.

Table 45 shows the results.

The tariffs identified for electric Smart cars seem to be sufficiently in line with market prices, although slightly higher for scenarios 2 and 3. The selected operator operates in the metropolitan city of Cagliari, where demand is certainly higher; therefore, the rates may be lower. In the case of microcars, the comparison term instead shows a clear difference in favour of the solutions proposed in the case of Sant'Antioco. This suggests that regardless of cost, the rates for this type of vehicle could be revised upwards in compensate for those of other vehicles, such as the minibus. In this case, in fact, the identified tariffs appear to be too high, particularly in scenario 4. The scooter fares also appear rather low versusthe comparison. The above considerations also apply here. Finally, the tariffs identified for bicycles appear to be in line with market values.

**Table 45– Benchmarking vehicle rental rates: Hourly rates (in euros)**

| | Scenario | | | Operator | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | Play car (a) | Sharengo (b) | Adduma car (c) | Zig Zag (d) | Cabubi (e) |
| Smart | 7.10 | 6.50 | 5.80 | 6.00 | | | | |
| Microcar | 5.00 | 4.10 | 3.10 | | 12.00 | | | |
| Minibus | - | 7.40 | 15.60 | | | 6.60 | | |
| Scooter | 4.30 | 4.50 | 4.80 | | | | 14.90 | |
| Bicycles | 0.40 | 0.40 | 0.50 | | | | | 0.30 |

Notes:
(a) Cagliari
(b) Rome, Milan, Modena and Florence
(c) Florence
(d) Milan and Rome
(e) Cabubi
N.B. All rates considered include the rental of electric vehicles.

# 8. Financial Analysis

In this feasibility study, the cost necessary to purchase the fleet of vehicles is not considered in the economic framework because it is non-refundable and financed by the Region of Sardinia. For completeness of the analysis, the table below shows the costs by reference scenario.

### PROPOSED FINANCIAL FRAMEWORK

| Vehichles and facilities | Quantity | Unit cost (€) | Value added tax (€) | Totale cost (€) |
|---|---|---|---|---|
| A.1 Construction of six charging stations and/or columns for pedal-assisted bicycles; | 8 | 6.500,00 | 1.430,00 | 63.440,00 |
| A.2 Purchase of electric motor boats | 4 | 24.000,00 | 5.280,00 | 117.120,00 |
| A.3 Purchase of microcars with electric motors and two seats; | 4 | 12.500,00 | 2.750,00 | 61.000,00 |
| A.4 Purchase of cars with electric motors and 2 two seats; | 4 | 23.000,00 | 5.060,00 | 112.240,00 |
| A.5 Purchase of pedal-assisted bicycles; | 34 | 1.400,00 | 308,00 | 58.072,00 |
| A.6 Purchase of electric motor scooters; | 6 | 2.400,00 | 528,00 | 17.568,00 |
| A.7 Purchase of charging points for cars and scooters | 11 | 6.000,00 | 1.320,00 | 80.520,00 |
| A.8 Purchase of minivan with electric motor | 0 | 48.000,00 | 10.560,00 | 0,00 |
| Installation, additional security charges, test and other cost | 1 | | | 90.040,00 |
| **Total** | | | | 600.000,00 |

### FINANCIAL FRAMEWORK SCENARIO 2

| Vehichles and facilities | Quantity | Unit cost (€) | Value added tax (€) | Totale cost (€) |
|---|---|---|---|---|
| A.1 Construction of six charging stations and/or columns for pedal-assisted bicycles; | 8 | 6.500,00 | 1.430,00 | 63.440,00 |
| A.2 Purchase of electric motor boats | 0 | 24.000,00 | 5.280,00 | 0,00 |
| A.3 Purchase of microcars with electric motors and two seats; | 8 | 12.500,00 | 2.750,00 | 122.000,00 |
| A.4 Purchase of cars with electric motors and 2 two seats; | 6 | 23.000,00 | 5.060,00 | 168.360,00 |
| A.5 Purchase of pedal-assisted bicycles; | 34 | 1.400,00 | 308,00 | 58.072,00 |
| A.6 Purchase of electric motor scooters; | 6 | 2.400,00 | 528,00 | 17.568,00 |
| A.7 Purchase of charging points for cars and scooters | 11 | 6.000,00 | 1.320,00 | 80.520,00 |
| A.8 Purchase of minivan with electric motor | 0 | 48.000,00 | 10.560,00 | 0,00 |
| Installation, additional security charges, test and other cost | 1 | | | 90.040,00 |
| **Total** | | | | 600.000,00 |

### FINANCIAL FRAMEWORK SCENARIO 3

| Vehichles and facilities | Quantity | Unit cost (€) | Value added tax (€) | Totale cost (€) |
|---|---|---|---|---|
| A.1 Construction of six charging stations and/or columns for pedal-assisted bicycles; | 8 | 6.500,00 | 1.430,00 | 63.440,00 |
| A.2 Purchase of electric motor boats | 0 | 24.000,00 | 5.280,00 | 0,00 |
| A.3 Purchase of microcars with electric motors and two seats; | 6 | 12.500,00 | 2.750,00 | 91.500,00 |
| A.4 Purchase of cars with electric motors and 2 two seats; | 5 | 23.000,00 | 5.060,00 | 140.300,00 |
| A.5 Purchase of pedal-assisted bicycles; | 34 | 1.400,00 | 308,00 | 58.072,00 |

| | | | | |
|---|---|---|---|---|
| A.6 Purchase of electric motor scooters; | 6 | 2.400,00 | 528,00 | 17.568,00 |
| A.7 Purchase of charging points for cars and scooters | 11 | 6.000,00 | 1.320,00 | 80.520,00 |
| A.8 Purchase of minivan with electric motor | 1 | 48.000,00 | 10.560,00 | 58.560,00 |
| Installation, additional security charges, test and other cost | 1 | | | 90.040,00 |
| **Total** | | | | **600.000,00** |

## FINANCIAL FRAMEWORK SCENARIO 4

| **Vehichles and facilities** | Quantity | Unit cost (€) | Value added tax (€) | Totale cost (€) |
|---|---|---|---|---|
| A.1 Construction of six charging stations and/or columns for pedal-assisted bicycles; | 8 | 6.500,00 | 1.430,00 | 63.440,00 |
| A.2 Purchase of electric motor boats | 0 | 24.000,00 | 5.280,00 | 0,00 |
| A.3 Purchase of microcars with electric motors and two seats; | 4 | 12.500,00 | 2.750,00 | 61.000,00 |
| A.4 Purchase of cars with electric motors and 2 two seats; | 4 | 23.000,00 | 5.060,00 | 112.240,00 |
| A.5 Purchase of pedal-assisted bicycles; | 34 | 1.400,00 | 308,00 | 58.072,00 |
| A.6 Purchase of electric motor scooters; | 6 | 2.400,00 | 528,00 | 17.568,00 |
| A.7 Purchase of charging points for cars and scooters | 11 | 6.000,00 | 1.320,00 | 80.520,00 |
| A.8 Purchase of minivan with electric motor | 2 | 48.000,00 | 10.560,00 | 117.120,00 |
| Installation, additional security charges, test and other cost | 1 | | | 90.040,00 |
| **Total** | | | | **600.000,00** |

# 9. Marketing Management

Several considerations are necessary in relation to the management of the vehiclefleet and to general activity, particularly from a marketing point of view,and therefore the ability to effectively intercept part of the consumer demand interested in using the naturalistic area.

In the fixed costs foreseen for the three considered scenarios (2, 3 and 4),personnel costs for the ordinary management of the fleet were foreseen, which included two full-time employees. Evidently, however, this will not be sufficient. In all of the scenarios, in fact, it was assumed to reach at least 60% of the demand among users potentially interested in the area. However, this cannot happen automatically. The person who will manage the service must be able to set up and implement an effective communication and promotion campaign for the service. The general costs include €5,000 per year for creating and managing promotion tools (e.g., a website, social advertising campaigns, press material and advertisements. This is obviously not enough because it refers to the ordinary management of marketing activities. Therefore, it is necessary to have specialist skills in tourism marketing, knowledge of the reference market, knowledge of the demand and so on.

When choosing how to manage the intervention and, therefore, when choosing whether or not to outsource management, the implementing entity will have to consider several aspects. If the choice is internal management, then the contractor will have to ensure that it has a specialist figure on its staff or, if unavailable, consider additional annual coststo recruit at least one marketing officer. If the service is outsourced service, then the contractor shall request such competencies from the entrusted party. This means that when preparing the tender, the implementing entity shall identify the minimum conditions for the successful tender, in light of the annual costs identified for the different scenarios, to integrate and guarantee the necessary expertise and simultaneously obtain a fair profit margin. The possibilities may include reductions of the auction-based amount and/or the availability of facilities, such as, for example, the free availability of premises for the business location and parking areas for vehicles, exemption from or discounts to local taxes and participation in activities to promote and raise awareness among citizens and tourists.

For external procurement, it is certainly good practice to make an initial expression of interest to assess how many and which economic actors might be interested in managing the contract and to verify minimum requirements and conditions. However, a source of important leverage in bargaining with an external party is the fact that the latter does not require the availability of means, as they are already purchased through the regional contribution.

Here are some considerations in relation to the scenarios.

### Scenario 2

In order to ensure the use of bicycles and scooters, scenario 2 assumes a shift of part of the demand among users who usually use public transport and, especially, private cars to the two types of two-wheeled vehicles, as compared to scenario 1. As noted in the analysis of scenario 1, based on the normal travel habits of the area's residents and tourists, the bicycles and scooters proposed for purchase by the contractor would remain almost unused. For this reason, it is necessary to promote awareness among potential users as well as services through effective communication.

### Scenarios 3 and 4

The skills described above are necessary with reference to all of the scenarios analysed but particularly for scenarios 3 and 4, which assume the addition of one or two electric minibuses. Although these are vehicles for five or six people, the economically and environmentally efficient management of these vehicles requires the necessary skills to utilise them at a certain occupancy rate. This implies a non-negligible ability to intercept certain segments of demand from particular groups, which, in turn, requires close collaboration with the entity that will manage the naturalistic area to study and propose composite transport and use offers. If this were not to happen, the purchase of minibuses would have no reason to be supported.

# 10. Environmental and urban constraints

## 10.1 Environment

Considering the typology and consistency of the proposed tasks, even if they must be subject to an environmental impact assessment, the realization of the intervention should not entail negative environmental effects but would allow compatible uses of natural resources by users, thus preserving the resources' naturalistic and environmental value. The intervention is considered necessary and functional for protecting the territory because, in addition to ensuring the sector's needs for pure environmental conservation, the intervention favours sustainable use activities. All installations will be oriented towards reducing $CO_2$ production and providing beneficial effects for the whole environment.

Although the habitats in the concerned area are currently in a good state of conservation, these habitats are exposed to greater impacts during summer due to human presence and unregulated use, which are critical due to the lack of eco-sustainable management and pose serious risks of degradation to the site's ecosystem. No alterations to the landscape are expected during this project's realization because all of the interventions have low environmental impacts and will mostly be carried out with removable and non-impactful systems.

Based on analysis of the proposal, the interventions' objective is to enhance the environmental and landscape heritage of the stagnant areas along the Salt Roads and within the SCI areas, which will ensure effective usability of the site. They will significantly reduce $CO_2$emissions in the urban area of Sant'Antioco, with obvious benefits for the population. In particular, the environmental interventions mainly fall within the provisions foreseen and defined within the SCI Management Plans, designed for the site's management, conservation and sustainability.

Because the competent bodies have approved the management plans, in substance, the proposed interventions have already been evaluated as eligible, thus allowing faster implementation of the interventions. For this reason, although it is necessary to assess the intervention's environmental impacts, or rather to request to make it subject to impacts assessment, the intervention will not generate significant negative environmental repercussions on the site. Therefore, the level of impact is acceptable.

## 10.2 Urban Planning

The areas belong to the municipal administrations or are state property.Therefore, they are at the authority's disposal.

The interventions proposed in the project will be located in coastal landscape area no.5, called the Amphitheatre of Sulcis and topographically falling within the IGM cartography in sheet 564, section II, Giba, with CTR cut at 10,000, comprising Tratalias (564110), Giba (564120), Porto Botte (564150) and Sant'Anna Arresi (564160); in sheet 564, section I, Carbonia; sheet 564, section III, Sant'Antioco; and sheet 564,section IV,Calasetta, with CTR cut at 10,000 of Parangianu (564020), Carbonia (564030), Matzaccara (564060), San Giovanni Suergiu (564070), Sant'Antioco (564100), Tratalias (564110), Punta de S'Aliga (564140) and Porto Botte (564150).

In general, considering that the proposed interventions mainly involve supplying vehicles, it will be necessary to prepare specific documentation only for installing the charging stations, lounge-type benches and charging columns.

The following requirement arises from the plans or programmes:

- Some of the concerned areas fall within the “Stagno di Santa Caterina” SCI (SIC ITB042223).The proposed interventions are consistent with the actions set out in the relevant management plans.

The following requirement arises from municipal regulations:

- The proposed interventions are consistent with the regulatory provisions of the current urban-planning instruments of the municipalities involved in the itinerary.

The following are constraints and other regulatory requirements:

- In the areas affected by the intervention, the provisions deriving from the establishment of the SCI, DM 14.10.1967, Legislative Decree 42/2004, art. 10bis of L.R. 45/89 and the PAI all apply.

# 11. Conclusions

As mentioned in the introduction, this study is aimed not at arriving at an executive project, but verifying the context in which the intervention proposal formulated by the Municipality of Sant'Antioco, concerning the purchase and installation of low-emission vehicles to facilitate access to the "Stagno di Santa Caterina" natural area, is included and the possible intervention scenarios and the conditions necessary for the intervention to be concretely feasible and economically sustainable.

Therefore, this analysis does not determine a single choice among the scenarios identified, but points out the advantages elements of each scenario and the possible risk factors to which the implementing subject must pay particular attention during the drafting of the executive project.

Below is a summary of the main elements emerging from the analysis.

The purchase and implementation of low-emission electric vehicles, regardless of the scenarios proposed, **represents an intervention consistent with the regional strategies** (Section 4.1 ) in terms of mobility, energy production and management, emission reduction, sustainable development, tourism development and the enhancement of environmental tourism attractors.

**This study's analysis starts from the assumption that two preconditions must be met** for the proposed intervention to have the desired effects and be implemented effectively (Section 4.2 ). The first one concerns the actual redevelopment of the Santa Caterina Pond, an activity envisaged by the Le Vie del Sale project. Assuming the completion of this project, a new naturalistic attraction will be created that will draw flows of visitors towards the area and therefore justify the use of the proposed low-impact mobility services. The second precondition concerns the effective completion of the cycling routes provided by the Regional Cycling Mobility Plan, to which is linked the concrete possibility of accessing the area by bicycle.

Regarding the composition of the vehicles that would compose the fleet, an opportunity was identified **to evaluate the replacement of the 4 electric boats**, which would be useful for the area's internal use, with other types of vehicles useful for reaching the area and which could be used by residents and tourists to address further mobility needs (Section 6.2 ).

Regarding the estimated demand (Section 5 ) and current travel habits (Section 6.1 ), there is a **disparity related to the types of vehicles proposed for purchase** (Section 6.3 ). In particular, bicycles and scooters would be almost completely unused. Given the intervention's objectives, including promoting active mobility and the use of the territory, appropriate information, communication and promotion activities should be adopted in all scenarios to encourage part of the demand that generally uses private cars and traditional public transport to instead use bicycles and scooters (Section 6.3 ). This implies that **adequate communication and marketing skills** are available to the operator. This element should be taken into account when choosing the actual management of the activity, whether it is internal or external to the implementing entity (Section 9 ).

To promote a mobility model accessible to all and meet the mobility needs of those who habitually use collective public transport, some cars in the fleet should be replaced with one

(Scenario 3) or two (Scenario 4) **electric minibuses that also facilitate the transport of people with reduced mobility** (Section 6.3 ). The analysis of vehicle occupancy rates (Section 6.3 ) shows that, based on the current modal split of mobility demand, the purchase of two minibuses would not be convenient at the moment, particularly from an economic point of view, so **replacing three cars with one minibus as proposed in Scenario 3 seems more coherent and sustainable** (Section 7.1 ). In this case, however, the need for sufficient marketing expertise to ensure adequate vehicle utilisation rates is even more stringent (Section 9 ).

Given the use rates of the various means, **the fleet composition proposed in Scenario 3 appears the most balanced and coherent with the composition of the demand** (Section 6.3 ). In fact, the occupancy rate of electric cars is higher than in Scenario 2 and lower than in Scenario 4, which is too close to saturation. In addition, in the case of minibuses, as mentioned above, the occupancy rate in Scenario 3 is higher and therefore more economically appropriate than that estimated for Scenario 4.

**Regarding the environmental impact** on the territory and the community, **Scenarios 2, 3 and 4 provide appreciable results, and the differences appear negligible**, although Scenario 4 has the lowest impact of all (Section 6.6 ). Undoubtedly, regardless of the baseline scenario, the proposed intervention will reduce these impacts considerably.

Even in the case of **fleet management costs, the differences between scenarios appear negligible**: estimated total annual costs range from a maximum of €95.5 thousand in Scenario 2 to €91.5 thousand in Scenario 4 (Section 6.7 ).

In light of the vehicle fleets' composition, the current modal distribution of demand and the vehicle occupancy rates, the estimated rates to be applied to cover the costs, indicate that **Scenario 3's tariff system is more balanced and appropriate overall in terms of the market rates** applied by other car sharing operators than those proposed in the other scenarios (Section 7 ).

Regarding **commercial activity**, Scenario 4 requires a greater availability of management and marketing skills, particularly due to the need to manage the sale of the 2 minibuses in an efficient and economically sustainable way. However, because the fleet contains no minibuses, Scenario 2 requires a lower level of expertise. Because it requires the purchase of only one minibus, **Scenario 3 appears to be the best compromise** between the need to make the mobility system accessible to all and the quantity and quality of skills necessary for its management (Section 9).

The scenarios appear to contain **no particularly critical differences in terms of environmental constraints**. No scenarios anticipate any particular landscape alterations, as they all anticipate the use of vehicles with low environmental impact, as well as removable and minimally invasive systems (Section 10 ).

In conclusion, in relation to the objectives of the intervention proposal received from the Municipality of Sant'Antioco and those of the DESTI-SMART project, the following elements were considered in the study:

- Coherence with the regional strategies
- Necessary preconditions
- Possible composition of the vehicle fleets

- The scenarios' ability to meet mobility need demands
- Accessibility of mobility services
- Environmental impacts
- Operating costs
- Tariff coherence
- Skills required for management.

According to these elements, Scenario 3 contains the most balanced framework of sustainability and feasibility and is capable of achieving the stated objectives while ensuring the most efficient management. This result is obviously linked to the entire set of assumptions made in the analysis.

## NEXT STEPS

To make a final decision regarding the best solution, an additional in-depth analysis by the managing entity should assess the following aspects:

1. Effective coordination with the Le Vie del Sale project and the Regional Cycling Mobility Plan, as well as certain definitions related to the conclusion of the planned interventions;
2. At least for the first period, the opportunity to purchase other means in place of electric boats, the later purchase of which could be facilitated, using other funds, during a more advanced phase when demand for their use will be more consolidated;
3. The opportunity to purchase of an electric minibus to allow greater and better accessibility for mobility services
4. An in-depth assessment of the reference market (mobility services, car sharing, etc.) to verify the following:
    a. Necessary management and marketing skills
    b. Effective availability of these skills and, therefore, the choice of internal or external management on the part of the implementing entity
5. In the case of external management, careful evaluation of the characteristics of the service to be entrusted and the degree of attractiveness of the contract by possible market players.

# 12. Figures and Tables

### Figures



### Tables

# 13. Sources and Bibliography


Banca d'Italia (2018), Turismo internazionale dell'Italia https://www.bancaditalia.it/statistiche/tematiche/rapporti-estero/turismo-internazionale/

European Commission: DG MOVE Update of the Handbook on External Costs of Transport https://ec.europa.eu/transport/themes/sustainable/studies/sustainable_en

Integrated National Energy and Climate Plan 2030 https://www.mise.gov.it/index.php/it/198-notizie-stampa/2040668-pniec2030

Istat(2019 a), Demo.istat http://demo.istat.it/

Istat (2018 a, 2019 b), Movimento dei clienti nelle strutture ricettive http://dati.istat.it/

Istat (2018 b), Aspetti della Vita quotidiana - Viaggi e vacanze degli italiani http://dati.istat.it/

Istat (2018 c), Aspetti della Vita quotidiana – Spettacoli http://dati.istat.it/

Istat (2011) Censimento Popolazione e Abitazioni http://dati-censimentopopolazione.istat.it/Index.aspx?lang=it

Ministero delle Infrastrutture e dei Trasporti (2017) Linee Guida per la Valutazione degli Investimenti in Opere Pubbliche http://www.mit.gov.it/node/5272

Project Le Vie del sale – Valorizzazione ai fini turistico ambientali dell'itinerario "Le Vie del Sale" (2018)

RAS – Sired (2019) http://osservatorio.sardegnaturismo.it/

Regional Cycling Mobility Plan. Sardegna (2018)

https://www.regione.sardegna.it/index.php?xsl=2425&s=386900&v=2&c=156&t=1&tb=13769

Regional Energy Efficiency Action Plan 2013 – 2020 https://www.regione.sardegna.it/j/v/2420?s=1&v=9&c=15038&na=1&n=10&esp=1&tb=15028

Regional Operational Programme Sardegna ERDF 2014-2020 https://www.sardegnaprogrammazione.it/index.php?xsl=1384&s=278013&v=2&c=12950

Renoldi S. (2012), Fonti amministrative e statistiche ufficiali in ambito turistico la regione Sardegna tra seconde case e "sommerso statistico ufficiale". Temi Economici della Sardegna CRENoS 02/2012. CUEC https://crenos.unica.it/crenos/publications/fonti-amministrative-e-statistiche-ufficiali-ambito-turistico-la-regione-sardegna-tra-0

Sardinia Region Environmental Energy Plan 2015 - 2030 https://www.regione.sardegna.it/j/v/2420?s=1&v=9&c=15038&na=1&n=10&esp=1&tb=15028

Sardinia Smart Specialisation Strategy (RIS3) https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/policy-document/smart-specialisation-strategy-sardinia

Zara. A, Cao D. (2015) Destinazione Sardegna. Analisi della domanda turistica. CUEC https://crenos.unica.it/crenosterritorio/pubblicazioni/destinazione-sardegna-analisi-della-domanda-turistica

# 14. Annex 1– Tables Outside the Text

# *Sustainable mobility model towards naturalistic areas:*
# *The case of Santa Caterina—Sant'Antioco Regione Sardegna*

DESTI-SMART
Interreg Europe

Delivering Efficient Sustainable Tourism with low-carbon transport Innovations:
Sustainable Mobility, Accessibility and Responsible Travel

European Union
European Regional Development Fund

Lead Partner

Advisory Partner

**[https://www.interregeurope.eu/desti-smart/](https://www.interregeurope.eu/desti-smart/)**

**Prepared by**
Andrea Zara
Via Giudice Guglielmo, 19
09131 Cagliari (Italy)
e-mail: zara.andrea@hotmail.it
phone: +39 392 8340155
p.iva 03889430926