European Commission

Clean energy for EU islands: Smart electromobility

Syros, Greece

Clean energy for EU islands

Smart electromobility in Syros, Greece

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Authors:

Clean energy for EU islands secretariat

Lucija Rakocevic (Th!nk E), Arnor Van Leemputten (Th!nk E),

Nikos Ntaras (CRES), Wannes Vanheusden (3E),

DAFNI

Petros Markopoulos, Fanis Christakopoulos, Konstantina Zoumpoulaki,

Municipality of Syros

Andreas Gialoglou (Municipality of Syros)

Reviewers:

Marina Montero Carrero (3E), Jan Cornillie (3E)

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www.euislands.eu | info@euislands.eu

Summary

The goal of the technical assistance is to identify optimal business models for the municipality of Syros to be involved in the operation of EV charging stations. This includes looking into the PV generation capacity needed to cover the consumption from the chargers on the island. Syros wants to become an example for smart electric mobility in Greece and the EU. The transition to electric mobility is still in the initial phase, the municipality has applied for the national programme "Antonis Tritsis" for funding to electrify its municipal fleet (including mini-busses and passenger vehicles etc.). In addition, the municipality has secured funds for a study to analyse the optimal locations for 20-22 charging points on the island. The study will be completed by end of March 2022 and it will involve an analysis by the Hellenic Electricity Distribution Network Operator (HEDNO). While the Syros team, namely the municipality and Network of Sustainable Greek Islands (DAFNI), started a longer-term project for transition to electric mobility of the whole island, the goal of the technical assistance is to focus on the possibility for optimal operation and use of the 20-22 charging points that will be owned by the municipality and are part of the above-mentioned study.

The technical assistance entailed the following tasks from the Clean energy for EU islands secretariat:

- Overview of best practices: together with the Center For Renewable Energy Sources (CRES), who is the regional partner, best practices for business models of charging stations for municipalities have been reviewed and presented.
- Regulatory analysis of the Greek framework to identify business models and potential barriers for Syros municipality
- Possible solutions for Syros based on the study for charging points, best practices and regulatory barriers, solutions have bene proposed for the use of municipality-owned charging locations on the island
- Design of a PV system that could provide the energy required by the charging stations

Glossary

CAPEX	Capital expenditure, representing both the hardware, installation, and soft costs of a solar PV system.
OPEX	Operating expenditure, specifically for the operation and maintenance of the solar PV system done under contract.
Peak power (Wp)	This is the power of a PV module for standard test conditions (STC). The sum of the modules of a power plant then gives the total peak power of the power plant, expressed in kWp or MWp.
Performance ratio (PR)	The performance ratio (PR) is an important indicator for characterising the behaviour of a PV plant. The PR represents the ratio in % between the actual and theoretical energy production taking into account the available sunlight in the plane of the PV modules. It is determined by the choice of system components as well as design and maintenance requirements, but also by the location and vicinity of the project. The result of the initial PR indicated in this report represents the PR at plant start-up.
Average expected yield (P50)	This is the average expected long-term production for a PV plant (i.e. with a 50% probability of exceeding it). It can be presented as production in MWh/year or as the ratio between production and peak power of the plant. In the latter case, we speak of specific yield, generally presented in kWh/kWp/year.
Yield with 90% probability of exceedance (P90)	The value of the P90 gives the expected yield in 90% of cases (90% probability of exceeding). In other words, the risk of not reaching this value is 10%. This results from the combination of all the uncertainties of the yield calculation, particularly the uncertainty related to the annual variation of the irradiation, obtained by means of probability laws. When calculating the P90, it is important to differentiate observation periods, which can vary from one year to 20 or 25 years depending on the life of the project. The different risk measures are defined according to whether one wants to assess the risk associated with cash flow over a single year or the cumulative income over the lifetime, which changes the way in which the uncertainty associated with annual variations is taken into account. When quantifying the risk over a single year, the uncertainty of climate variability is taken into account in its entirety. Over a longer observation period, this same uncertainty is reduced since less sunny years are generally compensated by years with more sun.
Transposition factor	The Transposition Factor is the ratio of the incident irradiation (GlobInc) on the plane, to the horizontal irradiation (GlobHor). I.e. what you gain (or loose) when tilting the collector plane. It may be defined in hourly, daily, monthly, or yearly values. It is computed by applying a transposition model to the horizontal hourly values. The models that PVSyst offers are the Hay and Perez model. The result depends namely on the diffuse irradiance.
Perez model	The Perez model is a transposition model, which is a more sophisticated model requiring good (well measured) horizontal data.

Table of Contents

1. Introduction to Syros

Syros is a Greek island with a population of 21 507 inhabitants, and with an area of 83.6 km^2. The capital of Syros, Hermoupolis, is also the administrative and cultural capital of the whole of Cyclades island group. Syros' economy consists of:

- The primary sector, including agriculture which covers 4.5 % of the economy;
- The secondary sector, including industry, such as food and horticulture industry which represents 30.3 % of the economy;
- The tertiary sector, which covers services and represents 65.2 % of the economy.

This chapter provides the overview of the power system and road transportation sector of Syros. The power system overview includes details on the current and planned interconnections with the neighbouring islands as well as an overview of current and planned energy generation plants. The overview of the transportation sectors provides a detailed assessment of the road transportation vehicles owned and operated by the municipality of Syros. In addition, the overview summarises the road transportation services offered to Syros' inhabitants and tourists including buses, taxis, rental vehicles and courier services.

1.1 Power system of Syros island

1.1.1 Existing situation

The power system of Syros is located in the Cyclades region of the Aegean Sea, 145 kilometres from Athens. It is interconnected with the mainland from Lavrio port (108 km) and with three neighbouring islands which are Tinos (33 km), Mykonos (35 km) and Paros (46 km). The power capacities of submarine three-pole AC power cables range from 140 to 200 MVA of 150 kV, as shown in Figure 1.

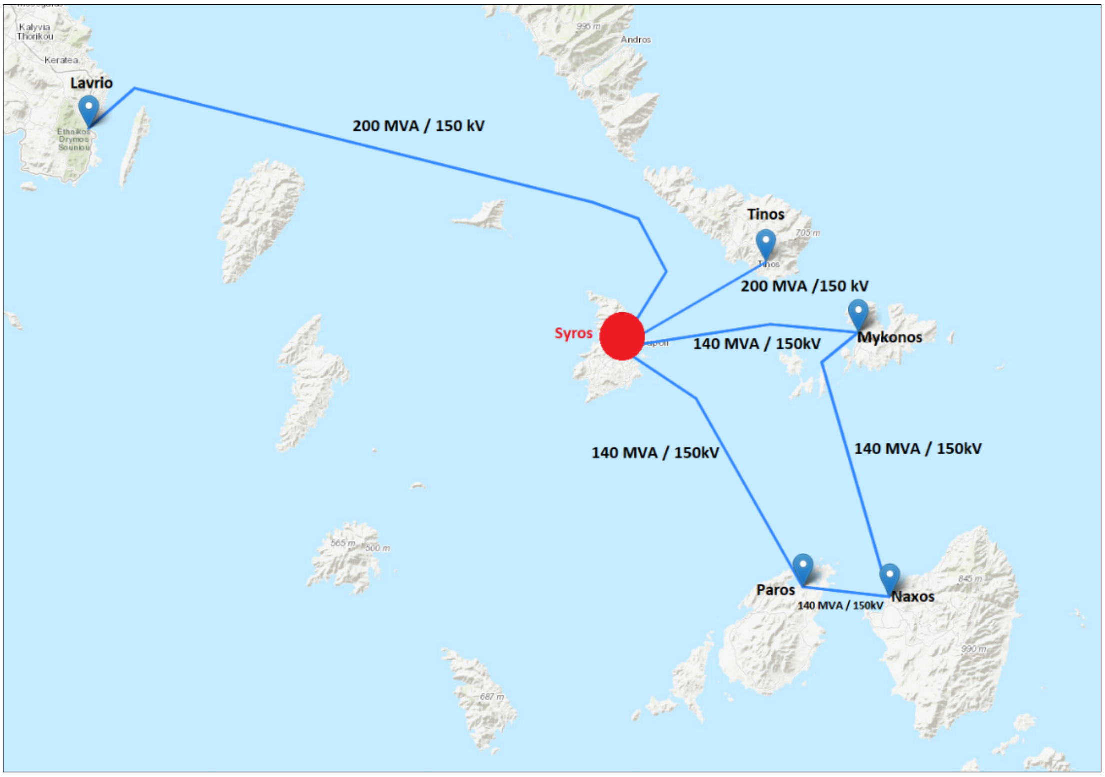


Figure 1. Interconnections of Syros power system

Table 1 shows the individual cables that connect the five islands with each other and the mainland.

Table 1. Underwater interconnection cabling

From	To	Type and cable cross-section (mm^2)	Cable length (km)
Syros	Lavrio	Cu/XLPE – (3X) 630 mm^2	108
Syros	Tinos	Cu/XLPE – (3X) 630 mm^2	33
Syros	Mykonos	Cu/XLPE – (3X) 300 mm^2	35
Syros	Paros	Cu/XLPE – (3X) 300 mm^2	46
Paros	Naxos	Cu/XLPE – (3X) 300 mm^2	7,1
Naxos	Mykonos	Cu/XLPE – (3X) 300 mm^2	44,7

The Syros interconnection is part of the Interconnection of Cyclades Islands, a technically complex project, which ensures the reliable, economic, and sufficient supply of electricity to the islands of Syros, Paros, Tinos, Mykonos and Naxos among others. More specifically, phase A was comprised of the connection of Syros Island with Lavrion (mainland) as well as with the islands of Paros, Mykonos, and Tinos. Phase B consisted of the connection of Paros Island with Naxos Island and the connection of Naxos Island with Mykonos Island. Phase C included the second interconnection between Lavrion (mainland) and Syros Island. The project was completed in October 2020.

1.1.2 Future plans

The interconnection of the Cyclades region with mainland of Greece is part of the ten-year island interconnection development program of the Independent Electricity Transmission Operator. The next phase (4th) of the electrical interconnection of the Cyclades completes a large-scale project aimed at the energy integration of the island complex in the mainland system, with benefits for both the islands and the national economy. The start of this phase was launched by the announcement in 2020 of the tender for the interconnection of Naxos with Santorini, which poses the most important part of the planned island interconnections since other islands will be interconnected and supplied radially.

More specifically, the interconnection of the Cyclades region, with a budget of €385 million, will be completed in 2024. It includes the interconnection of Serifos with the mainland transmission system through the new high voltage station in Lavrio via an underwater AC cable connection with a capacity of 200 MVA. It also involves the direct connections of Milos with Folegandros and then with Thira. Thus, the interconnections will allow the reliable electricity supply of the Cyclades from the mainland system and the utilisation of the RES potential, with significant environmental and socio-economic benefits.

1.1.3 Energy production

The electrical system of Syros covers the needs of electricity of a total amount of 21 507 inhabitants. The wide variation in daily and seasonal demand prove that the features of the system are quite demanding. In addition, Syros is an island with a strong urban character meaning that the energy demand intensity is not limited to the summer period (seasonality), which is also verified by the appearance of a peak demand in January. Lower energy demand months are considered the months of October and November and the months of May and June. The peak demand of Syros in 2020 reached 23 MW. The electrical system overview prior to the island's interconnection is shown in Table 2.

Table 2. Electrical system overview

Year	Average (MW)	Peak (MW)	Electricity demand per year (GWh)	RES electricity (GWh)	Thermal electricity (GWh)	Area (km^2)	Population
2017	10.8	21.7	94.3	5.99 / 7.27 *	88.8	83.6	21 507

* Net metering included

The installed power of the power plants prior to the island's interconnection is listed in Table 3 which represents the power generation profile in the system. The photovoltaic units that function under the programme of virtual net metering are partially excluded because they do not directly contribute to the grid.

Table 3 Installed capacity of power plants in Syros

	Wind farms	PV plants	PV rooftops	PV net metering	Hybrid stations	Thermal plants*
Installed capacity (MW)	2.84	0.99	0.71	0.05	2.64	45.1

*In reserve with a view to its gradual dismantling

The total contribution to the energy production of 2018 for the power system of Syros is shown in

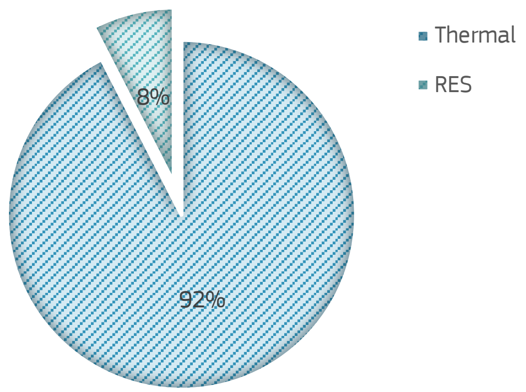


Figure 2. The variability of production, the low rate of exploitation of RES, as well as the restrictions that may be imposed by the system operator, are the main reasons for the low level of penetration of renewable energy sources. Nowadays the energy mix of Syros is considered to be that of mainland Greece and it is as shown in Figure 3.

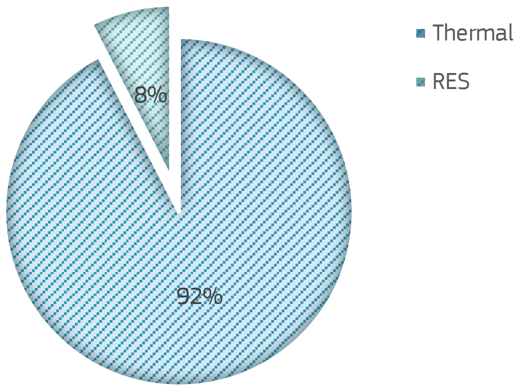


Figure 2. Energy mix of energy production on Syros prior to interconnection to the mainland

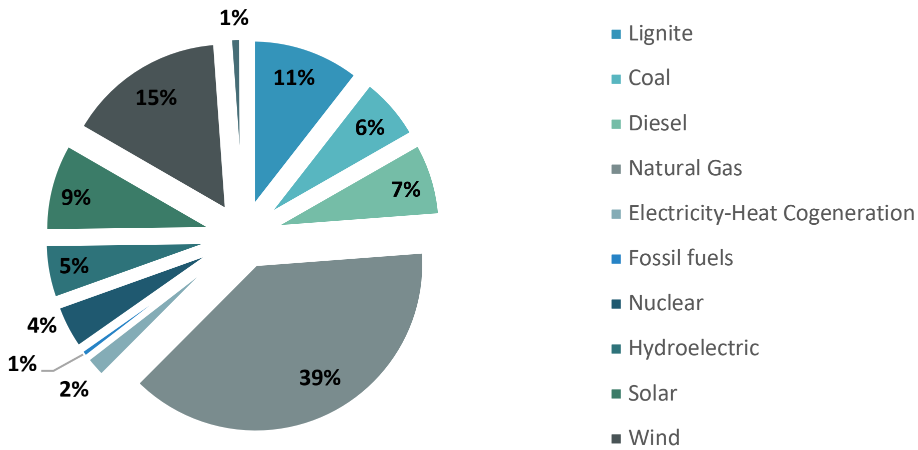


Figure 3. Greece's energy mix 2020 (including energy from interconnections with neighboring countries)

1.1.4 Thermal station

The thermal station was built in 1960 in the southern area of the port of Syros, at a distance of about 1 700 meters from the centre of the urban settlement of Hermoupolis. It operates with fuel oil and its electromechanical equipment has been periodically updated. Before 2018 – the year of Syros' interconnection – the thermal station used to cover the energy needs of the island, operating in cooperation with the local wind farms and solar PVs. However, the completion of the interconnection of Syros with the mainland network forced the station to function only in cases of emergencies as a reserve. The total thermal installed capacity in Syros equals 45,1 MW.

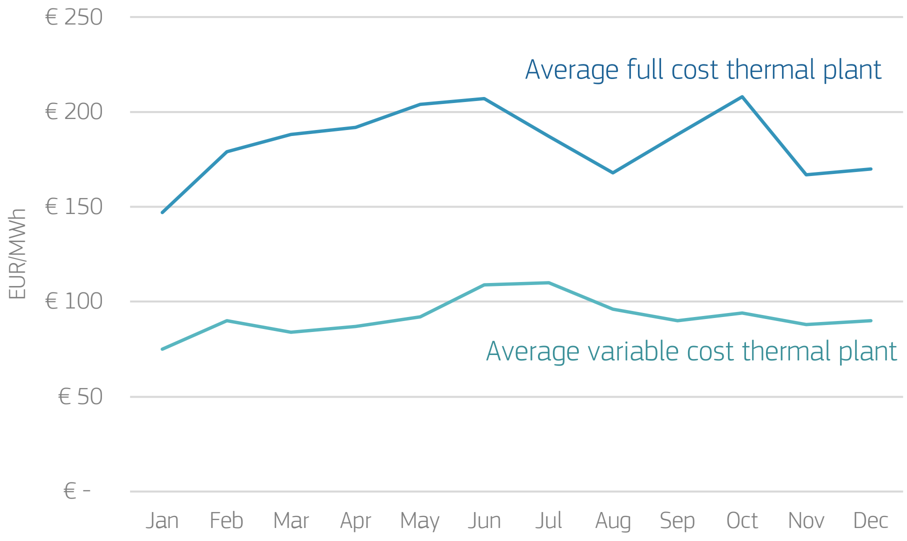


Figure 4. The thermal station in Hermoupolis, Syros

The average total and variable production costs of the thermal station in the power system are shown in Figure 5. The graph shows mothly data for 2017, before the island was interconnected with the mainland and neighbouring islands.

Figure 5. Cost of production of thermal station Syros – 2017

1.1.5 RES plants

Before being interconnected with the mainland transmission system, Syros' power system, was considered saturated in terms of the penetration of RES technologies by the Energy Regulatory Authority in Greece. This authority has set specific limits of maximum available power for the installation of such stations. However, the completion of the interconnection with the mainland expands those margins ensuring the utilisation of the wind and solar potential of the islands in the near future.

Figure 6. PV station in Syros

Figure 7. Wind farm in Syros

As mentioned, in the power system of Syros there is a wind farm consisting of four wind turbines with an installed capacity of 2.84 MW while there are photovoltaic units across the island, with a total installed capacity of 0.99 MW. It is worth mentioning that the type of photovoltaics that is allowed to be installed in saturated networks from 2016 onwards are only photovoltaics that belongs to the special programs of rooftop PVs and net metering.

Considering the RES submitted applications, the interest is growing further due to the interconnection with the mainland. Table 4 shows the status of applications for the three main RES categories (wind farms, PV units, and biomass/biogas plants).

Table 4. Status of RES installation applications in the Syros system in 2021

	Number of applications	**Cumulative power of applications (MW)**	**Number of applicants with a license**	**Cumulative power of applications with a license (MW)**
Wind farms	5	7.04	5	**7.04**
PV stations	14	1.087	14	**1.087**
PV roofs	147	0.707	147	**0.707**
PV net metering	20	0.15	18	**0.14**

Figure 8 demonstrates the applications for the wind farms with production licenses, which awaiting installation permits (green areas), wind farms with applications under consideration (yellow areas), and wind farms with operation permits (green with red border).

Figure 8. Status of applications of wind farms

1.2 Information on the potential users of the charging network

1.2.1 Municipal fleet

The Municipal fleet consists mainly of passenger vehicles, facility management vehicles, (garbage trucks, pick up vans, general use trucks etc.), motorcycles and few buses servicing municipality's transportation service. The tables presented in Annex 3 list the vehicles by type (passenger – motorcycle – truck – bus) of all the municipality's fleet vehicles as registered in the Municipality's official registration list.

The municipality owns 9 passenger vehicles of which 8 are in use and 12 motorcycles. The detailed of these vehciles and the department that uses them are provided in Annex 3.

In addition, municipal fleet has 41 trucks many of these are garbage trucks though they are not registered as a separate category. Five trucks belong to the Technical services department, while the rest of the fleet of trucks are registered in the Cleaning, Environment and Agricultural Policy municipality department. Ten trucks are out of use because of age or due to technical problems.

Three out of six municipal buses in total, as presented in Annex 3. Three of these are out of service since 2017. Currently, the Municipality has applied at Antonis Tritsis National Funding Program (AT12 Electromobility Call) in order to purchase, among other, four new electric buses for the needs of municipal transport service. The results of the program are not yet announced.

1.2.2 Passenger transportation services

Bus Operator (KTEL)

In Syros there is a private bus operator (KTEL) running mostly suburban transportation service. KTEL company own 13 buses in total. KTEL also operates municipality owned mini-buses presented in Annex 3, via a municipality-KTEL agreement. Therefore, all together KTEL operates 16 buses. Moreover, additional bus companies are operating on Syros which are part of tourism industry and operated organised tours.

Taxi

Three taxi companies are servicing Syros Island. According to 17494/1302/08.02.2019 Southern Aegean Regional governor decision, the maximum capacity of taxi operators for an island is 33 taxi permits. According to the same decision, 40 operators are already operating in Syros surpassing therefore the capacity decided by the regional authority.

1.2.3 Other transportation services

Rentals

The rental sector accounts for 36 rent-a-car companies and 25 rent-a-bike companies. We have to point out that some of them are the same, meaning companies that operating in both cars and bikes rentals.

Table 5. List of rent-a-car companies on Syros

	REGISTRATION NAME	COMPANY BRANDNAME
1	AEGEAN PARADISO EE	AEGEAN PARADISO
2	ALEXANDRE IOANNOU MATSAKIS	DOOMATCH ELLADA
3	CSP HERMES EE	CSP HERMES EE
4	DUSK O.E.	DUSK
5	FAIR SEAS SHIPPING AND YACHTING SERVICES ΜΟΝΟΠΡΟΣΩΠΗ ΙΚΕ	
6	SYROS MALENA RENTAL MOTO AND CAR IKE	SYROS MALENA RENTAL MOTO AND CAR
7	ΑΓΓΕΛΙΚΗ ΝΕΣΤΟΡΑ ΠΑΠΟΥΤΣΑ	
8	ΑΙΚΑΤΕΡΙΝΗ ΓΕΡΑΣΙΜΟΥ-ΜΑΡΙΑ ΚΑΠΕΛΛΑ Ο.Ε	SMILING CARS
9	ΑΛΕΞΑΝΔΡΟΣ ΑΡΒΑΝΙΤΗΣ ΚΑΙ ΔΗΜΗΤΡΙΟΣ ΑΡΒΑΝΙΤΗΣ ΟΕ	ALEX RENT A CAR
10	ΑΜΒΡΟΣΙΑ - ΠΛΥΤΑΣ ΙΔΙΩΤΙΚΗ ΚΕΦΑΛΑΙΟΥΧΙΚΗ ΕΤΑΙΡΕΙΑ	ΠΕΡΙ ΤΙΝΟΣ ΙΚΕ
11	ΑΝΔΡΕΑΣ ΚΑΙ ΙΣΙΔΩΡΟΣ ΦΡΕΡΗΣ ΕΤΑΙΡΙΑ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΕΥΘΥΝΗΣ	ΑΛΦΑ ΓΙΩΤΑ ΕΠΕ
12	ΑΝΤΩΝΙΟΣ ΙΩΑΝΝΗ ΚΑΖΑΝΤΖΑΚΗΣ	GALISSAS RENT A MOTO - GALISSAS TOURS - ALPHA RENT A CAR - DIODOS
13	ΑΡΤΕΜΙΟΣ ΕΜΜΑΝΟΥΗΛ ΨΥΧΑΛΗΣ	ROAD RUNNER - ΜΑΝΟΣ - MANOS
14	ΒΑΛΣΑΜΑΚΗΣ ΑΝΩΝΥΜΗ ΞΕΝΟΔΟΧΕΙΑΚΗ-ΤΟΥΡΙΣΤΙΚΗ-ΕΜΠΟΡΙΚΗ ΚΑΙ ΝΑΥΤΙΛΙΑΚΗ ΕΤΑΙΡΕΙΑ	SUNRISE BEACH SUITES SYROS
15	ΒΑΣΙΛΙΚΗ ΛΕΦΤΕΡ ΜΑΡΤΙΚΟ	1901
16	ΓΕΡΑΣΙΜΟΣ & ΠΑΝΑΓΙΩΤΗΣ ΣΙΓΑΛΑΣ Ο.Ε.	
17	ΓΕΩΡΓΙΟΣ ΕΛΕΥΘΕΡΙΟΥ ΔΡΟΣΟΣ	ΑΝΥΨΩΤΙΚΗ ΣΥΡΟΥ
18	ΓΙΩΡΓΑΚΗΣ-ΣΥΡΟΣ ΑΝΩΝΥΜΗ ΕΜΠΟΡΙΚΗ, ΤΕΧΝΙΚΗ ΚΑΙ ΤΟΥΡΙΣΤΙΚΗ ΕΤΑΙΡΕΙΑ	ΓΙΩΡΓΑΚΗΣ ΣΥΡΟΣ ΑΕ
19	ΔΑΛΕΖΙΟΣ Ι ΡΟΥΣΣΟΣ Γ ΟΜΟΡΡΥΘΜΗ ΕΤΑΙΡΕΙΑ	CTB
20	ΘΡΟΝΟΣ ΙΔΙΩΤΙΚΗ ΚΕΦΑΛΑΙΟΥΧΙΚΗ ΕΤΑΙΡΙΑ	ΘΡΟΝΟΣ ΙΚΕ
21	Ι.ΒΑΜΒΑΚΑΡΗΣ ΚΑΙ ΣΙΑ ΟΕ	
22	Ι.ΠΡΙΝΤΕΖΗΣ-Ε.ΠΡΙΝΤΕΖΗΣ ΟΕ	SMART
23	ΙΩΑΝΝΗΣ ΚΟΥΜΠΗΣ ΚΑΙ ΣΙΑ ΟΕ	ΚΟΥΜΠΗΣ
24	ΚΑΛΛΙΟΠΗ ΜΟΣΧΟΥ ΣΤΑΘΟΠΟΥΛΟΥ	MAISTRALI RENT A CAR
25	ΚΕΡΚΟΥΡΟΣ ΕΤΑΙΡΕΙΑ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΕΥΘΥΝΗΣ	ΚΕΡΚΟΥΡΟΣ ΕΠΕ
26	ΚΙΝΗΣΙΣ ΕΝΟΙΚΙΑΣΕΙΣ ΜΕΤΑΦΟΡΙΚΩΝ ΜΕΣΩΝ ΜΟΝΟΠΡΟΣΩΠΗ ΕΤΑΙΡΕΙΑ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΕΥΘΥΝΗΣ	GALERA
27	ΚΩΝΣΤΑΝΤΙΝΟΣ ΑΝΤΩΝΙΟΥ ΧΑΤΖΗΝΙΚΟΛΑΟΥ	
28	ΚΩΝΣΤΑΝΤΙΝΟΣ ΓΑΒΙΩΤΗΣ ΚΑΙ ΣΙΑ ΕΤΕΡΟΡΡΥΘΜΗ ΕΤΑΙΡΕΙΑ	mycitycar rental by gaviotis
29	ΜΑΝΟΥΣΟΣ ΙΩΑΝΝΗΣ ΚΑΙ ΣΙΑ ΟΕ	GALISSAS RENT A CAR
30	ΝΙΚΗ ΒΑΜΒΑΚΑΡΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ	ΝΙΚΗ ΒΑΜΒΑΚΑΡΗ ΑΕ
31	ΝΙΚΟΛΑΟΣ ΒΑΣΑΛΟΣ ΚΑΙ ΣΙΑ Ε.Ε.	ΓΑΛΗΝΙΟΣ ΟΡΜΟΣ - ΚΑΛΙΑΚΟΥΔΑ
32	ΠΑΓΙΔΑΣ ΑΝΤΩΝΙΟΣ ΚΑΙ ΣΙΑ ΜΕΤΑΦΟΡΙΚΗ ΕΤΑΙΡΕΙΑ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΕΥΘΥΝΗΣ	ΠΑΓΙΔΑΣ EXPRESS ΕΠΕ

33	ΠΑΝΑΓΙΩΤΗΣ ΕΥΑΓΓΕΛΟΥ ΒΑΣΙΛΙΚΟΣ	ARGONAFTES SHIPPING AND TRAVEL SERVICES ΚΑΙ ΒΑΣΙΛΙΚΟΣ RENT A CAR - VASSILIKOS RENT A CAR - ARGONAFTES SHIPPING AND TRAVEL SERVICES - ΒΑΣΙΛΙΚΟΣ RENT A CAR
34	ΣΩΤΗΡΙΟΣ ΓΕΩΡΓΙΟΥ ΚΑΛΛΙΝΙΚΟΣ	CAOMMA
35	ΤΙΜΟΛΕΩΝ ΙΩΑΝΝΗ ΔΗΜΗΤΡΙΑΔΗΣ	
36	ΧΡΗΣΤΟΣ ΓΕΩΡΓΙΟΥ ΠΕΛΕΚΗΣ	DIANA ROOMS - VISIT SYROS

Table 6 List of rent-a-bike companies on Syros

	REGISTRATION NAME	**COMPANY BRANDNAME**
1	AEGEAN PARADISO EE	AEGEAN PARADISO
2	SYROS MALENA RENTAL MOTO AND CAR IKE	SYROS MALENA RENTAL MOTO AND CAR
3	ΑΓΓΕΛΙΚΗ ΝΕΣΤΟΡΑ ΠΑΠΟΥΤΣΑ	
4	ΑΙΚΑΤΕΡΙΝΗ ΓΕΡΑΣΙΜΟΥ-ΜΑΡΙΑ ΚΑΠΕΛΛΑ Ο.Ε	SMILING CARS
5	ΑΛΕΞΑΝΔΡΟΣ ΑΡΒΑΝΙΤΗΣ ΚΑΙ ΔΗΜΗΤΡΙΟΣ ΑΡΒΑΝΙΤΗΣ ΟΕ	ALEX RENT A CAR
6	ΑΜΒΡΟΣΙΑ - ΠΛΥΤΑΣ ΙΔΙΩΤΙΚΗ ΚΕΦΑΛΑΙΟΥΧΙΚΗ ΕΤΑΙΡΕΙΑ	ΠΕΡΙ ΤΙΝΟΣ ΙΚΕ
7	ΑΝΝΑ ΓΕΩΡΓΙΟΥ ΦΡΕΡΗ	GEORGE RENT A MOTO - GEORGE ROOMS AND STUDIOS GALISSAS
8	ΑΝΤΩΝΙΟΣ ΙΩΑΝΝΗ ΚΑΖΑΝΤΖΑΚΗΣ	GALISSAS RENT A MOTO - GALISSAS TOURS - ALPHA RENT A CAR - DIODOS
9	ΑΧΙΛΛΕΥΣ ΙΣΙΔΩΡΟΥ ΔΑΛΜΥΡΑΣ	
10	ΒΑΛΣΑΜΑΚΗΣ ΑΝΩΝΥΜΗ ΞΕΝΟΔΟΧΕΙΑΚΗ-ΤΟΥΡΙΣΤΙΚΗ-ΕΜΠΟΡΙΚΗ ΚΑΙ ΝΑΥΤΙΛΙΑΚΗ ΕΤΑΙΡΕΙΑ	SUNRISE BEACH SUITES SYROS
11	ΓΕΡΑΣΙΜΟΣ & ΠΑΝΑΓΙΩΤΗΣ ΣΙΓΑΛΑΣ Ο.Ε.	
12	ΓΕΩΡΓΙΟΣ ΠΕΤΡΟΥ ΠΡΙΝΤΕΖΗΣ	
13	ΓΙΩΡΓΑΚΗΣ-ΣΥΡΟΣ ΑΝΩΝΥΜΗ ΕΜΠΟΡΙΚΗ, ΤΕΧΝΙΚΗ ΚΑΙ ΤΟΥΡΙΣΤΙΚΗ ΕΤΑΙΡΕΙΑ	ΓΙΩΡΓΑΚΗΣ ΣΥΡΟΣ ΑΕ
14	Ι.ΒΑΜΒΑΚΑΡΗΣ ΚΑΙ ΣΙΑ ΟΕ	
15	Ι.ΠΡΙΝΤΕΖΗΣ-Ε.ΠΡΙΝΤΕΖΗΣ ΟΕ	SMART
16	ΙΩΑΝΝΗΣ ΚΟΥΜΠΗΣ ΚΑΙ ΣΙΑ ΟΕ	ΚΟΥΜΠΗΣ
17	ΚΕΡΚΟΥΡΟΣ ΕΤΑΙΡΕΙΑ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΕΥΘΥΝΗΣ	ΚΕΡΚΟΥΡΟΣ ΕΠΕ
18	ΚΙΝΗΣΙΣ ΕΝΟΙΚΙΑΣΕΙΣ ΜΕΤΑΦΟΡΙΚΩΝ ΜΕΣΩΝ ΜΟΝΟΠΡΟΣΩΠΗ ΕΤΑΙΡΕΙΑ ΠΕΡΙΟΡΙΣΜΕΝΗΣ ΕΥΘΥΝΗΣ	GALERA
19	ΚΩΝΣΤΑΝΤΙΝΟΣ ΔΗΜΗΤΡΙΟΥ ΔΡΑΚΟΣ	
20	ΛΕΩΝΙΔΑΣ ΧΡΗΣΤΟΥ ΜΑΡΟΥΣΟΣ	
21	ΝΑΜΠΙΛ ΣΑΜΙ ΝΑΝΤΑΦ	
22	ΝΙΚΗ ΒΑΜΒΑΚΑΡΗ ΑΝΩΝΥΜΗ ΕΤΑΙΡΕΙΑ	ΝΙΚΗ ΒΑΜΒΑΚΑΡΗ ΑΕ
23	ΣΩΤΗΡΙΟΣ ΓΕΩΡΓΙΟΥ ΚΑΛΛΙΝΙΚΟΣ	CAOMMA
24	ΧΡΗΣΤΟΣ ΓΕΩΡΓΙΟΥ ΠΕΛΕΚΗΣ	DIANA ROOMS - VISIT SYROS
25	ΧΡΗΣΤΟΣ ΔΗΜΟΣΘΕΝΗ ΠΑΠΑΛΕΟΝΑΡΔΟΣ	VELTRA

Couriers

Based on Cycladic Chamber of Commerce official data, Syros has 8 courier companies as presented in the table below.

Table 7 List of courier companies on Syros

	REGISTRATION NAME	COMPANY BRANDNAME
1	FAIR SEAS SHIPPING AND YACHTING SERVICES ΜΟΝΟΠΡΟΣΩΠΗ Ι.Κ.Ε.	
2	ΑΝΤΩΝΙΟΣ ΣΤΥΛΙΑΝΟΥ ΚΑΡΑΜΟΛΕΓΚΟΣ	ANTONIO SERVICES
3	ΓΑΔ ΑΛΟΙΣΙΟΣ ΚΑΙ ΣΙΑ ΟΕ	ΜΕΤΑΦΟΡΕΣ ΣΥΡΟΥ ΓΑΔ (SYROS TRANSPORTATION GAD)
4	ΔΗΜΗΤΡΙΟΣ ΦΩΤΙΟΥ ΞΑΓΟΡΑΡΗΣ (DIMITRIOS FOTIOU KSAGORARIS)	
5	ΕΥ ΖΗΝ Ι.Κ.Ε.	GALERA TRAVEL
6	ΗΛΙΑΣ ΞΕΝΙΚΑΚΗΣ Ι.Κ.Ε.(ELIAS XENIKAKIS)	ΞΕΝΙΚΑΚΗΣ ΙΚΕ (XENIKAKIS IKE)
7	ΚΩΝΣΤΑΝΤΙΝΟΣ ΕΥΣΤΑΘΙΟΥ ΚΟΡΑΣΙΔΗΣ (KONSTANTINOS EUSTATHIOU KORASIDIS)	
8	ΣΕΒΑΣΤΙΑΝΟΣ ΑΝΤΩΝΙΟΥ ΡΟΥΣΣΟΣ (SEVASTIANOS ANTONIOU ROUSSOS)	

There are more transportation companies operating on the island, namely for cargo transfers, using mostly heavy professional trucks.

2. Electric mobility ecosystem basics

To implement e-mobility there should be basic understanding of all the actors involved in the e-mobility ecosystem. This section includes an explanation of the main actors in the e-mobility ecosystem and the contractual framework needed to assure its optimal functioning. The scheme in Figure 9[1] shows:

- The interrelation between different stakeholders needed for e-mobility
- Contractual relations related to electricity, land use, mobility and charging that allows for smooth operation of the system and
- Data collection points that make optimisation of mobility, electricity and land use systems.

[1] The Greek translation of the e-mobility ecosystem scheme is provided in Annex 1: E-mobility ecosystem scheme (Greek)

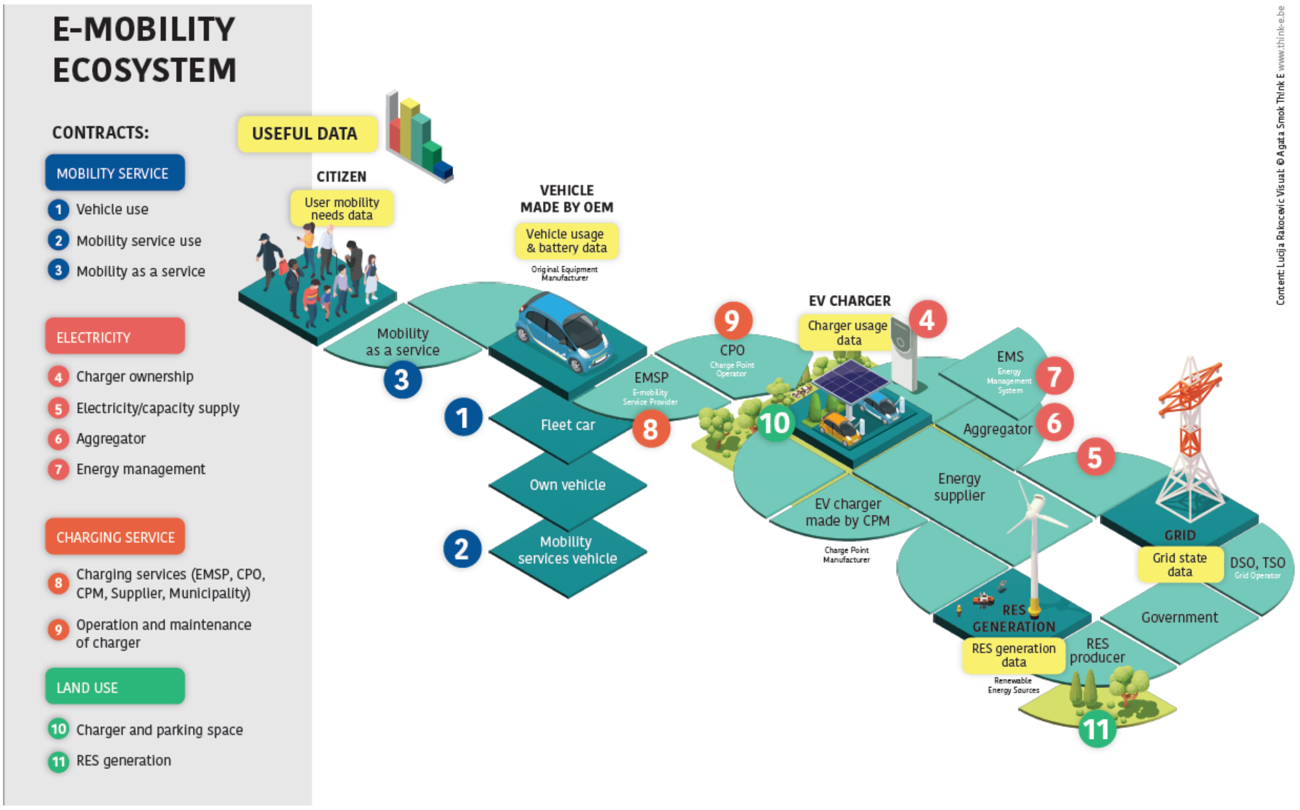
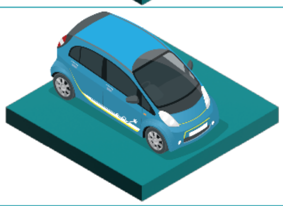
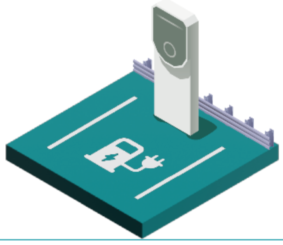


Figure 9. Scheme of the e-mobility ecosystem with main actors, contractual agreements and data

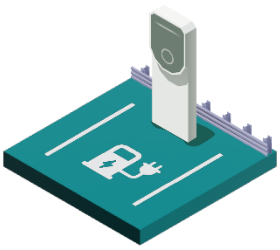
E-mobility revolves around citizens who will use electric vehicles (EVs) to fulfil their mobility needs. For EVs to operate, the battery needs to be charged using electricity. The charger needs to be placed on a parking location for which land use is needed. The electricity can be used from the grid, or ideally from a local renewable energy generation source, such as PV or wind turbine.

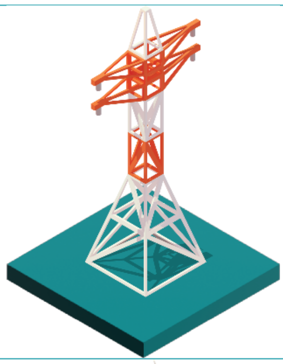
From the **mobility** point of view, the following stakeholders (with reference to Figure 9) and related mobility contracts exist:

Icon in the scheme	Name of stakeholder	Mobility contract
	Citizen, mobility user	Mobility-as-a-service contract to choose from different mobility options (public transport, taxi, rental vehicles etc.)
	Electric vehicle owner: • citizen, • fleet operator (rent-a-car company, car sharing, etc.) • mobility service operator (taxi, public transport, etc.)	Vehicle use contract Mobility service contract

	Charger and related parking space owner	Operation and maintenance of charger contract

From the **electricity** point of view, the following stakeholders with their characteristics exist:

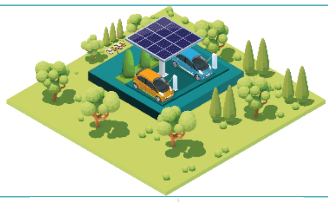
Icon in the scheme	Name of stakeholder	Characteristics
	Citizen, EV user	Owner of an EV
	Mobility service provider (taxi, rent-a-car, public transport etc.)	
	Electric vehicle (EV)	Driving range (battery capacity) Vehicle-to-grid (V2G) capability
	Original Equipment Manufacturer (OEM)	
	E-mobility service provider (EMSP)	Company providing access to charging points to the EV user
	EV charging point or charger	AC or DC charging Power capacity (kW) Charging current Smart charging capable V2G capable
	Charge point manufacturer (CPM)	
	Charge point operator (CPO)	Company operating multiple chargers
	Energy management system (EMS)	Company managing energy use by an EV, charging by EV charger, electricity production by RES producer
	Aggregator	Company that aggregates energy capacity provided by multiple charger/EVs Capacity can be offered to DSO for balancing or on the wholesale energy market

	Electricity grid	Available capacity at the connection Possible current for charging
	Distribution system operator (DSO) or transmission system operator (TSO)	
	Energy supplier	Company providing electricity to the user
	Renewable energy source (RES) generation plant	At the location of a charger Separate RES plant Might include additional storage Connected to the grid or behind the meter of the charging station
	RES producer	

The function of some of the electricity stakeholders overlap. The electricity and charging contracts are:

- Charger ownership contract
  Function: Regulating ownership of the specific charger.
  Contract sides: Contract signed between new charge owner (citizen, local government, fleet company, company etc.) and the charge point manufacturer (CPM).
- Electricity/capacity supply
  Function: Contracting allowing consumption of electricity with defined capacity by the charger and in case of V2G injection of electricity into the grid by the charger.
  Contract sides: Charge point operator or charger owner and DSO, energy supplier or RES producer.
- Aggregation contract
  Function: Providing control of EV batteries through chargers to aggregate energy capacity when needed.
  Contract sides: Aggregator and EV owner and charger owner/operator.
- Energy management system contract
  Function: Controlling EV charging, RES generation and charger use to balance energy consumption and use to have the least effect on the grid or minimum price for the user.
  Contract sides: EV owner, charger owner, RES producer or DSO and EMS company
- Charging services contract
  What: Access to specific chargers.
  Contract sides: Between EV owner (citizen, fleet company, local government, etc.) and either CPO, EMSP or CPM depending on who is operating the charger.
- Operation and maintenance of charger contract
  What: Operation and maintenance – making sure the charger and the charging location and charger are accessible, charger is working under contracted conditions, data is provided to the contract defined actors.
  Contract sides: Contract signed between the owner of the charger (citizen, local government, fleet company, company etc.) and charge point operator (CPO or CPM).

From the **land use** point of view, the following stakeholders and related contracts exist:

Icon in the scheme	Name of stakeholder	Land use contract
	Operation and maintenance provider of charger and parking space	Land use contract for charging and parking space
	RES producer	Land use contract for RES generation plant
	Land owner	Land use contract

In order to optimise energy and mobility services data can be collected at multiple points, as indicated by the yellow icons in the scheme, see Figure 9. When defining a contract with any of the above-mentioned service companies, it is extremely important to define who owns the data, with whom can data be shared and how it can be used. The data can be used to track and predict:

- Mobility use and needs
- Charging infrastructure use and needs
- Renewable energy production use and needs
- Grid expansion needs

Such data is of value for island development planning, and the municipality should try to ensure that this data is available to the municipality in timely manner and in useful format.

The role of the government is multi-dimensional, as different levels of government might be responsible for regulating mobility, electricity, and land use sectors. The island municipality can influence as a stakeholder that is in charge of local mobility and land use planning. Through e-mobility, the municipality can become an active participant in the electricity sector. The local government is crucial in defining the local rules for the use of vehicles and parking and should be involved in electricity grid and charging infrastructure planning.

The local government can also get involved in RES generation and its planning. Moreover, the local government could establish an energy community and assure that more local stakeholders, including the citizens, can be involved in the local energy planning, and specifically e-mobility, promoting sector coupling.

3. Business models and best practices

When a local government decides to transition to e-mobility, the strategy for deployment of charging infrastructure needs to be decided. There are three main strategies:

- **Demand driven**
  The location of new chargers is defined based on the EV driver and other user mobility needs. This strategy decreases the risk of underused infrastructure. The local government can help the process by defining the heatmap of the island indicating where the installation of chargers would be preferable. The local government could also help by going through the process of choosing the charger installer in advance.
- **Planning oriented**
  The local government, together with other stakeholders, defines the list of locations where chargers can be installed. This strategy requires close cooperation between local governments sectors for mobility and urban planning and coordinated with the DSO. The local government could also make sure that the land ownership on the specific locations is either public or work with local owners to define clear procedure.
- **Business oriented**
  Location of the chargers is defined based on the needs of the private sector and the local government regulates for example the land use, interoperability of chargers to avoid infrastructure lock-in, or access by the local citizens. This option requires the least involvement and effort from the local government but also allows for the least control.

The municipality of Syros, in alignment with the national regulation promoting the development of municipal EV charging plans, has decided to start its electromobility transition using a planning-oriented approach, where the municipality in coordination with the DSO (HEDNO) and its own land planning and transport sector will decide on the allowed locations for the deployment of the first publicly available chargers.

Best practice:
The Canary Islands regional government, together with the Canary Technical Institute (ITC,) have prepared a strategy for electric mobility for the Canary Islands detailing the plan for the transition to electric mobility and a heatmap for the charging infrastructure for each of the islands.
The strategy can be used for demand driven approach or for local governments to use planning-oriented approach and define specific locations for the charging stations based on the strategy.

Link to the study

In this chapter, we present different e-mobility business models and explain how the local government can get involved and which role it could play. However, while in many cases the provided examples present local governments from cities on mainland, it is important to understand that insular islands have two specific characteristics which require their business models to be slightly modified to presented city examples. These are:

- seasonality of island's mobility and energy needs, and
- insular island market where the local government, local community and private businesses are closely connected.

Seasonality is seen not only in electricity consumption as previously discussed but also in the mobility needs. Namely, during summer season (May to October) the number of inhabitants of Syros increases, followed by the increase in mobility use and needs. Data from 2021 (see Figure 10) shows that in 2021 the number of passengers arriving to Syros triples in August compared to April, May and October. In addition, the number of private vehicles arriving to Syros triples in July compared to April and even increased by five in August in comparison to April. This seasonality in the number of users needing mobility, but also number of vehicles using the road infrastructure has to be taken into account when assessing business models.

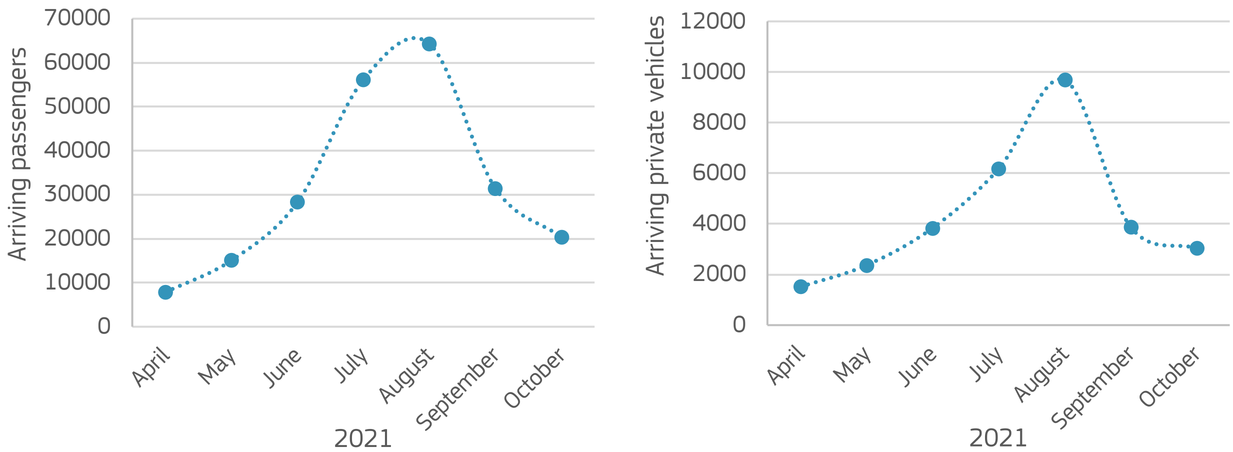


Figure 10. Seasonal nature of the number of passengers and private vehicles arriving to Syros in 2021

In addition, Syros represents an insular market. The municipality collaborates closely with the local industries and business owners, such as rent-a-car company and other services to assure the reinforced measures are coordinated with all stakeholders whose livelihood depends on it. Therefore, discussed business models should be implemented in collaboration with these stakeholders to assure that the local community and businesses also benefit from the transition to e-mobility.

Three aspects of business models for EV charging are presented below:

- business models for charger installation, operation and management between the municipality and private sector (charge point installers or operators);
- business models for additional usage of the public chargers and/or the municipal fleet to assure optimal usage of the public chargers; and
- business models for the involvement of additional stakeholders that can be developed in the later phases of the electrification of transport on Syros.

Along with the discussion of business models, the relevant examples of islands, where possible, or cities/municipalities that have used the mentioned approach are presented.

3.1 Business models for charger installations, operation and management

The European Investment Bank distinguishes five main contractual models that can be used to roll-out recharging infrastructure.

1. **The public contracting model**
   The municipality keeps control over the infrastructure and retains most of the project risks, from construction to exploitation. This requires a high level of investment from the side of the municipality.

Advantages (+)	Disadvantages (-)
- Faster implementation - Infrastructure owned and operated by the city - Data owned by the city - City keeps the decisions on where and how to expand the charging infrastructure - Assures minimum usage of the charger by the EV owner	- Requires a lot of investment from the city - Requires know-how for management and operation of the charging infrastructure

Example:
The city of Amsterdam partnered with the electricity utility company Nuon and the charge point installation company Heijmans following a demand driven approach to charger installation. Once a demand for a charger is received, the private partner analyses the demand and proposes the best solution. The solution is approved by the city and the city pays the installation to the private partner. The charger is owned and managed by the city of Amsterdam. The data is owned by the city and analysed in collaboration with Amsterdam University. Based on this analysis of the charger usage, decisions can be made for new charger installations.

2. **The joint-venture model**
   The municipality partners with the private sector and they share the overall control of the infrastructure. The project risks are also shared. The model remains flexible on financing of the expenditure.

Advantages (+)	Disadvantages (-)
- Project risks are split between the municipality and the charge point operator, and financing conditions are set at the beginning.	- Requires direct involvement of the municipality in financing, operation and maintenance - Requires know-how from the municipality.

Example:
Oslo is the first city that installed public chargers in Europe and is now the city with the most EVs in Europe. Therefore, they developed the know-how over the years and the human capacity to be able to own and operate their own charging infrastructure.
Oslo implements public charging through a joint-venture approach. The city's agency plans where the new public chargers will be and takes into account the demand by EV drivers to adjust its plans. The chargers are installed by the city and a single private contractor. The public chargers on public land are owned and operated by the city administration. When it comes to publicly accessible chargers on privately owned land, they are owned by private companies and operated through collaboration of the city agency with the real-estate companies. The city rents these spots during the night to make them publicly accessible to EV owners for charging.

3. **The concession model**

A private party is given the concession to run and exploit (and build) the EV charging infrastructure. The (financial) risks lie with the concessionaire. The municipality can make more demands on where and what kind of infrastructure will be rolled out according to a contract. This allows the municipality to promote smart charging infrastructure, for example, or to put restrictions on the tariffs charged to end consumers. Many aspects of the concession model can be tailored to suit the public authority's objectives and constraints.

Advantages (+)	Disadvantages (-)
- Low financial risk for the municipality - The municipality can pose demands on the type of charger, tariff charged to consumers, operation/maintenance etc. - Very versatile from the operational and financial point of view	- Needs to be given for a specific number of years - Requires preparation from the municipality, as their current choices must be followed for X number of years - Revenues are collected by the operator, but can be shared.

Example:
London: the contract between the municipality and the operator determines the length of the contract, the ownership of the charger (infrastructure) and the financial arrangement (e.g. revenue share). For example, for one of the municipalities within London, the financial arrangement is such that the charge point operator works with the municipality to find the best location for the charger, covers the cost of installation and pays a fixed annual fee to the municipality for the charger location, while the municipality provides a parking spot for each of the chargers. The charging/usage data is shared with the municipality and its authorities in order to better understand the needs for future charging infrastructure.

4. **The availability-based model**

The municipality allocates the project risks between the public and the private sector, but the municipality collects the revenues from the EV charging stations and therefore retains the demand (revenue) risk of the project. The private sector finances the expenditure and is paid back by the public authority over the duration of the contract only if the infrastructure is available for the intended use. This enables the municipality to enforce inclusive tariffs for local residents without the concern for infrastructure availability. However, this does hold a financial risk for the municipality if the recharging point is underused.

Advantages (+)	Disadvantages (–)
- The Investment risk is shared between the municipality and the charge point operator - The municipality owns the charger and infrastructure - The municipality collects the revenue	- The demand risk is on the municipality completely - The charge point operator is paid for a specific number of years if the charger is operational and available for use

5. **The license model**

A party that complies with the policy rules drawn up by the public authority can be given permission to install, manage and operate charging points in the public space. The licence can include constraints over what the private sector can do. The private sector keeps the control over the infrastructure and retains most of the project risks, from construction to operation, it finances the expenditures and collects the revenues from the consumer. Through licences it is possible to limit the number, but erection at less favourable locations cannot be enforced. Where there is a limited number of licences or even just one licence, transparency obligations can apply when granting the licence.

Advantages (+)	Disadvantages (–)
- The municipality can limit the number of operators given the licences - The licence can include limitations of what the operator can do - The private sector finances the installation and takes over all the risk during operation - This approach follows demand, which assures a minimum usage	- The municipality doesn’t control where the chargers are installed – no control over low penetration areas - The private sector keeps control of the infrastructure

Public contracts or joint venture models put the control with the municipality but leave little room for innovation from the private sector. While the license model leaves room for private innovation, it does not guarantee an inclusive operation of chargers.

The choice of the model depends on the goal that the municipality of Syros wants to achieve and their expected level of involvement. In addition, business models used in Syros should ensure the involvement of all needed stakeholders to allow for local stakeholder collaboration. Therefore, the joint venture model, where Syros stakeholders can be represented through an energy community together with the local government could be one of the solutions.

Different models can also be chosen for regular chargers and fast chargers. Moreover, the municipality can decide to implement a combination of these models.

Before deciding on a model, the municipality needs to decide the **range of services** it would like to provide and the services a private partner should provide. The decision about the partner and its services will need to be made early, so that any aspect not covered by that relationship can be planned for by the municipality. For example, if the municipality is looking to only purchase equipment (under availability-based model), it will need to develop a plan to manage data and provide payment services for the chargers.

The model choice also depends on the **market maturity**. Even though Syros has an immature market, electromobility is growing fast and the market will change on a relatively short time period. In order to avoid an infrastructure lock-in, the municipality should always provide contract, concession or license for a short-limited time. For example, typically in a starting EV market, all models will need to be combined with a subsidy, as in many places the exploitation of recharging infrastructure does not represent a sufficiently profitable business case, due to the initial low usage time. If the municipality would have concluded a long-term contract including this subsidy, this would lead to unnecessary costs as the exploitation of recharging points becomes more profitable once the number of EVs on the island increases.

An ICCT working paper[2] from 2021 on electric vehicles and experience from European cities explains that some of the main challenges that cities face in implementing charging infrastructure are **planning, installation delays and soft costs**. The responsibility of planning can fall on different actors depending on which approach to implementation the municipality decided to follow. With the study to identify the locations for chargers, the municipality of Syros decided to follow the planning-oriented approach, where the local government defines the location of chargers that operators can apply for.

Due to delays in installations, the procedure of approval and installation of the chargers can take from one to twelve months or more. Finally, the accent is placed on the soft costs, meaning the cost of finding the right site, meeting building codes, obtaining a grid connection, receiving a building permit etc. Soft costs can be in some cases three to five times the cost of the actual charger. Therefore, if the municipality of Syros can decrease soft costs and installation delays by planning the charger locations and helping the operators with receiving the grid connection and building permits, they would already be providing significant input into the initial costs of the installation.

The above-mentioned business models represent different ways for the municipality to be involved in the operation and exploitation of publicly accessible EV recharging points. When implementing any of the models it is important to keep in mind best practices for supporting the roll-out of EV charging infrastructure.

3.1.1 Coordinate with neighbouring municipalities or islands

Throughout Europe, municipalities discover the advantages of cooperating with neighbouring public authorities. Through joint procurement of infrastructure, municipalities can lower costs, create platform to exchange lessons learned and best practices, while at the same time ensure uniformity of charging infrastructure.

[2] https://theicct.org/publication/efficient-planning-and-implementation-of-public-chargers-lessons-learned-from-european-cities/

3.1.2 Supporting legislation

The e-mobility challenge touches multiple sectors, it is not only a mobility challenge, but also equally challenging for the energy, building and spatial planning sectors. Policy to promote e-mobility should therefore not only focus on one specific aspect but instead attempt to apply a multi-sector approach. Successful e-mobility infrastructure rollouts are not only focused on publicly accessible charging points, which are part of the solution, but need to be seen in combination with private recharging points. Building policies to support private charging infrastructure, assuring new buildings or parking areas are designed in a way to allow for future installation of charging infrastructure. These sort of policies, from national, regional or local government can go a long way in promoting the uptake of e-mobility. The evolution of this private (or semi-public) infrastructure directly relates to the demand of publicly accessible recharging points. Municipalities should re-evaluate their implementation strategy based on the evolution of e-mobility and user needs, data collected based on the existing infrastructure.

3.1.3 Competition for the market

Public authorities should enable open market access. Open markets lead to competitive pricing and innovation that will benefit the end consumer. There are various measures a municipality can take to support open and transparent market access:

- **Reduce financial risk for the bidders** to increase the number of participants. Municipalities can research and provide potential locations and ensure sufficient licenses or grid connections are in place (or agreements are made with the DSO to upgrade the grid capacity in the near future).
- **Put a time limit on the contract** to allow for flexibility in the fast-growing e-mobility market. As mentioned above, the EV market is very dynamic and the uptake of EVs on the island can influence the recharging point implementation strategy. It is important for the municipality to be able to change strategies based on recent developments on the island.
- **Auction locations to the highest bidder** to stimulate open market access. The locations on Syros will be determined by the study. This study can be used to auction individual locations based on their estimated market value. Locations close to high traffic points will represent a higher financial potential for interested parties. Choosing only one provider for the entire island reduces the openness of the market and provides no incentive for competitive pricing or innovation. Therefore, it is a best practice to auction the locations in smaller lots.
- **Batching locations** provides the opportunity to include low traffic points with public recharging point infrastructure. By creating batches of locations of about the same economic value (combining high traffic locations with low traffic locations) the municipality can ensure all residents on the island have access to public charging infrastructure. The economic value of a location is an important result of the previous study in order to successfully apply this strategy. However, certain business models (such as the license model) do not mandate the construction of infrastructure on the acquired locations. The municipality should choose an appropriate business model where a minimum number of recharging points are required for each location.
- **Price as an award criterion** can be an incentive to ensure not only low cost for the public authority of Syros but also for the end consumer. Especially in the early stages of EV uptake, the price of charging is important to gain traction and increase the number of EVs on the island. Other solutions to reduce the cost for end consumers include an intervention from the municipality on the charging tariff. This can be achieved through specialised RFID cards

supported by the island of Syros on which a reduction can be offered. RFID cards for the local residents allow to differentiate between locals using the charging station and tourists and apply a different pricing strategy. In addition, members of an energy community on Syros could have a cheaper price than those that are not members, such as tourist. The difference in price can be used to pay back for the needed charging infrastructure.
The price can also differentiate depending on time of use in order to incentivise charging during the times that RES plants are producing. Therefore, lower charging price during the periods of high RES generation and vice versa.

3.1.4 Qualitative tender

When preparing a qualitative tender for EV charging infrastructure the municipality should keep in mind the following 7 guidelines:

1. Recharging points are well-designed and positioned
2. Infrastructure is interoperable, both in terms of hardware (connector fits vehicle) and software (infrastructure can communicate and interact)
3. Infrastructure is future proof
4. It is easy to find and use, and users know in advance what they will pay for recharging
5. Infrastructure functions properly, with a high uptime, while errors and bugs are quickly resolved
6. It is (cyber-)secure
7. It is defined who owns and who can access the collected charger usage data and in which timeframe.

Besides the setting requirements regarding the quality of infrastructure, public authorities should make sure these can be enforced. To this end, public authorities should require guarantees from bidders or include enforcement mechanisms in their tender specifications. A common example are penalties for failure to meet uptime requirements.

3.2 Business models for usage of public or semi-public fleets and chargers

Vehicle fleets represent the easiest way to start transition to electric mobility. This is due to the fact that in case of fleets the business model is related to one public body or company that is making a decision to change multiple vehicles. In the case of Syros, the municipality is changing the municipal fleet and introducing the electric mobility to the island. In order to popularise e-mobility, the municipality could co-own an EV sharing system with local mobility service providers (taxis, rent-a-car companies) to provide additional services. This can be implemented through an energy community or a cooperative where municipality and other local stakeholders can be members of such a community. Business model for EV sharing is presented below with European examples.
With a goal to optimally use the installed e-mobility infrastructure and integrate electric mobility with the rest of the electricity sector, business models need to take into account smart charging and possible use of EV as a local storage through vehicle-to-grid. While current regulation in Greece is limiting the use of vehicle to grid, smart charging depends on the technical specifications of the charging infrastructure and represents basics for optimal business models.

3.2.1 e-Car Sharing

As the transition to the electric mobility has not yet started on Syros, Syros municipality could consider to co-own EVs with other local business owners (taxis, rent-a-cars) within an energy community. These vehicles could use the publicly available charging stations to popularise electric mobility, increase awareness and provide the option for visitors to use EVs. Therefore, Syros could use an e-Car sharing business model to provide the use of part of the municipal fleet during part of the day or weekend for use by local mobility service companies.

The car can be used in the part of the day or weekend, when it is not used by the municipality, by the mobility service companies or energy community members who become subscribers to this service. Further, the local mobility service companies or energy community members could avoid the risk of vehicle ownership and the cost for car maintenance is distributed among multiple users. The subscription fee is based on the daily or monthly driving distance of a subscriber, for the local community.

Moreover, if municipal fleet of Syros cannot be available for the car sharing services, they could partner with a company that would provide EVs and car sharing services, while the municipality could offer the municipal chargers. That way these public charging locations would in certain time period be available only for the car sharing services.

Examples:

Spanish islands

E-car sharing on the Spanish islands is organised by electric utility Endesa. Endesa has installed charging stations across Spanish islands and provided EVs for e-car sharing options. This has been used to increase awareness[3] about electric mobility and provide a wide spread of charging stations that would make the use of EVs on islands by tourists or local citizens possible[4].

Malta

Car Sharing Services Malta (CSSM), a subsidiary of CAR2GO Israel, has unveiled a car sharing service using a fleet of electric cars (Renault ZOEs)[5]. The car sharing service in Malta uses a convenient, free mobile application that is able to find the electric cars available nearby. The app finds the electric car that you can drive in any direction you want, before leaving it parked in one of the locations identified on islands of Malta and Gozo[6].

GoTo Malta is not just the first car-sharing club in the Mediterranean island nation, it is also resolutely post-fossil-fuel: the newly-launched service provides 150 Renault ZOE EVs[7] to drive around Malta or Gozo.

Offered via a government-backed scheme, the EVs can be booked via an app and are available 24 hours a day. The Maltese government has reserved 450 parking spaces for the scheme in high-use parking areas and is planning to install 225 double-chargers throughout both islands.

There is a monthly membership fee for GoTo Smart, and fees depending on how EV is being used and for how long[8].

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[3] https://www.endesa.com/en/projects/all-projects/energy-transition/electric-mobility/ecar-discover-emission-free-mallorca

[4] https://www.endesa.com/en/projects/all-projects/energy-transition/electric-mobility-baleares-canarias

[5] https://www.legaleappalti.it/dip3oo0o/car-sharing-malta

[6] https://malta.italiani.it/car-sharing-a-malta-una-realta-concreta-in-crescita/

[7] https://www.fleeteurope.com/en/smart-mobility/others/article/new-car-sharer-goto-malta-uses-only-zoes?a=FJA05&t%5B0%5D=GoTo%20Malta&t%5B1%5D=car2go&t%5B2%5D=Malta&t%5B3%5D=Israel&t%5B4%5D=Car%20sharing&curl=1

[8] https://www.goto.com.mt/standard-fees/

Pantelleria, Italy

The island of Pantelleria has implemented amiGO car sharing for EVs[9]. The cars can be rented for the time necessary through the "amigocarsharing" app[10], which can be downloaded free of charge for the Android and IOS platforms. The cars can be picked up in the dedicated spaces and can be released either in the pick-up parking lot or in another parking lot.
The municipality is using the car sharing options to decongest road transport and to promote the shared use of the vehicles and e-mobility. The islands, in fact, especially in the summer months, are filled with tourists who very often reach them by private vehicle, complicating the local traffic situation. The amiGO car sharing in Pantelleria is the first car sharing service inaugurated for a smaller island in the Mediterranean and in addition to being useful for residents who could share the use of the car, it will serve to encourage tourists not to arrive on the island with their own private vehicle, being able to access a more sustainable solution for internal travel.

Another advantage of the service offered by amiGO concerns the possibility of using, with a single registration, the entire fleet of cars present in the localities of Sicily where this service is active. Among these we mention Palermo , Trapani , Catania , Enna , which are the main hubs of connections to and from the island.

Currently there are 5 parking stations in Pantelleria to serve the car-sharing scheme and it is expected that there will be the deployment of 10 electric vehicles (Renault ZOEs) available for the car-sharing scheme. Two of the 5 parking lots are situated at the port and city centre of Pantelleria, one at the airport and two more at Khamma-Tracino and Scauri.

The multiple services for car sharing include differences if the car is returned to the same location or a different one as with regular car-sharing services.

3.2.2 Smart charging and Vehicle to Grid (V2G)

When setting the requirements for the charging stations Syros should keep in mind that for the optimal integration of EVs into the electricity grid, chargers should offer smart charging[11] capabilities. Only if the charging stations can provide smart charging can they be optimally used to balance the local grids and assure security of supply. The flexibility that smart charging stations can offer for the electricity grid when vehicle is parked (Charging can be interrupted in case of high consumption periods, charging can be activated in the periods of high RES generation to assure local balancing, etc.) is a service that either municipality or charge point operator can offer to the DSO.
V2G is an advanced form of smart charging where the charger and a vehicle are capable of allowing electricity to flow in both directions, from grid to the vehicle and from vehicle (battery) to the grid. In this way the vehicle is not only parked and possibly charging but can be used for energy services to the grid when not in use.

Currently this type of service is not monetised on the local energy markets, but smart charging can also allow for aggregation of flexible assets (parked car batteries) by a third party (aggregator) to offer services on the energy market. Obviously the more EVs can be aggregated the better, and in

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[9] https://gds.it/pantelleria-da-domani-attivo-car-sharing-gestito-da-amat-palermo/
[10] https://www.amigosharing.it/site/amigo.php?t=map
[11] https://smart-cities-marketplace.ec.europa.eu/sites/default/files/2021-02/D32.1D3_Solution%20Booklet_EVs%20and%20the%20Grid.pdf

some countries that allow for this service to be offered on the energy market, the minimum capacity of 1 MW requires aggregation of large number of EVs.

In the start of the electrification process and due to the regulatory barriers, V2G does not yet have an easily implemented business model. However, the municipality is strongly advised to require the installation of smart chargers. Smart chargers help not only allow for these business models in the future, but also allow for remote monitoring and control needed for optimal maintenance and operation.

Example:

Porto Santo, Portugal

Island of Porto Santo[12], Portugal is a location where electricity utility EEM, Renault vehicle manufacturer and the Mobility House charge point operator are implementing a project of smart mobility for the purpose of both decarbonising the transport of the island and increase flexibility of the electricity grid to assure higher RES integration. The project includes 40 chargers, of which all but two are smart chargers and two include V2G capability. In addition, the second life batteries, mentioned in the next section are used for the implementation of stationary storage for increased grid flexibility.

3.3 Business models for other stakeholders

With transition to e-mobility, additional business models for other local stakeholders become available. Here we discuss just some of the business models that are related to electrification of road transport.

3.3.1 Second Life of Battery

An EV battery is required to be replaced when the capacity reduces to 70%-80%. However, these batteries can still be utilised for energy storage systems. Used EV batteries can be used as local storage for rooftop PV, solar streetlight applications, backup power for telecom towers, or grid flexibility storage. This extends the useful life of the battery by another ten years before they need to be disposed. Utilising the second life of the battery also leads to a way for an EV owner to monetise the investment. Example of such 2nd life battery use can be seen in Porto Santo example above.

3.3.2 Battery Swapping

This business model is optimal for e-bikes or e-scooters that can be very useful for short trips on islands. Charging times are not needed as one can easily replace the empty bike or scooter battery with a charged battery from the charging station. In addition, due to controlled charging conditions, batteries last for longer charging cycles. The battery swapping provider has a contract with the customer, which contains the automated swapping of discharged to charged batteries for the e-bike or e-scooter. The swapping provider follows his/her own optimised charging strategies. Whereas the customer possesses a battery for a temporary period.

[12] https://www.mobilityhouse.com/int_en/our-references/porto-santo-emisson-free-island

3.3.3 Mobility as a Service

Mobility as a Service (MaaS) means the integration of various forms of transport services into a single mobility service accessible on demand. There are currently several initiatives in typically larger cities/urban areas. To meet a customer's request, a MaaS operator facilitates a large offering of transport options, be they public transport, ride-, car- or bike-sharing, taxi, car or bike rental, or a combination. The aim of MaaS is to provide an alternative to the use of private car that may be as convenient, more sustainable, help to reduce congestion and constraints in transport capacity. This development may have an impact on the business models as set out as it can replace some of the transportation by EVs with other modes of transportation. On the other hand, it may well prove to be easier to reach out to larger fleet-owners such as car sharing companies, car rental companies or similar having a professional large-scale counterpart that in turn offer EV transportation to its customers.

3.3.4 Demand Responsive Transport (DRT)

DRT is a transport service where day-to-day operation is determined by the requirements of its users. Typically, this involves users calling a booking service, which will then plan a route for the day to pick-up users and take them to their required destination. Increasingly, such systems are also using internet connections; via web browser or mobile apps, to enable bookings. While this has been active in private transport services, it is becoming more and more popular for public road transport services and aims to replace the traditional public transport timetables and defined paths. DRT helps reduce emissions and congestion due to removing unnecessary trips and routs, allows for cost-efficient connectivity of dispersed population and can help support citizens with limited mobility. An example of such app, Moia by Volkswagen[13] will be tested and applied with e-mobility on the Astypalea island.

Examples:

Niepolomice, Poland

The municipality of Niepolomice, Poland[14] is an example where DRT has been used to replace the traditional public bus transport with tele-bus system, an on-demand bus service for three districts. With the new services users can request a journey between any two of 77 stops in the covered area, up to 30 minutes before required departure. The service has been mainly used by commuting workers, students and elderly people. The system faced initial opposition when it was introduced in 2007. However, its user base grew and currently represents a good example of cost-effective public transport.

[13] https://www.moia.io/en

[14] https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/2018-06-27_Policy_Brief_Demand_Responsive_Transport.pdf

3.4 Greek islands examples

Currently, there are multiple Greek islands in the process of electrifying their road transport. Even though the transition to e-mobility is at its initial stages, it has started on multiple Greek islands, mainly in close collaboration with local stakeholders. Examples of Greek islands include:

- Astypalea[15], a collaboration between several stakeholders including the Greek Government and the Volkswagen Group, where the aim is to replace all conventional vehicles on the island with EVs. The aim is to provide a successful example of smart and sustainable Mediterranean island through implementation of not only e-mobility and smart charging, but also smart mobility in combination with RES generation through implementation of hybrid plants (RES in combination with storage system).
- Chalki[16], the project is starting as a donation from Citroen to the Chalki municipality to use six EVs as part of municipal fleet. In collaboration with national government, Vinci and Akuo Greece this will continue into a project to further transition road transport and couple it with RES generation on the island.
- Kythnos, where in the framework of Kythnos Smart Island run by DAFNI and the National Technical University of Athens, multiple smart mobility applications are implemented on the island including electrification of the municipal fleet, e-bike sharing, aiming to achieve synergies between mobility and energy,
- Ai Stratis[17] where a clean energy project has been implementing a hybrid plant to increase RES penetration. E-mobility is part of the project with testing charging station being installed.

[15] https://smartastypalea.gov.gr/

[16] https://www.media.stellantis.com/em-en/citroen/press/citroen-s-innovative-approach-to-sustainable-mobility-helps-transform-chalki-into-a-smart-and-zero-emission-island

[17] https://www.aistratis-greenisland.gr/

4. Regulatory framework, barriers and enablers of e-mobility

4.1 Legislative and regulatory framework

The main legislative act for e-mobility in Greece is Law 4710/2020 for the promotion of e-mobility and its derivative ministerial decrees. The law allows for the installation of publicly accessible chargers at existing parking spaces, gas stations, parking lots of shopping centres, supermarkets and in other public areas, along highway and motorways. It also introduced the establishment of charging operators and calls for multiple incentives, subsidies, and mobility privileges to EV users to encourage their deployment.

Currently, the majority of the public charging stations in Greece is installed in densely populated urban areas, while high-power (fast) chargers are mainly installed in rest areas of highways. The year 2020 has seen a significant increase in the implementation of EV charging infrastructure in Greece with the overall number of chargers increasing from 58 in 2019 to 334 in 2020 and up to 498 in 2021. When it comes to islands, the charging infrastructure has been mainly implemented in large ones, such as Crete, while small islands are still considered to be low integration zones.

While the legislation framework has been established recently in Greece, the regulatory framework is currently under development. E-mobility implementation and business models is related to other aspects of energy transition such as use of storage, aggregation of assets for offering flexibility services and demand response.

The detailed regulatory framework for energy storage systems is needed. This framework is expected to enable further penetration of renewable energy production and storage locally on the islands, providing clean energy for sustainable e-mobility uptake. Clean energy production and e-mobility usually operate in a complementary way as there is a need for clean energy to maximise the emission benefits of e-mobility while the e-mobility network may promote the functionality and stability of the electric network, through V2G interaction.

EV Charging Plans (EVCP) are currently under development on municipality level and by the end of March 2022 all municipalities should complete their Charging Plans. Syros, as a capital of Regional Division has the responsibility to complete its EV charging Plan until the end of 2021.

In the recent regulatory framework, the procedure for the deployment of EV Charging Plans (EVCP) and their content are determined in quite a detailed way. However, there are still some points of ambiguity that could act as a regulatory barrier.

4.2 Current barriers to e-mobility

While the Greek government is expected to introduce the regulatory framework for energy storage facilities, the regulation for installation of stand-alone storage systems and their operation connected to the grid or at the location of the set of charging stations is still not clear. This presents a barrier to deployment of e-mobility as island systems have to keep security of supply as priority in the energy transition.

EVs, together with the implementation of V2G or smart charging, could serve as an aggregated storage system or flexibility asset, respectfully, for grid balancing through demand response. However, in order to fully use this benefit of e-mobility to the electricity system, further provisions from the EU 2019/944 Electricity Directive need to be implemented. The V2G is not yet fully regulated on the EU level either, while testing projects have been running for years and the technology is ready.

The specific characteristic of islands is the need for involvement of local stakeholders and the community. Therefore, implementation of energy transition and e-mobility which affects the economy and life of local stakeholders can be implemented through energy communities. While energy communities in Greece have been regulated since 2018 with Law 4513/2018, its implementation and regulation are not always clear. There is an ongoing effort to improve the regulatory framework for energy communities.

According to the Greek legislation framework, ambiguities have been detected in the licensing procedure of EV charging stations. Specific cases of charging infrastructure (spatial/per location) are foreseen while it is not clear which is the exact licensing procedure for other cases. The problem is intensified due to the lack of experience of public authorities' officers in charge. In addition, the fact that there are various legal authorities (on a municipality geographic area) such as port authority, airport authority etc. that are responsible for the specific zones such as port, airport etc. and not the municipality authority itself resulting an extra complexity in the implementation process because of perplexed responsibilities. The advantages of islands should be in easier local coordination of the stakeholders to assure that the soft cost and delays in the installation of chargers is minimised.

Additionally, some of the barriers to implementation of e-mobility are lack of charging infrastructure and high prices of electric vehicles. Therefore, the initiative for electrification should come from the bottom-up with the municipality taking the initiative, as is the case with Syros. In addition, the low-integration areas have been recognised to have a good potential for private charging infrastructure as the areas for the chargers is easily available. However, private charging infrastructure doesn't offer the possibility for local stakeholder collaboration in business models and high expose to public for awareness raising.

Moreover, while islands such as Syros are getting interconnected, the capacity of local grids to easily integrate the new charging infrastructure should not be overlooked. The planning of the charging infrastructure from the local stakeholders and municipalities should be highly coordinated with the DSO.

4.3 Enablers of e-mobility

The incentives for e-mobility in Greece are undertaken by the national government. The actions of national government have focused on systematic solutions:

- providing subsidies for purchase of electric vehicles,
- providing enabling framework for charging infrastructure assuring integration with the grid through requiring local plans for charging infrastructure and assessment of the additional capacity needs for distribution and transmission system operator.

To overcome the barrier of high cost of purchasing an EV and charger, there is currently a subsidy scheme running (GO ELECTRIC or Kinoumei Ilektrika[18]), to promote the e-mobility uptake at a national level. This national level support scheme, based on the Min. Decision 77472/520, provides subsidies to citizens, taxis and legal entities for purchase of EVs or e-bikes and for natural persons for installation of private home chargers. Specifically, for the islands, the scheme provides additional incentives i.e., the possibility for a legal entity to purchase up to 6 vehicles (instead of 3 vehicles for the rest of the country) and increased tax benefits (greater reduction of taxable income for legal entities that are participating in the scheme and are based on islands).

When it comes to overcoming the barrier of grid integration, a major programme is underway by the independent transmission system operator (IPTO) to interconnect all islands with the mainland. Through this project, Syros was connected to the mainland in October 2020, as explained in the Introduction chapter. The interconnection helps provide securty of supply and more available capacity for implementation of e-mobility charging infrastructure. Furthermore, the national electricity distribution network operator (HEDNO) is running a major program on the upgrade of the electricity network to increase its capacity and allow for smarter monitoring.

Moreover, following the guidelines of the EU Green Deal, Greece has already developed its national Just Transition Plan to compensate for the transition from oil and coal fired power stations in specific rural areas and all non-interconnected islands to clean energy production. This plan foresees major investments in these areas that will promote, among others, the e-mobility uptake. Indicatively, in the current coal mining area of the Western Macedonia region, there is going to be a development of an industrial e-mobility park. This park foresees a plant for battery production and e-mobility chargers. Apart from the obvious advantage of promoting e-mobility at a national level, such initiatives are expected to make local citizens more familiar with e-mobility. Furthermore, through the relevant initiative Greco Islands, it is expected that islands will be supported to deploy e-mobility, in accordance with their Just Transition pathways.

[18] https://kinoumeilektrika.gov.gr/

5. Summary of the study for location of charging infrastructure

Syros Municipality has initiated its Electric Vehicles Charging Plan (EVCP), in accordance to legislation requirement. The study is ongoing by an external contractor who is in collaboration with municipality's EVCP working team. The draft result of the study proposes installation of 52 public chargers, with the total capacity of 1 335 kW. Figure 11 shows the map of Syros with the identified locations for the chargers, as presented by the study.

Figure 11. Google maps image of the Syros island with indicated locations for public chargers

While the study includes all the details about the identified locations and chargers, in Table 8 below we provide the summary of foreseen chargers grouped by type and with indicated charger capacity. Therefore, the plan includes a proposal for:

- one location for two e-bike chargers;
- 25 locations for 49 normal power EV chargers, of which one will be available for taxis only;
- one location for one high power EV charger;
- one location for two high power chargers for electric light duty trucks; and
- one location for two high power E-bus chargers.

As can be seen from Figure 11, the highest density of the charging locations is in the urban area of Hermoupolis, while 14 locations with 28 normal power chargers are distributed across the island: three (six chargers) in Kini, two (four chargers) in Galissas, four (eight chargers) in Finikas, two (four chargers) in Megas Gialos and three (six chargers) in Vari.

Table 8 Summary of proposed chargers

No of chargers	No. of charger locations	Type of vehicle	Type of charger	Charger capacity [kW]
2	1	Electric bike	Normal power	3.5
48	24	Passenger vehicle	Normal power	22
1	1	Taxi	Normal power	22
1	1	Passenger vehicle	High power	50
2	1	Trucks	High power	50
2	1	Intercity bus	High power	50

The study is yet to be completed and accepted by the municipality of Syros as the final document. Therefore, the proposed charging locations, types or numbers might still change.

6. Proposed solutions for transition to smart electric road mobility in Syros

The Municipality of Syros, which covers the whole island, has started the planning-oriented approach to electrification of the road mobility. The study proposing location of 52 publicly available electric vehicle chargers for the roll out of the e-mobility charging infrastructure and the bases for the EV charging infrastructure for Syros is ongoing. The Municipality would like to take an active role in the roll-out of the EV charging infrastructure, instead of just being the authorisation body for the installation of chargers. Based on the discussed possible business models, the current situation with the regulatory framework in Greece and the preliminary results of the study, in this chapter we propose which business model Syros Municipality could use to get involved and which measures would be useful to take to encourage faster uptake of EVs and transition to electric mobility.

As discussed in Section 3, Syros has two specificities, seasonality and insular, connected economy, which have to be taken into account in the proposed business model. While electric mobility introduces a change, it should be seen as part of the overall island economy and culture. It has to consider other aspects such as optimal land use, which requires optimal use of planned/needed public and private charging infrastructure. Moreover, e-mobility has to provide cross-sectoral solutions which benefit not just mobility bus but also existing local economy, which has seasonal aspects.

Due to these aspects, the proposed solution for Syros municipality is the closest to **the joint-venture model** presented in the Section 3. In the joint-venture model, the municipality partners with the private sector to share the financing and overall control of the charging infrastructure. This option would provide a possibility for the local private sector to join in the transition.

Syros municipality could take over the responsibility to work with HEDNO and other stakeholder to identify needs for the new chargers based on the analysis of the charging data and requirements from EV users, as it has the best overview of the situation on the whole island. Such involvement would already help as it would bring down or minimise the soft costs and delays for the installation of the chargers. Moreover, in the cases where the land is public this would be the additional participation of the municipality.

Once the locations are identified, the municipality could co-invest in the charging infrastructure together with the private sector or/and local stakeholders. This can be done in a systematic way through a cooperative, or on case-by-case bases, depending on the landownership, as discussed in the case of Oslo.

The implementation of charging infrastructure through a **cooperative or energy community** could bring an additional benefit, which is the variation in the price for the use of the charger by the member of the community and others. As Syros faces the seasonality in their mobility needs, we see that during the summer months the number of vehicles on the islands drastically increases as shown in Figure 10. The increase in vehicle number during the summer causes one of the two effects, one if the increase pollution and road traffic and the other is the financial stress for the additional investment in case those vehicles need charging infrastructure. The cooperative/energy community concept would allow Syros to have two charging prices, one for members of the community (local businesses, stakeholder, local citizens EV users) and the other for temporary visitors to the Syros. The **difference in price** could be used to finance further electrification of mobility, development of charging infrastructure and/or mobility needs during high season.

In addition, to decrease the development of unnecessary infrastructure the co-ownership of charging infrastructure would allow maximal use of the private charging infrastructure as well. The use of the private charger could be rented out by municipality during specific period of time to make it available for public use. This way local stakeholders could additionally benefit from having their own charger and municipality could use **private or semi-public** infrastructure to satisfy the needs of the tourism.

The differentiation on the charging price could be made also based on the time of use to encourage charging when **local RES generated electricity** is available in the Syros system.

Additional detailed analysis is needed with regards to local land use, electricity prices, investment model and possible charger use times and periods to provide an estimate of prices that could be used for these models, and hence the specific financial calculation.

The installation of chargers is done by companies selected through public procurement process for a specific period of time. It is important that the municipality clearly specifies the needed characteristics of the chargers, where smart capability is a necessary characteristic for optimal operation and maintenance of the charging infrastructure. For charging infrastructure to provide the most benefit to the local electricity grid and in combination with the RES generation, it is important to be able to control the charging and perform demand side management.

The same company that installs the chargers can operate and maintain the chargers in collaboration with the municipality or cooperative as an owner. This collaboration needs to define among other, the access and ownership to **the charging data**. The charging data is necessary for planning of the future e-mobility needs. The collaboration with the private sector is helpful here as well, as the usage data for semi-public and public chargers can be made available to the municipality.

Supporting policies

Syros Municipality could encourage transition to e-mobility and further uptake of EVs through local policy. Some of the recommended policies are:

- Preferential treatment for parking for EVs arriving to the island in comparison to other vehicles;
- Other preferential treatment for EV users in use of island's services (restaurants, stores etc.) which would encourage users to prefer EVs.
- Incentivise or collaborate with local mobility businesses (taxi, rental companies) to transition their fleets to EVs. This increases visibility of EVs, allows citizens to become familiar with EVs without the risk of ownership and helps market green economy and tourism.
- Allow for easily publicly visible testing site for vehicle-to-grid in collaboration with the DSO. While the use of V2G capable chargers is not yet regulated, a controlled testing site would allow for local example of possible benefits such technology has for energy system and in collaboration with PV generation.

7. Proposed PV system

E-mobility provides a way to decarbonise the road transport. To ensure the environmentally friendly character and the sustainability of the solution, e-mobility should be combined with RES generation to produce clean electricity that will be used for the EVs charging. Moreover, for island systems like Syros, it is important to plan the capacity needs of the proposed charging infrastructure and try to match these needs with the local generation.

The Syros municipality has proposed a location for the installation of the ground mounted PV plant whose electricity will be used to offset the planned EV charging infrastructure energy demand through the scheme of virtual Net metering.

This chapter briefly lists the main steps needed to implement a PV plant in Greece based on the existing regulation and provides the details for the proposed PV plant on the specified location.

7.1 Authorisation steps for PV plant

According to the Greek regulatory framework for development of RES plants, the following steps need to be completed[19]:

- **Site selection**
  Based on the Law no. 4685/2020 and the RES Special Spatial plan. For ground mounted PV plants, it is important to keep in mind the restriction related to high-yield agricultural fields, where for each Regional unit 1% (for islands) of the total cultivated land can be used for the PV installations with installed capacity higher than 1 MW. is the PV projects are dealt on a case-by-case basis.
- **Certification of the RES producer**
  Based on the Law 4685/2020, this certification is acquired by the RES producer from the Regulatory Authority of Energy. This certification represents project feasibility approval. Two categories of the projects are defined where PV falls under non-special projects which have a simplified application procedure. This certification is not necessary for PV plants with installed capacity lower than 1 MW.
- **Administrative authorisation**
  Administrative authorisation includes the environmental impact assessment and other sector opinions needed for the realisation of the project (archaeological, forestry etc.). Based on the Law 4685/2020 the projects are grouped in categories and the PV plants with installed capacity lower or equal to 10 MW fall into Category B. The projects of this category must meet predefined environmental terms (Standard Environmental Requirements procedure) and the application is examined by the Decentralised regional administration.
- **Grid connection permit**
  For RES plants with installed capacity lower than 8 MW, HEDNO is responsible for issuing non-binding preliminary Grid Connection Offer immediately after issuance of the Certification for the RES producer. Once the environmental approval is acquired, HEDNO checks if the proposed plant can be connected to the grid at the foreseen location and issues Binding Grid Connection Offer. For PV plants with installed capacity lower than 1 MW, the Grid Connection Offer is automatically binding.

[19] Regulatory inventory, the Clean energy for EU islands Secretariat

- **Installation license**
  Installation license, based on the Law No. 3468/2006, is acquired from the decentralised regional administration once the binding grid connection offer and environmental permit are acquired. Once the installation license is acquired it is valid for 2 years and the PV plant has to be installed within this period .
- **Operation license**
  Operation license is issued once the plant has been constructed and successfully started operation by the decentralised regional administration and the Ministry for Environment and Energy.

7.2 Proposed technical solution for PV plant

7.2.1 Site overview

The proposed location for the installation of the photovoltaic plant is on a mountainous terrain next to the town of Kini, Syros, Greece. The area under consideration is depicted in Figure 12 and is approximately 1.7 km². The place indicated by the placemark in the figure was chosen for the installation of the PV plant as it is south facing, with adequate area for the installation of 1 MWp of PV panels, relatively unobstructed by shading obstacles, and close to the town of Kini which might ease the grid connection and the construction.

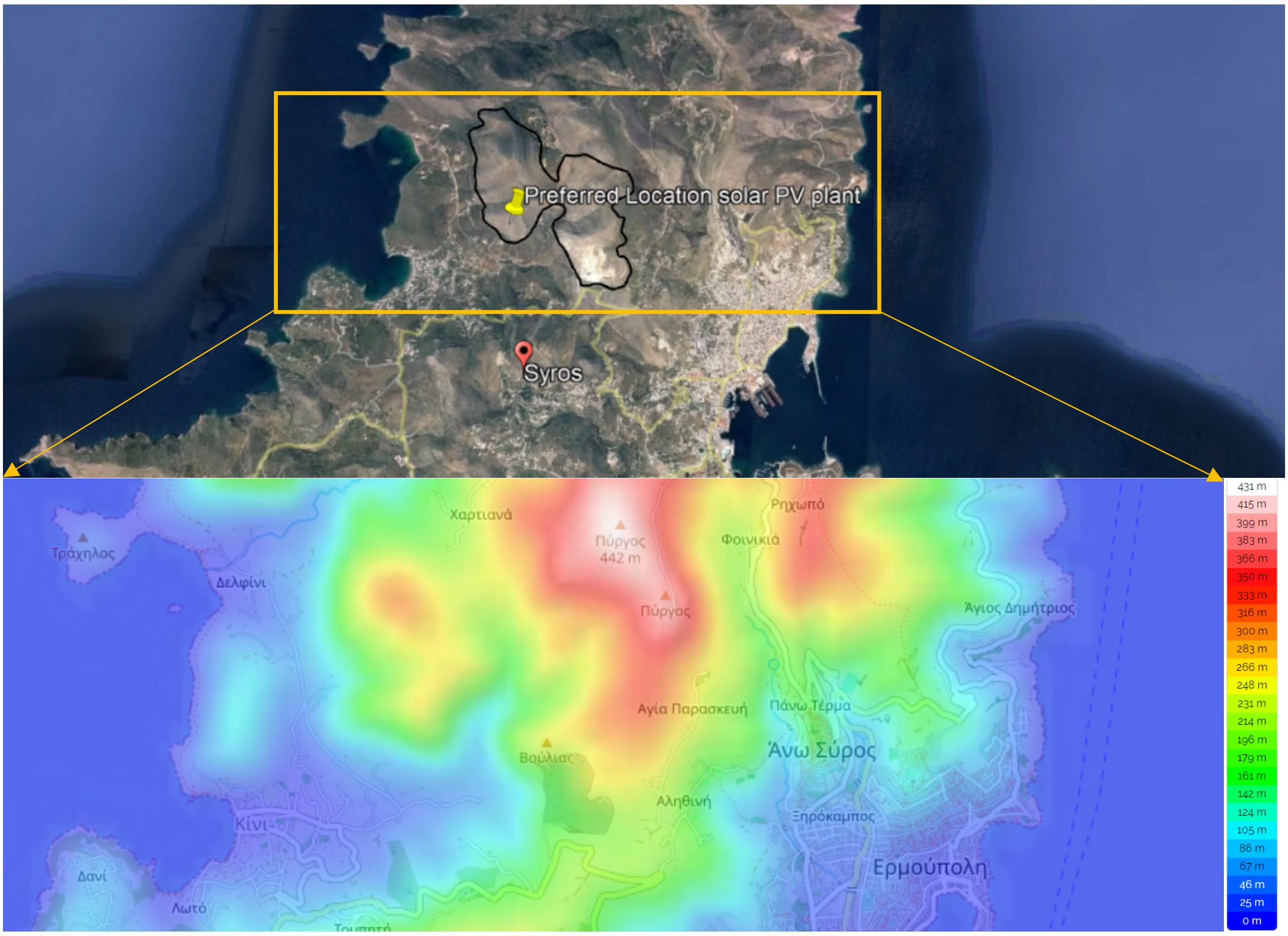

Figure 12. Map of preferred location for PV plant, and zoomed in view with elevation

7.2.2 System design

The PV plant consists of solar PV modules mounted on the side of a south-facing hill with an approximately slope of 32°. They are mounted on supporting structures, as illustrated in Figure 13.

Figure 13. Typical solar hillside setup

7.2.3 Layout

The solar PV system layout is based on the specific topography of the site. The intention of the design is to maximise the solar energy production coming from 1 MWp of installed PV panels. The tilt angle of the modules is 26°, the azimuth is 9° (South=0°). with a total of 1,904 PV modules, representing a total capacity of 1.009 MWp. A layout is provided in Figure 14.

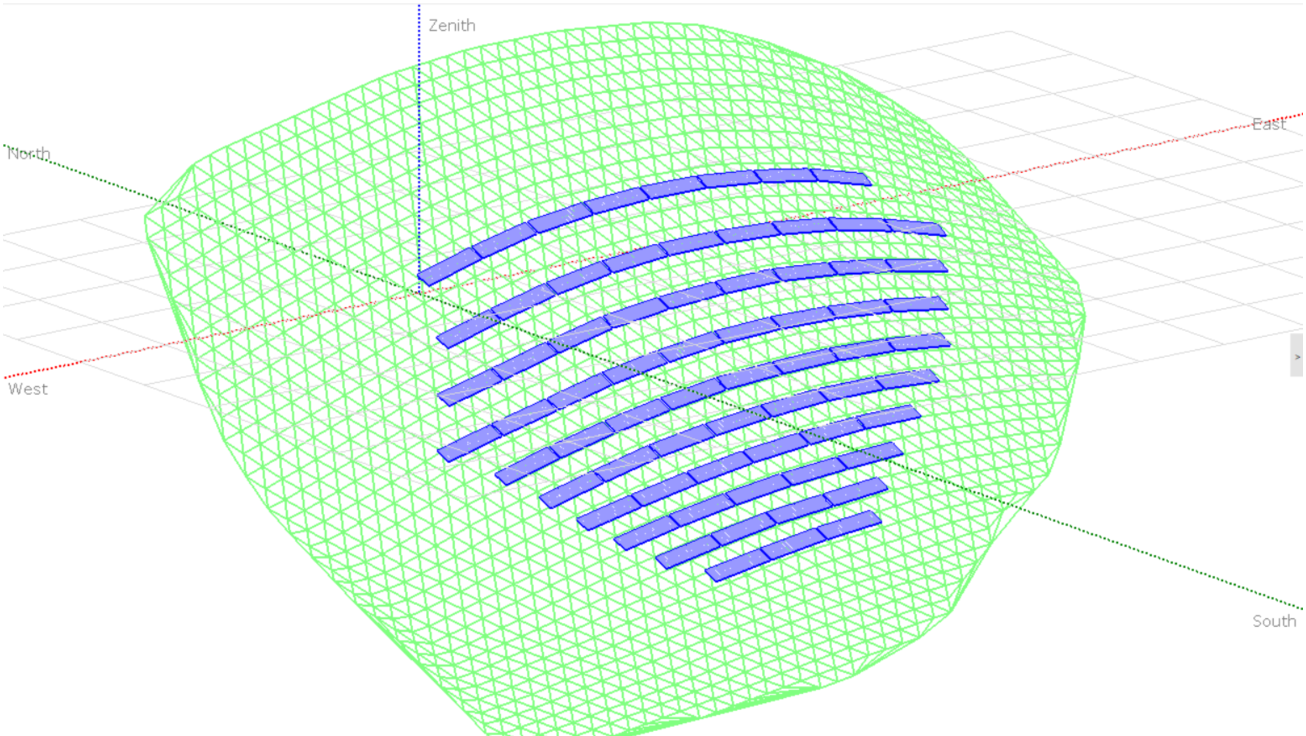

Figure 14. Layout of PV arrays

7.2.4 Long Term Yield Assessment

The objective of this section is to calculate the long-term yield of the PV system associated with several confidence intervals. To do this, we used different sources of meteorological data to estimate the most realistic yield. Dynamic simulation models (PVsyst) are used to characterise the system's behaviour and calculate the corresponding output. We consider the uncertainties affecting the solar resource as well as the system's efficiency to determine the statistical characteristics of the predicted values. Using these data, the expected average output (P50) is calculated to better quantify the risks associated with the PV project, particularly in its first year of operation. In conjunction with the long-term yield study, it is recommended that a system design audit be conducted to assess the risks associated with detailed engineering.

Project overview

Simulation parameters are based on documents provided by the Syros team. The main system parameters are summarised in Table 9.

Table 9 System parameters

PARAMETER	VALUE	UNIT
System peak power	1,009.00	kWp
Latitude	37.4540	°N
Longitude	24.9160	°E
Altitude	ca. 200	m a.s.l.
Tilt	26.3	°
Azimuth	9	° (South=0°)
Module power	530W	
Nb of modules	1 904	
Inverter AC power	185	
Nb of inverters	5	

Meteorological data

Global solar irradiation and temperature

We considered different meteorological data sources for the yield study. Table 10 gives a comparison of horizontal irradiation results.

Table 10 Global irradiation on the horizontal plane (kWh/m²/year)

SOURCE	NO. OF YEARS	AVERAGE IRRADIATION
Soda-HelioClim	16	1 553
Meteonorm	20	1 773
Soda-HelioClim	16	1 905
3E Solar Data	16	1 840
PVGIS-CMSAF	10	1 902
SolarGIS	26	1 746

We use each horizontal irradiation source to calculate the yield before combining the results by using a statistical weighting function. This function takes into account the specific characteristics of the data, such as the number of years available and the uncertainty of resource quantification according to our own experience. Table 11 shows the weighted horizontal irradiation as well as the in-plane irradiation. These weighted values are given as an indication only since they are not directly used in the calculations. The transposition factor is obtained from the irradiation data of 3E Solar Data and the Perez transposition model. The ambient temperature used in the simulations is also presented. It comes from 3E Solar Data's database.

Table 11 Weighted irradiation, transposition factor and temperature

PARAMETER	VALUE	UNIT
Weighted horizontal irradiation	1 819	kWh/m²/yr
Transposition factor	11.9%	
In-plane irradiation	2 035	kWh/m²/yr
Ambient temperature	18.2	°C

Monthly breakdown

The monthly breakdown of the meteorological data is given in Table 12.

Table 12 Monthly breakdown of the meteorological data

MONTH	HORIZONTAL IRRADIATION (KWH/M²)	IN-PLANE IRRADIATION (KWH/M²)	AMBIENT TEMPERATURE (°C)
January	68	99	10.4
February	82	106	13.8
March	140	169	14.2
April	175	189	15.3
May	221	220	18.4
June	239	228	22.5
July	249	242	24.6
August	223	235	24.7
September	167	195	22.7
October	119	154	19.3
November	77	109	16.8
December	59	88	14.9
Year	**1 819**	**2 035**	**18.2**

Yield calculation

We calculated the system performance by using dynamic models (PVSyst v7.2) as well as its own assessment tool (LTYA v2.9). Table 13 gives a summary of the system performance loss assumptions.

Table 13 System performance loss assumptions

PARAMETERS	ASSUMPTIONS
Horizon shading	The horizon shading line was considered. It was extracted from SolarGIS Prospect.
Dirt and soiling	Soiling losses were estimated at 1.5%.
Near shading: irradiance loss	We considered shading losses based on the horizon profile of the centre of the solar PV plant. No nearby large buildings or trees are present and are thus not taken into account.
Reflection (IAM)	Usual glass parametrisation was considered (Ashrae b0=0.05).
Irradiance dependencies	We used the PV module file from the PVsyst database (PAN-file).

Near shading: electrical loss according to strings	Electrical loss from strings were not considered[20].
Power tolerance of modules	We assumed a quality gain based on the power tolerance[21] stated in the product datasheet.
Temperature dependencies	Simulations consider the rear surface of the PV modules are open (Uc=29 W/m².K).
Light induced degradation (initial)	LID is estimated at 0% for the selected modules, n-type.
Mismatching	Module mismatch losses were estimated at 0.4% for unsorted PV modules. String mismatch is supposed to be 0.1%.
DC cabling	DC cable calculations were not provided. Corresponding losses were assumed to be 1.5% at STC.
Inverter	We used the inverter file from the EPC (OND-file).
AC cabling	AC cable calculations were not provided. Corresponding losses were assumed to be 1%.

The plant availability and module degradation rate were considered to estimate the system performance over the project lifetime. They both are described in Table 14.

Table 14 System performance loss assumptions - lifetime

PARAMETER	ASSUMPTION
Availability	We considered a commercial availability of 99%. Grid availability is assumed to be 100%.
Annual degradation factor (ageing)	Annual degradation is estimated at 0.5%

Mean expected yield (P50)

Table 15 shows the average expected yield (P50) of the system. As mentioned, results are obtained by weighting the results obtained from the different meteorological sources.

Table 15 Mean expected yield (P50)

PARAMETER	VALUE	UNIT
System peak power	1,009.00	kWp
Performance ratio at plant start-up (PR)[22]	88.4%	
Plant availability	99.0%	
Yearly degradation factor	-0.5%	
Specific yield – Year 1[23]	1,781	kWh/kWp/yr
System yield – Year 1	1,797	MWh/yr
System yield – 20 Years	34,291	MWh

[20] Not expected to be more than 1 %, so not so significant for the feasibility study.
[21] Power Tolerance is the actual range a module can deviate from its specified STC Max Power. STC stands for Standard Test Conditions, and refers to the lab conditions panels are tested under (1000W per square meter of sunlight). https://www.infiniteenergy.com.au/power-tolerance-solar-panels-explained/#:~:text=Power%20Tolerance%20is%20the%20actual,per%20square%20meter%20of%20sunlight). The chosen modules have a power tolerance of 0%-3%. https://www.energiasolarphb.com.br/produto/modulo-jinko-solar-jkm530m-72hl4-tv/

[22] PR without plant and module degradation
[23] Including availability and average degradation during year 1

Uncertainties affecting yield estimates

The expected yield is affected by several uncertainties of different types. The uncertainty due to the climate variability is stochastic and its effect is levelled out when calculating long-term averages. Most other uncertainties, e.g. those related to the modelling, the site or the system, are systematic and its effect is not levelled out when calculating long-term averages. The uncertainties affecting the yield estimates are summarised in Table 16. All uncertainty values are standard deviations and apply to well-functioning systems. Negative outliers in performance due to bad installation, low-quality components or extreme local conditions (e.g. heavy soiling or unidentified shading) are not taken into account in these uncertainties. We have determined the uncertainty values based on an extensive literature study and own calculations.

Table 16 Uncertainties considered for the calculation of the probabilities

UNCERTAINTY	VARIABLE	VALUE
Due to the yearly variation	Climate variability	1.2%
Affecting the resource estimation	Resource quantification	3.5%
	In-plane conversion	2.0%
Affecting the system performance	Optical	1.4%
	Module	1.4%
	Electrical	0.8%
	Degradation	0.3%

Yearly and monthly breakdown

Table 17 shows the yearly performance ratio, as well as the corresponding P50 results.

Table 17 Yearly performance ratio and expected yield

Year	Performance Ratio (PR)	System yield p50 (MWh)
1	87.3%	1 797
2	86.8%	1 788
3	86.4%	1 780
4	86.0%	1 771
5	85.5%	1 762
6	85.1%	1 753
7	84.7%	1 744
8	84.3%	1 735
9	83.8%	1 727
10	83.4%	1 718
11	83.0%	1 710
12	82.6%	1 701
13	82.2%	1 693
14	81.8%	1 684
15	81.4%	1 676
16	81.0%	1 667
17	80.5%	1 659
18	80.1%	1 651
19	79.7%	1 642
20	79.3%	1 634

Table 18 shows the monthly values for the performance ratio and the average yield (P50) at year 1.

Table 18 Monthly performance ratio and system yield at year 1

Month	Performance Ratio (PR) – year 1	System yield (p50) – year 1 (MWh)
January	91.7%	91
February	90.3%	97
March	89.4%	152
April	88.6%	169
May	87.4%	194
June	85.6%	197
July	85.0%	208
August	85.3%	202
September	86.4%	170
October	88.2%	137
November	90.0%	99
December	90.4%	81
Year	**87.3%**	**1,797**

The expected yields with 100% availability at various probabilities are listed in Table 19.

Table 19. Expected yield with various probabilities (100% availability)

Parameter	Value	Unit
System | specific yield (P50) - year 1	1 816 | 1 799	MWh/yr | kWh/kWp/yr
System | specific yield (P75) - year 1	1 756 | 1 741	MWh/yr | kWh/kWp/yr
System | specific yield (P90) - year 1	1 703 | 1 688	MWh/yr | kWh/kWp/yr
System | specific yield (P99) - year 1	1 610 | 1 596	MWh/yr | kWh/kWp/yr

Cost estimate

A cost estimation is provided in this section. the costs are dependent on various local factors, which include among other technology, labour, duties, taxes,. A more relevant and accurate cost estimate will be subject to an official quote by a service provider. The costs, excluding tax, are summarised in Table 20 and are based on the most recent power generation cost breakdown by IRENA[24] and previous projects . The cost for the solar system includes the hardware (PV modules, inverters, the non-module hardware), the installation, and soft costs as indicated in Annex 2: Balancing of System (BoS) costs for solar PV. This is estimated at 675.5 €/kW for utility scale solar PV in Greece. A detailed cost breakdown for each component can be seen in Figure 15. Additionally, we see it as best practice to include 5% of the total CAPEX for contingency reasons.

Table 20. System costs

ID	Parameter	Value (EUR)
A	CAPEX (excl. tax)	
1	Capital cost of solar system (675.5 €/kWp)	681 580
2	Spares and contingency (5%)	34 079
	Total CAPEX	**715 658**
B	OPEX (excl. tax)	
1	Annual O&M cost (15.8 €/kWp)	15 942

[24] IRENA, Power Generation Costs 2020, https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020

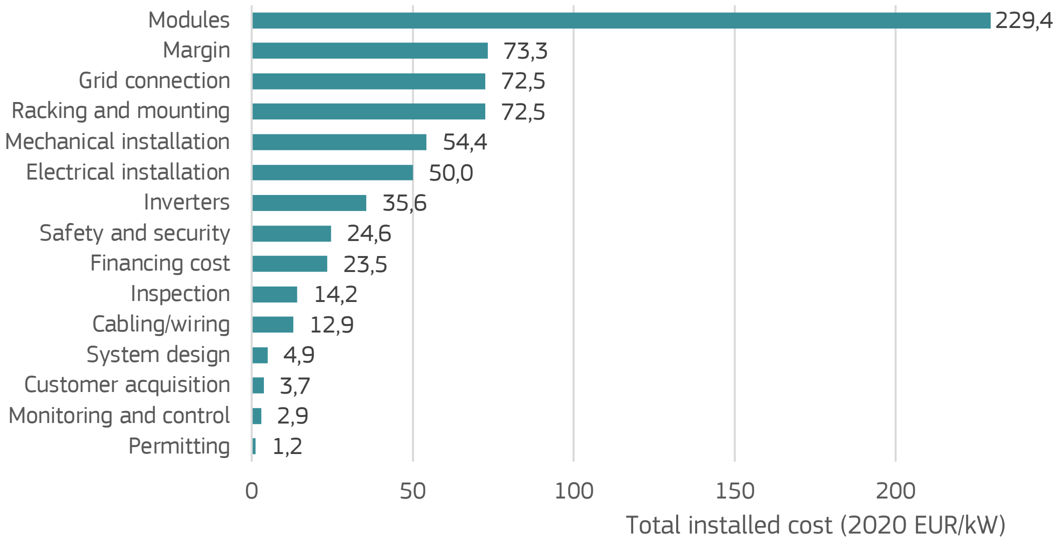

Figure 15. Detailed breakdown of utility-scale solar PV total installed cost in Greece, 2020
(source: IRENA Power Generation Costs 2020)

Operation and maintenance are all activities or programs linked to the correct and efficient operation of the PV installation. Operation ranges from the supervision and operation of the installation to planning preventive maintenance or predicting capacity. Maintenance refers to the maintenance of the PV installation itself, as well as the maintenance of the site. PV maintenance refers to the replacement or repair of all possible components of the PV system, from the modules and the load-bearing structure to the wiring of each component. Site maintenance refers to activities such as site supervision and compliance with environmental regulations.

The average utility-scale O&M costs in Europe are estimated at 15.8 €/kW per year, according to the latest IRENA report[3]. This includes costs such as insurance and asset management as well. However, it does not include the replacement cost for the inverters after 10 – 15 years. This should be accounted for when considering the long-term financial impact of operating a solar PV system over the project lifespan of 20 years.

Summary of PV plant calculations

A long-term yield estimation was done for a ground-mounted PV solar plant on Syros, Greece. The solar plant has a total peak power (DC) of 1 009 kWp. The PV modules are mono-crystalline and are installed on a south-facing hillside at a tilt angle of 26°. The project includes string inverters.

Table 21 shows expected values for the average in-plane irradiation, the initial performance ratio, and the average expected yield (P50).

Table 21: Average expected yield (P50)

Parameter	Value	Unit
System peak power	1 009	kWp
Mean yearly in-plane irradiation	2 035	kWh/m²/yr
Performance ratio at plant start-up (PR) *	88.4%	
Specific yield (P50) - year 1 **	1 781	kWh/kWp/yr
System yield (P50) - year 1 **	1 797	MWh/yr
Yearly degradation factor	-0.5%	
System yield (P50) - 20 years	34 291	MWh

* PR without plant availability and module degradation

** Including availability and average degradation during year 1

This study indicates that a 1 009 kWp solar PV plant at Syros will produce 34 291 MWh of electricity over a project lifespan of 20 years, based on a P50 probability. The system will cost approximately €715 658 to complete and €15 942 per year to operate and maintain using a third-party O&M contractor.

8. Conclusions

The municipality of Syros has initiated a long term project in collaboration with DAFNI to become an exemplar island regarding sustainable e-mobility. Within this project, the municipality is in the process of finalising its EV Charging Plan that will identify the location for more than 20 charging stations that will be publicly available. In addition, the municipality has applied for funding to the national programme “Antonis Tritsis” regarding the electrification of the municipal fleet (including mini-busses and passenger vehicles etc.). The technical assistance for Syros island focused on the transition to electric mobility in road transport. The goal of the technical assistance is to identify optimal business models for the municipality of Syros to be involved in operation of EV charging stations. This includes looking into the required PV generation capacity that could cover the consumption from the chargers on the island.

The report provides analysis of the current state of the energy and mobility system on Syros provided by DAFNI and Syros Municipality. In order to better understand the municipality’s role in the installation and management of the charging infrastructure, Section 2 explains the ecosystem of the electric mobility. The focus was not only on the energy aspects of the ecosystem, but also on mobility and land use, as well as the potential stakeholders and binding contracts with them.

Section 3 provides an overview of the possible business models related to the charging infrastructure with examples from European practices. The focus was put on the examples that would identify the role of the local government. In collaboration with the private sector and the local stakeholders, the municipality could take part in more business models related to the use of EVs and their infrastructure explained.

An analysis of the regulatory framework for electric mobility and EV infrastructure in Greece is presented in Section 4. We also identify barriers and enablers are also identified, especially when it comes to the way that electric mobility can be integrated in the whole energy system and provide additional benefits such as system back-up, flexibility and integration of RES.

Section 5 provides a brief summary of the preliminary results of the study for the location of proposed charging infrastructure. It proposes the installation of 52 public chargers, including the chargers for e-bikes, EVs, electric trucks and busses. The total capacity of the proposed chargers distributed across the island is 1.3 MW.

Section 6 discusses the specifics of the proposed business model that Syros Municipality could use to be involved in the ownership and management of the charging infrastructure. Local policy recommendations are also provided.

Finally, while e-mobility is a step to towards decarbonisation, full benefit to the system is achieved when e-mobility is coupled with the RES generation. The Syros Municipality and DAFNI provided the proposed location for the PV plant of 1 MW. The PV plant capacity is not only chosen based on the capacity of the proposed chargers and the provided location, but also to benefit from the simplified authorisation and implementation procedure that PV plants with installed capacity of less than 1 MW have in Greek regulation.

Based on the overall assessment, the implementation of EV public charging infrastructure on Syros is recommended to be done through joint-venture business model. The municipality Syros is encouraged to involve local private sector in this mobility transition to assure that the transition is long term and fosters local economic development. The involvement of the local private sector and local community in investment and use of e-mobility could be organised through a cooperative or an energy community. This concept would allow for variation in pricing for the local community or businesses and for other users that are temporary inhabitants of Syros.

Seasonal increase in road transport and mobility needs require a strong policy and political support from the municipality for the e-mobility, to encourage the shift from current practice to more sustainable mobility solutions. Due to the seasonality of the energy and mobility needs on the island and to optimise the use of EVs and installed infrastructure it is encouraged to assess proposed business models for car-sharing and for semi-public options for the use of the future private charging infrastructure. To assure sustainable development the implementation of the charging infrastructure should be coupled with the installation of PV generation, where the proposed location can be used for installation of 1 MW PV plant.

References

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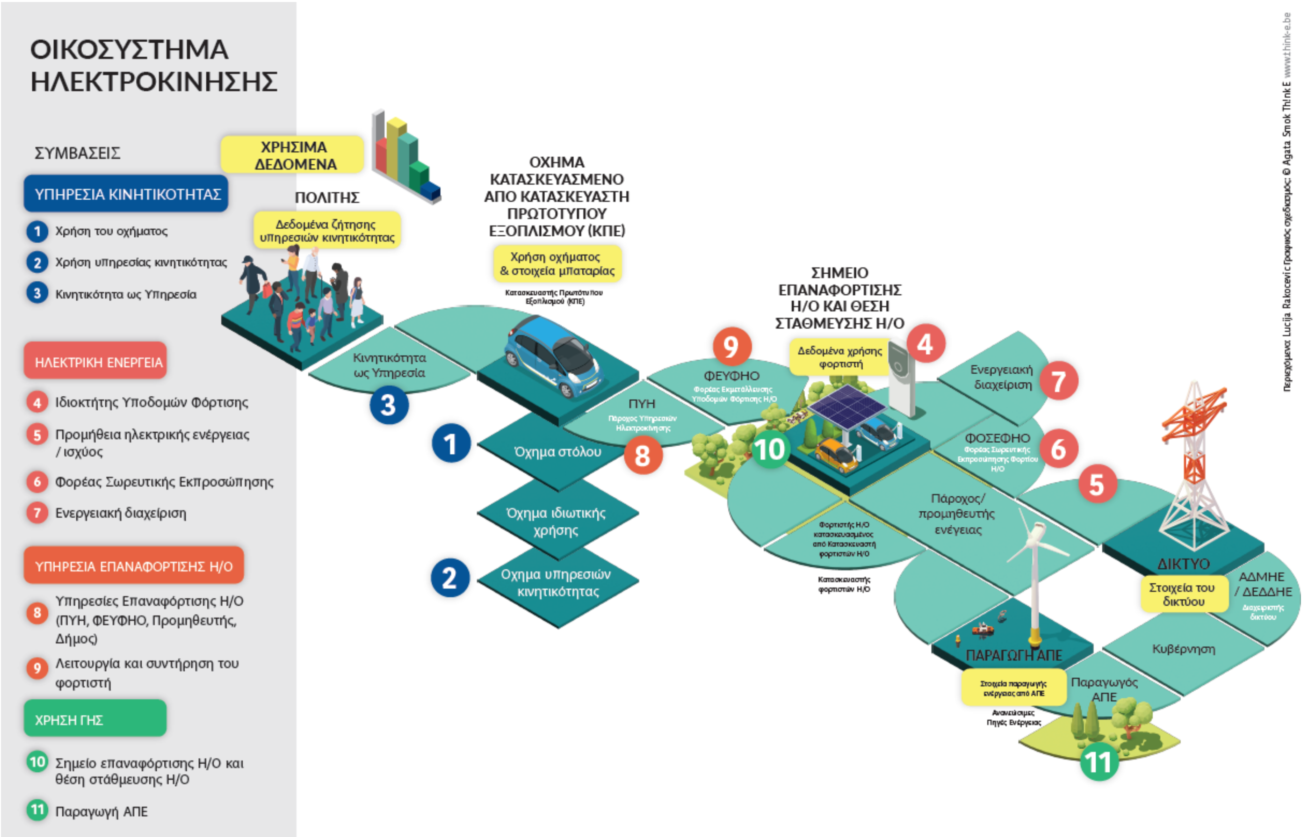
- DAFNI – Network of Sustainable Greek Islands (https://dafninetwork.gr/en/)

Annex 1: E-mobility ecosystem scheme (Greek)



Annex 2: Balancing of System (BoS) costs for solar PV

Category	Description
Non-module hardware	
Cabling	• All direct current (DC) components, such as DC cables, connectors and DC combiner boxes • All AC low voltage components, such as cables, connectors and AC combiner boxes
Racking and mounting	• Complete mounting system including ramming profiles, foundations and all material for assembling • All material necessary for mounting the inverter and all type of combiner boxes
Safety and security	• Fences • Camera and security system • All equipment fixed installed as theft and/or fire protection
Grid connection	• All medium voltage cables and connectors • Switch gears and control boards • Transformers and/or transformer stations • Substation and housing • Meter(s)
Monitoring and control	• Monitoring system • Meteorological system (*e.g.,* irradiation and temperature sensor) • Supervisory control and data system
Installation	
Mechanical installation (construction)	• Access and internal roads • Preparation for cable routing (*e.g.,* cable trench, cable trunking system) • Installation of mounting/racking system • Installation of solar modules and inverters • Installation of grid connection components
Electrical installation	• DC installation (module interconnection and DC cabling) • AC medium voltage installation • Installation of monitoring and control system • Electrical tests (*e.g.*, DC string measurement)
Inspection (construction supervision)	• Construction supervision • Health and safety inspections
Soft costs	
Incentive application	• All costs related to compliance in order to benefit from support policies
Permitting	• All costs for permits necessary for developing, construction and operation • All costs related to environmental regulations
System design	• Costs for geological surveys or structural analysis • Costs for surveyors • Costs for conceptual and detailed design • Costs for preparation of documentation
Customer acquisition	• Costs for project rights, if any • Any type of provision paid in order to get project and/or off-take agreements in place

Financing costs	• All financing costs necessary for development and construction of PV system, such as costs for construction finance
Margin	• Margin for EPC company and/or for project developer for development and construction of PV system includes profit, wages, finance, customer service, legal, human resources, rent, office supplies, purchased corporate professional services and vehicle fees

Annex 3: Municipality owned vehicles for road transport

PASSENGER CARS

Table 22. List of passenger cars owned by the Syros municipality

	Municipality department that uses the vehicle	Acquisition year	Year of circulation	Circulation number	Brand	Model	Engine capacity (cc)	Km (31-1-2020)
1	NATIONAL EMERGENCY AID CENTRE	2006	2006	KHI 4841	HYUNDAI MOTOR C	H1	2 351 c^3	40 866
2	SOCIAL PROTECTION EDUCATION AND SPORTS	2002	2003	KHI 4807	HYUNDAI MOTOR C	MATRIX	1 599 c^3	110 757
3	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	2010	2010	KHH 4610	KIA	CEED	1 396 c^3	44 579
4	URBAN PLANNING	2001	2001	KHI 2016	SEAT	LEON	1 390 c^3	96 275
5	TECHNICAL SERVICES	2000	2000	KHI 1547	PEUGEOT	PARTN ER COMBI SPACE	1 360 c^3	153 312
6	ADMINISTRATIVE SERVICES	2007	1992	KHI 9864*	ROVER		1 396 c^3	
7	SOCIAL PROTECTION EDUCATION AND SPORTS	1999	1999	KHI 2015	HYUNDAI MOTOR C	ATOS	999 c^3	94 136
8	SOCIAL PROTECTION EDUCATION AND SPORTS	2002	2002	KHI 4162	HYUNDAI MOTOR C	MATRIX	1 599 c^3	219 505
9	CULTURE &TOURISM	1998	1998	KHH 4671	HYUNDAI MOTOR C	ATOS	999 c^3	180 036

* Nat in use since 24/8/2015

MOTORCYCLES

Table 23. List of motorcycles owned by the Syros municipality

	Municipality department that uses the vehicle	Acquisition year	Year of circulation	Circulation number	Brand	Model	Engine capacity (cc)	Km (31-1-2020)
1	CLEANING, ENVIRONMENT AND	1985	1985	YE 8494	PIAGGIO	VESPA-50	49 c^3	

	AGRICULTURAL POLICY							
2	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	1997	1997	EMT 24	SUZUKI		249 c³	55 967
3	ADMINISTRATIVE SERVICES	2001	2001	NZY 730	P.T. FEDERAL	ASTREA GRAND	97 c³	75 325
4	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	2002	2002	EMP 534	P.T. KAWASAKI	KAZE – R	111 c³	43 675
5	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	2004	2004	EZA 733	THAI HONDA	JC 33	125 c³	57 826
6	TECHNICAL SERVICES	2004	2004	EZA 738	THAI HONDA	JC 33	125 c³	44 442
7	TECHNICAL SERVICES	2006	2006	EZB 691	THAI HONDA	JC 33	125 c³	44 966
8	TECHNICAL SERVICES	2007	2007	EZZ 688	THAI HONDA	JC 33	125 c³	47 569
9	TECHNICAL SERVICES	2007	2007	EZZ 589	K.L.S.P.A.	BLITZ JOY 125R	124 c³	41 402
10	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	2007	2007	EZZ 446	PIAGGIO	T1 TRICYCLE	218 c³	39 839
11	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	2008	2008	YAB 1607	PIAGGIO	C 29	49 c³	
12	CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY	2010	2010	EZN 765	MODENAS	X-CITE	130 c³	52 341

TRUCKS

Table 24. List of trucks owned by the Syros municipality

	Acquisition year	Year of circulation	Circulation number	Brand	Model	Engine capacity (cc)	km (31-1-2020)	Comments

CLEANING, ENVIRONMENT AND AGRICULTURAL POLICY DEPARTMENT								
1	1989	1989	KHI 9877	MERCEDES	LP813	5 675 c^3		Not in use since 3/11/2016,
2	1989	1989	KHI 2008	DAIMLER	1314 K	5 958 c^3	258 399	Not in use since 18/05/2020
3	1990	1990	KHY 2255	MERCEDES	LP813	5 638 c^3		Not in use
4	1991	1991	KHY 2256	MERCEDES	LP111 3	c^3		Not in use
5	N/A	1995	KHY 2292	NISSAN VEHICULO	M 130.15 0/2	5 985 c^3		Not in use
6	1994	1994	KHI 2007	MERCEDES	1314 K	5 958 c^3		Not in use since 4/11/2015
7	1995	1996	KHI 2014	NISSAN MOTOR IB		2 953 c^3		Not in use
8	1995	1995	KHY 2295	NISSAN VEHICULO	M130.1 80/2	6 925 c^3		Not in use since 10/7/2014
9	1995	1995	KHY 2293	NISSAN MOTOR IB	M 130.15 0/2	5 985 c^3	132 993	
10	1995	1996	KHY 2296	MERCEDES	1314	5 958 c^3	251 215	
11	1997	1997	KHY 6702	MERCEDES – BENZ	1314/4 2	5 958 c^3		Not in use since 19/6/2015
12	1997	1997	KHY 6733	NISSAN VEHICULO	TRADE 100	2 953 c^3	177 905	
13	1999	2000	KHI 2010	NISSAN VEHICULO	CABST AR	2 953 c^3		Not in use

14	1999	1999	KHI 2009	MERCEDES	1523	6 374 c^3	267 550	
15	2000	2000	KHI 1520	IVECO – MAGIRUS	MP190 E30W	9 500 c^3	40 389	
16	2000	2000	KHI 2013	MAN	10.224 LC	6 871 c^3	14 872	
17	2000	2000	KHI 1506	IVECO – MAGIRUS	MP190 E30W	9 500 c^3	74 931	
18	2001	2001	KHI 2027	PIAGGIO	DAIHAT SU HIJET	1 296 c^3	199 239	
19	2003	2003	KHI 4809	PIAGGIO	PORTE R 1300 EFI	1 296 c^3	193 779	
20	2004	2005	KHI 4822	PIAGGIO	PORTE R MAXXI	1 296 c^3	161 965	
21	2005	2006	KHI 4842	DAIMLER CRYSHLER	1823 K	6 374 c^3	117 145	
22	2006	2007	KHI 4854	PIAGGIO	PORTE R 1300 EFI	1 296 c^3	105 618	
23	2007	2007	KHI 9856	PIAGGIO	S85E	1 296 c^3	128 136	
24	2007	2007	KHI 9862	VOVLO	FL M 4X2R	7 146 c^3	161 591	
25	2008	2008	KHI 9884	MERCEDES – BENZ	1824 K	6 374 c^3	166 424	
26	2009	2008	KHI 9871	DAIMLER CRYSHLER	1829 K	6 374 c^3	190 816	
27	2009	2009	KHH 4602	FIAT	DUCAT O	2 287 c^3	51 316	
28	2009	2009	KHI 9900	MERCEDES -BENZ	1829 K	6 374 c^3	179 461	

29	2008	1996	KHI 9891	MERCEDES	814	5 917 c^3	793 090	
30	2009	2010	KHH 4606	DAIMLER CRYSHLER	970.05	6 374 c^3	367 354	
31	2010	2011	KHH 4665	PIAGGIO	PORTE R	1 296 c^3	85 959	
32	2010	2010	KHH 4608	MERCEDES –BENZ	1829 K	6 374 c^3	120 837	
33	2014	2014	KHH 4684	ISUZU NL 85E	N1R	2 999 c^3	41 022	
34	2014	2014	KHH 4685	PIAGGIO	PORTE R	1 201 c^3	24 890	
35	2014	2015	KHH 4696	MITSUBISH I H MI	MITSUB ISHI CANT	2 998 c^3	16 984	
36	2015	2000	KHH 4692	SUZUKI	CARRY	1 298 c^3	270 272	
DEPARTMENT OF TECHNICAL SERVICES								
1	2001	2001	KHI 2041	MAZDA	B 2500 CAB PLUS 4X4	2 500 c^3	101 715	
2	2002	2002	KHI 2049	PEUGEOT	PARTN ER	1 868 c^3	108 065	
3	2008	2008	KHI 9867	VOLKSWA GEN	2KN	1 968 c^3	104 550	
4	2009	2009	KHI 9893	PIAGGIO	PORTE R EFI1.3	1 296 c^3	59 760	
5	2010	2010	KHH 4611	PIAGGIO	PORTE R	1 296 c^3	80 671	

BUSES

Table 25. List of buses owned by the Syros municipality

	Acquisition year	Year of circulation	Circulation number	Brand	Model	Engine capacity (cc)	Comments
1	2000	2002	KHI 2044	MAN	SS 400L	4 580 c^3	Not in use since 28/12/2017,
2	2000	2002	KHI 2045	MAN	SS 400L	4 580 c^3	Not in use since 29/12/2017,
3	2000	2002	KHI 2046	MAN	SS 400L	4 580 c^3	Not in use since 13/7/2017,
4	2010	2010	KHH 4609	SOLARIS	URBINO 8.6	6 693 c^3	
5	2015	2016	KHH 6987	KARSAN	MPXL H CXL H STAR H ATAK	4 485 c^3	
6	2015	2016	KHH 6988	KARSAN	MPXL H CXL H STAR H ATAK	4 485 c^3	