Journal of Energy

VOLUME 72 Number 2 | 2023

journal homepage: http://journalofenergy.com/

A Comparative Analysis of Electric Mobility Operations in the Island States: A Case Study of Malta and Cyprus

Andy Bugeja, Brian Azzopardi, Eleftherios G. Loizou

***Summary* — The Malta and Cyprus partnership strengthened through the H2020 NEEMO (Networking for Excellence in Electric Mobility Operations) TWINNING project activities, which also led to the development of longer-term collaboration strategies for the future of electric mobility operations. Through information sharing between the two island nationsin the Mediterranean, the major goal was to improve sustainable transportation. The capacity-building activities helped to characterise the state of the two islands' electric transportation industries. Workshops, seminars, educational initiatives,andexchangevisitsareallpartofthemethodsused to increase capacity and promote collaboration. The research highlights the significance of sustainable energy sources and infrastructuredevelopmentforthesmoothtransitiontoelectric mobility and transportation. Energy systems, land transportation, and the optimisation of the entire energysystem are alldiscussed, compared and analysed. The findings highlight the legal framework, the EIRIE platform, and the differences between Malta and Cyprus in the e-mobilitysector. The integration of renewable energy in both nationsand the charging infrastructure, tariffs, and rates are also examined.**

***Keywords* — transport, electric, mobility, charging, vehicles**

I. Introduction

The transition to electric mobility is vital for addressing climate change and establishing a sustainable transportation system. This study focuses on Malta and Cyprus, two island nations with much of the same potential and obstacles in electric transportation. The project seeks to improve sustainable transportation and offer useful insights on electric mobility in island nations through information sharing and collaborative actions.The methodology used merges a project- based approach with a range of activities. Interactions and information sharing between stakeholders from Malta and Cyprus are facilitated via workshops, seminars, educational programmes, and exchange visits, which results in developing a longer-term strategy.

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The paper includes the information that was exchanged amongst NEEMO project participants. It provides an overview of the legislative framework, NEEMO's integration into the EIRIE platform, and an examination of differences between Malta and Cyprus in the e-mobility sector. Incentives for private charging service providers, the integration of renewable energy, and energy storage facilities are covered in the study. The results indicate the necessity of a robust infrastructure and environmentally friendly energy sources to meet the rising demand for electric vehicles. Additionally, the study provides insights into the policy framework, the EIRIE platform, and the potential integration of other Malta College of Arts, Science and Technology (MCAST) Energy initiatives in the future.

The NEEMO TWINNING project aims to enhance the scientific, engineering, and research capabilities of MCAST Energy Research Group (MCASTEnergy) within the MCAST Institute of Engineering and Transport (MCAST IET). By collaborating with internationally recognised research institutes, this study, which focuses on electric mobility research, helps to strengthen MCAST Energy's performance and capabilities. Through this twinning project, MCAST Energy seeks to increase its expertise and advance the studyof electric mobility.

This project involves several interactions with top scientific institutions, such as the Austrian Institute of Technology (AIT), Cyprus Energy Agency (CEA), and Nicosia Development Agency (ANEL). These alliances make it easier to connect with people in relevant sectors and gain access to a wide range of networks. Meetings, conferences, schools, seminars, and exchange programmes are among the events.To create long-term collaboration plans for electric transportation on the islands, members from MCAST and ANEL actively maintains connections between Malta and Cyprus in the electric mobility sector.

II. Methodology

The methodology combines a project-based approach with various gatherings and activities to build knowledge in e- mobility for island states. These initiatives, which seek to provide participants with a thorough understanding of the electric mobility sector in Malta and Cyprus, include workshops, seminars, education programmes, and exchange trips. The interactions between the two countries were primarily focused on identifying common requirements, difficulties, possibilities and limits in the electrictransportation sector. These interactions allowed for constructive involvement with important Cyprus and Malta stakeholders, fostering cooperation and the creation of longer- term strategies in this field. By employing this technique, the project hopes to enhance sustainable transportation by offering valuable info on how electric mobility works in island states.

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https://doi.org/: 10.37798/2023722456

III. Result

The findings from the bilateral exchange of information between representatives from the EU-funded projectNEEMO [1] are presented in this chapter. The regulatory framework,the EIRIE platform, the integration of NEEMO inside the EIRIE platform, and an analysis of the differences between Malta and Cyprus in the e-mobility industry are outlined inthis section.

Shared data from FOSS [2] on the overall framework for encouraging electric cars and supplied data on local and thematic transport electrification, including forecasts for the deployment of electric vehicles by 2030, are shown in Fig 1 (the blue colour (bottom) represent the registration of electric vehicles, while the green colour (top) indicate the registration of electric motorbikes and motorcycles). This study also discusses incentives for private charging service providers, renewable energy versus charging stations, and electrical energy storage facilities.

A thorough knowledge of the policy framework, the European Interconnection for Research Innovation & Entrepreneurship (EIRIE) platform, and the possibility for future integration of MCAST Energy projects will be provided by discussing the specific findings generated from these exchanges and dialogues.

The PAN European Technology Energy Research Approach (PANTERA)projectalsoincludesintegratingMCASTEnergy initiatives, such as the NEEMO project, onto the EIRE platform in the future.

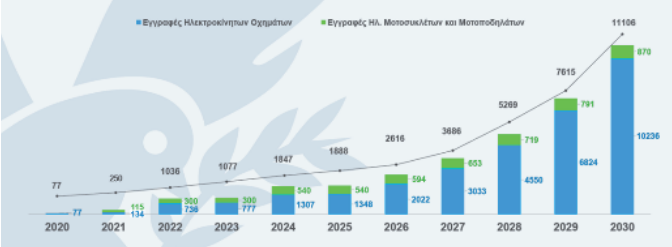

Fig. 1. Snippet from FOSS presentation - Projections of new electrical-based means of transportation. (*Blue:EVs,Green:e-Bikes*).

Furthermore, through the exchanges, MCAST and ANELwere able to exchange discussions on the following:

1. Design policies and modelling energy systems for the energy transition,
2. Current status of land transport.
3. Optimisation of the whole energy system.

Cyprus and Malta's respective renewable energy generating capacities were compared. The conversations on how the design regulations were changed in conjunction with the start of the COVID-19 epidemic and how pollution and carbon dioxide emissions were addressed. Also discussed were the similarities and differences between Malta's and Cyprus' power generation. The primary emphasis is on the following:

1. The high seasonal fluctuation in demand for power. Mainly due to summer tourists,
2. The construction of the Euro-Asia interconnector will end the isolation of the electrical grid in Cyprus.
3. Both islands have abundant solar energy, which necessitates the development of an effective system for deploying electrical storage for renewable energy sources. The construction of 50 MW of solar thermal power with eight hours of storage was proposed for Cyprus.

During the exchange programme, Cyprus Institute [3] offered Cypriot data, while some Maltese data was quoted from the National Statistics Office Malta [4]. Discussions about transportation, electric mobility, and the state of transportation in both Islands were also analysed, and Table I contains a summary of the comparison.

Table I

Fleet Comparison for Malta(MT) and Cyprus(CY) (data collected in 2021)

Fleet	Petrol		Diesel		Hybrid		Electric	
	MT	CY	MT	CY	MT	CY	MT	CY
Passenger cars	206318	541792	97067	135463	4297	9290	1488	114
Motorcycles (including scooters)	32762	57973					2126	218
Buses (route/coach/ private/ minibus)	-	-	2232	6358			11	-
Trucks	1343	6633	53555	138493	-	-	67 *	-

*Special Purpose Vehicles

Discussions and analyses of semi-fast charging station rollout planning, similar methodologies, and charging infrastructure were conducted, particularly through bilateral talks with the Cyprus Electricity Authority [5]. On similar lines, the transmission and distribution networks of Malta and Cyprus were studied. Cyprus has a 1478 MW overall generating capacity and operates independently. On the other hand, Malta has a conventional generation capacity of 380 MW and an extra 200 MW capacity that can be imported from Sicily (Italy) via an AC interconnector. Given the physical restrictions on both Islands, it is interesting that it has 132kV outgoing feeders for such a small island as Malta.

According to Reuters, in Brussels on February 14th 2023, the European Parliament enacted legislation formally outlawing the sale of new gasoline and diesel vehicles in the European Union beginning in 2035 [6]. This regulation attempts to tackle the urgent-problem of climate change while accelerating the switch to electric cars. The goal of the European Union is to promote the widespread use of electric cars and dramatically lower carbon emissions in the transportation industry, making a significant advancement towards establishing a more environmentally friendly and sustainable mobility system within the EU.

According to the ruling by the EU, CO2 emissions from automobiles and vans must beeliminated by2035. In addition, it is hoped tha tby 2030,CO2 emissions from automobiles and vans will have to be decreased by 50% from their levels in 2021. These strict regulations are designed to push the car sector toward greater sustainability and mitigate the negative effects of climate change. The legislation's aggressive emission reduction goals spur the creation and use of low- carbon technology like electric cars and alternative fuels, enabling the development of a cleaner, more environmentally friendly transportation industry.

Malta has 309,170 automobiles, assuming an annual mileage of 5,000 km per car, with 50% of the cars being converted to electric vehicles. Based on a conservative consumption rate of 0.2 kWh/km, Malta would need an additional 150 GWh of energy from the electrical system to charge the EVs. With an average annual EV trip of 7,000 km, Cyprus would require an additional 480 GWh of electricity each year.

These estimates emphasise the need for a strong infrastructure

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and sustainable energy sources to enable the transition to electric mobility by highlighting the rising need for electricity to power electric cars as they become more common in the respective countries.

The PV-based regulatory procedures and installation restrictions for Malta and Cyprus were discussed. Most photovoltaic (PV) installations are linked to the distribution network, while there are legal distinctions between PV installations on the two islands' distribution networks.

The service providers currently offer charge services have also been the subject of several discussions. The tarifffor Cyprus's e-charge service (in € per kWh) is provided in Table II. Malta's corresponding public charge rates are stated in TableIII.

Table II

Tariff (€/kWh charges) for thee-charge Service in Cyprus (CY) [7]

Year	Regular Charging (€/kWh)	Fast Charging (€/kWh)
2020	0.19	0.22
2021	0.22	0.25
January-August 2022	0.25	0.28
September-October 2022	0.37	0.40
November 2022-	0.35	0.38

ChargeMyRide [8] is the smartphone application for Malta's public EV charging. Customers of the so-called E-Drive plug charger enjoy advantageous pricing; ChargeMyRide-tariffs Malta's are listed in Table III.

Table III

Public EV Charging rates by Charge My Ride-Malta[8]

E-DrivePlug'n'ChargePackagesinMalta	
MediumCharging	FastCharging
Off-peak:€0.1698/unit	Off-peak:€0.1798/unit
Onpeak:€0.1885/unit	Onpeak:€0.1985/unit

Malta has on-peak and off-peak prices, unlike Cyprus, where the prices are constant throughout. The off-peak hours arefrom midnight to 6 am and noon to 4 pm every day on weekdays and Saturdays. On Sundays, the entire day is considered as off-peak for EV charging.

As of August 30th 2021, Enemalta [10] has been accepting applications from EV owners in Malta who wish to charge their vehicles privately in their garages. EV owners can benefit from a rate of €0.1298 per unit during off-peak hours, while on-peak hour use is subject to the appropriate electricity tariff bands. The use of the EV charger will be monitored by a separate meter. Enemalta website outlines the technical requirements for installation [11], and specific guidelines are given to address queries about electricity supply, single or three-phase requirements and EV meter installation.

Table IV

Domestic/Commercial EV Charging Tariffs in Malta (Part 1) [9]

EV Charging off-peak consumption tariff:	
Residential/Non- residential	Fixed rate of €0.1298/unit
EV Charging during peak hours tariff:	
Residential	Tariff Band Apply
Non-Residential	Fixed rateof€0.1485/unit
EV Meter Application Chargeson Existing Accounts:	
Single Phase	€50 (onetime)
Three Phase	€ 80

Table V

Domestic/Commercial EV Charging Tariffs in Malta (Part 2) [9]

Monthly Residential EV Meter Service Charge:	
Single Phase	€ 4
Three Phase	€ 6
Monthly Non-Residential EV Meter Service Charge:	
Single Phase	€ 6
Three Phase	€ 8

Compared to Cyprus's 35 cents per unit, Malta's off-peak tariff of roughly 13 cents per unit of electricity is remarkably low. If the EV energy meter is registered as non-residential in Malta, the tariff during peak hours is 14 cents per unit, but if it is registered as residential, things become complex. For residential off-peak rates, it covers the entire household's current usage, for which the applicable electricity price bands are in effect and can reach a maximum of 61 cents per unit. Additionally, one must take into account the one-time installation fees of €50 and €80 for the single and three-phase EV energy metres, respectively, as well as a monthly service fee of €6 (for single phase supply) or €8 (for three-phase supply). The client must establish a separate electrical installation for the EV Chargers to qualify for the EV energy meter. This installation might cost up to €1000, depending on the cable lengths. Of course, the estimate does not include the EV charger.

The E-Charge Service, offered by the Unit of EAC [7], is responsible for Cyprus's electric vehicle (EV) charging infrastructure. The architecture of the charging system, the communication standards, the specifications of the charging stations, the pricing scheme, and the geographic reach are all highlighted. The E-Charge Service provides Mode 3 charging while maintaining constant two-way communication between the vehicle and the charging station. The Type-2 plugs available at the charging stations allow for the simultaneous charging of two automobiles. The cost of issuing and replacing RFID cards is included in the price structure and connection and subscription fees. The E-Charge Service intends to encourage the use of electric vehicles, lower carbon emissions, and foster environmental sustainability in Cyprus.

The semi-fast charging stations installed by EAC allow charging of electric vehicles up to 21kW regular charging and 50 kW DC fast charging. Each charging station has two Type- 2 charging plugs,which can serve two vehicles simultaneously at full load.

Electric vehicle charging stations have been installed in public places covering the whole of Cyprus.The navigation map with the specific number of charging stations taken care of by EAC [7] is found in Fig 2,including the thirty-three (33) (The blue circle denotes the quantity of charging points in the area) Semi-Fast-Charging

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Station Infrastructure (22kW AC) in Cyprus.

To safeguard the environment and reduce carbon emissionsfor a better and clearer environment for Cyprus and beyond, the major goal of the e-charge service is to promote electric vehicles in Cyprus.

Malta introduced off-peak and peak rates for the public medium and fast charging stations on the island. Similar to residential charges, off-peak times are from 00:00 to 05:59 in the morning, from 12:59 to 15:59, and all day on Sundays(i.e., between 00:00 am and 11:59 pm).

Information is given on the locations of the 22kW AC semi-fast charging stations. For medium charging, the E-Drive charges are 17 cents per unit during off-peak hours and 19 cents per unit during peak hours. Fast charging costs 18 cents per unit for medium charging and 20 cents per unit for fast charging, respectively.

The charging locations can be seen in Fig 2for Cyprus andFig 3 to Fig 6 for Malta.

With approximately ten (10) pillars in Gozo and fifty (50) pillars in Malta, the EV charging service partially funded by the EU served the EV community on the islands for over a decade. The locations of the charging pillars of an old EV charging infrastructure still in use in Malta are given in Fig 3. Unlike the newly installed EV charging system,the user needs a monthly subscription for the old system in Malta, and the rates are fixed at 21 Euro cents per kWh.

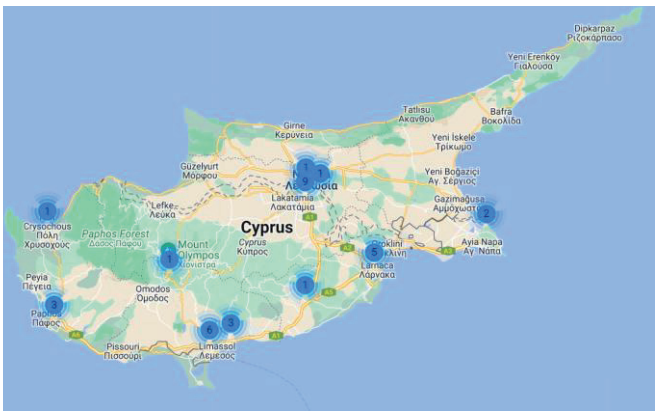

Fig. 2. The location and number of Semi-Fast-ChargingStations (22kW AC) installed in Cyprus by EAC [7].

There are three locations where one may charge an electric vehicle for free: one is in Cirkewwa next to the Gozo Ferry; another is at the port in Marsa; and a third is at the Taxbiex yacht marina. Due to the electricity from the PV panels assembled on the tent above the station, free charging is possible within the former EV charging infrastructure.

Fig. 3. Old charging station locations in Malta

All electric cars in Malta that adhere to AC (Alternating Current) charging system specifications can be charged at public charging stations. The three-phase supply used by the medium-speed AC recharging pillars can give energy up to a maximum of 22kW. For interoperability reasons, L-category electric car chargers come with two Type 2 vehicle connections, according to the standard socket outlets in EN 2- 62196.

The location of the twenty-three (23) fast chargers in Malta is given in Fig 4. The chargers also require at hree-phase supply input, thefast charging pillar installed in Malta can give DC electricity for EV charging at a maximum power output of up to 43kW.

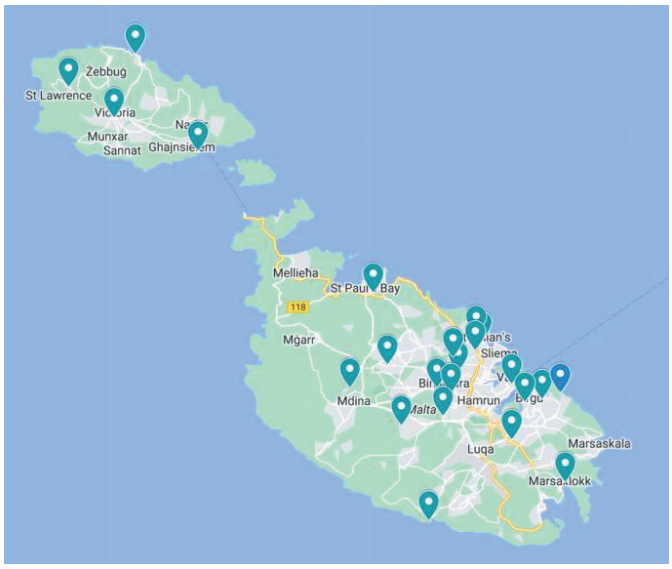

Fig. 4. Fast Charging Locations in Malta

The locations of the 30 medium DEMO chargers that are part of the recently installed EV charging infrastructure are shown in Fig 5.

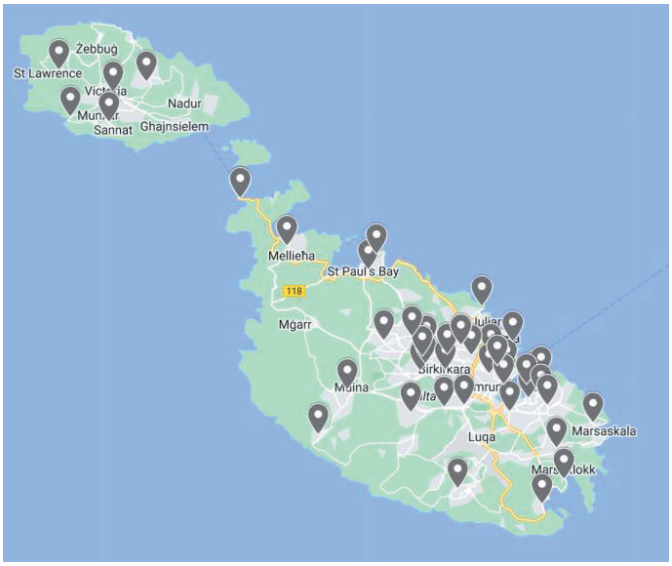

Fig. 5. Medium DEMO Charging locations in Malta

As shown in Fig 6,the newly installed EV charging infrastructure includes over three hundred eighty charging pillars in Malta.

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Fig. 6. All newly installed 384 public charging pillars in Malta

Finally, the following data on Cyprus has been compiled: reserve requirements, PV, wind, biomass, CSP, andanticipated storage technology profiles.

The losses, capacity, and operational reserves comprised most of the grid information. InCyprus, distribution losses added 3.2 per cent to the total generation, while transmission losses accounted for 1.5 per cent of the total generation. For the whole model horizon beyond 2019, a capacity reserve margin of 20% more than the annual peak demand was considered. While RET without storage was given a lesser capacity credit because of its irregular availability, storage alternatives and conventional thermal plants were permitted to contribute 100% of their rated capacity.

The operating reserves (spinning reserves), following the Republic of Cyprus's renewable energy strategy, were approved. The amount of the expressed total reserve is:

1. A constant 60 MW demand.
2. An additional 10% of PV generation and 50% of wind energy is produced instantaneously. The reserves were open to all traditional thermal methods contributions, and storage options were provided. Additionally provided was the overall annual PV generation. The annual PV profile is illustrated in Fig 7 in kWh/kWp.

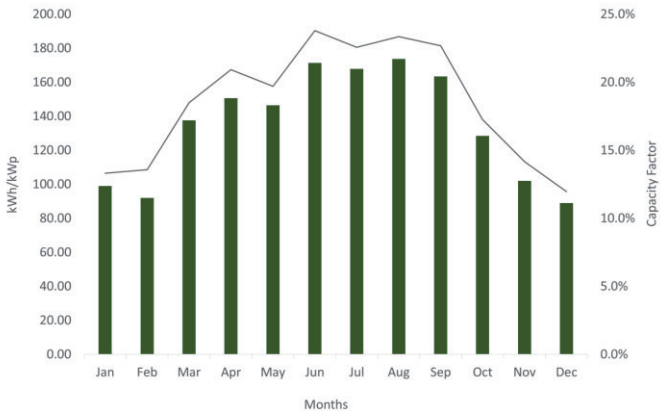

Fig.7. Plot for the PV energy produced throughout the year shared by The Cyprus Institute

IV. Conclusion

The importance of cooperation and information exchange to improve sustainable transportation is shown by the research on electric mobility conducted as part of the NEEMO project by MCAST in Malta and ANEL in Cyprus. Stakeholders from both nations engaged in constructive discussion through workshops, seminars, and exchange visits, identifying shared needs, challenges, opportunities, and limitations in the electric transportation industry.

The information exchange results between the two countries provide insight into the differencesbetween Malta and Cyprus in the e-mobility sector. The study also looks at energy generation and storage facilities and integrating renewable energy sources.

The two nations' most recent advancements in electric mobility policy, and research findings, were analysed, followed by a comparative study between the island states Malta and Cyprus.

The analysis underlines the urgent need to accelerate the transition to electric vehicles as the European Union adopts rulings to phase out gasoline and diesel automobiles by 2035. Malta and Cyprus must concentrate on infrastructure development and sustainable energy sources to fulfil the increased demand for power in light of estimates of anincrease in the adoption of electric vehicles.

Overall, this study delivers valuable info on the electric mobility market in Malta and Cyprus, aiming to improve environmentally friendly transportation. The two nations canhelp the EU in a more environmentally friendly andsustainable mobility system by exchanging information, encouraging collaboration, and implementing a longer-term strategy into action.

Acknowledgement

We would like to sincerely thank the MCAST Energy team for their invaluable assistance in familiarising themselves with the distinctive features of the study area. We want to thank ANEL from Cyprus for their remarkable contribution to this study, notably in renewable energy and electric transportation.

We also thank the Energy, Environment and Water Research Centre (EEWRC) of the Cyprus Institute, the Electricity Authority of Cyprus, the Cyprus Energy Agency, the Department of Road Transport of the Ministry of Transport Communications and Works for generously providing us with the necessary data and information. Their assistance with data and human resources has been considerable and has significantly aided in completing this study.

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