

PRISMI

Promoting RES Integration for Smart Mediterranean Islands

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Abstract:	An overview on the state of RES use in the study islands will be prepared stressing limits and potentials of RES spread. Specifically, all barriers to RES exploitation will be presented in terms of policy, regulations and funding schemes.

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EXECUTIVE SUMMARY

European island communities are developing strategic energy plans driven by concerns related to climate change and security of energy supply. Today technology advancements encourage for a wide number of alternative solutions available for the stakeholders and decision makers in the island communities that have to decide the type, the configuration, the capacity, the operation of these new plants that at the same time need to be harmonised with various environmental, social, technical and economic constraints.

SWOT Analysis including a scan of the internal and external environment is an important part of the strategic planning process. Factors internal to the investigated system usually can be classified as strengths (S) or weaknesses (W), and those that are not in the control of the system under evaluation, i.e. they are external, can be classified as opportunities (O) or threats (T).

When attempting the implementation of SWOT Analysis in energy projects, and more specifically in the implementation of renewable energy in various island communities then a number of parameters need to be taken into account, such as the availability of resources, socioeconomic structure, political issues, regulatory environment and environmental constraints.

Within PRISMI Project we use the SWOT analysis to assess the Mediterranean islands situation as acceptable to implement RES projects. The aim is to identify factors that are favourable (Strengths, Opportunities) and unfavourable (Weaknesses, Threats). In fact PRISMI will create in this report a model SWOT Analysis that may be followed in cases that relevant issues are raised in other island regions.

The objective of the present report is to provide a concise view of the PRISMI islands, their characteristics and the SWOT Analysis Table for the most suitable RES implementation in each one of them. Many works have been developed in the SWOT Analysis of various energy related issues and, more specifically, to RES and their implementation in the islands. A short reference to these works is included in the report. In the context of the present report SWOT Analysis has been carried out facing the following axes that are considered to be crucial in the design and implementation of RES investments in the PRISMI islands:

- ✓ Energy systems strategy
- ✓ Economics - financial risks
- ✓ RES resources availability and technological options
- ✓ Society - social impacts - public awareness
- ✓ Environmental impacts
- ✓ Location - territory - accessibility

Most of European islands have very limited land resources availability with conflicting demands. In addition to that, the terrain may cause difficulties and hinder RES

applications. Another important issue that is addressed here is how easily the islands are accessed in terms of infrastructure (harbours, road networks) as well as in terms of transportation for the people and the equipment / installations.

Each of the five sets of islands included in PRISMI scope are analysed extensively using SWOT methodology. The full Tables of SWOT Analysis may be found in the Appendix.

1. INTRODUCTION – BASIC CONCEPTS OF SWOT ANALYSIS

European island communities are developing strategic energy plans driven by concerns related to climate change and security of energy supply. In general energy strategic plans determining the investments and capacity planning need to take into account various technological, economic, and policy-related considerations. The type and configuration of a new energy plant, the capacity, the technology, the social acceptance, the environmental impacts and the timing of these potential new RES installations for the islands are critical parameters that need to be determined in the energy systems capacity and investment planning decision making[1]. Today technology advancements encourage for a wide number of alternative solutions available for the stakeholders and decision makers in the island communities that have to decide the type, the configuration, the capacity, the operation of these new plants that at the same time need to be harmonised with various environmental, social, technical and economic constraints.

Various methods have been employed by policy makers, researchers, practitioners in order to develop the most efficient and promising energy strategic plans. The SWOT Analysis is a very common process in strategic planning, providing a framework to assess and evaluate a wide range of inputs from technical, financial and other perspectives in a way that facilitates decision making. SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. The SWOT analysis headings provide a good outline for reviewing and assessing the strategy, position and direction of a company, a business proposition, a set of projects or any other alternative ideas for an issue under evaluation.

SWOT Analysis including a scan of the internal and external environment is an important part of the strategic planning process. Factors internal to the investigated system usually can be classified as strengths (S) or weaknesses (W), and those that are not in the control of the system under evaluation, i.e. they are external, can be classified as opportunities (O) or threats (T).

The implementation of SWOT Analysis depends on the type of system under consideration, on the available time and budget. For example SWOT may be carried out by team of experts through brainstorming or just by desk. It aims at: a) assessing the current status, the trends and the dynamics, b) the total recording of advantages and weaknesses as well as of the opportunities and threats, and finally c) the processing - prioritizing and exploitation of the results for the shaping of strategic choices. The SWOT analysis is a way to study and bring out the special characteristics of a thematic issue, a project, a strategic alternative, as well as its perspectives for the future. The strengths and weaknesses refer to the present and the interior of the subject under evaluation, recording the points in which the subject is stronger or weaker, while opportunities and

threats refer to external issues that might come up in the recent future and effect positively or negatively the specific area under consideration.

When attempting the implementation of SWOT Analysis in energy projects, and more specifically in the implementation of renewable energy in various island communities then a number of parameters need to be taken into account, such as the availability of resources, socioeconomic structure, political issues, regulatory environment and environmental constraints.

Within PRISMI Project we use the SWOT analysis to assess the Mediterranean islands situation as acceptable to implement RES projects. The aim is to identify factors that are favourable (Strengths, Opportunities) and unfavourable (Weaknesses, Threats) and finally to help addressing the following questions:

- *How can we make the most from the regions' STRENGTHS to increase the RES penetration in the islands?*
- *How can we circumvent the islands' WEAKNESSES by choosing the best technology options?*
- *How can we create OPPORTUNITIES and then capitalize on them?*
- *How can we manage possible THREATS, so that the 2020 RES targets will not be compromised by unfavourable evolution?*

In fact PRISMI will create in this report a model SWOT Analysis that may be followed in cases that relevant issues are raised in other island regions.

Due to its critical (in terms of timing) status the strategic planning processes of renewable energy implementation for island communities need an integrated assessment that will highlight strong points and will reveal risks that need to be faced when RES are implemented in the islands. Therefore SWOT Analysis is a very useful tool in that respect.

Internal factors include resources and experiences. In general, the internal analysis included Strengths and Weaknesses and is related to (specifically in energy systems):

- Physical resources (location, resource capacity and availability, terrain, facilities, equipment)
- Access to natural resources, technology, patents and copyrights
- Existing experiences and knowhow
- Human resources able to carry out and operate specific projects
- Financial resources, funding possibilities

External Analysis includes all the forces that affect significantly the prospects of the issues under consideration but are not controlled by the owner of the problem. Examples of these forces may be:

- Policy issues of the country that the energy plant will be based
- Political, environmental and economic regulations
- Technology issues, such as availability and access in the technology, difficulties in its implementation

- The economy - local, national, or international economic environment
- Funding opportunities (donations, legislature and other sources)
- Regulations and Legislation (currently and in their perspectives)
- Future technological and social trends in the field
- The social attitude in the area - public awareness
- Relationships with suppliers and partners

The primary objective of a SWOT analysis is to help organizations develop a full awareness of all the factors involved in a decision. SWOT analyses may serve as a precursor to any sort of company action, such as exploring new initiatives, making decisions about new policies, identifying possible areas for change, or refining and redirecting efforts. When drafting a SWOT analysis, individuals typically create a table split up into four columns to list each impacting element side-by-side for comparison. Strengths and weaknesses won't typically match listed opportunities and threats, though they should correlate somewhat since they're tied together in some way.

2. RELEVANT PREVIOUS WORKS IN THE FIELD

Many works have been developed in the SWOT Analysis of various energy related issues and, more specifically, to RES and their implementation in the islands. A short reference to these works follows.

In the context of ENERSCAPES Project [2], detailed SWOT Analysis has been carried out in terms of RES – Landscape situation in Malta.

P. Blechinger et al. provide a global overview on the small island landscape showing the respective population, economic activity, energy demand, and fuel costs for almost 1800 islands with approximately 20 million inhabitants currently supplied by 15 GW of diesel plants. Based on these parameters, a detailed techno-economic assessment of the potential integration of solar PV, wind power and battery storage into the power supply system has been performed for each island. The focus on solar and wind was set due to the lack of data on hydro and geothermal potential for a global island study. It revealed that almost 7.5 GW of photovoltaic and 14 GW of wind power could be economically installed and operated on these islands reducing the GHG-emissions and fuel consumption by approximately 50%. In total numbers more than 20 million tons of GHG emissions can be reduced by avoiding the burning of 7.8 billion litres of diesel per year. Cost savings of around 9 USDct/kWh occur on average by implementing these capacities combined with 5.8 GWh of battery storage. This detailed techno-economic evaluation of renewable energies enables policy makers and investors to facilitate the implementation of clean energy supply systems on small islands. To accelerate the implementation of this enormous potential we give specific policy recommendations such as the introduction of proper regulations [3].

The report entitled ‘Maximisation of the Penetration of RES in islands – ROADMAP’ is a deliverable of the STORIES Project, with full title “Addressing barriers to STORAge technologies for increasing the penetration of Intermittent Energy Sources”, and is cofinanced by the Intelligent Energy – Europe (IEE) programme. The main objective of the STORIES project is to facilitate RES penetration in islands, through modifications in the legislative and regulatory framework that will help adopt energy storage technologies. Partners coming from countries that include islands, both from Southern and Northern Europe, and two European networks/councils worked together in order to exchange experiences from their countries and examine the effect of different environmental conditions and regulatory frameworks on RES market development [4].

Following first attempts in the early 1980s that provided useful information on the reliability of the photovoltaic energy generation, Sicily’s remote islands share a number of pioneering achievements in the utilization of solar energy. In [5] an assessment of the progress and the remaining gaps in the large-scale adoption of renewable energy in said numerous islands is made. The most advantageous technologies are identified, so as to allow new stakeholder commitment for further progress in the forthcoming transition from fossil to renewable energy.

A very detailed analysis for the development prospects of Gozo island as well as a methodological and analytical SWOT in various aspects of interest has been developed in [6]. Again there SWOT is carried out in various important dimensions of Gozo development, such as cultural heritage, tourism, land uses, infrastructure and pollution.

Strategic planning including energy strategic planning also with the use of SWOT and Multicriteria Analysis for a southern Spanish region has been developed in [7]. Finally, in [8] a policy feasibility study for a complete upgrading of the energy system of this Mediterranean Island is carried out. Pantelleria, situated between Sicily and Africa, owns a large potential in terms of renewable energy resources, although there are some obstacles in turning it into a Near Zero Energy system. Starting from a deep energy system audit, the study proposes the project for a near zero energy island, through the efficient transformation of the different existing natural energy resources into electrical energy and heat: the solar, the wind-based and the geothermal systems. In this way, the island can be turned into an almost autonomous system. The main difficulties connected to the implementation of the project can be identified in the national energy policies as well as in the specific local situation, characterized by a strong private monopoly on generation and distribution of electrical energy which has no incentive for supporting the costs connected to the energy requalification of the island. On the other hand, the local administrations, involved in the project through bottom-up European policies, do not have the cultural and economic tools to go on with the implementation.

3. RES SUITABILITY ISSUES – SOME COMMENTS

The several scattered islands in the Mediterranean Sea are non-interconnected to the electricity grid of the mainland. In this context, RES is a solution that can contribute to the electricity production of the islands where the demand load is usually covered by costly in operation Autonomous Thermal Power Stations (ATPS) [9]. On the other hand, RES technologies are sometimes related with some issues that must be encountered for a proper RES integration to the local grids. In the following paragraphs some of these issues and the corresponding solution using the appropriate RES technology are presented.

Wind energy is a very suitable and with mature technology solution for electricity production in the remote islands, as they usually have a fairly good wind potential. However, the installation of wind parks may create some problems in the frequency/voltage dynamic stability of the electrical grid due to the fluctuations in their production which is related to stochastic wind speed behavior [10]. In this context, the implementation of the appropriate energy storage technologies may constitute a reliable and financially competitive solution to the existing autonomous thermal power stations.

Concerning the exploitation of the solar potential of the islands, it is a fact that Mediterranean islands have significant solar irradiance. However, photovoltaics could be a problem in land use as they have relatively low energy density (i.e. kW/m²). The proposed solution is to use existing infrastructure (e.g. building integrated solutions, roofs, parking shelters etc.) and other low productivity/economic value areas.

Furthermore, significant work has been carried out by various research teams (with special reference to PRISMI participants) for developing optimal solutions for remote islands electrification systems. Indicatively, the idea of creating various types of hybrid energy systems (e.g. a combined wind - photovoltaic (PV) based hybrid system with the use of an appropriate energy storage device, or other types of hybrid energy systems) have been extensively analysed and integrated solutions are suggested that could be adjusted to island systems and highlight the advantages of the proposed solutions [11], [12], [13], [14], [15].

In [16] an energy and environmental analysis of a small hybrid system are presented. A preliminary energy and environmental analysis of a vertical-axis micro wind turbine have been assessed along with the environmental impacts evaluating the soil, hydro geological, biodiversity and noise impacts.

In some islands other RES types than wind and solar may be very suitable due to resources availability, easiness of access, terrain, land uses etc. For example geothermal energy, biomass, wave energy may be more suitable than wind and solar. Many research works have been carried out for the biomass conversion. Concerning one of the PROSMI

Project countries, in [17] the energy potential of biomass from growing short rotation coppice on unused agricultural land in the Republic of Croatia is used to investigate the feasibility of Combined Heat and Power (CHP) facilities fuelled by such biomass. Large areas of agricultural land that remain unused for food crops, represent significant potential for growing biomass that could be used for energy production purposes. This biomass could be used to supply power plants of up to 15MW_e in accordance with heat demands of the chosen locations.

4. PRISMI ISLANDS DESCRIPTION

A short and as concise as possible description of PRISMI islands is following in this Chapter, in order to acquire an integrated view of the areas and make the SWOT Analysis as comprehensive as possible. The characteristics described are considered to be the most relevant to RES implementation and to the energy systems of the islands in general, as well as more relevant to the social and natural environment of the islands.

4.1 GOZO REGION (MALTA)

Gozo (in Maltese Għawdex) is an island of the Maltese Archipelago in the Mediterranean Sea, which includes the main island of Malta, Gozo, Comino as well as several little islets. Gozo is the second-largest island of the Maltese archipelago and is separated from mainland Malta by 5km stretch of sea (25 minutes by ferry). The total area of the region is about 67 km² and according to the census of March 2014 the population is about 37,300 inhabitants (representing approximately 8% of the entire national population), with a density of 540 inhabitants/km². The island of Gozo together with the smaller Comino forms the 5th Region of Malta. Similarly to other 4 regions, Gozo region has a limited power and legal autonomy.

Gozo is a distinctive place with rich cultural, historical and natural assets, whose sustainable exploitation could be used productively for the development of the island region as well as the national economy.



Figure 1: Gozo Region (Source: Google Maps)

The main land use in the islands of Malta so as in Gozo, is agriculture which covers almost the half land area, when the other half is covered by Natural habitats and urban/developed areas, consequently a large proportion of the population of Gozo deals with farming and agriculture. The rural distinctive character of the island makes it perceive as generally more green than the sister island of Malta.

Gozo Region appears a significant region of protected areas which includes two Areas of Ecological Importance / Sites of Scientific Importance (AEI/SSI), one Special Area of Conservation (SAC) of International Importance and one Special Protected Area (SPA). In general, 32% of agricultural land is found within Natura 2000 sites throughout the Maltese Islands.

The small size of the island renders space very sensitive and as a result limits opportunities for both business and industrial activity. Its economic development, being closely tied to agriculture and services such as tourism, is directly linked with its high level of environmental quality. The economic development in Gozo is also highly conditioned by the issue of the double insularity, which may necessitate a tailored-made approach to address the challenges and realities originating from this issue.

Concerning the electricity production for Gozo Region, there are no power stations in Gozo and the area is supplied with electricity from Malta via three submarine cable circuits which pass over the island of Comino.

4.2 FAVIGNANA ISLAND (ITALY)

Favignana is an island of Italy belonging to the archipelago of the Egadi Islands, Sicily. The main island of the Egadi, is located about 7 km from the western coast of Sicily,

between Trapani and Marsala, and is part of the municipality of Favignana. According to the census of 2011 the population of the island is about 3400 inhabitants.



Figure 2: Favignana Island (Source: Google Maps)

The island is mainly covered by Mediterranean scrub and Mediterranean pine forests. It has an area of 19 km² and a coastal development of 33 km jagged and rich in cavities and caves. Although in antiquity it was rich in vegetation, today it is poor because of deforestation. The island is crossed from north to south by a mountainous dorsal. Favignana is part of the Egadi Islands nature reserve set up in 1991. The Islands income sources are mainly tourism and fishing. The group of Egadi Islands is composed by three islands, two islets and a series of rocks and cliffs. The islands are located about 7 km far from the west coast of Sicily, belonging to the (Administrative) District of Trapani. The climate is mild in winter and warm and sunny in summer. The Municipality of Favignana consists of 4,200 inhabitants, and it includes the islands of Favignana, Marettimo and Levanzo and the smaller islands of Maraone and Formica.

The current electrical demand of Favignana results to be 12,56GWh (2011) with an annual production of 15,16GWh (2011) that shows the poor efficiency of the old distribution system. The consumption triples during summer months compared to the off-season months average due to the strong touristic fluxes. The touristic season lasts for almost four months. The Egadi islands are not connected to the Italian national grid. The energy system consists of a thermal power plant with seven diesel engines with an overall power of around 12MW. There is just a small renewable production due to photovoltaic systems, the total peak power of which is around 170kW.

Regarding the renewable resources, Favignana as the whole south part of Italy presents a high potential, especially considering solar (Figure 3) and wave energy (Figure 4).

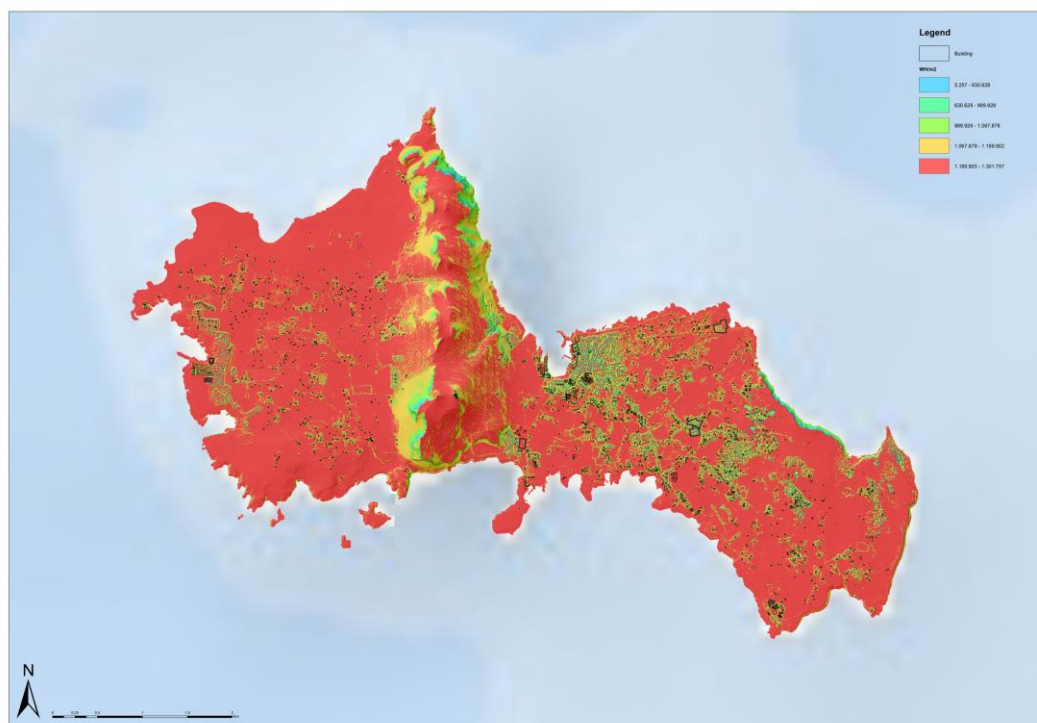


Figure 3: Solar potential for the island of Favignana (Sapienza team elaboration)

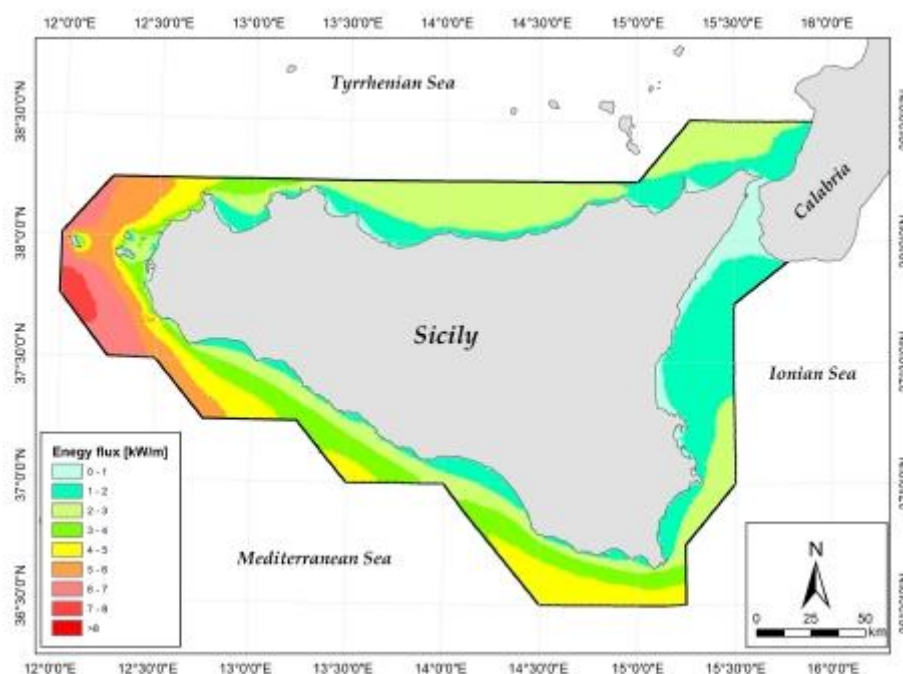


Figure 4: Yearly annual average wave energy flux for the island of Favignana [18]

Through the project "Sole e stelle delle Egadi" four different type of intervention were implemented: solar thermal and photovoltaic systems integrated in the architecture of the area and the landscape for public and private buildings; vegetable oils generators with engine power of approximately 100 kW; a sustainable mobility project including

electric bicycles, electric scooters, columns and photovoltaic roofs for charging needs; intervention on public lighting which will replace the existing bulbs with new LED lamps without changing the morphology of the street lamps. In collaboration with the Marine Protected Area a process of environmental certification has also started aiming at safeguarding the environment and the creation of local brands of environmental quality for the main tourist activities of the place: accommodation, food, guided tours, dive centers, passenger transport, fishing, rental and leasing of ships, car, motorcycle and bike and mooring services.

Today the Egadi Islands, as other Italian islands, are not yet connected to the national grid by producing energy locally, mainly fossil. As part of the green Egadi 2015 projects new equipment will be installed at very high efficiency (LED) in the system of public lighting of Favignana and charging stations for electric vehicles with photovoltaic roof will be made. The administration has also chosen to invest a significant portion of the available resources to purchase electric vehicles to make more sustainable the municipal fleet and to build four new photovoltaic systems on many public facilities. Regarding the investments in the private sector the private photovoltaic systems purchase has been encouraged.

In the Municipality of Favignana the AzzeroCO2's project "Sole e stelle delle Egadi" was funded by Italian Ministry of Environment through the call "Renewable sources, energy saving and sustainable mobility in the smaller islands". The objectives of the project are to encourage, within the territory of the three islands of Favignana, Levanzo and Marettimo, the deployment of renewable energy, efficient technologies and the promotion of sustainable mobility, leading to a reduction in 36% of CO2 emissions compared to the current level. In 2015 the Italian Ministry of Environment granted the Municipality of Favignana to continue the project "Sole e stelle delle Egadi", in order to put new LED fixtures in the installation of public lighting and create the charging columns for electric vehicles with photovoltaic roof.

Another project funded in Egadi Islands is "Eco-innovazione Sicilia", which aimed at encouraging sustainable tourism. The need arises from the large influx of summer tourists, on an island that may host up to 60,000 people a day, in front of the usual 4,500 residents, which would be detrimental to the environment. These activities are part of the initiatives launched in the South of Italy by ENEA (National Agency for new technologies, energy and sustainable development) and they have been funded by the Finance Act 2010. The project involves the implementation of measures on the sustainable management of water resources, the cycle of waste and natural resources, including studies on the quality of marine and coastal environment.

4.3 KORČULA AND VIS ISLANDS (CROATIA)

Korčula is a Croatian island in the Adriatic Sea. It has an area of 279 km², 46.8 km long and on average 7.8 km wide and lies just off the Dalmatian coast. Its 15,500 inhabitants (2011) make it the second most populous Adriatic island after Krk and the most populous

Croatian island not connected to the mainland by a bridge. The island is largely covered with Mediterranean flora including extensive pine forests. Korčula Island is extremely fertile and is densely covered with evergreen conifers and pines, as well as Mediterranean plants and herbs. Average electricity consumption for the Island of Korčula is about 55 GWh/year.

First Sustainable Energy Action Plans (SEAPs) were developed through IEE Meshartility project. To achieve the goals set by the SEAPs, the island was one of the target areas of the IEE BEAST project on how to transform into a smart, green and sustainable territory together with the islands of Mljet, Lastovo, Peljesac Peninsula and Dubrovnik West Coast. Two additional projects, which involve inhabitants on the island of Korčula, are ongoing: Energy Renovation of households and Small PV systems. The former is being implemented by private investors, with the help of Municipality of Vela Luka, Association “Novi otok” and co-financed by Croatian Environmental Protection and Energy Efficiency Fund and Dubrovnik Neretva County. The latter is mainly conducted by private investors. [19, 20]



Figure 3: Korčula & Vis Islands (Source: Google Maps)

Vis is a small Croatian island in the Adriatic Sea and it is the farthest inhabited island off the Croatian mainland, with a population of 3,617 in 2011. Vis has an area of 90.3 square kilometers. The highest point of the island is 587 meters above sea level. Once known for its thriving fishing industry in the late 19th and early 20th century, the main present-day industries on the island are agriculture and tourism. Concerning island's electrification, Vis currently depends on a submarine link with the island of Hvar. A PV power plant project is being developed for several years and the project completion is still pending. The renewable energy potential in the case study area is very noticeable, in particular regarding the solar energy (figure 4). The electricity consumption of Island of Vis was 17,6 GWh in the year 2016.

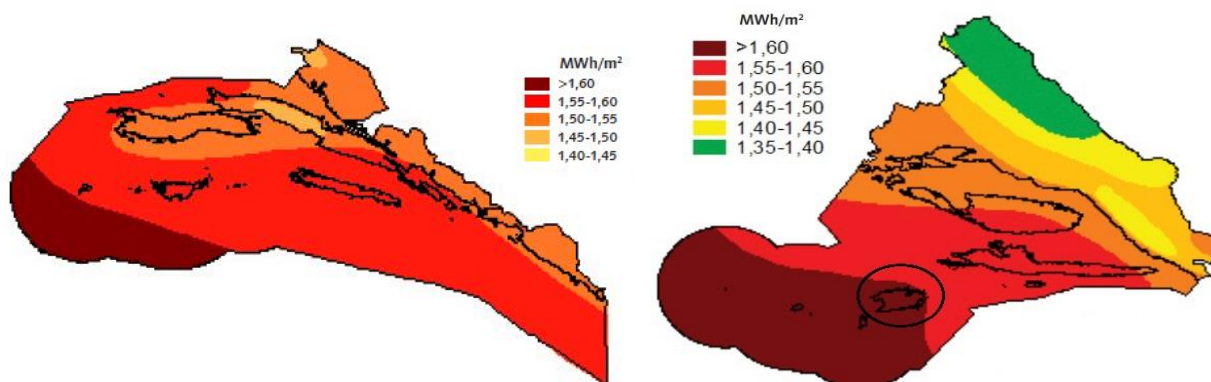


Figure 4 Solar energy potential of the case study area: islands of Korčula and Vis [18], [19]

Both Korčula & Vis Islands are areas included in the Natura 2000 grid. The islands differ in terms of development and number of inhabitants, as well as the quality of their connection to the grid and transport connections, which makes them interesting for comparative study.

4.4 AKAMAS PENINSULA (CYPRUS)

Akamas Peninsula is located on the northwest end of Cyprus and is defined by the administrative boundaries of eight local authorities: the municipality of Peyeia and the village-communities of Kathikas, Pano & Kato Arodes, Ineia, Drousheia-Pittokopos, Androlikou and Neon Chorion and the abandoned village of Fasli. The total area of the peninsula is 230 square kilometers (Cyprus area: 9.251 square kilometers) and is one of the least inhabited places on the island with 6000 inhabitants (census 2011).

The mountainous nature of the peninsula there contributes to the fact that there are not any streets running through her heart and some roads highlighted in the Cypriot road maps of the area are not asphalted. In addition, half of the terrestrial part of the peninsula is part of the European network - NATURA2000. Akamas presents a comprehensive and complete picture of the characteristic vegetation of the coastal and lowland areas of the island in good physical condition and presents a rich marine ecosystem. Akamas Peninsula is one of the most important areas of Cyprus for migratory birds and the European Environment Agency noted that it was one of only 22 areas of endemism in Europe.



Figure 4: Akamas Peninsula in Cyprus (Source: Google Maps)

4.5 TILOS ISLAND (GREECE)

Tilos island, comprising the demo-site of TILOS system, is located at the south-eastern part of the Aegean Sea and belongs to the far-remote complex of Dodecanese (~220 nautical miles from the central Greek mainland port of Piraeus). The island size is approximately 63km² and its coastal perimeter is almost 63km, with its terrain being basically semi-mountainous and mountainous, except for a long valley extending from the island center to its south. On the island, there exist two main communities, namely Megalo Chorio (north part of the island) and Livadia (south-eastern part of the island), with the total island permanent population reaching approximately 533 habitants (255 and 278 respectively) and increasing considerably (even tripling) during the summer period due to tourists' arrivals. The current electricity needs of Tilos (in the order of 3.2GWh per year – annual peak demand of approximately 1MW) are covered exclusively by the operation of the oil-fired power station of Kos island (in the north of Tilos), through an interconnector (undersea cable of 20kV) that reaches the north side of the island after first crossing through Nisyros island (Figure 5).

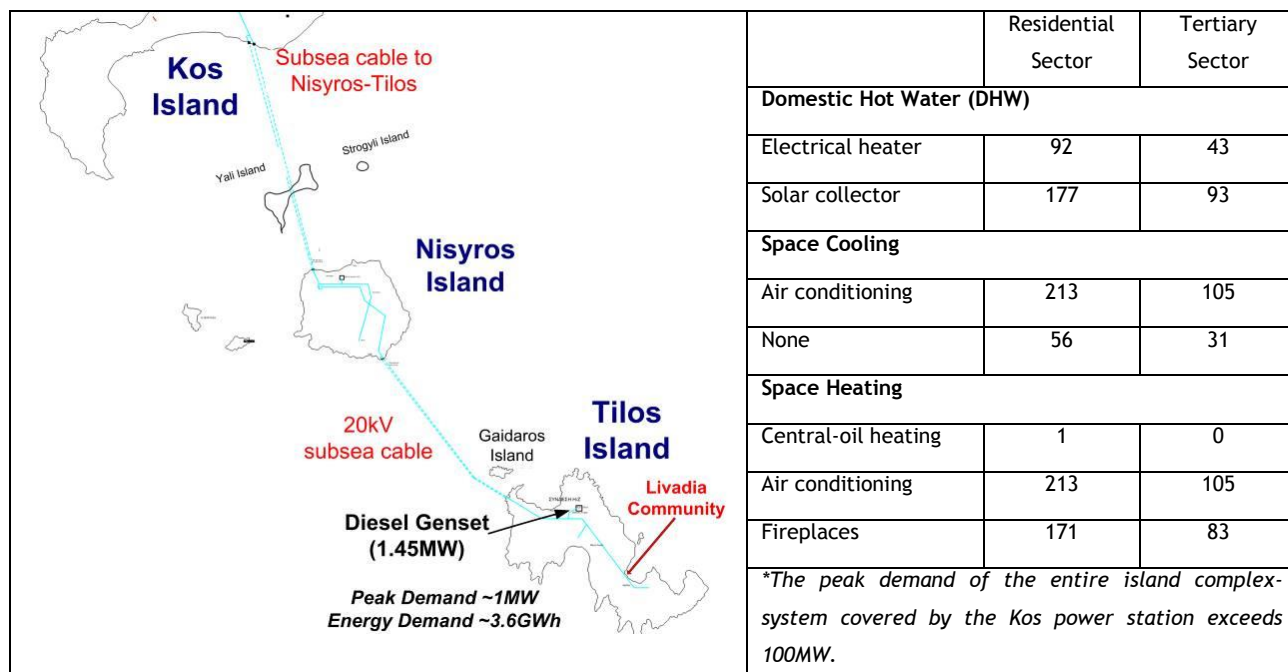


Figure 5: Interconnection of Tilos island to the island of Kos, through Nisyros (Source: HEDNO, 2013), and characteristics of DHW and space heating/cooling in the building sector of the Livadia community (south part of the island) (Source: Municipality of Tilos, 2013)

Power distribution on the island is achieved with the use of a local, overhead line power grid comprising of 24km medium-voltage and 20km low-voltage lines as well as 36 transformers along it. Owing to persistent faults of the undersea cable, the island often suffers from black-outs that can last for time periods even in the order of 15-30 min (especially during the summer period). To this end, despite the fact that a back-up diesel generator of 1.45MW does exist on the north part of the island to face similar events, it cannot be directly dispatched since it is manually operated. Concerning the breakdown of energy needs, out of the total electricity consumption of approximately 3.2GWh, almost 300MWh derive from public-use loads such as street lighting, water pumping and bores, with the rest being attributed to the local residential and service sector. This is largely owed to the fact that due to the mild climate conditions, the islanders largely rely on the operation of air conditioning units for both space heating and cooling needs, while it is approximately 1/3 of the local building sector that uses electrical water heaters for satisfying hot water needs (Figure 5).

Finally, similar to the majority of Aegean Sea islands, the island of Tilos appreciates high-quality solar potential (~1800kWh/m² on the horizontal plane) and mild Mediterranean climate conditions. At the same time, its wind potential may be determined as of medium-high quality (>6m/sec for the greatest part of the island territory) (see also Figure 6). Recapitulating, Tilos comprises a typical small-scale Aegean island region that although appreciating respectable RES potential relies on the operation of the Kos island oil power station for covering its electrification needs.

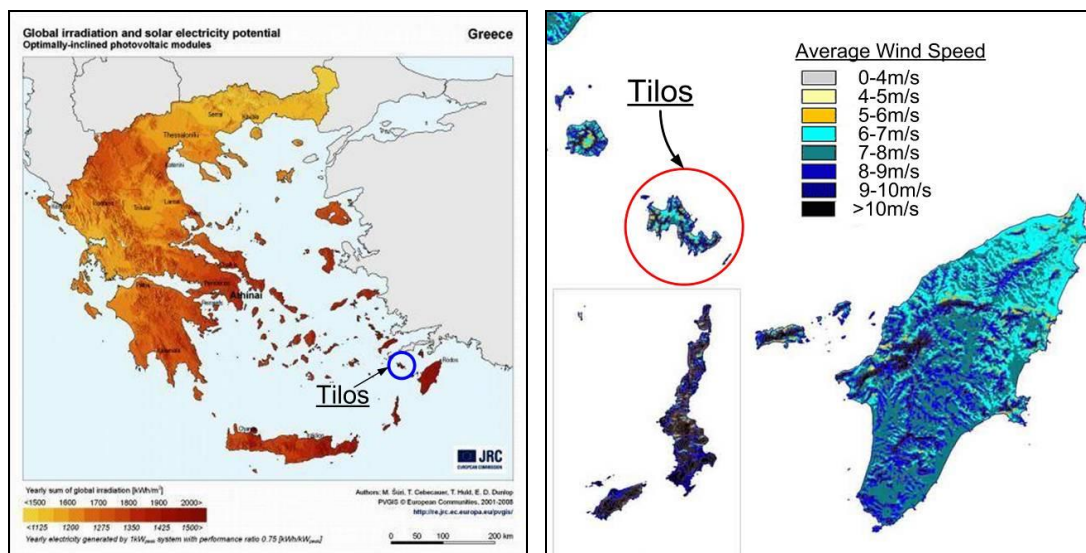


Figure 6: Solar and wind potential quality for the island of Tilos

Acknowledging the security of supply problems faced by the islanders due to the insufficient grid interconnection with the electricity system of Kos, as well as the high-quality solar potential and the medium-high quality wind potential of Tilos, the proposed energy solution suggests application of the TILOS system through the development of a microgrid in the south part of the island that will mainly serve the community of Livadia (annual energy consumption in the order of 1.5GWh and peak demand in the order of 450kW, Figure 7).

To this end, the proposed configuration employs high-temperature NaNiCl_2 battery storage along with indirect, residential hot water storage and DSM, coordinated under the energy management system of TILOS system. More precisely, the main components of the proposed solution are given in the following, informed also by a preliminary sizing study undertaken by *Younicos*, *Eunice* and *TEIP* (see also ANNEX).

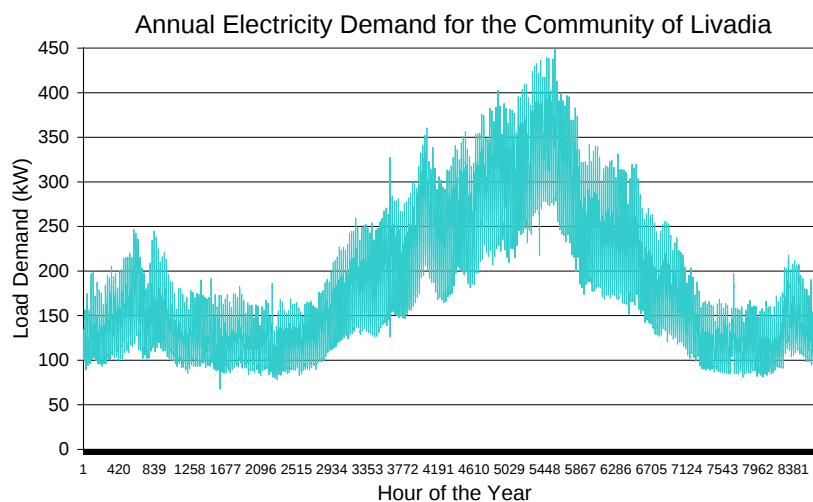


Figure 7: Hourly load demand of the Livadia area (Source: HEDNO, 2013)

5. SWOT ANALYSIS FOR RES IMPLEMENTATION IN EACH PRISMI ISLAND

The objective of the present report is to provide a concise view of the PRISMI islands, their characteristics and the SWOT Analysis Table for the most suitable RES implementation in each one of them. As previously described, SWOT analysis investigates the strong and weak points of an organisation / a geographical area for a certain subject / issue. Strengths and Weaknesses comprise the internal environment, while, on the other hand, Opportunities and Threats are related to the external environment analysis, the driving forces and the critical issues encouraging and hindering the next steps of the organisation in order to achieve its strategic objectives and mission. In that respect, when dealing with the SWOT Analysis for the implementation of Renewable Energy in the islands, the Analysis should be focused in the parameters affecting the design, the funding, the implementation and the acceptance of these innovative energy solutions in these places.

To name some of the parameters that affect RES selection, design and implementation, the following categories may be realised:

- ✓ Energy systems strategy
- ✓ Technical and Technological issues - RES Industry Development - technology maturity and support availability and cost
- ✓ Social effects - The maturity and acceptance of innovative and alternative energy systems by the local society - Public awareness
- ✓ Economic efficiency and economic environment
- ✓ The funding possibilities of the new energy systems, the economic situation prevailing in the area
- ✓ Financial risks and uncertainties
- ✓ Renewable Energy Regulatory Policy and Framework - Legislation - The Regulatory framework in the specific area / country that may (or may not) encourage the RES implementation -possible subsidies- permission procedures etc. Institutional Framework
- ✓ Resources - Location - Geographical constraints - RES potential in the area

Some of the above factors may overlap with each other. However, it is believed that a detailed analysis, even with overlaps, will be very useful at this stage of the work that the initial approach and the identification of strategic options is carried out.

More specifically, SWOT Analysis in the context of the present report has been carried out facing the following axes that are considered to be crucial in the design and implementation of RES investments in the PRISMI islands:

- ✓ Energy systems strategy

The energy systems strategy deals with the overall energy strategic planning of an area as this has been defined by the country's energy systems. Therefore, major strategic issues are dealt with in terms of encouraging or not RES penetration.

✓ Economics - financial risks

As it is well understood, the economics affect dramatically the energy systems planning. This has to do with the economic situation, the funding opportunities, the new financing schemes of energy projects and the ability of a country or a region to implement them, as well as in a micro-scale the economic efficiency of each particular RES project and the availability of private investors.

✓ RES resources availability and technological options

The Renewable Energy potential for each of the most promising renewable sources is analysed here. Wind, solar, geothermal and wave energy, along with biomass conversion are the energy sources that are the most serious candidates to be applied, either isolated or in combination in hybrid systems. Therefore, in addition to the potential, other issues like technological awareness and maturity are also dealt with.

✓ Society - social impacts - public awareness

Society usually plays a very crucial role in the acceptance and the success of novel energy projects. The reactions of the public, their awareness and attitude, the availability of human resources that may work and support technically the energy plants will seriously affect the RES penetration, beyond any technical and financial constraints. Another very important issue that needs to be addressed here is the nexus of other activities on the island (i.e. agriculture, tourism, industrial production, etc.)

✓ Environmental impacts

The natural environment is affected by any human intervention. The same applies to energy projects; however, RES have less environmental impacts than conventional energy sources. The type of the natural and human environment and how this will be affected by any new RES implementation is explained in this clause. In any case, in European countries the licensing process of a project is determined by its environmental impacts; therefore serious attention is needed to develop this issue in detail in order to avoid future problems and difficulties.

✓ Location - territory - accessibility

Most of European islands have very limited land resources availability with conflicting demands. In addition to that, the terrain may cause difficulties and hinder RES applications. Another important issue that is addressed here is how easily the islands are accessed in terms of infrastructure (harbours, road networks) as well as in terms of transportation for the people and the equipment / installations.

In the light of the above analysis, each of the five sets of islands included in PRISMI scope are analysed extensively using SWOT methodology. The full Tables of SWOT Analysis may be found in the Appendix. The main conclusions of this analysis are presented in the next paragraph.

6. CONCLUSIONS

After the detailed SWOT Analysis of the PRISMI Regions and islands it is obvious – as expected – that there is a very promising RES potential in all of them. Certainly very good conditions in the whole EU area and each country separately provide excellent opportunities for RES investments; however, there are various internal and external difficulties that need to be overcome for their successful implementation.

It seems that the regulatory conditions and the legislation is one of the obstacles that need very serious efforts to be overcome; possibly in EU framework also and not only in each country separately.

In any case very detailed and specific for each island analysis indicates which are the best opportunities that need to be exploited for the successful implementation of RES.

Furthermore a model SWOT analysis has been developed in the present report to be used in any similar case of RES investments potential investigation in islands.

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APPENDIX: SWOT ANALYSIS TABLES

SWOT Analysis for RES implementation - TILOS ISLAND - GREECE

ENERGY SYSTEMS STRATEGY

STRENGTHS	WEAKNESSES
High increase of electricity demand for about six months per year encourages investments on energy infrastructure	Limited previous experience in Hybrid Energy systems on the island and in general
RES provide reliable solution to face continuous and unexpected black outs during the summer	
The successful implementation of an innovative European project encourages and promotes the idea of shifting to new energy systems	
OPPORTUNITIES	THREATS
Very positive European attitude towards shift to renewables	Relatively low prices for fossil fuels may slow down the push for renewables
The population and the visitors of Tilos would welcome new energy solutions with enhanced electricity security supply.	As everything new and innovative, the hybrid energy system of Tilos will have to overcome serious reservations and doubts from the local population

ECONOMICS - FINANCIAL RISKS

STRENGTHS	WEAKNESSES
The private investor involved in the project has long experience related to the development and operation of RES plants	The hybrid energy system of Tilos is innovative and there is no experience and know-how concerning its financial efficiency.
	There is not much experience in modern funding schemes with the cooperation of private and public sector
OPPORTUNITIES	THREATS
If new financial schemes with risk sharing and risk management attract RE projects are successful, this might have spill - over effects and reduces financial barriers for investments	There is no experience in private hybrid energy systems in Greece
Currently there are significant RES investments that have been successful in financial terms and might decrease risks	There is not much experience in modern funding schemes with the cooperation of private and public sector
Very positive climate towards Green energy investments in Greece	A hybrid power station electricity price has not been defined

SWOT Analysis for RES implementation - TILOS ISLAND - GREECE

RES RESOURCES AVAILABILITY AND TECHNOLOGICAL OPTIONS

STRENGTHS	WEAKNESSES
Very promising solar potential. Average quality wind speed around 6m/s. Very significant experience in the installation and operation of wind farms from the investing company.	Land and territory limitations reduce attractiveness for RE private investors in the Greek islands
Very significant experience in the installation and operation of wind farms from the investing company.	There is a confusion related to the propriety status of land in many Dodecanese islands
The research labs participating in hybrid energy systems project have more than 30 years experience in similar R&D activities	
OPPORTUNITIES	THREATS
Wind and PV investments are based on mature technologies without any particular risk	Operational problems may be caused due to the adverse sea environment
Energy demand is continuously increasing mainly due to the increasing number of visitors / tourists but also due to the migrants that are obliged to spend long time on the island.	

SOCIETY - SOCIAL IMPACTS - PUBLIC AWARENESS

STRENGTHS	WEAKNESSES
Tilos inhabitants have long experience with environmentally friendly development.	Since these developments are new, there are still some complaints about the long run impacts of the hybrid station, and their benefits from this type of green energy projects
The population and the visitors of Tilos provide strong support to RE projects due to their commitment to environmentally friendly development, and the efforts that have been made for their education and training in this type of projects support for RE deployment	There are some concerns related to the risk and the reliability of this system
OPPORTUNITIES	THREATS

SWOT Analysis for RES implementation - TILOS ISLAND - GREECE

Increasing local income in the mid term due to less fossil fuel costs, due to less electricity costs, to increased tourism and visitors in order to see the project, as well as due to the creation of new job positions.	If benefits associated to the new RES installations do not reach local population and only benefit a small fraction of the population, public acceptance may face serious problems
	There may be welfare losses in touristic areas in case landscape damages occur

SWOT Analysis for RES implementation - TILOS ISLAND - GREECE

ENVIRONMENTAL IMPACTS

STRENGTHS	WEAKNESSES
RES have much less impacts than any other form of conventional energy at least as far as emissions are concerned	Tilos is characterised as NATURA area and that caused difficulties in licensing procedures
	Tilos is a bird's migration route. Therefore the siting of the project needs a lot of attention in order to avoid some excessive environmental impacts
OPPORTUNITIES	THREATS
All the positive and supporting attitude and European trends towards clean energy due to their limited environmental impacts support substantially these new developments	RES are not without any impact. Therefore attention should be paid for the minimisation of nuisance during the construction period and the selection of the best location concerning visual and landscape impacts.
The project construction will mainly take place during the summer when many tourists will be present on the island. Since Tilos visitors are environmentally aware, this will enhance the acceptance of the project in the local society.	There may be welfare losses in touristic areas in case landscape damages occur
	There will definitely be some nuisance during the construction period

LOCATION - TERRITORY - ACCESSIBILITY

STRENGTHS	WEAKNESSES
Dodecanese Island Complex, where Tilos belongs, has a strategic importance in Greece since it is the South East corner of the country	Tilos has many difficulties in infrastructure. Its Harbour is located on a village with very difficult access to the rest of the island as far as equipment and installations are concerned
Tilos is a small - medium size island with almost 500 inhabitants which is an optimal size to demonstrate the autonomous islands green energy concept	Tilos has difficult access in general since there are days in the week that the island does not communicate at all with the rest of the islands or any other point of the country.
New people willing to stay in the island due to tourism and other promising activities may want to be trained to work in the hybrid energy system.	It may be difficult to find locally the human resources required for the operation of the energy system.

Rhodes, the centre of Dodecanese, a big island with almost 100,00 population, also one of the bases of the South Aegean Islands Region is only two hours by boat from Tilos.	there is a risk for exclusion of parts of the island from tourism development due to the new energy installations
OPPORTUNITIES	THREATS
It is very important to be able to have a demonstration site for the green European island concept in Greece; this will encourage the development of many small- medium size islands of Greece that have suffered substantially during the economic recession.	Land use legislation is very vague; thus there are serious difficulties in getting proper licenses and in detailed siting of the installations.
very good cooperation with universities and research centers pioneer in RES and hybrid energy systems	Growing competition in the installation and operation of autonomous island networks.

SWOT Analysis for RES implementation - GOZO ISLAND - MALTA	
ENERGY SYSTEMS STRATEGY	
STRENGTHS	WEAKNESSES
Gozo, due to its small scale, can have most of its energy generated through clean energy sources which may include micro-wind turbines, on-shore wind farms, biomass/energy from waste and solar energy.	Energy consumption in Gozo and Malta is derived from imported fossil fuels. NSO statistics indicate that energy consumption has been on the increase for the past eight years.
RES can provide an autonomous, clean and reliable energy solution to manage energy pick demands and black outs during the summer.	Large wind or solar farms may be not suitable for Gozo, due to the restricted availability of land.
Apart from solar, wind and wave technologies, there is a good potential energy production from waste biomass. Furthermore Gozo is evaluating the possibility of setting up a demonstration solar cooling plant.	Peaks of waste production during summer season can make difficult to manage waste biomass or other micro RES plants, as a long lasting source of energy
OPPORTUNITIES	THREATS
High price of electricity production for fossil fuels combined with good incentives (feed-in-tariff and solar grants) can enhance the spread of application of solar and other RES energy systems.	Costs related to the installation of PV/Wind systems are still consistent despite the incentives, so this may slow down the push for renewables

There is a high general commitment with regards to environmental and energy saving issues thanks to Eco-Gozo Plan, which is promoting funded projects and enhancing the shift towards Eco/sustainable practices	Wind energy is a sensible topic because of the impact on the landscape and poor availability of land.
ECONOMICS - FINANCIAL RISKS	
STRENGTHS	WEAKNESSES
Possibility to generate green jobs and foster eco-tourism if the island promotes more ecological initiatives and shifts towards energy self-sufficiency.	Low rate of return of investment in RES (long payback period).
Possibility to invest in new technologies (i.e. PV efficiency) and hybrid solutions that can provide a shorter payback period and less maintenance.	No prior experience in EPC schemes that can allow the financial boost in RES and cooperation of private and public sector
Increasing prices for electricity generated by hydrocarbon fuel encourage the development of sustainable energy production	In order to foster and promote RES there will be an increase in National recurrent expenditure.
OPPORTUNITIES	THREATS
RES can satisfy the ever increasing energy needs and contribute to a significant reduction of dependence on non renewable energy sources	The development of PV plants and other RES without appropriate landscape impact assessment will negatively affect tourism, which is the main source of income in the region.
Waste biomass could be used as energy source, reducing also the waste transportation and disposal costs	Without an adequate technological development <i>in loco</i> , logistics can become very demanding for Gozo's economy
Introduce a tax credit system for industries and commercial outlets that use renewable energy sources	Without adequate financial measures, PV generated (or other RES generated) electricity storage/pricing will be unfavourable

SWOT Analysis for RES implementation - GOZO ISLAND - MALTA

RES RESOURCES AVAILABILITY AND TECHNOLOGICAL OPTIONS

STRENGTHS	WEAKNESSES
Very promising solar and wind and wave potential, due to the latitude of Malta and to the high presence of offshore areas	Wind turbines may impact landscape quality or create nuisance. Also road access for the transportation of these turbines to the site of installation also needs to be taken into consideration
Establish a mechanical biological treatment plant for the treatment of Municipal Solid Waste and manure on Gozo.	Lack of a waste management plan can threaten the good results in the collection and treatment of solid waste, especially with bio waste and organic material
Ongoing Research on Hybrid Systems: a tri-generation plant (combined heating/cooling/power) in conjunction with a development (public or private) in Gozo and a low-grade geothermal heating/cooling system (also known as ground source heat pumps) as well as Aerothermal/Hydrothermal Climate Systems	Lack of professional expertise and trained engineers that can work and research on hybrid options. Moreover the funds for the implementation phases of the research are often missing, so studies finally are not implemented by the public government.
OPPORTUNITIES	THREATS
Total onshore wind farm potential in Gozo is estimated to be circa 10 Megawatts, representing circa 20% of the total electricity requirement in Gozo	The activities of deep-sea fishing, coastal fishing, sport fishing and underwater tourism can be threatened by a unbalanced development of wave energy production
The substantial rooftop space (e.g. on public buildings) is definitely a resource for investment in innovative renewable energy technologies. Moreover PVs can easily be integrated in existing building mass/structures	Lacking of ESCO / RES energy providers that can support the initial costs of a RES installation.
Strong potential in solar technology: there is already 1,495 MWp of photovoltaic systems installed in Gozo, which translate into 3.1% of the energy consumed by the island.	A barrier to invest in PV or wind farms is capital cost and the very long time required to recuperate this cost.
Once Energy Performance contracts and ESCOs will be applied in Malta, there will be a greater chance to increase the share of energy generated through renewables.	Energy demand is continuously increasing mainly due to the increasing number of visitors / tourists.

SWOT Analysis for RES implementation - GOZO ISLAND - MALTA

SOCIETY - SOCIAL IMPACTS - PUBLIC AWARENESS

STRENGTHS	WEAKNESSES
Gozo inhabitants are concerned about environmentally issues and are aware of eco-friendly development thanks to different campaigns developed through the Eco-Gozo strategic plan	Green energy projects should face public acceptance. It is also needed a strong political will/agenda to promote bigger RES projects/plants.
Through the domestic use of solar energy installation the bills are lowered and this means more disposable income for a family. The reduction of CO2 emission consequently bring savings in the health care system	Weak development in research on RES, especially regarding wave energy and hybrid systems.
OPPORTUNITIES	THREATS
Gozo could improve job numbers in the sector of RES development, installation and maintenance	Without a reinforcement of land use regulations, the landscape can be damaged by RES development.
The reduction on CO2 emissions will improve the health state of Malta's population	Gozo relies strongly on tourism. Installation of RES at bigger scale can be a risk in terms of impact on the naturalistic value of the island, threatening touristic activities.

SWOT Analysis for RES implementation - GOZO ISLAND - MALTA	
ENVIRONMENTAL IMPACTS	
STRENGTHS	WEAKNESSES
PVs are completely silent and potentially nonintrusive (visually as they can follow terrain or be fully integrated on flat and inclined roofs)	Gozo has a great number of environmentally protected areas, as the NATURA 2000 sites, and marine areas. In these areas it is very difficult to implement any kind of development/RES project.
Develop scattered PV plants or micro-wind can be easily done in Gozo, since significant roof areas are available in urban public areas. Moreover private individuals/entities could be brought on board in order to increase the number of installations.	Wind and wave energy shall be studied in detail since they potentially can provoke excessive environmental impacts, especially concerning migratory birds, the preservation of underwater landscape and fishing activities.
OPPORTUNITIES	THREATS
The high presence of offshore areas can support development of wave energy production without negative impacts on tourism	Biomass waste plants may have negative effects on ecological conditions
A balanced Local Energy Plan will help to guide on the application of RES and its integration on landscape and environment.	The need of development of ancillary infrastructures (in relation to RES plants) may negatively affect ecological conditions
LOCATION - TERRITORY - ACCESSIBILITY	
STRENGTHS	WEAKNESSES
Due to its small size and vicinity with Malta, Gozo could become a energy-self sufficient and ecologic island	The coastal environment, due to salinity, may threaten the development of specific RES, especially PV plants with current technology
Thanks to its small size, population and geography Gozo could act as a test bed for innovative technologies in renewable energy	The problem of double-insularity can affect the development of the energy sector since goods and technologies need to be transported to the island. This brings to an added cost for installation of technologies that cannot be found in Gozo.
Tourism can benefit from the ecologic driven approach, since more establishment can become green and Gozo can become an important destination for eco-tourism.	It may be difficult to find locally the human resources required for the operation of the energy system.
OPPORTUNITIES	THREATS

SWOT Analysis for RES implementation - GOZO ISLAND - MALTA

Thanks to the elaboration of a strategy of sustainable development for Gozo (Eco Gozo Strategy, 2015-2020) and the National investments in recent years Gozo can be enhance its vocation to be an Eco-Island.	Small land area with many competing land uses and small average land property sizes, is making difficult to realize big size RES plants. Moreover the fragmentation of land ownership points towards difficulty in employing large tracts of land for PVs.
The flexibility, reversibility, and possibility to easily integrate PV plants in urban and industrial environment, help to exploit and incerase the RES production in the island	Demanding logistics and costs needed to import PV systems and maintain supply
Develop a more attactive incentive scheme to support the installation of photovoltaic cells and micro wind on rooftops.	PVs's south reflection negatively affects drivers and landing aircrafts

SWOT Analysis for RES implementation - AKAMAS - CYPRUS

ENERGY SYSTEMS STRATEGY

STRENGTHS	WEAKNESSES
In the area there are the appropriate infrastructure in terms of the electricity grid for the admission of large consumers	There is a seasonal variation in energy demand mainly between summer and winter
	There is a monopoly on the electricity market in Cyprus
OPPORTUNITIES	THREATS
The integration of clean energy generation technologies can be done quickly and easily	The impacts that will exist with possible overloading of the network will be incalculable
There is a state strategic planning on energy issues that includes the area of the Akamas peninsula	

ECONOMICS - FINANCIAL RISKS

STRENGTHS	WEAKNESSES
Companies dealing with RES technologies are very competitive in terms of the prices and services they offer.	Limitation of RES investments due to the economic crisis of the previous years
OPPORTUNITIES	THREATS
The announcement of government grants for energy upgrading to businesses and households reinforces the use of RES.	The possible reduction in the price of petroleum does not encourage the use of RES technologies
Banks began to give loans for energy savings (green loans)	The Cypriot problem is a bit blocking foreign investors from investing in Cyprus because of the lack of stability

SWOT Analysis for RES implementation - AKAMAS - CYPRUS

RES RESOURCES AVAILABILITY AND TECHNOLOGICAL OPTIONS

STRENGTHS	WEAKNESSES
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SWOT Analysis for RES implementation - AKAMAS - CYPRUS

There is enough solar and wind potential in the area that remains untapped	Half of the terrestrial part of the peninsula is part of the European network - NATURA 2000, so the use of RES is reduced especially the wind turbines.
There is considerable experience, especially from photovoltaic systems installation and maintenance companies	The use of other RES technologies such as wave energy is not feasible and is not recommended in the area.
OPPORTUNITIES	THREATS
Photovoltaic systems and wind turbines are sufficiently mature RES technologies	Operational problems may be caused due to the adverse sea environment
Increased demand for energy due to the constant increase in permanent residents of the area	The extraction of natural gas from Cyprus will bring significant reductions in the use of renewable energy

SOCIETY - SOCIAL IMPACTS - PUBLIC AWARENESS

STRENGTHS	WEAKNESSES
Most tourists arriving in the peninsula are well informed and motivated about energy issues (energy savings, RES) and environmental protection	The average age of permanent residents in the region is high, mainly elderly people
Creation of new jobs in the area of RES in the wider Akamas region and consequently reduction of unemployment rates	
OPPORTUNITIES	THREATS
There is a state plan for the development and configuration of the area with information and awareness centers for the public.	If benefits associated to the new RES installations do not reach local population and only benefit a small fraction of the population, public acceptance may face serious problems
Develop a Sustainable Energy and Climate Action Plan (SECAP) and inform the local authorities through the PRISMI project	There are still some concerns-disagreements about the use of RES technologies in the region by certain population groups

SWOT Analysis for RES implementation - AKAMAS - CYPRUS

ENVIRONMENTAL IMPACTS

STRENGTHS	WEAKNESSES
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RES are considered to be clean forms of energy which have the least impact on the environment	The Akamas Peninsula has large protected areas for flora and fauna where it is prohibited any intervention in the natural environment
OPPORTUNITIES	THREATS
The area is environmentally protected through state and European regulations	Reducing tourism perhaps from the alteration of the natural environment by the use of RES (visual pollution)
LOCATION - TERRITORY - ACCESIBILITY	
STRENGTHS	WEAKNESSES
A small number of local authorities in the region, so their coordination is easier and their decision making is immediate	The inaccessibility of the area and the lack of an adequate road network make the access to the area more difficult
	Most RES companies have their headquarters in the capital, 2-3 hours away from the Akamas peninsula.
OPPORTUNITIES	THREATS
Study of the area by local universities and other research centers.	The area of Akamas is one of the most seismogenic areas in the island

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY	
ENERGY SYSTEMS STRATEGY	
STRENGTHS	WEAKNESSES
RES provide reliable solution to cover the growing electricity demand and to solve the summer blackouts issue	The old electric power infrastructure could have problems supporting a distributed energy system
Load is high during the touristic season and low during the rest of the year, thus the load curve and the PV production curve follow the same trend during the year	There is a high variation of the electrical load between summer period and the rest of the year
	Institutions have not great experience in energy planning, especially in RES and hybrid energy systems
OPPORTUNITIES	THREATS

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY

Possibilities to renovate the actual old grid system creating a Smart grid that could be a successful example for other Italian islands	Deterioration of existing electric power infrastructure could hide the economic benefits of RES-based hybrid system
RES penetration and energy efficiency are encouraged by the municipality, as shown by the presence of the project "Sole e stelle delle Egadi" and the successful implementation of European projects	The lack of experience of the energy utility in hybrid energy systems could slow down the transition to a new energy system
European, Italian and regional funds are supporting the development of renewable energy systems especially in small islands	
ECONOMICS - FINANCIAL RISKS	
STRENGTHS	WEAKNESSES
Good potential for the development of renewable energy sources	The utilities managing production and distribution of energy in small islands are economically supported by public subsidies because of the higher price of production. This way the kWh cost for the customers is the same as in the mainland on the national territory. Thus the need for RES implementation is not felt as needed from an economic point of view
Presence on the island of private investors interested in RES business	Higher investment costs due to transportation of material on an island
	All the RES systems of the island have been recently installed, thus it is not possible to assess their financial effectiveness with a multi-year trend analysis
OPPORTUNITIES	THREATS
Recently a new Italian law regarding the spread of RES on small islands has been published. It aims to stimulate innovative and economically sustainable investments on the electrical grid and on renewable power generators in small and medium sized islands not connected to the national grid	The low price and the possible reduction of fossil fuels cost could decrease the interest in RES technology
The project "Sole e stelle delle Egadi" is active and it aims to fund RES and sustainable mobility investments	The high level of bureaucracy could slow down the accomplishment of the new energy systems discouraging investors

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY

<i>Increasing in tourism due to the visibility that RES implementation could give to the island</i>	
<i>New job opportunities</i>	

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY

RES RESOURCES AVAILABILITY AND TECHNOLOGICAL OPTIONS

STRENGTHS	WEAKNESSES
Favourable mediterranean climate, big number of sunny days during the year	Favignana island contains 2 different SCI (Site of Community Importance) 1 SPZ (Special Protected Zone) and the whole island is an IBA (Important Birds Area) so the use of RES is reduced
Average annual value of irradiation on a flat horizontal surface on the island is between 1.40 and 1.7 MWh / m ²	Favignana is part of the Egadi Marine Protected Area so the use of WECs is limited
Average wave energy flux is one of the greatest in Italian seas, it is between 4 and 6 kW/m	The whole island has environmental restrictions thus wind turbines are not allowed
Good average wind speed, which is, at 25m height, between 6-7m/s	
OPPORTUNITIES	THREATS
PV investments is based on mature technologies without any particular risk	Wave Energy Converters are not a very mature technology in Italy
Energy demand is continuously increasing mainly due to the increasing number of tourists	

SOCIETY - SOCIAL IMPACTS - PUBLIC AWARENESS

STRENGTHS	WEAKNESSES
Citizens are aware of the RES potential of the island, thanks to previous investments on Favignana and other good examples coming from other Italian territories	The permanent resident average age is high, thus they are not open to innovation and external investors
Islanders are aware of the importance of the beauty of the territory that is strictly linked to the flux of tourism, the main income of the island. Thus they want to protect its integrity	There are concerns about the reliability of hybrid systems since they are new developments
OPPORTUNITIES	THREATS

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY

High rate of off-season unemployment. Citizens, especially the youngest, would gladly welcome the new job possibilities due to the RES implementation on the island	Currently many people are working in the thermoelectric sector, they could oppose to RES implementation
This project will give the opportunity to enhance the public awareness on RES beneficial impacts on the environment. Thus creating a strong environmentally friendly culture especially in young generations	

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY	
ENVIRONMENTAL IMPACTS	
STRENGTHS	WEAKNESSES
RES have less impacts than any other form of conventional energy at least as far as emissions are concerned	Favignana island has large protected areas where it is prohibited any intervention in the natural environment
Reduction in via sea fuel transportations and thus reduction of linked risks and emissions due to RES implementation	Because of environmental restrictions it is forbidden to install wind turbines
OPPORTUNITIES	THREATS
RES implementation will decrease the pollution and improve the quality of life	Construction of big plants could have impacts on the environment
Currently there is an issue about thermal pollution in the sea due to the thermal power plant. RES implementation will help to solve this problem	The location of WECs has to be chosen wisely because of the restrictions due to the Marine protected Area. The risk of impacts on the environment is very high
LOCATION - TERRITORY - ACCESIBILITY	
STRENGTHS	WEAKNESSES
On buildings there are not restrictions about PV installations	Very often the connections to the mainland are interrupted during winter and autumn due to bad weather conditions
A project to renovate and enlarge the current harbor is going to begin. This project would facilitate communications with the mainland	The current harbor is old and small
The orography helps transportation on the most part of the island	
Close to the mainland	
OPPORTUNITIES	THREATS
Islands are considered as natural laboratory for RES implementation. Favignana could become an example of green/smart island in Italy	There are many restraints about on ground installations of PV systems and moreover they are very vague, thus it is difficult to obtain all the needed licenses

SWOT Analysis for RES implementation - FAVIGNANA ISLAND - ITALY

Very good cooperation with universities and research centers pioneer in RES and hybrid energy systems analysis	
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SWOT Analysis for RES implementation - VIS ISLAND - CROATIA	
ENERGY SYSTEMS STRATEGY	
STRENGTHS	WEAKNESSES
Island is connected to the mainland electrical grid via electrical substation "Stari Grad" 110/35 kV with 49 km long electrical cable.	Existing connection from the mainland to the island doesn't meet existing requirements and has a negative impact on the economic development of the island
RES provide reliable solution to cover the growing electricity demand	
OPPORTUNITIES	THREATS
EU funds are providing a support for the improvement and the development of the energy systems and in general development of rural areas	Deterioration of existing electric power infrastructure
The EU is highly supporting the idea of developing a 100% energy independent island communities	
Self-sustaining communities	
ECONOMICS - FINANCIAL RISKS	
STRENGTHS	WEAKNESSES
Potential for the development of eco tourism and exploitation of renewable energy sources	Unsatisfactory creation of additional value in the island economy
	Municipal and utility companies' income is not sufficient for recruiting staff to work on development projects
OPPORTUNITIES	THREATS
New job opportunities	Large distance of regional centres
Investor interest and interests of residents for the projects	Insufficient entrepreneurship infrastructure
Promoting Development in the Tourism Sector	Insufficient use of national funding for projects; criteria is often not tailor made for island SME's

SWOT Analysis for RES implementation - VIS ISLAND - CROATIA

RES RESOURCES AVAILABILITY AND TECHNOLOGICAL OPTIONS

STRENGTHS	WEAKNESSES
Favourable mediterranean climate, large number of sunny days during the year	Unused potential of renewable energy sources
Potential locations for construction of solar power plants are in research phase	
OPPORTUNITIES	THREATS
High potential for exploitation of renewable neergy sources with an average wind speed of 5.4 m/s - one of the windiest part of the Croatia, and with more than 2700 hours of sun during the year with relatively low cloudiness	Parts of the old city of Komiža are under the conservation protection which disable the possibility to instal solar panels
Potential locations for construction of solar power plants are in research phase	
Very positive European attitude towards shift to renewables	
Geographic location is favorable for the exploitation for the RES (wind, solar and thermal energy of the sea)	
Wind and PV investments are based on mature technologies without any particular risk	

SOCIETY - SOCIAL IMPACTS - PUBLIC AWARENESS

STRENGTHS	WEAKNESSES
The city of Komiža is one of the first cities in the Croatia which decided to follow energy sustainable development based on the principles of energy efficiency, sustainable construction of new and reconstruction of existing facilities, and the use of renewable energy sources.	Citizens are insufficiently informed and they lack of knowledge on possibilities for the exploitation of renewable energy sources
Positive attitude of islanders about saving resources	Uncoordinated legislative framework hiders efficient planning and implementation of plans, once they are in force. Islands are the subject of many laws, ordinances, strategies and plan in Croatia, but all those national and local level strategic documents are not coordinated and, sometimes, in dispute

	Aging population and depopulation
OPPORTUNITIES	THREATS
Building sustainable development on the basis of environment protection - driver for innovation and job creation	Vertical coordination of the head of state, county and city development policy
	Exact time to obtain a license is legislative set but always much more time is needed. Especially spatial planning related to permits can take many years
	State, county and municipal development policy and restrictions on the Law on Construction and Legislative Acts

SWOT Analysis for RES implementation - VIS ISLAND - CROATIA	
ENVIRONMENTAL IMPACTS	
STRENGTHS	WEAKNESSES
RES have much less impacts than any other form of conventional energy at least as far as emissions are concerned	Island is protected under the NATURA and that caused difficulties in licensing procedures
OPPORTUNITIES	THREATS
	Strict conditions for construction, construction of the windpower plants is not allowed on the protected coastal area.
	Restrictions in development plans due to cultural and historical heritage
	Strategic Environmental Impact Study is very restrictive in terms of potential RES locations
LOCATION - TERRITORY - ACCESIBILITY	
STRENGTHS	WEAKNESSES
The geographic position is advantageous for exploitation	Distance from the mainland electrical grid requires high unit costs which caused long-term investment delays
	Property legal disputes - for many areas, there are long unsolved disputes, which makes it unavailable for any investments
	Lack of spatial planning - siting of the RES projects takes a lot of time
OPPORTUNITIES	THREATS
In the development strategy of the island's transport system it is necessary to prioritize the connections of land-based road networks with ports and ferry ports in Vis and Komiza. The island needs to ensure adequate connectivity throughout the year with the creation of multiple boosted traffic connections during the tourist season	Difficult traffic connection affects poor market offer, opportunity for service and maintenance of the equipment.

SWOT Analysis for RES implementation - KORČULA ISLAND - CROATIA

ENERGY SYSTEMS STRATEGY

STRENGTHS	WEAKNESSES
The City of Korčula is connected with the mainland power energy system of Dubrovnik-neretva County with the 110kV cable to the Pelješac peninsula. The city is also connected to the electrical substation in Blato and with the overhead power line to the Hvar island.	Old electric power infrastructure
Load is relatively low during the whole year except during the summer	Voltage drop during winter season in the area of Pupnat and Žrnovo
Geographic information system of the City of Korčula	Existing electrical substation is not sufficient for the planned development of tourism
OPPORTUNITIES	THREATS
Investors are interested in building a solar photovoltaic power plant in the City of Korčula, municipality of Vela Luka	Deterioration of existing electric power infrastructure
Island inhabitants are interested in mutual RES projects	
EU funds are providing a support for the improvement and the development of the energy systems and in general development of rural areas	
Possibilities of energy export and decreasing losses of electrical grid	
The EU is highly supporting the idea of developing a 100% energy independent island communities	
Energy efficiency measures funded by The Environmental Protection and Energy Efficiency Fund, Dubrovnik - Neretva County	
Energy consumption is concentrated on the relatively small surface areas	
Very positive European attitude towards shift to renewables	
Self-sustaining communities	
ECONOMICS - FINANCIAL RISKS	
STRENGTHS	WEAKNESSES

SWOT Analysis for RES implementation - KORCULA ISLAND - CROATIA

Development of citizen cooperatives	Revenues of the Vela Luka, Blato and Smokvica municipality along with the public utilities are not sufficient to cover the expenses for the recruiting the staff which would work on the development project
Great potential for the development of eco tourism and exploitation of renewable energy sources	Unsatisfactory creation of additional value in the island economy
	Municipal and utility companies' income is not sufficient for recruiting staff to work on development projects
OPPORTUNITIES	THREATS
Legislative framework which stimulates development of tourism sector, family farming, etc.	Stagnation/shutdown of industrial production
New job opportunities	Large distance of regional centres
Promoting Development in the Tourism Sector	

SWOT Analysis for RES implementation - KORCULA ISLAND - CROATIA	
RES RESOURCES AVAILABILITY AND TECHNOLOGICAL OPTIONS	
STRENGTHS	WEAKNESSES
Favourable mediterranean climate, big number of sunny days during the year	Unused potential of renewable energy sources
Average annual value of irradiation on a flat horizontal surface on the island is between 1.50 and 1.55 MWh / m ²	
Investor interest and interests of residents for the projects	
OPPORTUNITIES	THREATS
Geographic location is favorable for the exploitation for the RES (wind, solar, biomass and thermal energy of the sea)	
Wind and PV investments are based on mature technologies without any particular risk	
The possibility to include RES facilities in the strategic plan for RES exploitation of the county	
SOCIETY - SOCIAL IMPACTS - PUBLIC AWARENESS	
STRENGTHS	WEAKNESSES
Existing awareness of islanders for the need of protection and preservation of the environment and for the rational and efficient exploitation of energy sources.	Citizens are insufficiently informed and they lack of knowledge on possibilities for the exploitation of renewable energy sources
Positive attitude of islanders about saving resources	Uncoordinated legislative framework hinders efficient planning and implementation of plans, once they are in force. Islands are the subject of many laws, ordinances, strategies and plans in Croatia, but all those national and local level strategic documents are not coordinated and, sometimes, in dispute
OPPORTUNITIES	THREATS
Island's administration has signed the adhesion to the Smart Islands Initiative, which will foster their involvement in best practice exchange, awareness raising and provide future funding opportunities	Vertical coordination of the head of state, county and city development policy

SWOT Analysis for RES implementation - KORCULA ISLAND - CROATIA	
	Exact time to obtain a license is legislative set but always much more time is needed. Especially spatial planning related to permits can take many years
	State, county and municipal development policy and restrictions on the Law on Construction and Legislative Acts
	Ageing population and depopulation

SWOT Analysis for RES implementation - KORČULA ISLAND - CROATIA	
ENVIRONMENTAL IMPACTS	
STRENGTHS	WEAKNESSES
RES have much less impacts than any other form of conventional energy at least as far as emissions are concerned	The old city center of the Korčula city is under the conservation protection which prevents increase of energy efficiency through reconstruction of outer part of the house with the additional instalation of solar systems
	Korčula is a bird's migration route. Therefore the siting of the project needs a lot of attention in order to avoid some excessive environmental impacts (NATURA)
	Significant part of the island is protected under the NATURA and that caused difficulties in licensing procedures
OPPORTUNITIES	THREATS
	Strict conditions for construction, construction of the windpower plants is not allowed on the protected coastal area.
	Restrictions in development plans due to cultural and historical heritage
	Strategic Environmental Impact Study
LOCATION - TERRITORY - ACCESIBILITY	
STRENGTHS	WEAKNESSES
Close to the mainland and grid connected	Property legal disputes - for many areas, there are long unsolved disputes, which makes it unavailable for any investments
The geographic position is advantageous for exploitation	
OPPORTUNITIES	THREATS
	Poor traffic connection affects poor market offer, opportunity for maintenance of the equipment.