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NEW AUTONOMOUS AND SUSTAINABLE CONCEPT FOR THE ENERGY SUPPLY OF ERRIKOUSA ISLAND

Summary

A new concept to generate clean electricity on a selected remote Greek island with a population of less than 500 inhabitants has been developed, using only renewable energy sources (RES) and energy storage systems. The new energy plan takes into account the clean energy transition framework for islands and applies it to Errikousa, a selected island in the Ionian Sea. It also compares the proposed plan with the island's current energy coverage. The electricity demand coverage needs on this island are met by using conventional fuels with the operation of diesel engines. The authors selected and used appropriate software to optimise and design the energy systems. For the energy study of the island, integrated simulation models were created both for the current total energy supply and for different scenarios of the newly developed energy planning.

Keywords: energy transition, clean energy, remote island, simulation model, RES, storage system

Field of application for the findings: The findings inform island energy planners, municipal authorities, and utilities on replacing diesel with renewables plus storage. The results can guide policymakers and program designers on clean-energy transition strategies for islands. They also provide researchers and engineers with modelling and optimisation workflows for microgrids and hybrid systems in remote, low-population islands. They help investors, grantmakers, and technology vendors evaluate project viability and system sizing.

Addressed audience: ***academicians, energy researchers, policy makers and authorities, energy developers***

1. Introduction

In Greece, there are a considerable number of remote islands, most of which are not interconnected with the mainland electricity grid of Greece. It is very common that such remote places with high potential for usage of renewable energy systems aren't being fully taken advantage of. A new project to generate electricity on the selected remote Greek island Errikousa with a population of around 500 inhabitants has been developed, using only renewable energy sources (RES) and energy storage systems. This article describes this new concept scenarios for an energy system for Errikousa island in Greece and the simulations which ran with an software application. The simulations results are then compared with the current supply of energy in the island.

2. Description of current situation

According to IPTO 2020 the majority of the island's energy is provided by diesel generators and imported electricity via underwater cables from Independent Power Transmission Operator (IPTO). Table 1 shows a list of the available and running diesel generators on Errikousa Island.

The Public Power Corporation (PPC 2020) uses according to Kaldellis et. al. 2007 autonomous thermal power plants (CHPs) to meet the needs of the Aegean and Ionian islands.

It is important to note that the seven generators with a total capacity of 1.11 MW can produce more than the required demand of the island. These generators are switched on and off according to the real-time electricity demand.

Tab. 1: List of diesel generators on Errikousa Island as described in HEDNO 2022

No.	Generator	Capacity [kW]
1	G1	80
2	G2	80
3	G3	80
4	G4	90
5	G5	200
6	G6	180
7	G7	400

Fig. 1 shows a typical summer electricity demand curve on Errikousa island. This is different to winter months as in these months the amount of tourists is decreasing.

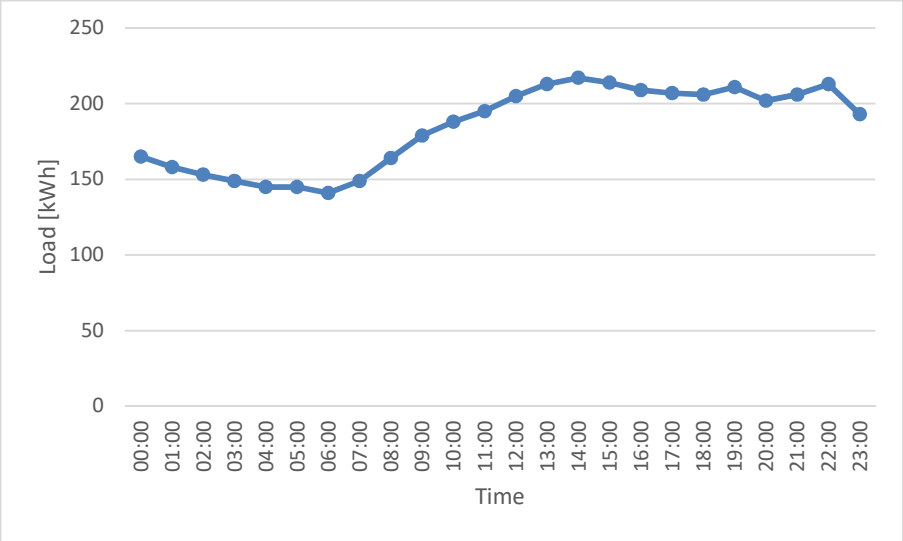


Fig. 1: Typical summer energy demand curve in Errikousa Island according to HEDNO 2022

3. New concept for energy production in Errikousa

It is important to describe first the potential of renewable energy sources. This is followed by the new energy planning with the aim of 100% renewable energy use and modelling with appropriate software.

4.1. Renewable energy potential

It is a fact that the vast majority of the remote Aegean and Ionian islands are characterised by a very high solar, but also a remarkable wind potential. The choice of renewable energy technologies is illustrated by a potential analysis which focuses on the location of the island and therefore the impact on the potential potential returns.

Regarding the solar potential Errikousa receives enough of sunlight throughout the year, making it a good location for the installation of solar panels. The solar potential for the island of Errikousa is above 1400 kWh/m² per year.

The average wind speed on Errikousa Island is around 4.5 m/s at 10 m (NASA 2018). Errikousa also features a harsh and hilly terrain with several elevated locations that are exposed to the wind. These topography features generate considerable wind speeds and turbulence, making wind energy generation possible.

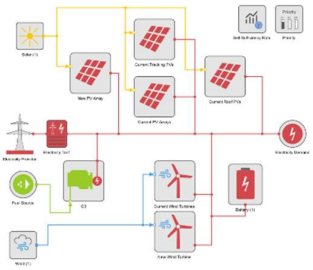
4.2. New concept

Taking into account the pressing need to meet the island's energy needs without further use of conventional and therefore polluting fuels, the prospects for the development of a new energy system on the island, based among others on the exploitation of the available solar and wind potential and the use of energy storage

systems, are proposed and explored.

4.3 Simulation model development

The authors selected and used appropriate software to optimise and design the energy systems. For the energy



study of the island, integrated simulation models were created both for the current total energy supply and for different scenarios of the newly developed energy planning. Fig.2 shows a possible concept with PV arrays, wind turbines and a battery for Errikousa island, as well as a backup diesel engine.

Fig. 2: Possible model of energy concept for Errikousa island

The energy comparison is carried out using real data describing hourly step by hour the production of the renewable energy plants for a full year of operation. The climate impact is presented on the basis of a CO_2 balance and taking into account the reduction of fuel requirements.

4. Simulation results

The main objective when implementing renewable energy sources is to lower the emissions of carbon dioxide. The currents sources of energy in Errikousa island still include diesel as a source, which has a high CO_2-emission factor of 1.1. With the simulations, it will be possible to completely eliminate the usage of diesel and replace it with sustainable sources.

5. Conclusion and future steps

A new project for the production of electricity on a selected remote Greek island with a population of less than 500 inhabitants has been developed for the island of Errikousa in the Ionian archipelago, using only renewable energy sources (RES).

The electricity demand coverage needs on this island are so far covered by the use of conventional fuels with the operation of diesel engines. To meet the island's urgent energy needs without using polluting fuels, the authors explored a new system based mainly on the island's solar and wind potential. The authors also evaluated energy storage solutions to support that system.

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