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Εθνικό Συμπόσιο
«Εφαρμογή Υβριδικών Σχημάτων Ανανεώσιμων Πηγών Ενέργειας για την Ικανοποίηση των Αναγκών σε Ενέργεια και Νερό στα Μικρά και Μεσαία Κλίμακας Νησιά του Αιγαίου»
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Ερευνητικό Έργο PHAROS - Πρόγραμμα Αριστεία II - ΓΓΕΤ

Raised Issues

- Energy consumption = economic growth
- HS impact on natural and human environment
- Proposed solution: RES energy production
- HS siting - strategic planning tool

introduction
study objectives
islands
methodology
Implementation
Conclusion
Current Legislative Framework for RES siting


The legal framework addresses the mainland and the island the same way, thus not taking into account the specificities of islands.

Insular Areas

Wind & PV Priority Areas are based on the existing wind energy potential without taking into account all vulnerable ecosystems and land-uses of potential conflict.

Study Objectives

Several Aegean Sea islands have been analyzed in order to size the systems needed to meet the electricity demand of each one with RESHS.

2 main directions:

- In the direction of the coverage of the energy and water needs with 100% RES.
- In the direction of the most cost efficient system configuration (RES + Diesel power station) which is observed when RES contribute the 80 to 85% of annual electricity demand.
Problems Non-interconnected islands face

- Use of imported oil – pollutant emissions
- Seasonal energy demand
- High power generation cost

Recommendations of the Scientific community for Non-interconnected islands

- Hybrid systems of diesel engines and RES
- Hybrid systems of energy storage systems (batteries, pumped storage and hydrogen storage) and RES

Greek insular areas

Methodology

The plan followed was:

- Review of the scientific literature on RES and HS siting methodologies
- Building of a multicriteria decision making methodology
- Application of the tool and method to several Greek Islands
Methodology – A review

Hybrid System siting is a multi-criteria decision making problem

- The first studies were confined to delimitation of exclusion zones (urban areas, historic sites, water bodies etc)
  - They were introduced during 2000s
  - Made use of GIS
- Other tools are based on methods of cost-revenue spatial optimization

Analytical Process

The optimum choice is made based on the level of criteria satisfaction and on the degree of optimism or pessimism of the decision maker.

Use of:
- Remote sensing (satellite images)
- Geographic Informational System (GIS) environment

Methodology Implementation

1. Determination of constraints and evaluation criteria for WF siting
2. Exclusion areas (constraints)
3. Site evaluation (evaluation criteria)
4. Suitability Map
5. ESA tool Optimization
SEALAB RES hybrid (including desalination) experimental unit

The existing experimental, hybrid RES station (small wind turbine, PV, batteries) in the Laboratory of Renewable Energy and Environmental Protection (SEALAB) was upgraded, adding a reverse osmosis desalination unit, suitable for the (under scale) experimental simulation of various RES hybrid (including desalination) schemes.

Database-SL tool

Database-SL tool was built in C#. It includes detailed long-term meteorological data (wind speed, ambient temperature, air pressure, solar radiation, and air density data) for many small and medium size islands of the Aegean Sea. The transported water data were included, load, heating, and fuel consumption, all the necessary geographical information (Natura sites, protected areas, infrastructure etc) for the siting and installation of HS in the islands examined.
Analysis of Several Islands

Case studies (Islands):
- Ag. Efstratios
- Donousa
- Karpathos
- Skyros
- Amorgos
- Astypalaia
- Anafi
- Sifnos
- Kos
- Kalymnos
- Megisti
- Rhodes

Demand Analysis

Load Demand Amorgos for 2011 (kw)/hour/day
ESA tool

introduction

study objectives

islands

methodology

Implementation

Conclusion

ESA tool Optimization (1/4)

introduction

study objectives

islands

methodology

Implementation

Conclusion

Karpathos Island

100% RESHS (E101):
  Tot cost: 96.7 MEUR

84.96% RESHS (E101):
  Tot cost: 41.1 MEUR

85.08% RESHS (E82):
  Tot cost: 41.3 MEUR

Megisti Island

100% RESHS (E82 or E48):
  Tot cost: 16.42 MEUR

100% RESHS (V27):
  Tot cost: 17.1 MEUR

81.4% RESHS (E82):
  Tot cost: 7.1 MEUR

80.6% RESHS (E48):
  Tot cost: 7.1 MEUR
The tool offers the chance to:

- Size the HS according to our needs
- Evaluate different scenarios of the HS morphology
- See how by adding larger components to the HS we cover a larger % of the demand and see how the total cost is influenced.

The tool offers the chance to for in depth analyses when needed in a specific area of results.
Despite the adoption of numerous constraints, there is still a remarkable rate of the total available area of the small and medium size islands of the Aegean Sea for RESHS siting.

Future studies are suggested to identify more detailed data and additional evaluation criteria, as well as to conduct fieldwork.

It was proven that RESHS could cover 80-85% of the islands’ load demand in the most economical way, bringing down the use of the local conventional power units to 15-20% annually.

The interactive nature of the method gives the opportunity for integration of the views and mood of the decision.
Thank you

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