Wave energy potential and in-depth analysis for the realization of a wave energy power station on Halki island

NEPTUNUS

HALKI

"Using wave power will allow decreasing Halki's dependency to the expensive and polluting diesel power plants located in Rhodes."

This project is supported by the EU Islands Facility NESOI.
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NESOI
EU ISLANDS FACILITY

NEPTUNUS

The European Islands Facility NESOI aims to unlock the potential of EU islands to become the locomotives of European Energy Transition. To do so, NESOI aims to mobilize more than €100 Million of investment in sustainable energy projects to give EU islands the opportunity to implement energy technologies and innovative approaches, in a cost-competitive way. NESOI has selected 56 such projects across the European Union an provide them with financial resources and technical support.

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ABOUT THE PROJECT

Project Promoter: Municipality of Halki

Stakeholders: Municipality of Halki, Aeolian Land S.A., Soft Energy Applications and Environmental Protection Lab, Univ. of Western Attica, Grid operator (DEDDIE)

Country Greece | **Sector** Wave energy | **PROJECT VALUE** 1.8 M€

DESCRIPTION

The municipality of Halki has set as a primary goal the transition of the island's energy system to a renewable power generation model that will cover or exceed its energy needs.

AIM OF THE PROJECT

In line with this objective, the project consists in conducting an in-depth analysis of the wave energy potential, to identify a suitable location for a wave energy power station and to undertake the permits and approval procedures, while ensuring the protection of the environment and the local ecosystem.

FUTURE STEPS

To provide, upon successful completion of the project, information and know-how to other islands, organizations and institutions, share the experience gained and contribute to the replicability and scale-up of the project.

HOW THE EU ISLANDS FACILITY NESOI SUPPORTS THE PROJECT

1. **Assessment of the key project sizing drivers**
2. **Identification of suitable technological options given existing project sizing requirements**
3. **Civil engineering study on the condition of relevant marine structures and the estimated installation cost to the breakwater**
4. **Definition of the required environmental permitting procedures**
5. **Cost Benefit analysis and socio economic and environmental impact evaluation**
6. **Definition of the technical, economic and financial, fiscal project inputs**
7. **Risk analysis and identification of available mitigation strategies**
8. **Assessment of existing procurement options (e.g. tender, PPP, etc.)**
9. **Financial modelling and identification of target scenario**
10. **Identification of financing/funding options**
11. **Action plan and identification of project monitoring procedures**

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INTERVIEW WITH

Vasileios Chantziaras, Scientific Associate of Halki's Mayor

Q: How was the project initially designed? Why choose this specific sector?

A: Our municipality wants to implement innovative solutions to enable the energy transition. We chose to investigate wave energy, since its an abundant resource for us. We want to be one of the first islands to use wave energy daily for energy generation. Therefore, when we saw that technical assistance is offered by NESOI, we made our application.

Q: What were the challenges? How did NESOI help overcome them?

A: The main challenge was that the wave energy generation is not technologically and commercially mature enough. Numerous methods have been developed, but the commercial readiness lags far behind solar and wind energy generation. We want to be innovative, but it's important also to choose the technology with the lowest risk of failing. NESOI provided an evaluation of the existing technologies and compared them in terms of maturity, risk, cost, etc.. As a municipality, this input was crucial for us, since we want to find solutions that work and are cost-effective to justify the investment to the inhabitants.

Q: What will be done next to pursue this project?

A: Now we have in our hands a set of studies, which will attract investors for the construction phase of the project. We know what we will build, where and what it will cost us. We hope that within the next 1-2 years we will be able to implement the wave energy generation plant and have it integrated into the island.

Q: What are your next steps towards clean energy transition?

A: We are interested in cooling and heating systems based on clean energy, electrical energy storage systems and different forms of wind energy. We also plan to tackle energy transition and depopulation challenges at the same time by reviving an abandoned settlement. The goal is to rebuild the bioclimatic and energy-friendly houses, which will be able to attract a permanent population to settle on the island.

THE IMPACT

ON LOCAL COMMUNITY

1. **Local Economy**

   Between 10-12 direct and indirect local employment opportunities will result from NEPTUNUS construction, manufacturing, transportation and operation & maintenance.

2. **Social Acceptance**

   This project has no environmental impacts, low visibility from the shore, minimum interventions on the local context. Additionally, this project has been included in Halki' s energy roadmap for the Clean Energy for EU islands, taking positive feedback from the local communities. These factors, combined with the increased energy security ensure the social acceptance of the project.

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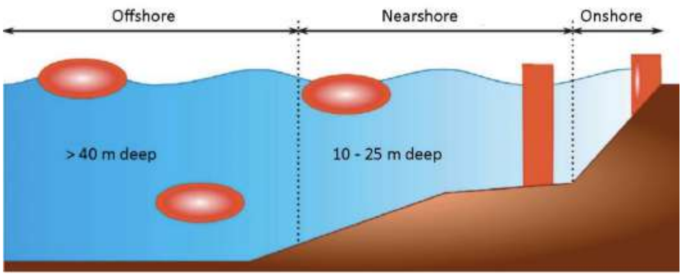
***Wave energy potential and in-depth analysis for the realization of a wave energy power station on Halki island* – Technical Focus**

FOCUS ON
WAVE ENERGY CONVERTERS

In general, energy can be retrieved from the sea in three different ways: from the tidal currents, from the dynamic energy of waves and from the thermal gradients between the sea surface and depths close to 1 km. In the Mediterranean sea and particularly concerning Halki, the exploitation of the dynamic energy of surface waves is the most suitable approach.

Wave Energy Converters (WECs) can be classified versus their installation location as “onshore systems”, “nearshore systems” and “offshore systems”. This classification is depicted versus their distance from the shore and the available bathymetry.

WECs can also be distinguished according to the device size and the directional characteristics of the wave versus the orientation of the device:



Classification of wave energy converters versus the installation location.
Source: : Iraide López, Jon Andreu, Salvador Ceballos Iñigo Martínez de Alegría, Iñigo Kortabarria. Review of wave energy technologies and the necessary power-equipment. Renewable and Sustainable Energy Reviews 2013; 27: 413-434.

Attenuators are long WECs with respect to the wave length, placed in parallel lines with regard to the wave’s direction. They consist of a series of cylindrical components, connected together with flexible hinged joints, which enable the rotational motion of each cylinder around the axes of these joints. In this way, each cylinder can perform this rotational motion independently to its neighbouring cylinders, attenuating, in a sense, the wave’s amplitude.

Point absorbers absorb energy from the relative motion between a wave-activated, moving body and a fixed structure. The electricity is produced by exploiting the bobbing or the pitching action of a device, through which the up and down motion of the wave is converted into rotational or reciprocating movements inside the device, depending on the involved mechanism at each alternative prototype.

Terminators have their principal axis parallel to the incident wave crest and terminates the wave. These devices extend perpendicular to the direction of wave travel and capture or reflect the power of the wave.

KEY NUMBERS
OF THE PROJECT

- **600 MWh** – Annual reduction in fossil fuel consumption
- **175 tCO_2eq** – Amount of GHG avoided per year
- **190 MWh** – RES-based electrical energy production per year
- **17.5 years** – Payback period

REPLICABILITY
IN OTHER ISLANDS

NEPTUNUS is the first Greek and European island to utilize wave energy. The project will be replicated near shore, where high wave power potential exists, even on mainland. The wave power station also has high replicability and scalability potential on other islands. Since this is designed as a modular system, the 200 kW unit for Halki will be adapted to any other island's needs, easy to build, with robust design and no environmental impacts.

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