The relatively high cost of electricity of isolated areas and non-interconnected islands increases the competitiveness and promotes the wider incorporation of technologies based on renewable energy sources that may, in other cases, seem economically inferior to conventional energy solutions. **GENERGIS** studied Skyros, a Mediterranean island, with the goal of analyzing its energy situation and planning its transition towards energy self-sufficiency based on renewable resources. In the framework of the project, social issues were coupled with local politics, energy policies with engineering practices and environmental benefits with economic considerations. The project produced an original plan for renewable energy autonomy of isolated communities, while the results of the analyses can be a useful tool in the hands of policy makers, civilians and energy providers.

Skyros is a non-interconnected island, the cost of electricity of which is one of the highest one reported among the Greek islands. This high cost undercuts the energy progress and environmental quality of the island and undermines the financial condition of the Greek state by requiring large amounts of public subsidies to balance the cost imposed on both the energy company and the inhabitants of the island. The main objectives of GENERGIS were to (1) involve the inhabitants of the community in the decision-making process and to raise public awareness, (2) involve local regulative authorities of the community, (3) perform detailed technical calculations through simulations, as well as exhaustive economic and environmental analyses, and, lastly, to (4) propose a concrete and original energy plan towards 100% sustainable living.

Through social interaction that included the realization of a survey and one-to-one discussions, it became clear that to some extent Skyros suffers from a clash between social and policy issues related to planned energy actions. Nevertheless, the people show an overall positive stance towards renewable energy resources for self sufficiency, with a conservative stance towards policies and actions at the expense of the environment and the preservation of natural beauty.

The proposals of GENERGIS towards 100 % renewable energy autonomy of Skyros were prepared for the electrical, thermal and transport sectors. The evaluations and comparisons of the proposals were based on thermodynamic, economic and environmental criteria.

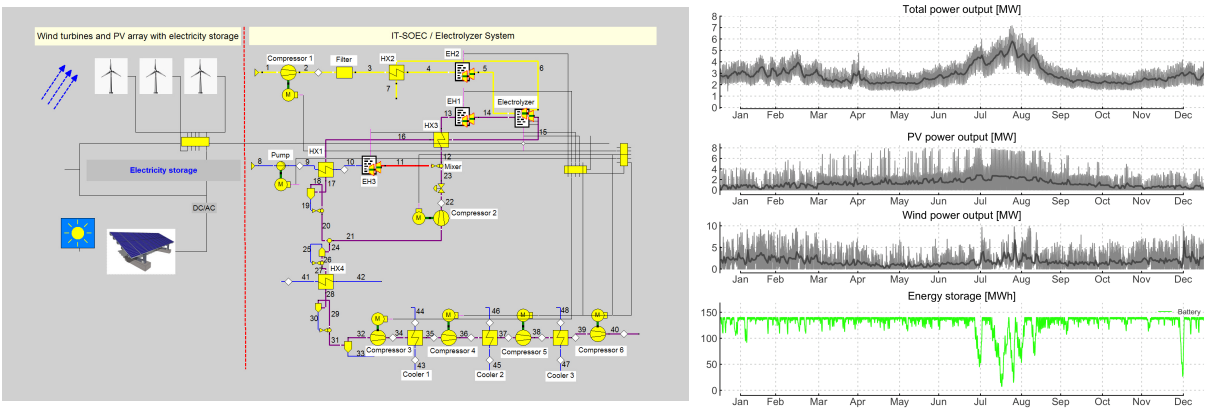

Figure 1: *Simulation (left panel) and results (right panel) of the hybrid plant combining PV and wind with electricity storage and hydrogen generation.*

The scenarios proposed for the electricity sector included hybrid power plants (plants that combined more than one technology in the same facility) for stand-alone and off-grid operation (i.e., autonomous energy operation, as is the case of many non-interconnected islands). The power plants were simulated and optimized for dynamic and transient operation involving energy peaks during high-energy demand periods. Energy surplus from energy fluctuations was used in added conversion processes to ensure safe, continuous and robust operation and offer additional profits. The first proposed hybrid plant utilized concentrating solar thermal with wind turbines and storage capacity, the second plant combined solar photovoltaic with wind

turbines and storage capacity and, finally, the third plant coupled solar photovoltaic with wind farm and hydro-pumped storage.

The analyses of the power plants showed that each plant presented both advantages and disadvantages. The system that combines photovoltaic, wind and electricity storage is found to be the best solution for Skyros overall. A very important result was that all three proposed power plants were economically viable when compared to the current energy situation based on diesel combustion. The lowest cost of electricity was calculated for the hybrid plant combining photovoltaic with wind turbines and storage (Figure 1), followed by the plant that combines photovoltaic, wind and hydro-pumped storage and last the concentrating solar/wind plant. The latter surpassed the others when it came to efficiency and relative land use. Lastly, environmental considerations showed similar results for all three of the plants, with somewhat increased greenhouse gas emissions for plants that required the replacement of units with short lifetime (batteries, electrolyzer).

The scenario proposed for 100 % renewable thermal demand currently based on diesel was related to solar-thermal energy generation with and without public subsidies. The analysis showed that the investment cost of the selected solar-thermal systems became smaller than the cost of diesel currently used for space heating purposes with public subsidy scenarios equal or higher than 50 %. In addition, the renewable scenario offered a significant decrease in carbon dioxide emissions on the order of 85 %.

The scenario proposed for the transport sector included electric- and hydrogen-based vehicles. Although the investment cost of the new car fleet was found to be high, the combination of fuel and maintenance costs of the fuel cell and electric vehicles was found to be 45 % that of the current fleet. In addition, the greenhouse gas emissions of the manufacture of the new cars can be balanced out through the avoided emissions of current use within only five years.

The analysis and evaluation of the three sectors showed that even high initial investment costs of renewable solutions are not necessarily prohibitive to their realization. The cost of energy generation based on diesel on islands is extremely expensive and requires public subsidies without offering any advantages. Renewable-based systems minimize environmental pollution and can justify subsidies associated with climate change mitigation measures. The study also proved that energy fluctuations of renewable stand-alone energy stations can be effectively balanced with storage facilities and other conversion processes that can act as storage systems (e.g., an electrolyzer generating hydrogen).

It is seen that the incorporation of new renewable energy applications on Skyros can provide the possibility to use local energy resources to face future changing energy requirements in a sustainable manner. The wider incorporation of stations based on renewable sources can lead the island to energy self-sufficiency with significant environmental advantages and economic growth. In addition, the incorporation of RES in the energy sector can provide a better standard of living, better quality of energy services and help to achieve national and international goals associated with the wider incorporation of renewable sources into the global energy sector.

GENERGIS resulted in a total of seven reports covering topics such as the legal framework of renewable energy in Greece, basic information on renewable resources, statistical background, detailed analysis of novel systems and a guide for sustainable development. All of these reports are available online and can be used as guides with educational character, improving the socio-economic impact for educated and empirical decisions and opinions.

The progress and results of the project are published on the project's website: www. genergis.eu

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