AUTONOMOUS WIND ENERGY SUPPLY TO ENHANCE CRAFT FISHING ACTIVITIES

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ABSTRACT

The Laguna de Rocha community was selected with the assistance of sociologists to enhance its productive activities, in a technology transfer regional project.

A complete renewable energy demonstration system was provided. The characteristics of the system and the appliances were agreed in a workshop attended by all community members. The wind potential assessment was performed using short time wind measurements in site related to those obtained at near-by meteorological stations.

The system generates electricity to refrigerate fish, to pump water and to power small tools.

After the system installation, users received training on the system operation and its power and energy restrictions.

***Key words**: isolated rural communities, hybrid wind PV autonomous system, wind power assessment*

1. INTRODUCTION

The regional project “Sustainable energy supply to isolated rural communities to enhance productive activities”, funded by OAS, is being carried out in Argentina, Paraguay, Peru and Uruguay.

At least two communities on each country involved, located at isolated rural areas, received through this technology transfer project renewable energy systems to improve their productive activities. These sustainable systems would be a showcase about how to satisfy productive energy needs of people who live without a reliable supply of conventional energy.

In Uruguay, among other productive activities, craft fishing and ship-restoring woodwork were selected. The Laguna de Rocha community, where fishermen and their families live, is located in a narrow sand extension between the lagoon and the Atlantic Ocean, in the south east country coast. The fish, shrimp and crabs production is sold to a neighboring sea side resort. They repair and also build small boats they use to sail and fish at the lagoon. In figure 1, Laguna de Rocha community is shown surrounded by sand dunes.

A hybrid autonomous wind-solar photovoltaic energy system was transferred to the community. Also two small freezers were provided.

Fig. 1 Laguna de Rocha community

As the technology transfer at rural areas requires a thorough knowledge of the community social conditions and their active participation, a multidisciplinary approach was chosen to reach the necessary conditions of agreement and participation of the beneficiaries. Both sociologists and energy specialists participate in this project.

2. COMMUNITIES SELECTION

The selection of the communities and their productive activities was performed carefully including the characterization of the communities in their social, demographic and organizational issues.

The methodology employed was implemented in a prior transference project, also funded by OAS, and was updated to address the challenges of this project.

The community involvement in the project, their internal organization, the fact that eventually there is an already established external support, the knowledge through careful enquiries of the production and its associated energy needs and the possibility of replication of the solutions adopted were the more important principles used in the selection.

The sustainability of renewable energy resources available on site and of their future use was also very important**.**

At each community, several meetings were held with their qualified representatives and a carefully designed enquiry, mostly related to energy and production issues was performed.

Using the information obtained at the enquiry and at meetings, the Work Group selected the type of system to be provided and completed a forecast of future energy needs.

The final decision on the system to be provided was taken in a workshop attended by all the community members, energy specialists and sociologists.

The community energy needs that will be satisfied were agreed upon: refrigeration of fish, shrimp and crabs, water pumping and the small workshop electrification to power small tools.

3. LOCAL WIND ENERGY POTENTIAL ASSESSMENT

Laguna de Rocha community is located near the coast of the Atlantic Ocean and the lagoon, so its exposure to winds is excellent.

The local wind climate characterization began with short term wind measurements performed for three months at 12m height in the future location of the wind generator. The mean velocity in the measurement period was 6.0 m/s. In figure 2, Work Group and community members are installing the anemometer. A lagoon view is also shown.

Fig. 2 Anemometer installation and Rocha lagoon view

In figures 3 and 4, the probability density curve of wind velocity and the wind rose obtained from these measurements are presented. In figure 3, also is presented the Weibull curve which best fits measured values. The form parameter is 2.5 and the scale parameter is 6.97 m/s.

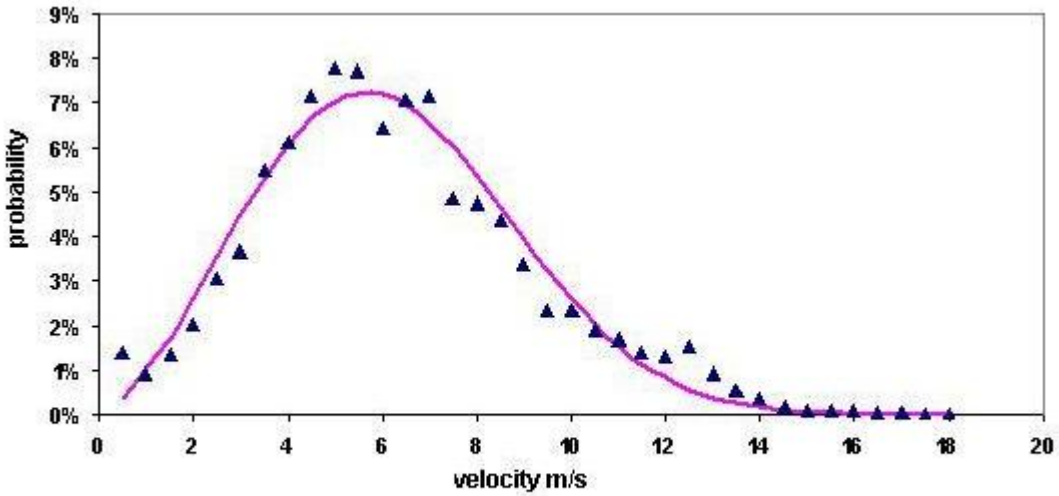

Fig. 3 Probability density curve of wind velocity measured values at Rocha and respective Weibull curve

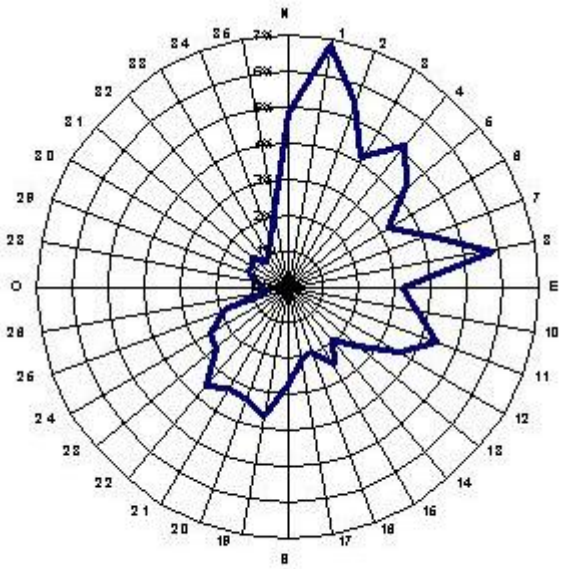

Fig. 4 Wind rose obtained from measurements at Rocha

The correlation between these measurements and simultaneous ones undergone at a near-by weather station was defined considering also that the windmill will be installed at 18m height.

Applying this correlation, a local wind velocity synthetic time series was obtained from the time series available in this station.
The characterization performed corroborates that the local wind potential may be exploited and a small windmill installed.

4. ENERGY SYSTEM DESIGN AND INSTALLATION

The energy needs agreed at the workshop will be satisfied with electricity generated in a small autonomous hybrid energy system. Two small freezers with a power rate of 213W and a 750 W water pump were also provided.
A complete load forecast was prepared that will be satisfied by the autonomous system. The mean daily energy consumption of the freezers depends on the season and the amount of fishing and was estimated in summer in 5112Wh. The mean daily pump consumption is 1125Wh.
A 1kW windmill Whisper H80 and four solar photovoltaic panels 50Wp were selected.
The windmill operation was analyzed using the windmill power- wind velocity performance curve and the wind velocity time series. A windmill power output synthetic time series was obtained. The capacity factor was 37%.
The energy produced by the four panels in summer goes from 280W.h to 940W.h.
In figure 5, as an example, the daily energy budget of the hybrid system in summer is shown.

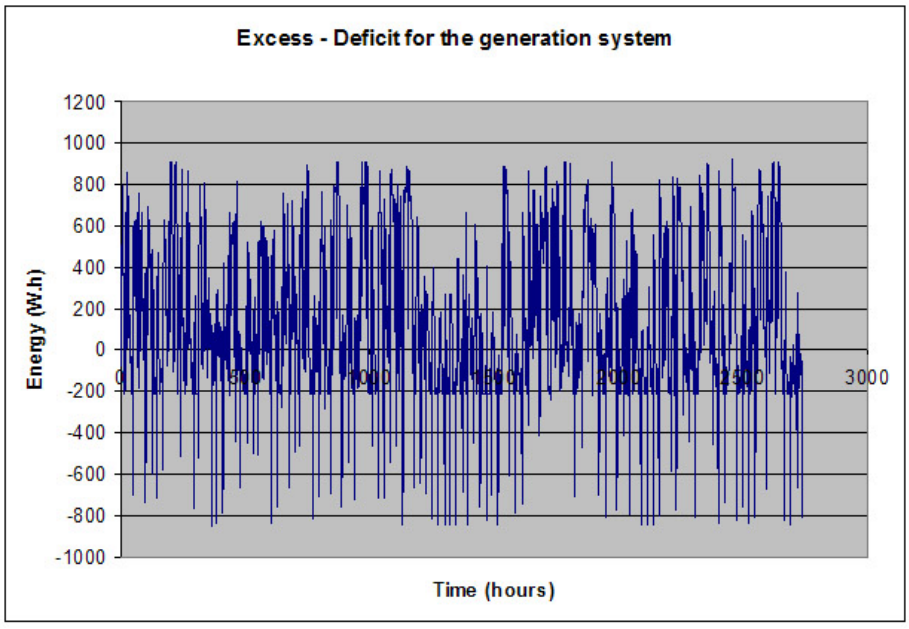

Figure 5 – Daily energy budget

The battery dimension was selected to fit a reasonable service quality without important deficits all year round**.** It was analyzed 400A.h and 600A.h battery capacity. With the first one an energy deficit of 2% equivalent to 2 day in the production period was determined, while with the second one 1% deficit or 1 day was found. The battery has a very significance cost therefore it was decided the installation of the smaller one. This decision implies for the user a careful use of the installation.
The system is technically and economically feasible. Its twenty years cost is less than the rural electric service cost due to the length of the line that might be installed in a zone of very high salinity where this community would be the only user.
In figure 6, the 1kW windmill located at 18m height next to the cabin where the freezers are located is shown.

Figure 6 Windmill installed at Rocha

The equipments installed were carefully selected according not only to climatic conditions but also to their future operation and maintenance that will be performed by members of the community. Due to the high salinity in the zone, the equipment as well as the 18m height windmill tower is salinity proof.
A training course about system operation and maintenance was provided to the community. Particularly, the training course highlight the user analyze of the energy availability to be conducted. The system restrictions about energy and power were clearly explained. This training is very important in technology transfers, especially in cases like a rural isolated zone.

5. PROJECT IMPACTS AND BENEFITS

This project is a contribution to the Millennium Objectives about the rural population through the sustainable renewable energy supply to an isolated community.

The promotion of rural productive activities is nowadays a main national concern. This system is an interesting showcase that could be reproduced at other craft fishing sites in the Uruguayan coast where several similar communities are developing nowadays.

The country has an important wind energy potential not yet exploited. Due to a current energy crisis, Uruguay intends to introduce new energy sources and autonomous hybrid systems are one of the possible and successful applications for wind and solar photovoltaic energy.

The Work Group carried out a very interesting multidisciplinary experience of technical development and relationship with a rural isolated community with a technology transfer of high social impact. Projects like this are successful accomplishments of the extramural activities of the University of the Republic of Uruguay.

The community has in operation a renewable energy system that satisfies their productive energy needs and that has been designed with their own contribution. Being an isolated community, the renewable energy system installed provides them a support to their resolution to continue with their lives there.

Through the training received, the beneficiaries are able to independently run their own energy system and detect its failures.

6. CONCLUSIONS

The technology transfer, especially at rural areas, requires a multidisciplinary approach to reach the necessary conditions of agreement and participation of the beneficiaries avoiding unsuccessful experiences.

The transfer process affects not only the beneficiaries but also the participant work group. The transference methodology applied in this project considers technical and social aspects.

The fact that there is a well established external support to the community by a NGO or a national program is very important for technology transfers because these organizations not only contribute to pave the way to establish the relationship

between the community and the work group but also continue aiding the community during the lifetime of equipments.
The wind energy assessment performed and the showcase installed will be integrated to a national wind energy promotion program.

7. REFERENCES

G. Lesino, M. E. de Castel, V. Nunes, “Energy Supply to Rural Community Centers“, ISES 2005 Solar World Congress, Orlando, Florida, USA, August 2005.

G. Lesino, V. Nunes, R. Roman, “Sustainable Energy Supply to Isolated Communities to Enhance Productive Activities: First Year Advances”, ISES 2005 Solar World Congress, Orlando, Florida, USA, August 2005.

V. Nunes, J. Cataldo, G. Casaravilla “Feasibility of the Use of Wind Energy Generation at Sewage Works in Montevideo City”, World Renewable Energy Congress, Brighton, England, July 2000.

Nunes V., Cataldo J., Casaravilla, G., Evaluación de los recursos energéticos renovables realizada en Uruguay y su aplicación para electrificación rural, ASADES, Revista de la Asociación Argentina de Energía Solar, Volumen 2, 1997.

Cataldo J., López C., Methodology developed for the wind power assessment in Uruguay, III Congreso Internacional Energía, Ambiente e Innovación Tecnológica, Caracas, Venezuela, 1995.