OPET Romania ENERO

Renewables use for rural remote households

The need for rural electrification in Romania

A large part of the Romanian population, -45%, is living in rural areas. Despite that the Romanian national power grid covers the whole territory, still there are some 70,000 rural not-electrified dispersed households. Several tens of thousands from these can't be connected to the public grid in the near future due to the large distances to the grid, implying prohibitive costs.

The most significant area in the country, with more than 40% of the total not-electrified households is the Western Mountains of Transylvania (or Apuseni) area. In general the Apuseni area has a medium solar and wind potential, which implies mixed technologies: wind + solar.

The costs of the electrification by grid connection is a reference for the commercial competitively of electrification by renewables. As standard case, for the grid connection to a remote settlement there are necessary: 2 km length aerial line on medium voltage 20 kV, a transformer unit 20/0.4 kV and 5 km lenght aerial line on low voltage. The average capital cost is over 1500 Euro/household.

From the social and economic point of view, the rural electrification by renewables is advantageous by:

-stabilizing the population within the local activities,

- keeping a clean environment,

-creating and keeping the jobs, with impact on the trade,

-safeguarding the traditional local activities and popular culture,

-building social behavior as collective management and collective ownership,

-encouraging the decentralized power production.

Within an EC funded project, a demonstrative application for rural electrification with PV-wind system, was built and operated in a Transylvanian remote location by the Romanian ICEMENERG institute.

The remote rural households are generally self-sufficient, and the power consumption is minimal. The typical yearly power need for such parsimonious life style, may not exceed 1000 kWh.

The site is the Surducel village, Bihor county, in the Western part of Romania, at coordinates $22^{o}20$'long. E, $46^{o}55$' lat. , in a hilly open area,, to an altitude of 520 m. The village gathers 17 households and 4 holiday houses, all of them are not-electrified. The main activity is animal farming.

The selected household is sited on the top of the hill. The family has 5 adult permanent members, belonging to three generations. The farm is composed of 4 rooms, shelter and stables for animals and other adjacent buildings. The farm is specific to agriculture and animals culture: 70,000 sq. m, 4 cows, two ox, some 10 pigs, 12-15 sheep and poultry.

Concept and equipment of the renewable energy system

The estimated solar irradiation in the region varies between 5-6 kWh/m^2 per day during the summer and 0.6-1.2 kWh/m^2 per day during the winter.

The designed renewables system contains 424 Watts solar PV (Solarex), approximately 25 kWh deep cycle, lead acid battery storage, a 3000 watt windmill and a 3000 watt inverter.

Taking into account the experimental character, the system was oversized in respect to the minimal needed power. Also the winter low temperatures may diminish significantly the capacity of the storage batteries.

Adjacent to the power system, it was installed a solar hot water system. The system was meant as a public hot water source for all the people living nearby. The system is composed by:

- solar collector panels (Greek company Foco);
- hot water storage tank (500 l thermal exchanger)
- hot water consumption tank;
- circulating pump;
- PV module (for DC supply pump);

Mounting works

The siting conditions require very specific mounting technologies. The equipment should be delivered and installed without motorized vehicles or power tools. The farm site is not accessible by ordinary motor vehicles, and the installation procedure should be applicable to any other remote sites. Horse drawn wagons were used to transport the equipment on the last kilometers.

The inclination angle of the PV panels during April-September was 33 South degrees-, and October to March, 68 South degrees.

No concrete was used for the wind mill tower and PV panels support and foundations, nor motorized machines were used for the digging works.

During three days, in June 1998, all the mounting works for the power system were performed. The system was commissioned immediately.

The works performed for the hot water system were finalised in summer 2000. Near a well, a wood structure for a bathroom-cabin was built.

Operation experience

The PV-wind system operated without interruption to the full satisfaction of the farmer family and with only one minor operational incident, as a diode failure in the AC/DC rectifier, on 10th July 1998, during a stormy day with lightning.

The farmer family has been instructed for the continuous observation and inspection of the system.

During the first operation years, the consumption was very modest: as example - 230.6 kWh for the year 1999, despite the fact that the solar radiation conditions permitted some 520 kWh to be produced. The very low consumption may be attributed to the modest amount of electrical appliances and mainly to the farmer concern and initiative not to overstress the system.

A general evaluation is given bellow, for the year 1999 resources:

- The average horizontal plan solar radiation: 377 W/m2
- The average perpendicular plan solar radiation: 432 W/m2
- The average wind speed: 4.6 m/s

Conclusions

The work of PV panels in tandem with the wind generator is advantageous in order to cover the power consumption.
The full capacity of this experimental renewables system is far from being used. **An extension of the supply system to include a power line to the nearest neighbor, is in progress.**

The opening of the market for such applications in Romania should be encouraged by specific financial conditions, aiming to rural electrification.

This successful application was essential to demonstrate the technology efficiency and to initiate the market development.

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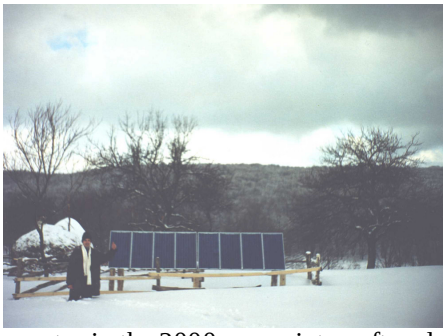
Table 1. MINIMAL POWER ENDOWMENT OF A REMOTE RURAL HOUSEHOLD

Consumer type	No. of points	P_i[W] installed	P_{tot}[W]total calculated
Indoor lighting (fluorescent or halogen)	5-8	13-18	130
Outdoor lighting (including sheds/stables	3-6	13-18	96
Radio +TV	1	100	100
Workshop machines	1	200	200
Refrigerator or boiler or pump	1	200	200



PV generator in the 2000 year winter, after cleaning