Communication

Wind Energy in Malta

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Wind energy is an attractive alternative source of energy. It is becoming increasingly popular in northern countries which have a good wind resource. It is estimated that there are about 17,000 machines providing about 2.7 GW in countries such as Denmark, Germany, Sweden, China, India, Hawaii and the U.S.A. etc.

Wind energy is a renewable, freely available, non-polluting source of energy. Although the wind is notoriously variable, the mean energy available is generally reliable constant over long periods of time. The wind energy resource of any country depends on two main factors; the general meteorological conditions that affect the particular zone, and the land area available for farms.

Observations of wind speed and direction taken by the Meteorological Office at Luqa during the period 1972-1991 have been analyzed for a determination of wind energy in the Maltese Islands.

The Prevailing Wind Direction

The prevailing wind direction is North West (260°-340°). Wind in this sector blows for 41.4% of the time and contributes to 54% of the total energy content. East to South East wind (080°-160°) blows for 18.8% of the time contributing 19% of the total energy. These two reciprocal sectors contain 73% of the total wind energy. The best locations for wind energy converters (WECs) in Malta are those areas exposed to the North Westerlies.

Wind Energy to Electrical Energy

Wind turbines come in a range of sizes, the biggest, have a rotor diameter of 100m, stand on a 100m high tower (Delimara P.S. stack 110m) and can produce 3MW at a wind speed of 11m/s. Smaller practical turbines have a 42m rotor, stand on a 50m tower and can produce 0.5MW at the same wind speed. This means that each large machine provides as much energy as 6 small ones. These machines have an electrical loading over 370W/m^2 which implies that they require an input wind energy of about 830W/m^2. Only part of the wind kinetic energy can be converted to practical use due to aerodynamic and electrical constraints. It is necessary, therefore, to assume a typical WEC to evaluate the amount of electrical energy that can be produced.

Wind Characteristics and Energy

The mean wind speed, at 100m above ground level, is 6.2m/s and provides 142W/m^2, the median wind speed is 7.3m/s and provides 235W/m^2. Both values are small when compared to the required input loading of 830W/m^2. The estimated annual wind energy at Luqa is 2944 kWhr/m^2.

The range of wind speeds observed allow a typical WEC to provide electricity during only 62% of the time: it would be at a standstill for an accumulated period equivalent to 4.6 months, half of which would occur from July to September. Furthermore during the 7.4 months production period, the conversion efficiency varies from 8% to 46% as is shown in Table 1.

Time %	Conversion efficiency %	Remarks
26.1	11.8	Wind speed low (4.5 m/s - 11 m/s)
26.7	45.7	Wind speed ideal (ca. 11 m/s)
6.5	33.1	Wind speed high (> 11 m/s): excess energy is spilled
2.1	15.4	Wind speed too high
0.2	7.9	Wind speeds too high

Table 1. Range of wind speeds observed and corresponding efficiencies

When the wind speed is higher than the rated capacity of the WEC, the excess energy is purposely spilled, keeping the machine producing at its maximum rated output. One typical WEC (irrespective of size) in the Maltese Islands can achieve a mean annual overall efficiency of 31%. This means that one 3MW WEC can produce 7154 MWhr annually.

Electricity Demand

During the period 1993-94 Enemalta produced a total of 1506 GWhr of electrical energy to meet demand. Thus a typical output from a 3MW WEC represents only 0.48% of the national demand for electrical energy, i.e. 10 large WEC would supply ca. 5% of the demand.

In 1975, a German team who carried out a similar study, proposed a wind turbine farm of 10MW producing 22,000 MWhr annually, amounting to 7% of the energy generated in 1974/75. It works out that the demand for electricity then was 314 GWhr p.a. Due to the increased demand, the same farm would today produce only 1.4% of that supplied in 1994.

It is interesting to note that while the Maltese population has grown by 21% between 1975 and 1994, the electricity generated rose by 380% during the same period.

The feasibility of Using Wind Energy in Malta

We suggest that the corrected Luqa observations provide a sound basis for a decision on wind energy utilisation in Malta. Of course the observations are site specific. The search for the best sites is still open, and it can be tackled with more refined methods of observation. It takes 12 large WECs to replace the gas turbines in current use, while 81 would be needed to replace completely one of Delimara's steam turbines. Such a number of WECs would have a prohibitive impact on the aesthetics of the Maltese islands as the best sites are likely to be of high landscape and ecological value. Alternative sites may be found in industrial zones such as Hal Far which has a high exposure to the south sector. Such a site might take 5-10 large WECs but may still suffer from proximity to the line of the main runway at Luqa airport. For workers in the area the WECs may produce an intolerable noise level. These considerations suggest that wind energy should be given a lower priority of exploitation than more workable alternatives like domestic solar water heating and distributed and centralised power generation via photovoltaics. However, serious consideration should be given to WECs dedicated to production of hydrogen by electrolysis rather than to augmenting power in the grid.