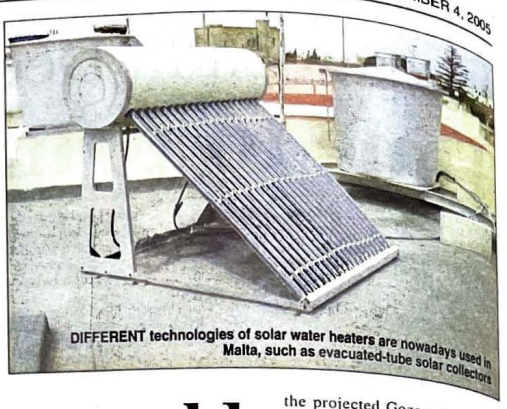
PHOTOVOLTAIC rooftop system installed in Malta



DIFFERENT technologies of solar water heaters are nowadays used in Malta, such as evacuated-tube solar collectors

Solar, wind energy could save Malta millions

ROBERT N. FARRUGIA, MARIO FSADNI, EDWARD A. MALLIA and CHARLES YOUSIF have compiled the first comprehensive study on the potential for renewable energy in the Maltese Islands. Their findings confirm that solar and wind energy are viable and cost-effective in the local scenario.

AS CRUDE OIL prices rocket, the cost of energy has suddenly become a major public talking point. The first straw that the public clutches at is that of alternative or, more properly, renewable energy (RE) sources. But hot on the heels of any public enthusiasm come cold showers as the public realises that little has been done so far to encourage the introduction of RE technologies in Malta.

In an attempt to set up part of the framework required for sensible discussion, we have compiled the first comprehensive study on the renewable energy potential of the Maltese islands based on long-term data. The overall limits to this study were set mainly by our situation of a small, isolated, and heavily populated island archipelago in the central Mediterranean. The approach and criteria adopted were intended to set an informed upper limit to this potential.

The study focuses only on "mature" technologies. The RE sources selected for evaluation were obvious ones: solar energy, wind energy and energy recovery from waste. All can be exploited with devices that have been on the market for decades now, such as solar water heaters (SWH), photovoltaic (PV) systems, wind turbines and bio-digesters. The track record of these technologies frees us from having to reinvent the wheel; we need only to adapt them to local conditions.

These chosen technologies were backed by the necessary physical data: intensity of sunlight, long-term wind parameters; quality and quantity of bio-digestible material.

A fact that needs to be kept in mind when dealing with most RE sources is that their power density (i.e. the power that can be extracted from a RE device for every square metre occupied) is much smaller than is the case for a fossil-fuel generation plant. So while a small oil-fired turbine rated at, say, 1 MW operating for 24 hours may cover an area of 500m^2, from that same area of PV panels one will only get 0.6 per cent of the electric energy.

Much the same considerations apply to SWH and wind. So the first decision to face is whether to go for a few centralised sites – essentially RE power stations – or for a large number of decentralised small units. We chose the second option for SWH and PV, and the first for wind power generation. Biogas presents a different case.

Photovoltaic systems

The potential for PV installations was determined through a realistic estimate of available roof area on domestic buildings, in industrial estates and on public buildings. The estimate considered losses due to shading, the effect of perimeter walls of roofs, the need for using rooftops to house water tanks, cooling systems, clothes lines etc. A 1.2 kWp system (costing Lm2,500 and occupying a flat roof area of about seven metres) on each available roof, with the potential contribution from industrial estates, schools, hospitals and other public buildings, would produce about nine per cent of 2003 electricity generation. This represents a saving of Lm4 million (2003 prices) on fuel per year.

Two points need to be kept in mind. The first is that with PV prices still quite high at Lm3 per watt (€7/W), no rapid take-up is likely to occur unless there are strong capital and/or unit selling price incentives.

The measures announced in the 2006 Budget are a start, but they remain intrinsically unattractive. One incentive that has been put in place is net metering, a barter arrangement that has Enemalta paying the private generator the same rate for units generated as that charged by the corporation. In addition, there is a grant of 20 per cent of the PV system capital cost, with a ceiling of Lm500. Both these incentives could have been much more generous without Enemalta noticing the slightest ripple in its cash flows for the next 15 years, as take-up is likely to remain very slow.

Wind energy

The choice of distributed generation for PV stands in stark contrast with the more centralised options called for by wind energy. Wind turbines are one RE source capable of supplying energy on a scale comparable to that provided by our power stations.

Small wind turbines can be installed on house rooftops, but the effects of a built-up urban environment on wind behaviour and wind turbine performance, as well as the scale of local amenity loss need to be determined.

While it is acknowledged that some potential also exists for wind turbines supplying properties located outside urban areas, this option has not been considered in the current analysis.

Given the visual impact of multi-megawatt machines in the local context, our estimate of the wind energy potential was based on wind turbines in the medium scale range. The average power density available locally was another constraint.

Only those locations expected with an average wind power density of 300 W/m^2 or higher at 50 metres above ground level were considered. Subsequently, technical, environmental and social constraints were assumed to limit the actual area available for wind farms to just four per cent of the area having an average power density of 300W/m^2 or higher.

If all three inhabited islands were considered, this would constitute a total of some six square km, which could support up to 45 MW of installed wind power. Such plant could supply between 4.5 and 5.4 per cent of the total electricity generated in 2003, and an attendant fuel saving of up to Lm2.4 million per annum.

For offshore wind farms, the technically feasible marine area was taken to include all those coastal localities having sea depths of 20 metres or less. Just two of the indicated areas—namely Is-Sikka il-Bajda off L-Ahrax tal-Mellieha, and Is-Sikka tal-Munxar, off the east coast – could sustain 29.5 MW of installed wind power, giving an annual production of between 2.9 and 3.5 per cent of 2003 generation and a saving of up to Lm1.5 million in fuel.

The inclusion of the long strip of marine area along the north coast of Gozo would double the number of turbines and more than double the output because of the very good conditions there.

Of course, offshore farms have added costs compared to onshore: for foundations and superstructures, for maintenance, for cable linking the farm to the (on-shore) grid, and for more weather resistant materials.

Solar water heaters

Solar water heaters were considered on a different footing. These devices do not generate electricity but displace it; so they will cut back on the energy used to heat water but not on the remaining electricity consumption of the household. A SWH makes more efficient use of the incident solar energy than PV panels; it has a lower capital cost and financing schemes to offset capital cost are in place. It needs little maintenance and should last for at least ten years.

To date, the installed surface area of solar collectors is some eight per cent of the overall potential in households, but there are doubts as to its effectiveness given the generally mediocre quality of SWH installation work. An optimistic upper limit suggests that full exploitation of the local potential for domestic SWH could displace four per cent of 2003 electricity generation, equivalent to a fuel saving of Lm1.8 million.

Sea currents

We did have a brief look at the possibility of electricity generation using sub-surface sea currents as there is a well established technology in this field. There were difficulties to derive an estimate: a lack of data on sea currents spread over both location and time, and data indicating currents with water speeds of below one knot, which are too low for generators to function. Clearly this situation can change if more promising data becomes available.

Biogas

The production of biogas, a mixture of methane (CH_4) and carbon dioxide (CO_2) obtained by digestion of organic waste is now well established. In our case the raw materials are the organic fraction of municipal solid waste (MSW), ideally separated at source, animal waste and sludge remaining from sewage treatment.

To reduce transportation of waste and sludge, the system could be based on two centres in Malta and one in Gozo: the existing site at Sant'Antnin and the projected north Malta sewage treatment plant, with the projected Gozo sewage treatment plant. An annual production of 20,000 tonnes of methane, used to power small generating sets, could offset about five per cent of 2003 generation, with a saving of Lm2.2 million on fuel. This quantity of methane would require treatment of most of the animal waste produced. On the other hand, it does not include the methane store currently being created at Iż-Żwejra landfill.

This significant RE potential cannot be realised in the short term. There are technical, planning and, above all, financial barriers in the way. But neither should it be attempted in a vacuum. It needs to be incorporated in an overall energy policy framework that would include not only an RE contribution, but also increased efficiency in conventional generation of electricity and improved energy use in both appliances and buildings.

The cost of renewable energy can be calculated. At present prices, a medium wind site like Luqa can produce electricity at 3.5 c/kWh, while a better site like Bahrija would generate at 2.5 c/kWh. For PV generation, cost would be 12-15 c/kWh, depending on discount rate. These values should be compared with a fuel cost of 2.5 c/kWh and a total cost of 3.2 c/kWh for Enemalta.

Ironically, wind energy, deemed to be "non-viable", can compete with conventional generation at current fuel prices; whereas PV is still some way away from that condition.

Contrary to persistent current rumours that solar and wind energy are "not viable" for Malta, we have confirmed that the overall potential of currently available RE technologies could offset up to 24 per cent of 2003 production, saving a total of Lm12 million worth of fuel every year at 2003 prices and some 30 per cent more at 2005 prices.

In addition, CO_2 emissions would be cut by 466,330 tonnes every year. This last would constitute 18 per cent of all CO_2 emitted locally in 2003.

The researchers used measurements produced by the RAF at Qrendi between 1958 and 1972 and others taken since 1993 by the Institute of Energy Technology of the University at both Tal-Qroqq and Marsaxlokk for information on strength of sunlight. For wind energy they used Luqa Met. Office data collected between 1972 and 1991. IET work at Bahrija over three years, and also referred to measurements taken over six years by the University Air Monitoring station at Gordan Lighthouse on Gozo.

The general approach was conditioned by the acute restrictions on space. For direct solar applications, they looked at space available on roofs of dwellings, large public and private buildings and in industrial estates. For onshore wind turbines, they had a very conservative estimate of available area and used only medium-sized rotors, in an effort to limit visual intrusion.

The researchers assumed the full area of shallow water (depth 20 metres or less) over offshore reefs to be available. It must be emphasised that turbines require to be spaced out if they are not to take the wind out of each others' sails.

A WIND FARM in typical Mediterranean landscape