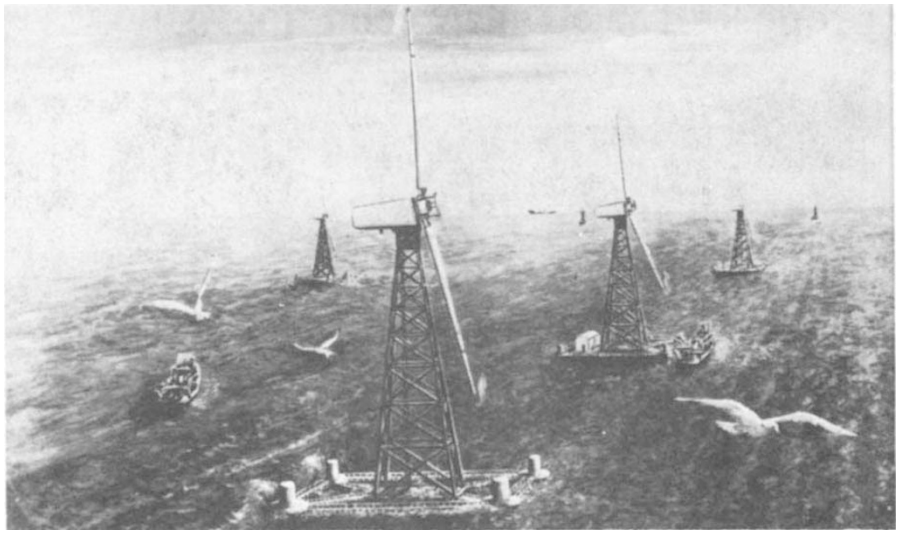

Offshore windmills: can they help conserve fossil fuel?

UK energy

The prospect for ocean-going windmills

THE generation of electricity from windmills sited off the coast of Britain is technically feasible and very likely economic, according to a recent study on the assessment of offshore siting of wind turbine generators commissioned by the UK Department of Energy.

Large arrays of land-based windmills are unattractive in the UK because of the lack of large areas of unpopulated hilly land. However, the UK does have the advantage of a wide continental shelf covered by shallow waters; it also has considerable experience in offshore engineering gained from the exploitation of oil and gas from the North Sea. The study, which should be published in full later this year, has identified several possible sites where the structures for offshore windmills could be built with existing technology. A synopsis of it was presented by P.B. Simpson and D. Lindley of Taywood Engineering — the main contractor for the study — at a meeting of the British Wind Energy Association last week.

Clusters of up to 200 offshore windmills spread over an area of about 60km^2 could be capable of providing 600MW of electricity to the national grid, the study concludes. Their main economic value would be in the savings they would contribute to the burning of fossil fuels. Machines with 100m diameter turbines placed in areas with an annual mean wind speed of 10m/sec could generate electricity at a cost of 3.4p kWWh — compared to the current cost of about 1.5 p/kWh of generating electricity from a coal fired power station. A similar field of 80m diameter turbines and an annual mean wind speed of 9.5 m/sec could generate electricity at a cost of 5.1 p/kWh.

Unlike conventional power stations, wind turbines have no fuel costs. The only costs to be factored into calculations of cost per kWh, therefore, are maintainence and capital costs. Moving offshore increases both considerably. According to Simpson and Lindley, the cost of the support structure for one wind turbine (excluding the turbine itself) would be £3 million. One machine would cost £34,000 a year to maintain; and support facilities onshore would have to be built at a cost of £25 million for a 200 machine cluster. Transmission costs for a 600 MWe cluster they estimated to be £171-189/kW — four times that for a conventional 600MWe power station. Construction period and operation time were assumed to be eight and 20 years respectively. They gave no total capital cost for a 200 machine cluster but Dr Peter Musgrove of Reading University, who also participated in the study, believes that a cluster with a generating capacity of up to 1000MWe could be built for roughly the same price of a conventional power station of the same capacity. All costs in the study were at mid-1979 prices.

Most of the capital cost of building wind turbines offshore would be taken up by building support structures which could withstand the rigours of the sea. So the greater the generating capacity of each machine, the more cost effective it would be. Wind turbine diameter is one of the three main factors affecting generating capacity, according to Simpson and Lindley. The other two are mean and rated wind speeds and cluster configuration. Machines spaced at anything less than fifteen turbine diameters are considerably less efficient than individual machines. In the particular sites considered in the study, mean water depth (10-25m), height of turbine axis above the water (1-1.5 × turbine diameter) and distance offshore (5-25 km) had only secondary effects.

These conclusions are based on the detailed analysis of three sites — Burnham Flats in the Wash approaches, Shell Flat off Morecambe Bay and Carmarthen Bay — chosen out of an initial 17 on technical and economic grounds. Lindsay and Simpson stress that these sites are not to be seen as automatic choices for future projects. The study did not include the question of amenity, they say, because it was felt that detailed proposals would be needed first. However, it did assume that all possible sites should be at least 5km from the coast.

If wind power is developed vigorously, thinks Dr Musgrove, it could match the development of nuclear power over the past 25 years and contribute 20% of electricity supply by the year 2000. It should be possible, he says, to build several arrays each containing 200 machines of 100m turbine diameter and capable of generating 5MW each. The net result of each array would be equivalent to one 1000 MW power station operating with a 35% load factor. Variability in wind speed would not be much of a problem because at offshore sites the wind is fairly constant over short periods. The greatest variation is seasonal but this has the advantage that the strongest wind is in winter.

To realise this potential, says Dr Musgrove, the UK should be prepared to support a government funded programme of at least £5 million per year on wind energy research for the next decade, compared to the £½ million spent last year by the Department of Energy; otherwise there is a danger that Britain will fall behind the US, Holland and Germany, its chief competitors in this field. The US and Germany are already building horizontal wind turbines of diameter up to 140m, whereas the UK has not yet received approval to build a 60m diameter horizontal axis machine even though £½ million has been spent on its design.

Dr Musgrove, however, is an advocate of vertical rather than horizontal axis machines. The problem with horizontal axis machines, he says, is that the blades are subjected to gravity loads acting in different directions and this considerably limits their size. A vertical axis machine would not have this problem and could be built to much greater diameters.

So far, however, the UK has gone no further than to design a 25m, 100-150kW vertical axis machine. A decision on further funding for that is also expected later this year. The next six months, therefore, will be decisive for the future of UK wind energy, thinks Dr Musgrove. Not only does a decision have to be taken on what should be done as a result of the offshore study, but decisions have also to be taken on the future of the 60m horizontal and 25m vertical axis designs.

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