Wind energy a hot prospect

Forget precious metals and fossil fuels, prospecting 1990s style means searching for wind: the stronger the better!

Governments worldwide – motivated by decreasing wind-energy costs and the need to reduce greenhouse-gas emissions – are encouraging and even legislating for greater use of wind energy. Crucial to the switch is the accurate mapping of wind resources, the first step towards defining the wind-energy resources of a country or region.

An extensive study by Pacific Power CSIRO's Centre for Environmental Mechanics has identified several sites in New South Wales with the potential to generate wind-energy. One of these sites, at Crookwell in the Southern Tablelands, will be the home of Australia's largest and first grid-connected wind farm, to be built and run by Pacific Power.

Leader of the CSIRO study, Dr Peter Coppin, says wind prospecting requires an understanding of the economics of wind-power distribution, plus skills in fluid dynamics, meteorology, numerical modelling and statistics.

'The cost of wind-generated electricity depends largely on the siting of turbines,' Coppin says. 'It is costly to transmit electricity long distances, so wind farms sited at the end of power lines can be competitive. And because the electricity generated by wind is a function of the cube of the wind speed, the cost falls significantly as wind speed at the centre of the turbine increases.' (A turbine at a site with five metres a second (m/s) winds will produce nearly twice as much power as a turbine sited where the wind averages 4 m/s.)

Coppin says mountain peaks are the obvious place to find strong winds because the moving air is squeezed through a smaller area of atmosphere. But wind speeds depend on a combination of topographic features, the effects of which are not obvious to the eye. Also, siting a whole wind farm is more difficult than placing a single wind turbine.

'Many potential sites have only one "sweet spot" with suitable wind speeds,' Coppin says. 'This is fine for a single turbine, but a wind farm requires a group of turbines spaced several hundred metres apart. If placed too close, the turbines can interfere with one another, a problem which is compounded by inconsistencies in wind direction.'

Coppin's team began their prospecting with a study of broad-scale meteorological patterns, paying special attention to frontal activity which in southern NSW is linked to strong winds. Historical and anecdotal records were also considered. From this information, several representative sites were selected and 40 m towers erected on-site to measure wind speeds at turbine-height. These data were then combined with topographical information to produce coarse-resolution models of wind-behaviour in each region. The final step involved detailed studies of cleared areas to define the best position for the wind farm and each turbine in it.

Coppin says the Crookwell site offers an ideal combination of elevated, cleared land, with the added bonus of power lines running through the property, minimising the cost of grid-connection. By the end of 1997, the wind farm at Crookwell should be generating about five megawatts of electricity from eight, 600 kilowatt turbines, enough to power some 3500 homes. When the winds are strong enough for the turbines to reach full capacity, the farm will supply all of Crookwell and export electricity back to Goulburn and the Southern Tablelands, on transmission lines owned by Great Southern Energy.

The Crookwell wind-farm is intended to lessen future dependence on coal-fired power production in NSW, thereby reducing carbon dioxide emissions by 9000 tonnes a year. (Under the NSW Power Supply Act of 1995, the state's power distributors are obliged to develop 'green energy' options). Further wind-energy projects are being planned for the state.

Another front-runner in Australia's wind-energy race is ETSA Corporation, which is conducting a 12-month study in South Australia to determine whether an economically-viable wind farm could be developed to sell 'green energy' into the planned National Electricity Market, to include SA, NSW and Victoria.

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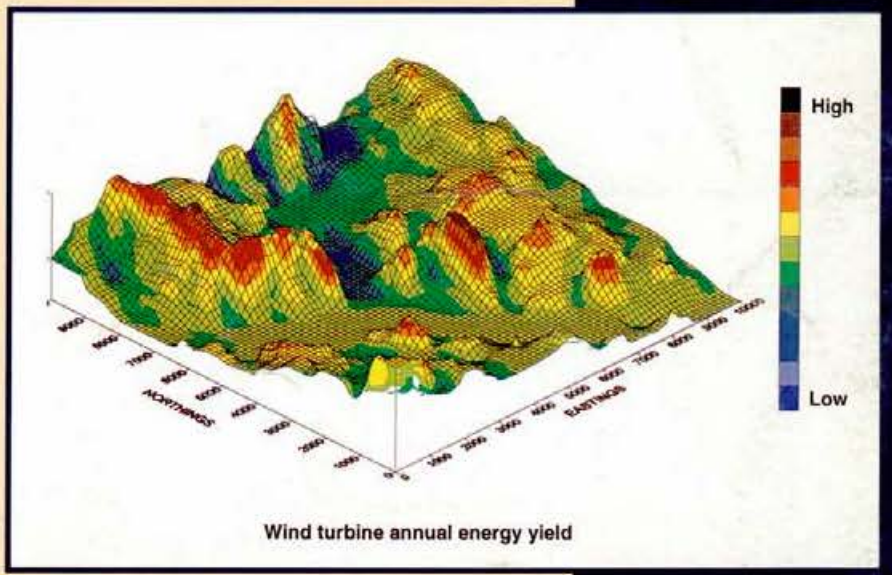
Above: Australia's largest existing wind farm, at Esperance in Western Australia was set up in 1994. It has nine wind turbines and can generate 2 MW of electricity, enough for about 1000 homes. In its first two years of operation, the Ten Mile Lagoon Wind Farm saved 3.4 million litres of fuel and avoided emissions equalling about 9880 tonnes of the greenhouse gas carbon dioxide.



Wind turbine annual energy yield

Below: The wind-energy research team at CSIRO's Centre for Environmental Mechanics has developed three-dimensional maps of potential wind resources in southern NSW.