Chapter 82
Sequential Experiences in Energy Producing Landscapes

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ABSTRACT

Wind turbines are a major presence in the landscapes of some countries. This presence will become more widespread across the world as the need to reduce coal dependence becomes more broadly accepted. This chapter uses the situation of the state of Victoria in southern Australia to explore the possible extent of landscape change under a move to 100% renewable energy sources, and to explore the key variables and tools for analysis and communication, which will identify the consequences and support planning. A scenario for a future level of wind power generation in Victoria is proposed, potential sites identified, and then the visual impact of these analyzed, not simply on a case-by-case basis but as a system of facilities across the landscape. People travelling by road, or train, will be particularly aware of the extent to which the change is pervasive and new analytical parameters, such as Zipf distribution and fractal dimension, are illustrated. New policy approaches and modes of impact communication are proposed.

INTRODUCTION

A Renewable Energy Future

The possibility of a world in which all our energy needs are met by renewable sources, and specifically wind, water and sunlight (WWS) has been recently proposed, and supported with appropriate analysis, by Jacobson and Delucchi (2011). They argue that all new energy needs could be met by WWS by 2030, while existing energy sources could be converted by 2050. As the renewable energy technologies improve and their prices drop, and as the world increasingly imposes a cost on greenhouse gas emissions, we will surely extend our existing use of WWS and the consequences for the landscape should be considered.

In their scenario for the future, Jacobson and Delucchi (2011) propose that wind and solar (specifically roof photovoltaic (RPV), plant photovoltaic (PPV) and concentrated solar (CSP)) energy together would account for 90% of future supply. The scope for new hydroelectricity is fairly low, but used with

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geothermal can fill some supply gaps. Tide and wave energy systems remain largely experimental. Jacobson and Delucchi calculate a requirement for 4 million wind turbines each of 5 MW and about 90,000 PPV or CSP power plants each of 300 MW. This sounds like it would take a lot of space. However, Jacobson and Delucchi calculate that:

"If 50% of the wind energy were over the ocean...and if we consider that 70% of hydroelectric power is already in place and that rooftop solar does not require new land, the additional footprint and spacing areas required for all WWS power for all purposes worldwide would be only ~0.41% and ~0.59%, respectively, of all land worldwide (or 1% of all land for footprint plus spacing)." (p 1161)

While this is small, relative to agricultural areas which occupy close to 40% of land worldwide (Ramankutty, Evans, Monfreda & Foley, 2008), the potential impact is exacerbated by the high visibility of the infrastructure, by the power generators needing to be reasonably close to population centres, and by these places (in which we live) also commonly being our culturally and environmentally important landscapes. Consequently we need to assess the effects in more sophisticated terms than simply footprints.

This chapter explores new ways to assess the landscape implications of moving to a WWS future. Some environmental effects, such as air and water pollution, would surely be reduced but others including wildlife impacts, noise and aesthetic impacts would likely increase. Here I focus on the visual impacts on the landscape without asserting that these are the only or even necessarily the major concern. A major increase in wind and solar energy infrastructure will both affect more people in their residential situations (albeit at impact levels similar to those experienced by some people already) and also affect people a lot more because of greater exposure while travelling around. Bishop (2011) reviewed the considerable research into the visual impacts of wind energy infrastructure. Prior work has however been focussed primarily on individual wind turbines and wind farms through model calibration studies using either visual preference or willingness-to-pay studies (Ladenburg & Dubgaard, 2007; Ladenburg, 2010). Apart from the work of Rodrigues, Montañés and Fueyo (2010) there has been little attempt to develop processes for understanding the aesthetic implications across a wide area or analysis of the experience of someone moving through WWS landscapes. This requires new thinking and new metrics for assessment of landscape impacts.

Visual Analysis

Visual landscape analysis has an extended history involving both qualitative and quantitative methods. Pioneering experts such as Lewis (1964), Fines (1968) and Litton (1974), were followed closely by those arguing for a more analytical approach using mapped data and photographs (Shafer & Brush, 1977). This analysis of the landscapes themselves, in particular their visual quality or scenic beauty, also opened the opportunity for analytic approaches to visual impacts on the landscape from introduced elements such as land use changes (Brush and Shafer, 1975; Dearden, 1980), forest management (Daniel & Boster, 1976), urban fringe development (Crystal & Brush, 1978), or forest insect damage (Buhyoff, Wellman & Daniel, 1982). In the 1970s and 1980s new technologies to support landscape analysis emerged and found applications. These included visibility analysis (Aylward & Turnbull, 1977) and raster overlay mapping (Tomlin & Tomlin, 1981), which both found their way into geographic information systems (GIS).

These two strands of development came together with the use of visibility algorithms and GIS to assess landscapes (Steinitz, 1990; Bishop & Hulse, 1994) and visual impacts (Hadrian, Bishop & Mitcheltree, 1988; Schroeder, 1988). In GIS visibility algorithms work by extending radial lines out from a viewing point and determining whether they intersect with the terrain before reaching the object of interest.

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