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Rapid land use change by coastal wind farm development: Australian policies, politics and planning

Nick Harvey[a,b,*], Romana E.C. Dew[a], Sarah Hender[c]

[a] The University of Adelaide, Adelaide, South Australia 5005, Australia
[b] James Cook University of North Queensland, Townsville, Queensland 4811, Australia
[c] Department of Environment, Water and Natural Resources, Keswick, South Australia 5000, Australia

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ABSTRACT

The siting of both onshore and offshore wind farms has caused controversy in a number of countries, particularly in Europe, which currently has the world's largest array of offshore wind turbines. Like the rest of the world there has been a dramatic increase in wind farm development In Australia over the last two decades but none of this has occurred in the offshore environment. Australian wind farms are predominantly located onshore around the southern part of the continent where wind energy is high. This has specifically affected rural coasts where it has created planning and land use policy issues along with environmental impacts and associated public and political reaction. This paper examines the geographic spread, timing and concentration of Australian wind farms around the coast. It also examines the extent to which scientific knowledge on wind farm impacts is incorporated into different state and federal land use and environmental policy and legislative frameworks. The paper concludes that the rapidity in the expansion of the Australian wind energy sector has outpaced strategic land use planning resulting in a piece-meal and cumulative wind farm development on rural coasts.

1. Introduction

The rapid expansion of wind-generated power has risen from a global cumulative installed capacity of 6100 MW in 1996 to 369, 553 MW at the end of 2014 (GWEC, 2015). Driven by an increasing emphasis on low-emission technologies and government policies directed to meet carbon abatement targets, wind energy has become one of the fastest growing sources of renewable energy worldwide. In order to meet this demand, arrays of wind turbines referred to as wind farms have been built around the globe. Technological change has resulted in an increase in the size and efficiency of turbines, which increased from 10 to 20 m diameter units generating 25–100 kW to megawatt units with rotor diameters of over 100 m installed on towers exceeding 100 m in height (Nelson, 2013, p.11). This has had consequent changes in the impact of individual wind farms. According to Nelson (2013) the US was an important player in the early development of wind farms but by the 1990s was overtaken by Europe, which had significant contributions from Germany. The Global Wind Energy Council estimates that Europe contains 36.25% of the installed capacity worldwide, North America 21.09% and Asia 38.45% with the majority of global growth since 2009 particularly in China (GWEC, 2015).

The growth in the wind energy industry worldwide has seen a simultaneous increase in the number of coastal wind farm developments. This increased capacity for electricity generation is due to the higher wind speeds associated with coastal areas and the potential for wind farms to be in close proximity to human settlements. Consequently, there has been a rapid expansion of both onshore and offshore wind farm developments. There is, however, a trade-off in between the benefits of increased energy efficiencies for offshore wind farms set against the reduced siting, installation and repair costs of coastal onshore wind farms. In Europe, due to the inherent difficulties in finding suitable onshore open spaces in coastal areas, offshore wind energy is becoming a much more viable option (Diesendorf, 2011; EWEA, 2012).

In Australia, recent wind farm development has mirrored the global experience with a rapid increase in output capacity, particularly over the last decade with about half of the wind farms now located around the coast. This is due to a reliable wind environment with coastal sites in close proximity to population centres and electricity grids, mostly on the southeast coast. Unlike Europe, due to Australia's abundance of open spaces and most of its coastal waters being too deep for offshore wind farm technology, all

* Corresponding author at: The University of Adelaide, Adelaide, South Australia 5005, Australia.
E-mail address: nick.harvey@adelaide.edu.au (N. Harvey).

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current wind farm developments are land-based (Diesendorf, 2011). Over a decade ago, Mercer (2003) noted this rapid development and potential impact on the Australian coast. Since then there have been a number of site-specific coastal wind farm studies and papers on planning approvals and legal issues but there is a gap in the literature relating to the national impact of this form of coastal development or its broader implications for coastal management.

This paper provides a global context for Australian coastal wind farm development using international examples from the literature of both offshore and onshore coastal wind farm development but focusing on onshore farms, which are of more relevance in Australia. The paper analyses the nature, growth and distribution of the Australian wind farm industry illustrating the extent, timing and impact of wind farm development on the coast. In particular, this paper examines the various issues associated with coastal wind farm development and the extent to which these have been addressed in coastal and planning legislation and policies. This is linked to broader theoretical aspects of the uptake of science into environmental policy. The paper concludes that the rapidity of this form of development has largely moved ahead of specific policies and development controls regulating the industry and this has created a significant land use change around the southern half of the Australian coast.

2. Methodology

Methods for the analysis of Australian wind farm distribution are outlined in a related paper by Harvey and Dew (2016) and summarised here. First, wind farm geo-referenced location data were obtained for all Australian wind farms installed up to mid-2015. These data where then compiled and digitized into an ArcGIS shapefile in order to examine the geographic distribution of all Australian wind farms, which as noted by Harvey and Dew indicated an apparent coastal concentration. In order to quantify this relative concentration a Euclidean distance was calculated between each wind farm and its nearest coastline and the total Australian wind farms were then grouped according to their distance from the coast. Based on these data, 'coastal wind farms' were defined by Harvey and Dew (2016) as being within 25 km of the Australian coastline. Data on the number of wind turbines and their installed wind generating capacity have also been recorded for each wind farm, since individual farms may have a larger number of wind turbines or a greater total generating capacity than the cumulative output of a number of smaller wind farms.

The current research paper builds on the initial assessment of coastal wind farm impacts (Harvey and Dew, 2016) by conducting an analysis of the regulatory planning and policy background, which led to this significant change in coastal land use. In order to do this an extensive review was undertaken for all government policies, legislation and political influences relating to the facilitation or control of coastal wind farm development and siting. The policy analysis required examining both federal and state policies relating to renewable energy matters but the review of legislation primarily focused on an analysis of state-based planning and environmental regulations relating to wind farm development approvals. The reason for this is that the Australian constitution gives individual states the powers to regulate resource use and each state has created its own separate planning and/or environmental legislation. Federal environmental legislation is generally not involved unless a specific wind farm development can be demonstrated to be of 'national' significance.

The research on policy and legislation was supplemented by a document analysis of what has happened 'in practice' through examination of government reports such as planning documents, conditions of approval and environmental impact assessment (EIA) documents. These were analysed to determine issues relating to wind farm development approvals resulting in land use changes.

In addition to a detailed examination of government policy and legislation, the paper uses industry and government statistics on wind farm development to analyse the patterns in the growth of the industry over the last 25 years, with specific focus on differences in the scale and timing of development within and between state jurisdictions resulting in consequent different levels of land use change. These statistical data are then discussed in the context of the geographic spread of wind farms around the coast and linkages to renewal energy policies and planning regulations.

3. Siting issues for coastal wind farm development, the global context

As of early 2015, total global wind power capacity sits at 370 GW increasingly rapidly from 48 GW in 2004 (REN21, 2014). In 2014, 1.3% of the estimated global energy consumption was collectively from wind/solar/geothermal power (REN21, 2014). The rapidity of wind power is shown through its average annual global growth rate of 18% from 2009 to 2014 (REN21, 2014). During 2014, wind generated more than 20% of electricity in several countries, including: Denmark, Nicaragua, Portugal and Spain (REN21, 2014). China was leading in wind power investment and total capacity for 2014, wind with installations rising a record 38 per cent, or 20.7 GW, from a year earlier (REN21, 2014). As of December 2014, 144 countries around the world have renewable energy targets (Climate Change Council, 2014).

In Europe, due to the inherent difficulties in finding suitable onshore open spaces in coastal areas, offshore wind energy is becoming a much more viable option, with the Europe containing the majority of the large offshore wind farms and 6 out of the top 10 are in the UK (Diesendorf, 2011; EWEA, 2012). This phenomenon in Europe has also resulted in reduced siting and environmental issues typically associated with the objections to onshore wind farm developments (Diesendorf, 2011; EWEA, 2012). Six out of the 10 of the world's largest wind farms are in the United Kingdom which now contains 3.4% of the overall global installed wind capacity (GWEC, 2015). In the UK, the siting of onshore wind farms is deliberated in some cases entirely by the local government; in contrast, offshore farms fall within the central government's jurisdiction (Jay, 2012). Toke et al. (2008) state that around 60% of all wind power planning applications are rejected by local councils in England and Wales. The degree of centralised control differs across Europe, for example in Sweden and Denmark, the consensus between local and national government is an important dimension of the authorisation process (Jay, 2012). Globally, the acceptability of onshore wind projects is strongly influenced by the institutional fit to policies and politics, market sectors, intra-firm acceptance and community involvement (Depellegrin et al., 2014; Toke et al., 2008; Wolsink, 2007).

Concerns about impacts of windfarms are often focused on their visual and aesthetic qualities, land-use impacts, wildlife especially aviary mortalities and community health (see Table 1). Additionally, offshore wind farms produce a set of specific marine impacts including marine ecosystem disturbance and navigational safety. Offshore wind farms make up a comparatively small percentage of the global grid-connected capacity only exceeding 8.5 GW across 14 countries (REN21, 2014). The majority of the large offshore wind farms are in Europe and 6 out of the top 10 are in the UK whose waters contain 51.24% of the global cumulative offshore capacity (GWEC, 2015; REN21, 2014). There has been a variety of factors discussed in Jay (2012) that have contributed to the success of offshore wind energy in the UK. Given a lack of such offshore developments in Australia this paper will only focus on issues associated