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Energy supply systems in Australia: A discussion essay on the potential for grid-connected photovoltaic systems to replace coal-fired power stations

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Introduction

With climate change threatening the environmental, and consequentially the economic basis of our civilisation, it is becoming increasingly important to reduce global greenhouse gas emissions. Australia has made a commitment to reduce domestic greenhouse gas emissions, of which coal fired power plants are a major source. This essay looks at the option of replacing electricity produced by these power plants with grid-connected photovoltaic systems. That is, solar panels installed on building roofs across Australia. The issues of environmental impact, cost and practicality are discussed with attention paid to both sides of the argument.

Environment

A major argument against photovoltaics is that they cause more environmental damage than they prevent, both in greenhouse gas emissions and toxic chemicals. Research has shown that the energy used to produce a solar array (a group of connected photovoltaic panels) is greater than the energy that solar array will produce in its lifetime (Goetzberger and Hoffmann 2005). It has also been shown that photovoltaics contain hazardous materials such as silicon tetra fluoride, cadmium, tellurium, copper and indium, which are released to the environment during manufacture and disposal (Fthenakis 2008; Watson et al. 2002). While these claims are based in research, it can be shown that they are either outdated or taken out of context.

Photovoltaics, in fact, have a lower environmental footprint than most power sources. The only source of greenhouse gas emissions attributed to photovoltaics is from the electricity used to manufacture them (Baumann, Hill and Hynes 1997; Andrews and Jelley 2007). By displacing carbon intensive electricity, photovoltaics make up for these greenhouse gas emissions in less than seven years (Watson et al. 2002; de Wild-Scholte and Alsema 2004). As they have a typical life span of 25-30 years (Watson et al. 2002; Andrews and Jelley 2007) the claim that they cost more in energy to manufacture than they produce is false. During production and disposal toxic chemicals can be released to the environment, the most notable of which is cadmium. However, research has shown that the proportions released per GWhr of electricity produced are many times less than that for coal (Fthenakis 2008). Furthermore, cadmium used in production is often sourced from the waste streams of mines, where it would otherwise be disposed of as hazardous waste

(Fthenakis 2008; Sinha et al. 2008). Overall solar power is proven to have a much lower environmental impact than coal, although high costs currently prevent further utilisation.

Cost

The cost of solar power is the biggest obstacle to it becoming a major power source. According to Goetzberger and Hoffmann (2005) solar power is the most expensive renewable energy source on the market. Thus large government subsidies are required to make photovoltaics economically feasible for residents to purchase. While the high price of solar power is undisputed, it has to be asked whether this is a temporary or permanent barrier.

Research has shown that solar power is set to become competitive with coal power in the medium term. According to Blakers (2008) the cost of photovoltaic systems will continue to decline as the efficiency of solar systems is expected to improve for many decades. Increased costs due to Australia's Carbon Pollution Reduction Scheme are likely to add 2c/kWh in the short term and 5c/kWh in the longer term to the retail price of coal supplied electricity (Blakers 2008), making solar power more economically attractive. It is likely that solar power will become financially viable in the near future, although there are concerns regarding the impact of introducing large amounts of solar power to the electricity grid.

Practicality

It is argued that solar power cannot be used as a major power source because it is unreliable and doesn't provide base load power (power that is always on to take up the minimum load in the grid). Solar panels don't generate electricity at night or when the panels are shaded by clouds or other obstructions. Once 10-20% of the electricity in the grid is supplied by solar power, storage and energy management are required to meet base load requirements (Blakers 2008; Goetzberger and Hoffmann 2005). This is seen as costly and one of the major barriers to solar power uptake. While no one denies the unreliability of individual solar panels, it is argued that this is an obstacle that can be overcome.

Studies have suggested that solar power, if implemented properly, can substitute for coal fired base load power. By spreading out solar panels across Australia, solar power as a whole becomes more reliable (Sovacool 2008). If solar power is combined with wind power it becomes even more reliable as the probability of neither wind nor solar power working at the same time is decreased (Blakers 2008; Palmintier, Hansen and Levine 2008). While it isn't suggested that solar and wind power can completely cater for the demands in the power grid, it is argued that with a small amount of natural gas and other renewable energy sources, fossil fuel power can be almost completely replaced (Blakers 2008). For this to be possible some energy would have to be stored. This can be achieved by utilising commercialised pumped hydro storage or other developing technologies (Blakers 2008; Kaldellis, Zafirakis, and Kavadias 2009; Sovacool 2008). To reduce the need for storage, power management could shift loads from night, when solar power does not produce electricity, to the day, when solar power is at peak performance (Goetzberger and Hoffmann 2005). Despite the arguments against solar power it can be seen that with the right approach solar power can be used as a reliable power source.

Conclusion

By analysing the main arguments against solar power it can be seen that these arguments are either insubstantial or

can be overcome with appropriate management. It can therefore be concluded that grid-connected photovoltaic systems can feasibly replace a large portion of coal fired power, and almost completely replace coal fired power if used in conjunction with other renewable energy sources such as wind. This has the potential to play a large part in Australia reaching its greenhouse gas reduction targets.

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