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Green Power voluntary purchases: Price elasticity and policy analysis

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ABSTRACT

Green Power schemes offer electricity from renewable energy sources to customers for a higher price than ordinary electricity. This study examines the demand characteristics of Green Power in Australia and policies which could increase its sales.

A sample of 250 pooled time series and cross sectional observations was used to estimate a statistically significant elasticity of demand for Green Power with respect to price of −0.96 with a 95% confidence interval of ±68%.

The wide variation in market penetration between jurisdictions and between countries for Green Power, and the low awareness of Green Power found by surveys indicate that Green Power sales could be increased by appropriate marketing and government policies.

The most cost effective means to increase sales was found to be advertising campaigns although only one Australian example was found, in the state of Victoria in 2005. It was also found that full tax deductibility of the Green Power premium to residential customers, exemption from the Goods and Services Tax and a tax rebate for Green Power are all probably less cost effective for promoting sales than direct government purchase of Green Power, in terms of cost per unit of increased sales.

1. Introduction

1.1. Background

Global warming from the human-generated increase in greenhouse gases in the earth's atmosphere is increasingly accepted by the public and the scientific community as a threat, not only to the world economy, but possibly also to civilization. The Stern Review (Stern, 2006) has highlighted the grave likely economic consequences of global warming and the relatively small costs in reducing its impact to acceptable levels. The world electricity supply industry must play an important part in greenhouse gas abatement. It is estimated that this industry will need to reduce greenhouse gas emissions by 60% by 2050 if atmospheric carbon dioxide is to be kept to the recommended tolerable maximum of 550 parts per million (Stern, 2006).The current level is 379 parts per million (IPCC, 2007). In 2002 Australia accounted for 1.2% of world energy consumption(British Petroleum, 2003)which, per capita, is about 3.6 times world average.

Green Power schemes are a means of countering global warming by encouraging growth in the generation of greenhouse-gas-neutral renewable energy. Renewable energy sources include solar, wind, small-scale hydroelectricity and biomass. Green Power can be defined as

> electricity that is produced from renewable sources and that has been differentiated from other electricity products and marketed as being environmentally friendlier (Salmela and Varho, 2006, p. 3669).

Green Power customers voluntarily pay an additional premium which covers the additional cost of generating the customers' electricity from renewable energy sources.

Green Power schemes use a technique to reduce greenhouse gas emissions which differs from both the carbon tax and cap-and-trade regimes. Green Power relies on the good intentions of consumers to pay for the additional costs of clean generation of electricity. If successful, Green Power could be an important means of reducing greenhouse gas emissions at minimal cost to governments and to the rest of society, paid for willingly by people. If it is found that global warming is not caused by human activities, the risk that the expenditure on abatement is futile is borne by the purchasers of Green Power. These advantages of Green Power schemes highlight the need to study the economics of Green Power, including what determines the demand in this market and how the Green Power market can be made to function so sales are maximised.

The objectives of this study are:

(1) To identify and quantify factors affecting supply and demand in the market for Green Power in Australia;

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(2) Using what is learned about the Green Power market to assess which government policies should be adopted with regard to Green Power.

To achieve these objectives, data were gathered on renewable energy generation capacities and costs and on Australian Green Power sales and prices. Regression analyses were conducted with quantity of sales of Green Power as the dependent variable, to determine which explanatory variables have statistically significant coefficients. This enables an estimate to be made of the elasticity of Green Power demand with respect to own price. The findings of these statistical analyses inform the policy analysis that follows.

The empirical investigation in this study concerns identification of factors driving demand for Green Power in Australia using price information, where available, for the various Green Power schemes, sales information from published audit reports and other data. This study differs from the other studies by (a) using actual Green Power sales as the dependent variable, (b) price for each scheme as an explanatory variable and (c) not relying on data on stated preferences or survey data on attitudes. The main contribution of this study is an estimate of the elasticity of demand for Green Power with respect to price from revealed preferences while attempting to discern other factors that may affect the market. No studies have been found which estimate a statistically significant elasticity of Green Power with respect to own price using revealed preferences. There are no empirical studies of the elasticity of demand for Green Power in Australia, so this study adds to empirical understanding of the Green Power market.

The plan for this work is as follows. After a survey of the literature on quantitative studies of the Green Power market, regression analysis techniques are used to identify which variables are likely to have the most effect on Green Power sales (based on sales data from published Green Power audits and price data from various sources). The price elasticity of demand with respect to own price for Green Power is estimated and then used in an analysis of the likely consequences and effectiveness of a number of government policy options to increase Green Power market penetration.

2. Review of Green Power markets

2.1. The market for Green Power

Economic theory presents the Green Power market as an example of private contributions to increase the supply of a public good, which is a good that is non-rival and non-excludable. The public good in this case is the reduction in greenhouse gas emissions, a good from which no one can be excluded and for which the enjoyment by one person does not diminish the enjoyment by others. Literature on the nature of impure altruism (Andreoni, 1990) has provided insights into the market for impure public goods of which Green Power is considered to be an example (Cornes and Sandler, 1994; Kotchen, 2005; Kotchen and Moore, 2007). A consumer faces a market choice in a situation where the public good is already available to the consumer through the efforts of others (Cornes and Sandler, 1994). For Green Power as an impure public good the private characteristic is not only the 'warm glow' from satisfaction of doing something good for the environment, but also the consumption of electricity for personal use, while the public characteristic is the reduction in greenhouse gas emissions arising from renewable energy generation displacing conventional energy sources. With plausible assumptions, Green Power, as an impure public good with substitutes available, can be shown to have a negative price elasticity of demand (Kotchen, 2005).

Nyborg et al. (2006) present a view of consumer motivation to behave ethically based on the perception of the behaviour of others, a form of herd behaviour which could result in multiple equilibria. This implies that temporary incentives to buy Green Power might result in sustained increases in Green Power sales.

Regarding policies on Green Power, Wustenhagen and Bilharz (2006), reporting on the German experience, noted the contrast between the great success of feed-in tariffs in encouraging growth of renewable energy generation and the performance of voluntary Green Power schemes which to date have had only a small impact but are growing rapidly. Van Rooijen and van Wees, (2006) found that voluntary arrangements without other policies to encourage growth of renewable energy are unlikely to give the industry any great impetus.

2.2. Literature on quantitative analyses of Green Power markets

Quantitative studies attempting to estimate demand for Green Power can be categorised as either stated preference studies or revealed preference studies. Among stated preference empirical studies of the Green Power market in various countries are studies by Arkesteijn and Oerlemans (2005) (Netherlands), Batley et al. (2001) (UK), Kotchen and Moore (2007) (USA), Roe et al. (2001) (USA), Wiser et al. (2001) (USA), Nomura and Akai (2004) (Japan) and Zarnikau (2003) (USA). These studies generally found that a significant portion of electricity customers were willing to pay more for electricity from renewable sources. Numerous studies have found that there are more people who say they are willing to pay the Green Power premium than actually do so (Batley et al., 2001: 481; Ethier et al., 2000: 59; Kotchen and Moore, 2007: 2; Roe et al., 2001: 923,924; Salmela and Varho, 2006; Wiser et al., 2000).

Studies of revealed preferences rather than only stated preferences included one by Menz and Vachon (2006), who performed a regression analysis to determine regulatory and physical (i.e. demand and supply) factors influencing wind power development in 39 states in the USA between 1998 and 2003. They found, among other things, that states which required utilities to give customers the option of purchasing Green Power had, *ceteris paribus*, significantly greater development of wind power (Menz and Vachon, 2006). Another study which looked at revealed preferences was Menges et al. (2005) who conducted a willingness-to-pay survey with actual monetary rewards and sacrifices to 200 subjects in Germany. Their results demonstrated that impure altruism is likely to be present and demand for Green Power was likely to be downward sloping and non-linear (Menges et al., 2005). Wiser et al. (2000) found in the USA Green Power sales appeared to increase with more expensive premiums although there was a large variation in customer response to different Green Power programs. This suggested that programs differed markedly from each other in the quality of the products and in effectiveness of marketing. Another factor was the regulatory environment, with ease of switching electricity suppliers in a competitive market encouraging the growth of Green Power sales (Wiser et al., 2000). The effect of the introduction of retail contestability on Green Power sales in Australia is examined in the present study. Kotchen and Moore (2007) used revealed preferences in a probit model which estimated the effect of price on the probability of participating in a Green Power scheme but did not give an estimate of elasticity. A survey of utility program managers by Wiser et al. (2005) found that Green Power sales increased with increased age of a scheme and that higher renewable energy purchase thresholds for residential customers could increase renewable energy sales. They also found little evidence that Green Power price to the customer has much effect on Green Power sales. Of the above revealed preference studies, none found a statistically significant elasticity of demand for Green Power.

2.3. The Australian electricity market

The Australian electricity supply industry is diverse in its structure, with each of the six states and two territories having its own mix of government owned vertically integrated