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Environmental labeling of electricity: Effects on consumer uncertainty about product attributes and likelihood to buy decisions

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Abstract

Using data collected by the U.S. Department of Energy we test how price and environmental marketing and labeling affects respondents' uncertainty about product attributes and about their purchase intentions.

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Introduction

As the electricity production market become deregulated, effective regulation of the marketing of electricity may allow customers to make choices that clearly reflect their preferences and thereby achieve customer-preferred outcomes. Some of these outcomes include the encouragement of renewable resources or the reduction of air emissions. An open question, however, is whether informed customer choice will lead to cleaner generating sources. This is of particular concern to policy makers because sulfur dioxide (SO₂), nitrogen oxides (NO_x) and carbon dioxide (CO₂) are all key contributors to a number of air pollution problems (acid rain, fine particulates, ground-level ozone, and global climate change). In addition, electricity generation creates about two-thirds of all SO₂ emissions in the U.S., and about one-third of all NO_x and CO₂ emissions (USEPA 1995).

Environmental labeling and marketing may have two potential impacts on electricity consumers. On one hand, consumers may already have well-formed priors about the environmental characteristics of the electricity they purchase. On the other hand, consumers may be relatively uncertain about these characteristics. One would assume that presenting environmental information to these latter consumers would have a potentially large impact on their level of uncertainty regarding the product's environmental characteristics and thus, may have large impacts on these consumers' purchasing decisions. While labeling has been the focus of major policy initiatives, little empirical research has attempted to understand the effects of different environmental information policies; particularly with respect to changes in consumer uncertainty. Our research uses data collected by the U.S. Department of Energy to test how price and environmental marketing and labeling affects respondents' uncertainty about product attributes and about their purchase intentions.

Approach

With the intention of evaluating the usefulness of environmental labeling, the Regulatory Assistance Project and the Department of Energy conducted a mall-intercept survey during 1997. In the survey, respondents viewed different electricity labels and were asked to perform a series of experiments. These experiments were designed to measure the performance characteristics of different electricity-labeling programs.

One-thousand adult respondents were recruited from shopping malls located in eight cities in the U.S. Although mall-intercept studies are typically not statistically representative of the U.S. population, the mall locations chosen for this study do provide a sample that represents a wide variety of social and economic circumstances (Table 1). Nearly all respondents pay the household bills and, therefore, should be somewhat familiar with electricity pricing although they may still be unfamiliar with the environmental characteristics of electricity.

Table 1. Sample Demographics.

Variable	
<i>Education</i>	
High School or Less	42%
Some College or Technical Training	35%
College Degree or More	23%
<i>Annual Household Income</i>	
Less than \$20,000	26%
\$20,000 - 39,999	38%
\$40,000 - 64,999	23%
\$65,000 or More	13%
<i>Race</i>	
White, Not Hispanic	67%
Black, Not Hispanic	21%
Other/Multiple	12%
<i>Average Age</i>	37
<i>Percent Female</i>	51
<i>Percent Who are Primary Handlers of Household Bills</i>	88

We used data from one of the survey experiments to test how marketing materials, eco-seals and labeling affect respondents' uncertainty about product attributes and about their purchase intentions.¹ The experiment required respondents to first rate a single electricity product on price, environmental impact and purchase likelihood after reading marketing bullet points. Respondents were asked to indicate on a Likert scale how expensive they think the product is, how good the product is for the environment, and how likely they would be to buy the product. Respondents were asked to note their answers on a scale from 1 to 10 where the scale endpoints denoted either very inexpensive/very expensive; not very good for the environment/very good for the environment; or very likely to buy/very unlikely to buy. After rating the products, the respondents were then shown the product's accompanying label. After viewing the label, respondents were asked the same sequence of rating questions.

The bullet points were experimentally manipulated; participants either saw marketing bullets that emphasized the environmental benefits of the product or the product's low price; under some treatments they also saw an environmental seal of approval. Label conditions were also subject to experimental manipulation. There were four possible label treatments. Respondents either saw a 'Full Label', which includes information on price, fuel mix, and emissions; 'Full, No Price', includes fuel mix and emissions information; 'Fuel Mix ', only fuel mix information is disclosed; or 'Emissions', only emissions are disclosed. All treatments contain the same information about the contract terms.

A preliminary examination of the data revealed an interesting phenomenon; there are differences in the proportion of individuals across treatments responding 'Don't Know' to the different perception questions (Table 2). Contingency tables confirm that similar percentages of

people across treatments stated ‘Don’t Know’ to the first (before labels were revealed) price ($\chi^2_{(9)} = 7.56, p = 0.579$) and likelihood to buy questions ($\chi^2_{(9)} = 3.90, p = 0.918$). However, there is a relatively large variation in the percent of individuals who answered ‘Don’t Know’ to the first environmental perception question ($\chi^2_{(9)} = 192.20, p = 0.001$). In addition, similar percentages of people across treatments stated ‘Don’t Know’ to the second (after labels were revealed) environmental ($\chi^2_{(9)} = 13.80, p = 0.129$) and likelihood to buy questions ($\chi^2_{(9)} = 13.62, p = 0.136$). Although there is a relatively large variation in the percent of individuals who answered ‘Don’t Know’ to the second price perception question ($\chi^2_{(9)} = 52.83, p = 0.001$).

Differences in the percent of individuals that stated ‘Don’t Know’ across the first perception questions may indicate that individuals’ have different levels of uncertainty for different product attributes. For example, the similarity in the number of individuals stating ‘Don’t Know’ to the first price perception question across treatments may indicate that respondents already are relatively confident that they know the price of electricity; thus, differences in marketing has little impact on respondent uncertainty. However, the striking variation in the number of individuals stating ‘Don’t Know’ to the first environmental perception question across treatments may indicate that respondents are not confident that they know the environmental characteristics of electricity; here differences in marketing may have large impacts on respondent uncertainty. In addition, there are differences in the percent of individuals that state ‘Don’t Know’ within the same treatment group before and after viewing the label information (Table 3). This suggests that respondents’ uncertainty is affected by the label information. This prompts us to further analyze the relationship between information provision and consumer uncertainty.

¹ See Winneg et al. (1998) for a complete description of the study.

Table 2: Percent of Respondents Answering ‘Don’t Know’, by Treatment.

Marketing Treatment	Before seeing label			Label Condition ^a	After seeing label		
	Price	Environmental	Likelihood to buy		Price	Environmental	Likelihood to buy
1. Price	19	49	11	Full label	11	6	5
2. Environmental	20	7	10	Fuel mix	19	8	9
3. Environmental	18	5	7	Emissions	22	6	9
4. Environmental	12	4	6	Full label	2	2	2
5. Environmental	15	7	10	Full, no price	17	5	11
6. Price	21	46	12	Fuel mix	27	11	10
7. Price	13	42	10	Emissions	19	6	6
8. Price with eco-seal	18	16	8	Full label	4	3	4
9. Environmental with eco-seal	11	7	7	Full label	5	4	5
10. Price	15	43	10	Full, no price	20	2	4

a 'Full Label' includes information on price, fuel mix, and emissions; 'Full, No Price', includes fuel mix and emissions information; 'Fuel Mix ' includes only fuel mix information; 'Emissions ' includes only emissions information.

Table 3: Chi square Results: Test of whether the Percent of Respondents Answering ‘Don’t Know’ Changed After Viewing Label Information, by Treatment.

Marketing Treatment	Label Condition ^a	χ^2 - Test Statistics		
		Price	Environmental	Likelihood to buy
1. Price	Full label	2.48	45.39* ^a	2.43
2. Environmental	Fuel mix	0.03	0.07	0.06
3. Environmental	Emissions	0.50	0.09	0.27
4. Environmental	Full label	7.68*	0.69	2.08
5. Environmental	Full, no price	0.15	0.36	0.05
6. Price	Fuel mix	0.99	30.06*	0.20
7. Price	Emissions	1.34	35.64*	1.09
8. Price with eco-seal	Full label	10.04*	9.85*	1.42
9. Environmental with eco-seal	Full label	2.45	0.87	0.36
10. Price	Full, no price	0.87	48.20*	2.76*

a 'Full Label' includes information on price, fuel mix, and emissions; 'Full, No Price', includes fuel mix and emissions information; 'Fuel Mix ' includes only fuel mix information; 'Emissions ' includes only emissions information.

b Denotes the test statistic is not significant at the 10 percent level.

To determine the relationship between the number of ‘Don’t Knows’ and the different marketing and labeling treatments, we estimate the number of ‘Don’t Know’ responses to the full set of perception/intention questions as a function of marketing and labeling treatment variables.

Specifically we estimate:

$$DK_Price_i = \beta_{01}PM_i + \beta_{11}GM_i + \beta_{21}PM_Cert_i + \beta_{31}GM_Cert_i \\ + \beta_{41}PM_P_i + \beta_{51}GM_P_i + \beta_{61}PM_F_i + \beta_{71}GM_F_i + \beta_{81}PM_E_i + \beta_{91}GM_E_i + e_i$$

$$DK_Green_i = \beta_{02}PM_i + \beta_{12}GM_i + \beta_{22}PM_Cert_i + \beta_{32}GM_Cert_i \\ + \beta_{42}PM_P_i + \beta_{52}GM_P_i + \beta_{62}PM_F_i + \beta_{72}GM_F_i + \beta_{82}PM_E_i + \beta_{92}GM_E_i + e_i$$

$$DK_Buy_i = \beta_{03}PM_i + \beta_{13}GM_i + \beta_{23}PM_Cert_i + \beta_{33}GM_Cert_i \\ + \beta_{43}PM_P_i + \beta_{53}GM_P_i + \beta_{63}PM_F_i + \beta_{73}GM_F_i + \beta_{83}PM_E_i + \beta_{93}GM_E_i + e_i$$

where DK_Price_i , DK_Green_i and DK_Buy_i denote whether individual i responds ‘Don’t Know’ to the price, environmental and likelihood to buy questions, respectively; the dependent variables are coded as one if the respondent stated they don’t know, zero otherwise.² PM_i is equal to one for individuals who view price-focused marketing, 0 otherwise and GM_i is equal to one for individuals who view environment-focused marketing, 0 otherwise. PM_Cert_i is equal to one for individuals who view price-focused marketing with an eco-seal, 0 otherwise; GM_Cert_i is equal to one for individuals who view environment-focused marketing with an eco-seal, 0 otherwise. PM_P_i is equal to one for individuals who viewed price marketing followed by price labels, 0 otherwise; PM_F_i is equal to one for individuals who viewed price marketing followed by fuel mix labels, 0 otherwise; and PM_E_i is equal to one for individuals who viewed price marketing followed by emissions labels, 0 otherwise. GM_P_i is equal to one for individuals who viewed environmental marketing followed by price labels, 0 otherwise; GM_F_i is equal to one for individuals who viewed environmental marketing followed by fuel mix labels, 0 otherwise; and

² Note that for this analysis we are combining responses to both the first and second questions.

GM_{E_i} is equal to one for individuals who viewed environmental marketing followed by emissions labels, 0 otherwise. The models are estimated as binary logits because the dependent variable is binary (0, 1).

Chi-square tests were performed to test the pair-wise and joint equivalence of parameter estimates. Specifically we are interested if the effect of price marketing alone is different than environmental marketing alone ($\beta_{0j} = \beta_{1j}$) and whether the joint impact of price marketing with an environmental seal is equivalent to environmental marketing alone ($\beta_{0j} + \beta_{2j} = \beta_{1j}$). We are also interested if the effect of adding price ($\beta_{4j} = \beta_{5j}$), fuel mix ($\beta_{6j} = \beta_{7j}$) or emissions ($\beta_{8j} = \beta_{9j}$) labeling is dependent upon whether it follows price or environmental marketing. In addition, we are interested in whether fuel mix or emissions labeling provides a greater impact given that it follows price ($\beta_{6j} = \beta_{8j}$) or environmental ($\beta_{7j} = \beta_{9j}$) marketing. Finally, we would like to know if the joint effect of price marketing with environmental information (environmental seal, fuel mix and emissions labeling) is different than environmental marketing alone ($\beta_{0j} + \beta_{3j} + \beta_{6j} + \beta_{8j} = \beta_{1j}$).

Results

The results indicate that different marketing information has different effects across questions (Table 4). There is no difference between price and environmental marketing in terms of affecting the probability that an individual is uncertain about the price of an electricity product ($\chi^2_{(1)} = 0.41, p = 0.5230$). In addition, adding an eco-seal does not affect price perceptions; the joint effect of price marketing with an eco-seal is no different than that of environmental marketing alone ($\chi^2_{(1)} = 0.04, p = 0.8472$). There are differences between price and environmental marketing in terms of affecting the probability that an individual is uncertain about the environmental quality of electricity. Individuals viewing environmental marketing

information are much less likely to state that they 'Don't Know' about the environmental quality of electricity ($\chi^2_{(1)} = 99.94, p = 0.0001$). Adding an eco-seal to price marketing information does decrease the likelihood that an individual states that they 'Don't Know' about the environmental quality of electricity. However, the joint effect of price marketing with an eco-seal is still less than that of environmental marketing alone ($\chi^2_{(1)} = 13.61, p = 0.0002$). Finally, with respect to the intention to buy question, there is no difference between price and environmental marketing in terms of affecting the probability that an individual is uncertain about their decision ($\chi^2_{(1)} = 0.66, p = 0.4171$). In addition, adding an eco-seal does not affect whether the person is uncertain about their purchase intentions; the joint effect of price marketing with an eco-seal is no different than that of environmental marketing alone ($\chi^2_{(1)} = 0.01, p = 0.9125$).

The results indicate that different labeling information has different effects across questions and that marketing can influence the effect of labeling (Table 4). Not surprisingly, price labels significantly reduce the likelihood that an individual is uncertain about the product's price and the effects are equivalent across marketing treatments ($\chi^2_{(1)} = 0.118, p = 0.7308$). Except for fuel mix labeling following price marketing, environmental labels do not affect an individual's price uncertainty. Fuel mix labeling following low-price marketing actually increases an individual's price uncertainty.

Individuals viewing fuel mix and emissions labels after low-price marketing are much less likely to state that they 'Don't Know' about the environmental quality of electricity; interestingly, the effect of emissions and fuel mix labels are similar ($\chi^2_{(1)} = 1.15, p = 0.2189$). Environmental labels provide no significant effect when viewed after environmental marketing materials. The joint effect of environmental information (eco-seal, fuel mix and emissions

information) and price marketing on reducing environmental uncertainty is greater than that of having environmental marketing alone ($\chi^2_{(1)} = 14.84, p = 0.0001$).

Finally, with respect to the intention to buy question, there are differences between price and environmental labeling in terms of affecting the probability that an individual is uncertain about their decision. Adding a price label to environmental marketing information significantly reduces the likelihood that an individual is uncertain about their intention to purchase decision. Providing environmental labels have no effect on the intent to purchase.

Table 4: Parameter Estimates: Probability that Respondent States 'Don't Know'

	Price Perception	Green Perception	Likelihood to Buy
PM	-1.519* ^a (0.139)	-0.579* (0.092)	-2.276* (0.150)
GM	-1.629* (0.128)	-2.778* (0.200)	-2.463* (0.173)
PM_Cert	-0.163 (0.263)	-1.006* (0.267)	-0.145 (0.345)
GM_Cert	-0.252 (0.299)	0.301 (0.382)	0.093 (0.357)
PM_P	-1.546* (0.473)	1.549* (0.644)	-0.347 (0.683)
GM_P	-1.773* (0.463)	-0.874 (0.595)	-1.240* (0.514)
PM_F	0.525* (0.252)	-1.511* (0.333)	0.079 (0.366)
GM_F	-0.005 (0.230)	0.192 (0.361)	0.175 (0.301)
PM_E	0.082 (0.279)	-2.161* (0.431)	-0.464 (0.447)
GM_E	-0.209 (0.226)	-0.165 (0.379)	-0.175 (0.301)

a * means the parameter is significant at 10% level.

Conclusions

Policy makers (and some producers) hope that environmental marketing and labeling restrictions imposed on a deregulated electricity production market will educate consumers about the environmental impacts of electricity use, thereby leading to a changes in purchasing

behavior, and ultimately, to a reduction in negative impacts. We find that many consumers are uncertain about the environmental characteristics of electricity. We also find that environmental labeling and marketing can have a profound impact on reducing consumers' uncertainty regarding these characteristics. One would assume that presenting environmental information to these latter consumers would have a potentially large impact on their purchasing decisions. Unfortunately the data preclude testing this effect.

References

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