Explaining Demand for Green Electricity Using Data from All U.S. Utilities

Marc N. Conte
Fordham University
mconte7@fordham.edu

Grant D. Jacobsen*
University of Oregon
gdjaco@uoregon.edu

September 2016

Published: Energy Economics, 60 (2016) 122-130.

Abstract

Green electricity programs enable households to voluntarily contribute to the development of renewable electricity by purchasing green electricity through their local utility. Using a dataset of all utilities in the United States, this paper explores the utility, consumer, and program characteristics that influence participation levels in green electricity, as well as whether a utility chooses to offer a program. Among other results, we find that the key determinants of program participation are the education of the consumer base and the affordability of the green electricity program. Our results enhance understanding of private provision of environmental public goods and could aid in ex ante evaluations of whether a green electricity program is likely to cover its administrative costs or be a cost-effective way of improving environmental quality.

JEL Codes: H41, Q42, Q50

Key Words: green demand, green electricity programs, private provision of environmental public goods, renewable energy

* Corresponding author. *Post:* 1209 University of Oregon; 119 Hendricks Hall, Eugene, OR, 97330; *Tel:* (541) 346-3419; *Fax:* (541) 346-2040. We are thankful for helpful comments received at the European Association of Environmental and Resource Economists Annual Conference.

1. Introduction

Green electricity programs enable consumers with pro-environment preferences to voluntarily take action that benefits the environment. In particular, these programs provide utility customers with an opportunity to voluntarily contribute toward the development of cleaner sources of electricity. Customers that enroll in programs agree to pay an additional amount on their monthly utility bill, either by paying a price premium for the electricity they consume, or by contributing a fixed dollar amount related to a set amount of kWhs of green electricity. This financial support provides the basis for enhanced development of renewable electricity.[1]

While green electricity programs comprise a small share (less than 1 percent) of total electricity sold in the U.S., they comprise a more substantial share of renewable electricity. O'Shaughnessy et al. (2015) report that, as of 2014, the voluntary green power market comprises about 26 percent of non-hydro renewable generation.[2,3] In the presence of learning-by-doing and economies of scale, the additional demand created by green electricity programs can play a non-trivial role in the development of renewable technologies and can potentially contribute toward cost reductions and the broader use of renewable electricity. Due to the social benefits associated with renewable energy, voluntary green electricity programs have been supported by state-level policies that have

[1] Green electricity programs are typically certified by a third party, and certification requires that the green electricity eligible for sale by a utility is equivalent to the electricity produced by their renewable generation facilities plus the amount of renewable energy credits (RECs) they have purchased. Renewable energy from generation that came online before 1998 or that is being used as the basis for compliance with mandatory regulations typically cannot be used to support a green electricity program.

[2] U.S. production of hydroelectricity has not grown in recent years due to environmental concerns and the unavailability of proper sites for large-scale hydropower generation.

[3] Utility green pricing programs represent about 10% of the voluntary market. Other segments of the green market include competitive suppliers, unbundled RECs, community solar, community choice aggregation, and voluntary power purchase agreements (O'Shaugnessy et al., 2015).

provided subsidies for the development of green electricity programs (Jacobsen et al. 2013, Glatt 2010) and the EPA's Green Power Partnership (GPP), which seeks to expand the market for green electricity through partnerships and voluntary arrangements with leading organizations.

While policymakers and utility managers appear to be interested in the proliferation of green electricity programs, it is not clear what factors lead to the availability of green electricity programs or predict their performance.[4] The existing literature on green electricity programs, which we review below, has produced mixed evidence and primarily consists of utility-specific case studies or survey evidence on stated willingness-to-pay (WTP) for green electricity. Understanding the determinants of program performance can help policymakers, who might subsidize such programs, and utility managers, who might implement a green electricity program, with their initial evaluations of whether participation levels will be substantial enough to justify the up-front costs of program development and operation. Similarly, improved understanding of the factors that predict whether a utility offers a green electricity program can assist policymakers and government officials in designing programs and policies that aim to increase the availability of these programs.

In this paper, we provide the first comprehensive evaluation of residential green electricity programs using data from the entire set of electric utilities in the United States. We combine data from the Department of Energy's (DOE) Energy Information

[4] Utilities are likely to be interested in green electricity programs because they believe offering a program will increase customer satisfaction or because they are required to by statute (e.g. Washington state). While green electricity is usually sold at a premium and provides an additional source of revenue (according to the 2010 Annual Electric Power Industry Report, the mean amount of revenue collected annually from a green electricity program among utilities with programs in place was $677,000), the extra revenue is typically offset completely by program costs, such as the procurement of RECs (O'Shaugnessy et al, 2015).

Administration (EIA) on electric utilities, data from the U.S. Census on household demographics, and data from the DOE's Office of Energy Efficiency and Renewable Energy (EERE) on green electricity programs. The analysis employs cross-sectional regression models of utility-level data and includes state effects such that our estimates are based on within-state variation in green electricity programs and our set of explanatory variables.

To preview our primary findings with respect to program participation, we find that enrollment rates in green electricity programs are increasing in education; that green electricity purchases per participant are increasing in income and liberalism and decreasing in the price premium for green electricity; and that the primary determinants of green electricity purchases per customer, which we consider to be the best overall measure of program performance, are the education of the customer base and the price premium for green electricity. In contrast with earlier studies based on case-studies, we do not document a relationship between consumption levels and participation in green electricity programs, as might be predicted if participation rates were driven by guilt from the emissions associated with electricity consumption. In sum, our main findings are that green electricity programs experience higher levels of participation in areas with educated consumer populations and when the programs are affordable, either due to elevated incomes or lower costs of participation. With respect to program offering, we find that the probability of a program being offered is increasing in the education, income, and average electricity consumption of the customer base. The overlap of these findings with the findings related to program participation suggests that utilities are at least partially able to infer the conditions under which green electricity programs are most likely to succeed.

Before proceeding, it is worth noting that the cross-sectional nature of our empirical setting does not provide an ideal setup for identifying precise causal relationships. While the analysis includes a large number of covariates and is based on within-state variation, we are not able to conclusively rule out the possibility of omitted variable bias due to the large number of factors that can influence participation in green electricity programs. Nonetheless, our results are suggestive of certain relationships, and, as we describe in the conclusion, they should be helpful in predicting where green electricity programs will succeed. This will be especially true if decision-makers are limited to the type of publicly-available data that we use as the basis of our study, which is likely to be the case absent private, and often expensive, data-collection efforts.

2. Contribution to the Literature

Our paper adds primarily to the literature on demand for green products, which is closely tied to the literature on private provision of environmental public goods. In addition to green electricity, examples of green products include energy-efficient residences, appliances, or cars; carbon offsets; organic food; and recycled products.[5] Studies of the voluntary purchase of these goods have typically fallen into one of four categories: revealed-preference studies of consumer characteristics that are associated with demand for green goods (e.g., Costa and Kahn 2013, Kahn 2007); theoretical models of the private provision of environmental public goods (e.g., Jacobsen et al. 2013, Kotchen 2009, Kotchen 2006); stated-preference studies exploring the willingness-to-pay for

[5] Many of these products provide both private and public value and can be considered examples of "impure" public goods (Kotchen, 2006).

environmental public goods (e.g., Zarnikau 2003, Roe et al. 2001); and evaluations of policies and programs aimed at increasing provision of these goods (e.g., Cohen and Vandenbergh 2012, Jacobsen 2011, Suter et al. 2008, Rose et al. 2002).

We contribute to this literature by providing perhaps the most generalizable revealed-preference study of demand for green products due to the comprehensive nature of our dataset. Additionally, our study is based in a setting that involves both a participation and a contribution decision, which allows us to investigate both the extensive and intensive margins of pro-environmental consumer behavior.[6,7] Theoretical models of the private provision of a public good (Bergstrom 1986) and empirical studies of charitable contributions (DellaVigna 2012, Landry et al. 2006, Smith 1995) suggest that the manner in which households make decisions is likely to differ depending on whether the decision is on the intensive or extensive margin. For example, Smith (1995) finds that while income has an impact on giving conditional on the decision to contribute, other factors, including age and altruism, determine whether an individual will engage in the private provision of a public good. Despite these findings, there is only a limited literature in this area related to green goods.[8]

In combination with other research, our findings suggest that education is an important determinant of demand for green products, regardless of whether the green

[6] Customers in programs that require participants to purchase green electricity for their entire monthly consumption do not make a contribution decision, but these types of programs are much less common than programs that allow participants to choose the amount of green electricity they purchase or choose the share of their monthly consumption that is covered by green electricity.

[7] Many types of pro-environmental behaviors involve consumer decisions on both the extensive and intensive margins. For example, individuals making decisions about whether or not to retrofit their home for energy efficiency or enroll in their local recycling program are making decisions on the extensive margin. The extent to which they invest in the retrofit or the amount of waste they recycle is a decision on the intensive margin.

[8] Jacobsen et al. (2012) provides evidence that determinants of participation in green electricity programs differ on the intensive and extensive margins, but the analysis is limited to a single Tennessee utility company.

product creates primarily public benefits or a mixture of public and private benefits and regardless of the extent to which the purchase can be displayed to others. The key finding from our study is that education has a strong relationship to demand for green electricity, a green good whose purchase is hard to display to others and that primarily creates public benefits. Kahn (2007) presents evidence that education is also positively related to adoption of hybrid Prius vehicles, a good which creates a combination of public and private benefits and a good that is highly visible to others once purchased. Finally, Loureiro and Lotade (2005) and Brécard et al. (2009), show that education is positively linked to demand for environmentally-friendly produce, which has substantial perceived private benefits in addition to public benefits. While not precisely a green good, there is also evidence that education is positively related to pro-environmental voting (Kahn, 2007).[9]

Our study also contributes to the narrower literature focused specifically on demand for green electricity. A portion of papers in this literature have used stated-preference surveys to evaluate willingness-to-pay (WTP) for green electricity. Roe et al. (2001) explore how education and environmental preferences impact an individual's WTP for renewable energy, finding that individuals with pro-environment preferences and higher attained levels of education have higher stated WTP for renewable energy. Zarnikau (2003) shows that stated WTP for renewable energy increases with an individual's salary and if the individual is white. Wiser (2007) finds that individuals who perceive themselves as politically liberal are more likely to be willing to pay for green energy, ceteris paribus.

[9] See Kahn (2002) and Jacobsen (2013) for additional studies of how economic and demographic factors influence the stringency of environmental regulations.

Gerpott and Mahmudova (2010) find that an individual's age and monthly electricity bill are negatively associated with WTP for green electricity.

Other papers have examined how various factors are associated with actual participation in green electricity programs. These revealed-preference papers are more closely related to the present study, with the exception being that the majority of the studies have been conducted in the context of a single green energy program using household-level data. Some studies have focused on the role of demographics or ideology (e.g., Clark et al. 2003, Kotchen and Moore 2007), while others have focused on the role of electricity consumption (e.g., Jacobsen et al. 2012, Kotchen and Moore 2008). The latter studies have generally been tied into theoretical discussion of "behavioral responses" and "moral licensing", which, in the context of green electricity, suggests that households that enroll in green electricity programs may increase their consumption of electricity after enrollment because it reduces the guilt associated with consumption.

As is evident from Table 1, which summarizes the findings from revealed preference studies of green electricity participation, the existing literature has not yet identified a set of factors that consistently predicts participation in green electricity programs.[10] The variation in specifications and settings used across studies complicates efforts to generalize results, and there is conflicting evidence on how most of the key demographic characteristics influence participation.

To our knowledge, few studies have used utility-level data to draw insights about green electricity programs. Mewton and Cacho (2011) examines green electricity programs

[10] We include Harding and Rapson (2013) in Table 1 even though they investigate a utility-administered carbon offset program because green electricity programs and voluntary carbon offsets have very similar features. See Conte and Kotchen (2010) for further discussion of the voluntary carbon offset market.

in Australia and finds that the sale of green electricity decreases as the price premium increases and also finds evidence that increasing competitiveness of the electricity market tends to increase these sales. Wiser et al. (2004) uses information on program characteristics to explore different determinants of program performance, including enrollment rates and green electricity sales, in 59 programs in the U.S and finds that program age has a positive impact on program participation and sales. While these studies are helpful for improving understanding of program performance, they are limited because they do not use data on consumer characteristics, investigate a relatively small sample of green electricity programs, and do not evaluate either program offering or green electricity sales per customer.

3. Data

The data source of greatest interest is the 2010 Annual Electric Power Industry Report, which is produced by the Energy Information Administration (EIA) and records utility-level information on a number of factors related to electricity sales and distribution for utilities in the United States.[11] Most importantly, the data include information on the number of residential customers enrolled in a green electricity program and the aggregate residential purchases of green electricity (measured in kWhs). Additionally, the data include information on the aggregate number of residential customers, aggregate residential consumption, and aggregate residential expenditures, and we use these

[11] We drop utilities that do not offer bundled services of energy and delivery or that report zero residential sales. We drop utilities that operate in multiple states (mostly cooperatives) because of difficulties related to controlling for state effects. We drop utilities from Alaska, Hawaii, or the District of Columbia because power markets in these regions differ substantially from the rest of the county.

variables to calculate average residential consumption and average residential price. The data also contain information related to the ownership of the utility (e.g., investor-owned (IOUs), government-owned, cooperative). Lastly, the data include information on the counties that are served by a utility, and we use this variable to link the utility to other sources of data that are available at the county level. In addition to the data from the Power Industry Report, we also obtained data from the EIA that reports whether the state in which a utility operates is regulated.[12]

We use the variables described above to generate several variables of interest. *Green Electricity Program* is a binary variable indicating the presence of a green electricity program and equals 1 if the utility has a positive number of green customers. *Enrollment Rate* is the number of customers in the green electricity program divided by the total number of customers and then multiplied by 100. *Green Electricity Purchases per Participant* and *Green Electricity Purchases per Customer* are two measures of program performance measured in kWhs per person and differ only in their denominator (participants versus the entire customer base).

To supplement the EIA data, we acquired more detailed data on the features of specific green electricity programs. These data are collected from the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL) based on a questionnaire distributed to managers of known green electricity programs. The data include information on the price premium associated with the program and when the program began. While this dataset does not cover all green electricity programs, due to survey non-response or because the program was unknown to NREL, we were able to link 63 percent of the utilities

[12] These data are available at http://www.eia.gov/cneaf/electricity/page/restructuring/restructure_elect.html.

that report a non-zero number of green electricity customers in the EIA data to the green-electricity program data collected by NREL.[13]

In addition to this utility-level data, we obtained information on the communities served by the utilities using a number of county-level datasets. Demographic data were obtained from Census datasets from 2010.[14] Data on results from the 2008 U.S. Presidential Election were obtained from the U.S. Election Atlas and include information on the proportion of votes cast for Obama, McCain, or another candidate.[15] We use these variables to construct *Democratic Vote Share*, which reports the number of votes cast for Obama divided by the total number cast for McCain or Obama. Data on whether a county is classified as a metropolitan or non-metropolitan county were obtained from the NCHS Urban-Rural Classification Scheme.[16]

For a utility, the value for each of the variables collected through the county-level datasets corresponds to the average value across all counties in which the utility operates. While this aggregation leads to some measurement error because utilities may only serve a part of a county, it also enables an examination of a broad array of factors that are not collected at the utility-level. Nonetheless, the coefficients on our estimates for variables collected at the county-level will likely be subject to a degree of attenuation bias and results should be interpreted in some cases as lower bound estimates.

[13] We also obtained information about the mix of energy sources associated with each green electricity program from the NREL data. The overwhelming prevalence of wind power as a principal energy source across green electricity programs, however, limited the statistical power of this variable, and it is not included in our present analysis.

[14] These data are available at http://quickfacts.census.gov.

[15] These data are available at http://uselectionatlas.org.

[16] These data are available at http://www.cdc.gov/nchs/data_access/urban_rural.htm.

Summary statistics are displayed in Table 2. The combined dataset includes information on 2,700 utilities that operate in a single state. Variables related to participation in green electricity programs are available for the 581 utilities we identify as having programs in place, although information on the green electricity price premium and program age is only available for about two-thirds of this subsample because it was obtained from the NREL questionnaire-based data. Regarding the variables related to green electricity, 22 percent of the utilities in the sample offer their customers green electricity programs, the average enrollment rate across programs is 1.29%, program enrollees purchase an annual average of about 4,230 kWhs of green electricity (roughly equivalent to 1/3 of annual consumption), the annual average purchase of green electricity per utility customer (including both program participants and non-participants) is approximately 59 kWhs, the average green electricity price premium is 2 cents per kWh, and the average program is 9 years old.[17] In terms of characteristics of the customer base, the average median household income across utilities is $45,450, the average share of the population that has graduated from college is 20%, the average Democratic vote share is 42%, the average share of the population that is over age 65 is 16%, and the average share of the population that is white is 85%.[18] Regarding utility characteristics, the average utility serves approximately 35,000 residential customers, the average annual consumption is 12.1 MWhs, the average price of conventional electricity is 10.5 cents per kilowatt-hour, four percent of utilities are IOUs, 26 percent are cooperatives, and 70 percent are

[17] There is a substantial range in the values across many of our variables. As we show later in the paper, our primary results are robust to the exclusion of outliers.

[18] Summary statistics deviate from national averages because our unit of observation is a utility and there is substantial variation in the number of customers served by utilities across the United States.

municipalities or have other forms of government ownership.[19] The typical utility sells about 400 MWhs of electricity to residential customers per year.[20]

4. Econometric specification

Our empirical analysis is based on a series of cross-sectional regressions. We begin with a series of models exploring green electricity program participation, as measured by program enrollment rate, green electricity purchases per participant, and green electricity purchases per customer. For each of the variables used to measure program performance, the estimates are based on a regression model of the follow form,

$$Outcome_i = \boldsymbol{X}_{\boldsymbol{i}}^{'}\alpha + \boldsymbol{Z}_{\boldsymbol{i}}^{'}\beta + \boldsymbol{State}_{\boldsymbol{i}}^{'}\gamma + \varepsilon_i. \quad (1)$$

where $\boldsymbol{X}_i$ is a vector of utility characteristics, including the number of customers, average consumption, average price,[21] dummy variables for whether the utility is an investor-owned utility or a cooperative (the omitted group primarily consists of municipality utilities), the portion of a utility's service area that is classified as urban, and the total amount of electricity sold to their residential customers.[22] $\boldsymbol{Z}_i$ is a vector of consumer characteristics measured at the county level, including median income, college graduation

[19] Of the government-owned utilities, 95% are municipalities.

[20] The large range in values for certain variables reflects observations that could arguably be classified as outliers and the ranges shrink substantially after dropping the top 1% of observations for all non-binary variables. For example, the range in enrollment rates is approximately 0% to 10% and the range in green electricity purchases per participant is 62 kWhs to 17 MWhs. As we discuss in Section 5, our results are robust to excluding these outliers from the sample.

[21] Average price will be different than marginal price due to the block-rate pricing schemes employed by most utilities, but utility customers are primarily responsive to average price (Ito, 2013).

[22] Total residential sales, which is effectively an interaction of number of customers and average consumption, is included only in the models that examine program offering. The rationale for this is that larger utilities, with more resources, may be able to more easily cover the upfront costs of developing a green electricity program. In contrast, there does not seem to be a clear theoretical avenue by which the total amount residential electricity sold by a utility should affect program participation (especially after controlling for the number of customers and average consumption). The inclusion of total residential sales exclusively in the program offering equation also allows us to estimate models of participation that correct for sample selection. We discuss this further in Section 5.

rate, democratic vote share, the share of the population that is elderly, and the share of the population that is white. $\boldsymbol{State_i}$ is a vector of dummy variables corresponding to each state. For the subset of utilities for which detailed program information was obtained from the NREL surveys, we also estimate models that include a vector of program characteristics, including price of green electricity and program age.

Following the participation models, we also estimate a linear probability model of program offering. These estimates are also based on equation (1), but they are estimated using the full sample of all utilities as opposed to the limited sample of utilities with green electricity programs. The results related to program offering are robust to both logistic and probit regression models.

A key feature of all regression models is the inclusion of state effects, which are used to control for unobserved characteristics that are experienced uniformly by all utilities within a state. For example, state effects control for any variation in green electricity programs driven by state policies, such as Renewable Portfolio Standards, which require that utilities operating within a state purchase a certain amount of their energy from renewable sources (either directly or via RECS).[23] Renewable Portfolio Standards might encourage green electricity programs if significant economies of scale exist in renewable energy production, or discourage green electricity programs if consumers are less likely to voluntarily take action if there is evidence that the government is taking action to move toward renewable energy. Regardless of the direction of the effect, the inclusion of the state effects ensures relationships between various state policies and green electricity programs will not bias our estimates.

[23] See Lyon and Yin (2010) for an empirical examination of the determinants of state RPS adoption.

For all outcomes, we estimate models both from the full sample that includes utilities in regulated and unregulated states, as well as for the restricted sample of regulated utilities. In regulated electricity markets, consumers do not have the ability to choose their electricity provider. For this reason, the county-level datasets on customer demographics that we merge with the utility data may be most representative of a utility's customer base for utilities in regulated markets. Additionally, relationships may be dampened in deregulated markets because consumers can simply choose a green electricity retailer that is not tied to the consumer's county of residence, rather than enroll in the green electricity program of a conventional utility.

5. Results

We present our results related to program participations in Tables 3, 4, and 5. Each table reports results for the full sample of all 581 utilities offering green electricity programs, as well as the limited sample of 523 utilities operating in regulated markets. For each sample, we also report a model that does not include program variables and one that does. Including the program variables reduces the sample to 354 regulated utilities and 366 total utilities. Following presentation of the results related to participation, we present results in Table 6 related to program offering, which are based on the broader sample of 2,700 utilities, including those that do not offer green electricity programs. We discuss these findings within the context of the participation-related results. Tables 7 and 8 present our final results, which examine the robustness of our findings.

Table 3 presents estimates from models in which the dependent variable is enrollment rate in a green electricity program. The results indicate that the primary factor associated with enrollment is the education level in the service region. A 10 percentage point increase in the number of customers that have college degrees is associated with a statistically significant 0.7-0.8 percentage point increase in participation rates in green electricity programs across all samples, or more than a 50% increase relative to the mean participation level of 1.29 percent. There is also some evidence that enrollment rate is lower when a utility has more customers. The most likely explanation for this finding is that utilities are willing to form green electricity programs that they anticipate will have low enrollment rates if there is a larger pool of customers to draw from (we discuss evidence consistent with this interpretation in the context of our results related to program formation).

Table 4 presents results in which the dependent variable is the kWhs of green electricity purchases per participant. Income and liberalism, as measured by Democratic vote share, are positively related to green electricity purchases per participant. The coefficient on income—a factor for which conflicting findings of positive and negative relationships have been documented in multiple previous case-studies (see Table 1)—is positive across all models and indicates that a 10% increase in median household income is associated with an increase in the average annual green electricity purchases per participant of about 290 to 450 kWhs. Similarly, a 10 percentage point increase in Democratic vote share is associated with an approximate 500 kWh increase in the average annual green electricity purchases per participant (based on the more detailed models that include program characteristics). The relationship between Democratic vote share and green electricity purchases provides further evidence that liberals are more environmentally conscientious with their electricity bill, as previous research has also documented that liberal households tend to have lower consumption levels of conventional electricity (Costa and Kahn, 2013). The negative and significant coefficient on green price premium, which reflects the net cost of purchasing each kWh of green electricity, indicates that green electricity is an ordinary good. Each cent/kWh increase in the price is associated with an approximate 900 kWh decline in the average purchases of green electricity per participant.

Table 5 presents results on the purchases of green electricity per customer, as opposed to per participant. The quantity of green electricity purchases per customer can be considered an overall measure of program performance, as it captures the combined impact of participation on the intensive and extensive margins. As with enrollment rates, education is one of the primary factors that is associated with green electricity purchases per customer. A 10 percentage point increase in the share of college graduates is associated with an additional purchase of 37 to 40 kWhs of green electricity for every household in a utility's customer base. The coefficient on price premium for green electricity is negative and significant at the 10% level, indicating that each additional cent in the green price premium is associated with a 26 to 31 kWh decline in green electricity purchases per customer.

The main conclusions from Tables 3, 4, and 5 are that green electricity programs are likely to experience higher participation rates when they are offered in areas with educated consumers and when they are affordable, either due to elevated incomes or less expensive green electricity. The importance of affordability is underscored by the high price elasticity of demand for green electricity, which we estimate at -2.68, as indicated by the coefficient on the green price premium in Table 4.[24] This elasticity is slightly greater in magnitude than estimates of price elasticities for conventional electricity, which have fallen between -2.25 and -0.04 (Espey and Espey, 2004).

While our main findings related to program performance are the importance of education and affordability, it is also worth emphasizing that across models and specifications we do *not* document a relationship between average consumption levels and any of the participation measures. Previous case studies have found mixed evidence of the relationship between consumption and participation, with some studies documenting a positive relationship, and others a negative one (see Table 1). A positive relationship is consistent with the notion that participation is driven by guilt from the emissions associated with household energy consumption. The lack of evidence of a positive relationship may be re-assuring from an environmental perspective because guilt-based motivations for enrollment can lead to "moral licensing" whereby households increase consumption following enrollment (Jacobsen et al. 2012).

We next turn to an examination of program offering, as opposed to program participation, and we report these results in Table 6. Among the demographic variables, the likelihood of program offering increases with income and education. A 10 percent increase in income is associated with a 1.4 percentage point increase in the probability of a program being offered and a 10 percentage point increase in education is associated with about a 5 percentage point increase in the probability of program offering. Both income and

[24] The estimated price elasticity of demand for green electricity is obtained using average values for green electricity price (12.69 cents/kWh, taken as the sum of the means reported in rows five and 15 of Table 2) and purchases of green electricity per program participant (4,232.90 kWhs/person reported in row three of Table 2) across all green electricity programs, along with the coefficient on the green price premium reported in column four of Table 4 (-892.63).

education are positively associated with program participation rates, which indicates that utilities are at least partially able to infer the level of demand for green power that exists within their customer bases. Elevated consumption levels are also positively associated with program offering. While certain case studies have found this to be a positive predictor of program performance, we find no evidence that this relationship holds on average, suggesting that utilities are perhaps erroneously targeting green programs at these areas. Utility ownership also affects the likelihood of green power program offering. IOUs and cooperatives are both about 24 percentage points more likely to offer a green electricity program than a government-owned utility, respectively. The results suggest, at least in our context, that government organizations are slower to adopt innovative green programs than private organizations. There is also some evidence that green electricity programs are more likely to be offered in urban areas.

We present additional robustness checks across outcomes in Table 7 using different subsamples of the data. First, we investigate whether our results are robust to outliers by analyzing a subsample of 2,323 observations (or about 85% of the original observations) in which we drop any observation that has a value falling in the top or bottom 1% of the distribution of our non-binary dependent or independent variables. Second, we drop utilities whose service area spans more than 10 counties because the observations for these utilities are likely to be subject to the greatest measurement error. There are 124 utilities (4.6 percent of the sample) that span more than 10 counties. For both subsamples, there are some deviations in coefficient magnitudes and statistical significance, but the results in each set of estimates are qualitatively similar to those we present in Tables 3 through 6.

As a final robustness check, we examine models that correct for the selection of utilities that have chosen to implement a green electricity program, which could lead to biased coefficient estimates if the factors that are associated with program offering are also associated with program participation. We estimate models that correct for selection using a two-step procedure following Heckman (1979) for all measures of program participation. As with the program offering model presented above, the selection equation includes total residential sales, but this variable is excluded from the second stage models.[25,26] The results of these models are reported in Table 8 and are consistent with our main results.[27] Education remains positively associated with participation both on the intensive margin and overall and income remains positively associated with participation on the extensive margin. There is also some evidence that participations levels are higher in programs formed by IOUs and in urban areas.

6. Discussion and Conclusion

Green electricity programs offer an avenue for consumers with pro-environmental preferences to take action to support renewable energy development. While green electricity programs may be limited in the extent to which they directly contribute to a shift in U.S. generation patterns due to their voluntary nature, they can play a role in the early

[25] See footnote 22 for an explanation of why total residential sales is included in the first stage, but not the second stage.

[26] Total electricity sales is not quite significant in our primary estimates focusing on program offering, in part because we compute standard errors by clustering at the state level, which is a conservative approach. When we compute standard errors following Heckman (1979), total electricity sales is significant in the first-stage. It is also significant, even with clustered standard errors, when we exclude observations that are arguably outliers (see column 8 of Table 7). For these reasons, it is likely to be an appropriate explanatory variable for our selection equation.

[27] All models are based on the full sample of utilities. Results do not differ meaningfully if the sample is limited to regulated utilities.

stages of technological development when small changes in demand (relative to overall consumption) may lead to decreases in the cost of renewable generation due to learning-by-doing or economies of scale. The incomplete adoption (22%) of green electricity programs across utilities provides an opportunity for continued growth in green electricity programs. This paper presents evidence on the factors associated with participation levels in green electricity programs and, in doing so, may provide information that will inform the successful expansion of green electricity programs in the future.

To review our main results, we find that enrollment rates are increasing in educational attainment, while the contribution amount conditional on program enrollment is increasing in income and liberalism and decreasing in the price of green power. Overall program performance, as measured by green electricity purchases per customer, is increasing in education and decreasing in the price premium for green electricity. We find no evidence that elevated consumption levels are associated with better program performance, which suggests that communities with larger average environmental footprints are no more likely to support green electricity programs.

The results we document should be of interest of policymakers or utility managers that are interested in the expansion of green electricity programs. The general implications from our study are that green electricity programs are most likely to succeed in regions where the consumer base tends to be educated and when the environmental program is affordable. Our results related to overall program performance (green electricity sales per customer) can assist in initial evaluations of whether participation in a green electricity program is likely to be substantial enough to cover the costs of program development and operation. Additionally, in combination with other research, our results have implications for how green electricity programs should be marketed. In particular, if marketing is primarily effective on the intensive margin, as suggested by Wiser et al. (2004), then our findings suggest that mailings should be targeted at neighborhoods with highly educated households that are likely to have the highest participation rates. More targeted marketing that led to a reduction in marketing expenditures could have a non-trivial impact on overall program costs, as marketing represents 18.8% of program revenues (Friedman and Miller, 2009). Passing these savings on in the form of reduced price premiums might further bolster participation rates in green electricity programs, as our results suggest prices are an important determinant of program participation.[28]

We also examine the factors that are associated with program formation, and we find that utilities tend to offer green electricity programs to educated and wealthy customer bases with high average electricity consumption. Given the overlap of these findings with the findings related to program participation, it appears that utilities are at least partially able to anticipate the conditions under which green electricity program succeed (and hopefully this study will further increase their level of awareness). These results regarding program offering may be helpful to public agencies, such as the EPA, that wish to expand the adoption of green electricity programs because they can help identify the types of utilities that are more likely to agree to implement a program.

While our study evaluates the factors that are associated with participation levels in green electricity programs once they are formed, we leave open several interesting

[28] Friedman and Miller (2009) estimate that customer acquisition costs (CACs) are $27 for green electricity programs. Assuming the average customer stays in a program for three years and using mean levels of green electricity consumption and green price premiums reported in Table 2, the CAC is equivalent to 10% of the extra revenue generated by a green electricity customer.

questions related to the overall impacts of green electricity programs. For example, we do not attempt to evaluate how frequently the extra revenues collected through green electricity programs cover the administrative costs of program development and maintenance. Nor do we attempt to shed light on whether public policies should subsidize green electricity programs, as they currently do in a variety of settings, based on their associated environmental benefits. Answering these questions is important as program managers and policy makers consider the future of green electricity programs, and we hope our study will promote future research in these areas.

References

Bergstrom, T., L. Blume, and H. Varian. 1986. On the private provision of public goods. *Journal of Public Economics* 29(1): 25-49.

Brécard, D., B. Hlaimi, S. Lucas, Y. Perraudeau, and F. Salladarré. 2009. Determinants of demand for green products: An application to eco-label demand for fish in Europe. *Ecological Economics* 69(1): 115-125.

Clark, C.F., M.J. Kotchen, and M.R. Moore. 2003. Internal and external influences on pro-environmental behavior: Participation in a green electricity program. *Journal of Environmental Psychology* 23: 237-246.

Cohen, M.A. and M.P. Vandenberg. 2012. The potential role of carbon labeling in a green economy. *Energy Economics* 34: S53-S63.

Conte, M.N. and M.J. Kotchen. 2010. Explaining the Price of Voluntary Carbon Offsets. *Climate Change Economics* 1(2): 1-19.

Costa, D.L. and M.E. Kahn. 2013. Do liberal home owners consume less electricity? A test of the voluntary restraint hypothesis. *Economics Letters* 119: 210-212.

DellaVigna, S., J.A. List, and U. Malmendier. 2012. Testing for Altruism and Social Pressure in Charitable Giving. *Quarterly Journal of Economics* 127(1): 1-56.

Espey, J.A. and M. Espey. 2004. Turning on the Lights: A Meta-Analysis of Residential Electricity Demand Elasticities. *Journal of Agricultural and Applied Economics* 36(1): 65-81.

Friedman, B. and M. Miller. 2009. Green Pricing Program Marketing Expenditures: Finding the Right Balance. Technical Report (TP-6A2-46449). National Renewable Energy Laboratory.

Gerpott, T.J. and I. Mahmudova. 2010. Determinants of Price Mark-Up Tolerance for Green Electricity – Lessons for Environmental Marketing Strategies from a Study of Residential Electricity Customers in Germany. *Business Strategy and the Environment* 19: 304-318.

Glatt, S. 2010. Public Benefits Funds: Increasing Renewable Energy and Industrial Energy Efficiency Opportunities. *State Policy Series: Impacting Industrial Energy Efficiency,* US Department of Energy.

Harding, M. and D. Rapson. 2013. Does Absolution Promote Sin? The Conservationist's Dilemma. University of California, Davis Working Paper.

Heckman, J.J. 1979. Sample selection bias as specification error. *Econometrica* 47: 153-161.

Ito, K. 2013. Do Consumers Respond to Marginal or Average Price? Evidence from Nonlinear Electricity Pricing. *American Economic Review.* In press.

Jacobsen, G.D. 2011. The Al Gore Effect: An Inconvenient Truth and Voluntary Carbon Offsets. *Journal of Environmental Economics and Management* 61(1): 67-78.

Jacobsen, G.D. 2013. Do Economic Conditions Influence Environmental Policy? Evidence from the US Senate. *Economics Letters* 120: 167-170.

Jacobsen, G.D., M.J. Kotchen, and M.P. Vandenbergh. 2012. The behavioral response to voluntary provision of an environmental public good: Evidence from residential electricity demand. *European Economic Review* 56: 946-960.

Jacobsen, G.D., M.J. Kotchen, and G. Clendenning. 2013. Community-Based Incentives for Environmental Protection: The Case of Green Electricity. *Journal of Regulatory Economics* 44: 30-52.

Kahn, M.E. 2002. Demographic Change and the Demand for Environmental Regulation. *Journal of Policy Analysis and Management* 21(1): 45-62.

Kahn, M.E. 2007. Do greens drive Hummers or hybrids? Environmental ideology as a determinant of consumer choice. *Journal of Environmental Economics and Management* 54: 129-145.

Kotchen, M.J. 2006. Green Markets and Private Provision of Public Goods. *Journal of Political Economy* 114: 816-834.

Kotchen, M.J. 2009. Voluntary provision of public goods for bads: A theory of environmental offsets. *Economic Journal* 119: 883-899.

Kotchen, M.J. and M.R. Moore. 2007. Private provision of environmental public goods: Household participation in green-electricity programs. *Journal of Environmental Economics and Management* 53: 1-16.

Kotchen, M.J. and M.R. Moore. 2008. Conservation from Voluntary Restraint to a Voluntary Price Premium. *Environmental and Resource Economics* 40: 195-215.

Landry, C. A. Lange, J.A. List, M.K. Price, and N. Rupp. 2006. Towards an understanding of the economics of charity: Evidence from a field experiment. *Quarterly Journal of Economics* 121: 747-782.

Loureiro, M.L. and J. Lotade. 2005. Do fair trade and eco-labels in coffee wake up the consumer conscience? *Ecological Economics* 53: 129-138.

Lyon, T.P. and H. Yin. 2010. Why Do State Adopt Renewable Portfolio Standards?: An Empirical Investigation. *Energy Journal* 31(3): 133-157.

Mewton, R.T. and O.J. Cacho. 2011. Green Power voluntary purchases: Price elasticity and policy analysis. *Energy Policy* 39: 377-385.

O'Shaughnessy, E., J. Heeter, C. Liu, and E. Nobler. 2015. Status and Trends in the U.S. Voluntary Green Power Market (2014 Data). Technical Report (TP-6A20-65252). National Renewable Energy Laboratory.

Roe, B., M.F. Teisl, A. Levy, and M. Russell. 2001. US consumers' willingness to pay for green electricity. *Energy Policy* 29: 917-925.

Rose, S.K., J. Clark, G.L. Poe, D. Rondeau, and W.D. Schulze. 2002. The private provision of public goods: test of a provision point mechanism for funding green power programs. *Resource and Energy Economics* 24: 131-155.

Smith, V.H., M.R. Kehoe, and M.E. Cremer. 1995. The private provision of public goods: Altruism and voluntary giving. *Journal of Public Economics* 58(1): 107-126.

Suter, J.F., G.L. Poe, and N.L. Bills. 2008. Do Landowners Respond to Land Retirement Incentives? Evidence from the Conservation Reserve Enhancement Program. *Land Economics* 84(1): 17-30.

Wiser, R.H. 2007. Using contingent valuation to explore willingness to pay for renewable energy: A comparison of collective and voluntary payment vehicles. *Ecological Economics* 62: 419-432.

Wiser, R., S. Olson, L. Bird, and B. Swezey. 2004. Utility Green Pricing Programs: A Statistical Analysis of Program Effectiveness. Topical Issues Brief (TP-620-35609). National Renewable Energy Laboratory.

Zarnikau, J. 2003. Consumer demand for 'green power' and energy efficiency. *Energy Policy* 31: 1661-1672.

Table 1: Summary of Revealed-Preference Studies of Participation in Green Electricity Programs

	Rose et al. (2003)	Clark et al. (2003)	Kotchen and Moore (2007) - Utility 1	Kotchen and Moore (2007) - Utility 2	Jacobsen et al. (2012)	Jacobsen et al. (2012)	Harding and Rapson (2013)	Jacobsen et al. (2013)
Outcome	Enrollment	Enrollment	Enrollment	Enrollment	Enrollment	Sales per Part.	Enrollment (Offset Program)	Enrollment
Scope	Single Program	Single Program	Single Program	Single Program	Single Utility	Single Utility	Single Program	Single State
Location	New York	Michigan	Michigan	Michigan	Tennessee	Tennessee	California	Connecticut
Explanatory Variable								
Elec. Cons.	n/a	n/a	n/a	n/a	+*	+*	-*	n/a
Income	n/a	+*	+*	+	+	-*	+	-*
Education	+	n/a	n/a	n/a	+	+	-	+*
Liberal	n/a	n/a	n/a	n/a	+*	-	n/a	+*
Age	-*	+*	+	-	n/a	n/a	-*	n/a
White	n/a	n/a	n/a	n/a	+	+	n/a	n/a
Urban	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Table 2: Summary Statistics

Variable	Mean	St. Dev.	Min.	Max.	Obs.
Green Electricity Program (binary)	0.22	0.41	0.0	1.0	2,700
Enrollment Rate (%)	1.29	2.32	0.0	24.9	581
Grn. Elec. Purch. per Participant (kWhs/person)	4,232.90	4,165.98	27.3	45,600.0	581
Grn. Elec. Purch. per Customer (kWhs/person)	59.34	140.27	0.0	1,846.9	581
Green Elec. Price Prem. (cents/kWh)	2.14	1.08	-0.1	10.0	366
Program Age (years)	8.81	2.44	1.0	13.0	380
Median Household Income ($1,000s)	45.45	9.32	21.4	103.6	2,700
Bachelor's or higher (%)	19.93	7.52	7.5	64.0	2,700
Dem. Vote Share (%)	41.95	12.75	5.0	87.1	2,700
Over-65 Population (%)	15.90	3.51	6.5	43.4	2,700
White (%)	85.01	13.81	15.2	99.2	2,700
Urban	0.36	0.43	0.0	1.0	2,700
Residential Customers (10,000s)	3.53	20.76	0.0	456.6	2,700
Average Ann. Consumption (MWhs)	12.09	3.57	1.9	37.0	2,700
Average Elec. Price (cents/kWh)	10.55	2.79	2.4	44.5	2,700
Investor-Owned Utility	0.04	0.20	0.0	1.0	2,700
Cooperative	0.26	0.44	0.0	1.0	2,700
Municipality or Other Government	0.70	0.46	0.0	1.0	2,700
Total Elec. Sales (1,000 MWhs)	0.40	2.07	0.0	56.6	2,700

Notes: Data sources are the U.S. Department of Energy and the U.S. Census.

Table 3: Regression Models of Participation on the Extensive Margin: Enrollment Rate

	Regulated Utilities		Full Sample	
	(1)	(2)	(3)	(4)
ln(Med. Inc.)	-0.16	-0.47	-0.11	-0.38
	(1.37)	(1.71)	(1.33)	(1.80)
Bachelor's or higher (%)	0.07***	0.08***	0.07***	0.08***
	(0.02)	(0.02)	(0.02)	(0.03)
Dem. Vote Share (%)	-0.00	-0.01	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)
Over-65 Population (%)	0.07	-0.02	0.06	-0.02
	(0.09)	(0.08)	(0.08)	(0.08)
White (%)	-0.00	-0.00	-0.00	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)
Urban	-0.48	-0.77	-0.50	-0.76
	(0.43)	(0.46)	(0.41)	(0.48)
Residential Customers (10,000s)	-0.01	-0.04**	-0.01	-0.03*
	(0.01)	(0.02)	(0.01)	(0.02)
Average Ann. Consumption (MWhs)	-0.07	-0.05	-0.07	-0.04
	(0.05)	(0.06)	(0.05)	(0.06)
Average Elec. Price (cents/kWh)	-0.05	-0.08	-0.08	-0.11
	(0.12)	(0.12)	(0.10)	(0.13)
Investor-Owned Utility	1.23	3.44**	0.63	2.19
	(0.82)	(1.39)	(0.62)	(1.30)
Cooperative	-0.28	-0.22	-0.27	-0.23
	(0.43)	(0.42)	(0.37)	(0.43)
Green Elec. Price Prem. (cents/kWh)		-0.35		-0.25
		(0.27)		(0.24)
Program Age (years)		0.09		0.03
		(0.14)		(0.13)
State Effects	Yes	Yes	Yes	Yes
R-squared	0.230	0.333	0.230	0.327
Observations	523	354	581	366

Notes: The dependent variable is enrollment rate. All models are OLS. The unit of observation is a utility. Standard errors clustered at the state level are reported in parentheses. One, two, and three stars indicate 10 percent, 5 percent, and 1 percent significance, respectively.

Table 4: Regression Models of Participation on the Intensive Margin: Green Electricity Purchases per Participant

	Regulated Utilities		Full Sample	
	(1)	(2)	(3)	(4)
ln(Med. Inc.)	3727.56**	4523.38**	2923.12*	4289.68*
	(1765.24)	(2191.89)	(1735.54)	(2212.26)
Bachelor's or higher (%)	-22.31	-21.71	-24.38	-20.77
	(41.21)	(32.89)	(39.75)	(31.81)
Dem. Vote Share (%)	29.46	51.81***	23.02	51.07***
	(18.39)	(15.56)	(17.15)	(15.57)
Over-65 Population (%)	169.20	60.98	154.62	57.88
	(122.00)	(99.30)	(116.47)	(98.19)
White (%)	-1.68	23.20	-2.09	21.84
	(24.86)	(15.52)	(24.09)	(15.71)
Urban	1420.59*	641.13	1555.24**	734.28
	(742.24)	(627.42)	(721.10)	(636.96)
Residential Customers (10,000s)	20.66	18.57	13.63	18.39
	(20.95)	(26.12)	(12.38)	(20.60)
Average Ann. Consumption (MWhs)	102.62	-57.29	63.57	-77.10
	(87.20)	(79.25)	(74.94)	(73.71)
Average Elec. Price (cents/kWh)	352.18	206.98	239.24	167.10
	(214.88)	(158.81)	(167.12)	(160.70)
Investor-Owned Utility	-2618.59*	-1733.97	-1618.35	-2200.35
	(1516.38)	(1775.00)	(1015.89)	(1488.19)
Cooperative	-922.64	-503.15	-616.60	-480.82
	(819.37)	(687.70)	(715.00)	(671.07)
Green Elec. Price Prem. (cents/kWh)		-957.06**		-892.63***
		(353.63)		(299.11)
Program Age (years)		-32.18		9.90
		(118.35)		(108.63)
State Effects	Yes	Yes	Yes	Yes
R-squared	0.228	0.262	0.255	0.272
Observations	523	354	581	366

Notes: The dependent variable is green electricity purchases per participant, measured in kWhs per program participant. All models are OLS. The unit of observation is a utility. Standard errors clustered at the state level are reported in parentheses. One, two, and three stars indicate 10 percent, 5 percent, and 1 percent significance, respectively.

Table 5: Regression Models of Overall Program Performance: Green Electricity Purchases per Customer

	Regulated Utilities		Full Sample	
	(1)	(2)	(3)	(4)
ln(Med. Inc.)	13.279	44.593	6.508	41.359
	(101.894)	(123.571)	(97.223)	(129.419)
Bachelor's or higher (%)	3.890**	3.699**	4.016***	4.025**
	(1.444)	(1.521)	(1.326)	(1.565)
Dem. Vote Share (%)	0.023	0.409	0.019	0.527
	(0.353)	(0.510)	(0.359)	(0.533)
Over-65 Population (%)	3.853	-0.024	3.408	-0.127
	(4.515)	(4.351)	(4.186)	(4.364)
White (%)	0.084	-0.119	-0.001	-0.181
	(1.067)	(1.401)	(0.975)	(1.429)
Urban	-17.391	-31.688	-14.618	-29.187
	(24.337)	(30.976)	(23.114)	(32.478)
Residential Customers (10,000s)	-0.476	-1.917*	-0.236	-1.365
	(0.508)	(1.045)	(0.325)	(0.967)
Average Ann. Consumption (MWhs)	-3.262	-3.939	-3.775	-3.746
	(3.132)	(4.000)	(3.109)	(3.865)
Average Elec. Price (cents/kWh)	3.973	-0.072	1.911	-2.502
	(7.514)	(6.994)	(6.089)	(7.407)
Investor-Owned Utility	63.373	171.041**	38.068	97.677
	(45.563)	(81.137)	(35.969)	(79.073)
Cooperative	-31.996	-31.059	-29.286	-29.640
	(24.911)	(24.726)	(21.390)	(24.144)
Green Elec. Price Prem. (cents/kWh)		-31.114*		-25.912*
		(16.100)		(14.319)
Program Age (years)		9.854		7.761
		(8.886)		(8.017)
State Effects	Yes	Yes	Yes	Yes
R-squared	0.276	0.378	0.275	0.367
Observations	523	354	581	366

Notes: The dependent variable is green electricity purchases per customer, measured in kWhs per utility customer. All models are OLS. The unit of observation is a utility. Standard errors clustered at the state level are reported in parentheses. One, two, and three stars indicate 10 percent, 5 percent, and 1 percent significance, respectively.

Table 6: Regression Models of Green Electricity Program Offering

	Regulated Utilities (1)	Full Sample (2)
ln(Med. Inc.)	0.140	0.143*
	(0.084)	(0.071)
Bachelor's or higher (%)	0.006***	0.005***
	(0.001)	(0.001)
Dem. Vote Share (%)	-0.000	-0.000
	(0.001)	(0.001)
Over-65 Population (%)	-0.001	-0.001
	(0.003)	(0.003)
White (%)	0.000	0.000
	(0.001)	(0.001)
Urban	0.033	0.038*
	(0.025)	(0.021)
Residential Customers (10,000s)	-0.003	-0.002
	(0.002)	(0.002)
Average Ann. Consumption (MWhs)	0.013**	0.010**
	(0.005)	(0.005)
Average Elec. Price (cents/kWh)	0.000	-0.002
	(0.006)	(0.004)
Investor-Owned Utility	0.225*	0.244***
	(0.119)	(0.082)
Cooperative	0.246***	0.244***
	(0.050)	(0.044)
Total Elec. Sales (1,000 MWhs)	0.037	0.032
	(0.027)	(0.027)
State Effects	Yes	Yes
R-squared	0.321	0.322
Observations	2,242	2,700

Notes: The dependent variable is green electricity program. All models are linear probability models. The unit of observation is a utility. Standard errors clustered at the state level are reported in parentheses. One, two, and three stars indicate 10 percent, 5 percent, and 1 percent significance, respectively.

Table 7: Sample Robustness Checks

	Drop Utilities with Outlier Values				Drop Utilities Serving 11+ Counties			
	Enroll. Rate	Grn. Purchases per Part.	Grn. Purchases per Cust.	Program Offering	Enroll. Rate	Grn. Purchases per Part.	Grn. Purchases per Cust.	Program Offering
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Med. Inc.)	-1.163	2166.698	-3.883	0.143*	-0.196	4388.213*	45.969	0.126*
	(0.931)	(1775.824)	(52.671)	(0.075)	(1.655)	(2276.032)	(120.966)	(0.069)
Bachelor's or higher (%)	0.089***	20.114	4.402**	0.004***	0.083***	-25.076	4.195**	0.004***
	(0.028)	(32.685)	(1.701)	(0.001)	(0.025)	(33.895)	(1.560)	(0.001)
Dem. Vote Share (%)	-0.007	60.806***	0.527	-0.000	-0.013	53.949***	0.155	-0.000
	(0.013)	(21.137)	(0.680)	(0.001)	(0.011)	(14.264)	(0.544)	(0.001)
Over-65 Population (%)	-0.065*	72.930	-1.064	-0.001	-0.003	45.426	-0.072	-0.001
	(0.038)	(82.496)	(2.013)	(0.004)	(0.094)	(105.618)	(4.460)	(0.003)
White (%)	-0.001	22.134	0.643	0.000	-0.008	28.382	-0.435	0.000
	(0.009)	(13.977)	(0.495)	(0.001)	(0.023)	(19.126)	(1.530)	(0.001)
Urban	-0.463	595.446	-9.292	0.034	-0.803*	668.152	-30.637	0.031
	(0.328)	(525.591)	(23.578)	(0.021)	(0.462)	(649.335)	(31.287)	(0.021)
Residential Customers (10,000s)	-0.048*	-17.960	-2.630*	0.015**	-0.073***	45.345	-3.751***	-0.002
	(0.025)	(31.092)	(1.491)	(0.007)	(0.018)	(63.701)	(1.137)	(0.003)
Average Ann. Consumption (MWhs)	-0.022	-71.996	-2.902	0.014***	-0.028	-59.475	-5.000	0.008
	(0.040)	(82.228)	(2.278)	(0.005)	(0.078)	(83.444)	(5.277)	(0.005)
Average Elec. Price (cents/kWh)	-0.030	-126.321	-1.602	0.006	-0.092	221.797	-2.715	-0.004
	(0.073)	(105.151)	(4.461)	(0.006)	(0.137)	(203.895)	(9.484)	(0.004)
Investor-Owned Utility	2.210	-692.415	98.800	0.027	4.196**	-3367.038	189.817**	0.038
	(1.352)	(1347.809)	(76.220)	(0.096)	(1.634)	(3429.807)	(78.681)	(0.101)
Cooperative	-0.365	235.529	-18.418	0.223***	-0.134	-710.446	-29.528	0.241***
	(0.292)	(593.398)	(17.328)	(0.043)	(0.448)	(708.183)	(25.915)	(0.044)
Green Elec. Price Prem. (cents/kWh)	0.030	-1533.011***	-19.926**		-0.412	-1080.042*	-38.932	
	(0.164)	(484.920)	(9.604)		(0.387)	(588.649)	(23.358)	
Program Age (years)	0.018	42.714	0.692		0.001	-4.673	10.674	
	(0.061)	(107.808)	(2.604)		(0.226)	(161.741)	(12.585)	
Total Elec. Sales (1,000 MWhs)				-0.030				0.094**
				(0.055)				(0.044)
State Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.420	0.438	0.465	0.347	0.407	0.257	0.402	0.336
Observations	328	328	328	2,323	334	334	334	2,576

Notes: The dependent variable is reported at the top of each column. Linear probability models are reported in columns 1 and 5, and OLS models are reported in columns 2-4 and 6-8. The unit of observation is a utility. Robust standard errors are reported in parentheses. One, two, and three stars indicate 10 percent, 5 percent, and 1 percent significance, respectively.

Table 8: Heckman Selection Models

	First Stage	Second Stage: Enroll. Rate	Second Stage: Grn. Purchases per Part.	Second Stage: Grn. Purchases per Cust.
	(1)	(2)	(3)	(4)
ln(Med. Inc.)	0.752**	1.279	3572.226*	94.620
	(0.348)	(1.287)	(1972.397)	(77.059)
Bachelor's or higher (%)	0.022***	0.111***	-7.257	6.341***
	(0.007)	(0.028)	(43.924)	(1.687)
Dem. Vote Share (%)	0.000	-0.003	23.050	0.023
	(0.003)	(0.011)	(17.778)	(0.688)
Over-65 Population (%)	-0.008	0.053	151.289*	2.955
	(0.016)	(0.056)	(87.451)	(3.335)
White (%)	-0.001	-0.006	-3.484	-0.191
	(0.004)	(0.015)	(22.511)	(0.873)
Urban	0.184	-0.145	1722.071***	8.028
	(0.114)	(0.422)	(658.200)	(25.194)
Residential Customers (10,000s)	-0.007*	-0.000	16.728	0.184
	(0.004)	(0.007)	(11.266)	(0.401)
Average Elec. Price (cents/kWh)	-0.012	-0.099	228.250*	0.419
	(0.018)	(0.075)	(122.767)	(4.424)
Average Ann. Consumption (MWhs)	0.053***	0.011	102.279	1.479
	(0.015)	(0.062)	(93.975)	(3.708)
Investor-Owned Utility	1.158***	2.682**	-661.933	167.897**
	(0.172)	(1.120)	(1731.601)	(66.973)
Cooperative	1.077***	1.585*	248.509	88.148*
	(0.095)	(0.887)	(1399.457)	(52.870)
Total Elec. Sales (1,000 MWhs)	0.102***			
	(0.038)			
Inverse Mills' Ratio		2.781**	1298.744	176.298**
		(1.204)	(1965.753)	(71.408)
State Effects	Yes	Yes	Yes	Yes

Notes: All models are estimated following Heckman (1979). First stage results are reported in column 1. Second-stage results are reported in columns 2-4 and the corresponding dependent variables are indicated in the column headings. The unit of observation is a utility. All models included 2,700 observations. Standard errors are reported in parentheses. One, two, and three stars indicate 10 percent, 5 percent, and 1 percent significance, respectively.