Green is Good – The Impact of Information Nudges on the Adoption of Voluntary Green-Power Plans*

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December 1, 2018

Abstract

A recent trend has been a move toward greater reliance on renewable or "green" energy sources, especially in the residential sector. Using a choice experiment, this paper examines how information nudges regarding the efficiency, cost, and environmental impacts of different power-generating sources impact consumers' preferences for adopting voluntary green-power plans. Based on 21,000 plan choices from two different samples totaling over 1,800 respondents, our results indicate that information nudges significantly impact respondents' choice of plan; promoting the advantages of the green plan or the disadvantages of the gray plan increases green plan adoption, and to a similar extent. The magnitudes of these effects are sizable and equivalent to a change in the monthly premium of $5/month. We document interesting heterogeneous treatment effects based on income, education, environmental attitudes, and existing participation in a green plan. Our results have clear energy policy and green power marketing implications of a plausible, economical, and effective mechanism to increase adoption of green-power plans.

Keywords*:* Renewable Energy, Green Power, Information, Nudge, Choice Experiment

JEL Codes*:* Q40, Q20, Q50, Q01, C83, C90, D91

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* We thank Danny Brent, Carl Kitchens, Allen Klaiber, Chunbo Ma, Matthew McMahon, Ivan Rudik, and Brock Stoddard for helpful comments and suggestions. We also thank conference participants at the 2017 Economic Science Association meeting and the 2017 Agricultural Economics Association meeting. IRB approval was received for all data collection reported in this paper through Texas Tech University (IRB-505638)

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1 Introduction

In the U.S., as well as in many other developed nations, there has been a growing trend toward greater reliance on renewable energy sources. While the U.S. Energy Information Administration (http://www.eia.gov) reported in 2016 that the majority of domestic energy production (roughly 80%) is from conventional hydrocarbon-based sources (e.g., coal, natural gas, and crude oil), energy from renewable sources (e.g., wind, solar, hydro, and biomass) now accounts for upwards of 12% of energy production and this percentage has been steadily increasing over the last decade.[1] One prominent area embodying this increases is renewable or "green" electric power generation, both in the U.S. and globally. As of 2016, the EIA reported that approximately 55% of renewable energy is used for electric power generation, and electric power generated from renewable sources accounted for roughly 15% of the total generation in the U.S.[2] Furthermore, the U.S. Department of Energy reported in 2015 that renewable electricity grew to 16.7% of installed capacity, and green power continues to grow with renewables accounting for 64% of the new capacity additions in 2015.[3]

Certainly a key contributing factor to the continued growth in renewable energy infrastructure has been supply-side increases arising from energy policy and regulatory reform (e.g., Renewable Portfolio/Electricity Standards, Clean Power Plan, Renew300, and Green Power Partnership).[4] That said, increasing consumer demand for green power – stemming from its environmental benefits, lower greenhouse gas emissions, and sustainability – has also played an important role. Prior research suggests that most people express a preference for greater reliance on green power (Greenberg, 2009), and many papers have documented that consumers are willing to pay a green-premium, typically in the range of $5-$15 per month, to purchase green power (see Menegaki, 2008; and Sundt & Rehdanz, 2015 for a review).[5] As a result, in recent years residential consumers have been increasingly offered the option to participate in voluntary green power programs. As of 2016, The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) reported that more than a dozen states mandate that green power be offered in competitive markets, and over 750 electric utilities offer green plans where power is at

[1] The remaining 8% is from nuclear generation.

[2] Worldwide, the EIA estimated that renewable energy accounted for approximately 22% of global electricity generation in 2013, and this is predicted to increase to 26% by 2020.

[3] Conventionally, the bulk of residential electric power has been predominately generated from the combustion of coal or natural gas. The U.S. Department of Energy reported in that in 2015 nearly 2/3 of the production in the electric power sector is coal or natural gas based (2015 Renewable Energy Data Book).

[4] We refer readers to the American Wind Energy Association (http://www.awea.org/advocacy/) for a discussion of these policies, as well as papers by Bird et al. (2005), Menz (2005), Menz & Vachon (2006), Vachon & Menz (2006), Gan et al. (2007), Fowlie et al. (2014), and Hollingsworth & Rudik (2018) for more detailed discussions surrounding the various policies and regulatory reforms aimed at promoting growth in renewable energy.

[5] A detailed review of this literature, and other factors that influence consumers' willingness to pay for green power, is provided in Section 2.

least partially generated from renewable sources (see Clark et al., 2003; Bird & Sumner, 2010; and Dagher et al., 2017 for further discussion on the growth of voluntary green power alternatives).[6] That said, the take-up rate of green plans remains relatively low, conservatively estimated at less than 5% in most cases (e.g., O'Shaughnessy et al., 2016). Given the increasing availability of green-power plans, combined with the evidence of apparent preferences for green power, it is important to think about mechanisms to increase take-up of such plans. Such insights would be valuable for renewable energy policy, as well as for the operational strategies of individual utilities in response to renewable electricity generation becoming increasingly more cost effective.

The aim of this study is to empirically examine how non-price, information "nudges" impact consumers' choices over residential electricity plans.[7] Specifically, we evaluate how the provision of information about the energy efficiency, production and social costs, and the environmental impacts of the different electricity-generating sources impact consumers' preferences for adopting green power. We conduct a choice experiment, administered via online survey, where respondents make a series of choices between adopting either a green-power plan, or a conventional plan where the electricity is generated from a hydro-carbon source, which we refer to generically as the "gray" plan. Prior to making their choices, we systematically vary whether individuals receive: (i) positive or negative information about the gray plan, (ii) positive or negative information about the green plan, (iii) some combination of positive or negative information about both plans, or (iv) neutral information (generic facts about electricity). The choice data obtained from the survey allows us to identify the causal impact of the pre-choice, information intervention on consumers' preferences for adopting voluntary green-power plans. As part of the design, we also systematically vary the expected monthly price premium associated with the green plan, which enables us to quantify the size of the information-effect relative to the pure-price effect. Lastly, we consider how existing participation in a green plan, personal attitudes toward the environment and green energy, and other socio-demographic measures impact plan choice, as well as their possible moderating role on the information effects. Importantly, by using a choice experiment we are able to consider eight different information conditions, which when combined with a sizable and diverse set of over 1,800 respondents, provides robust inference of the plausible impact of information nudges on voluntary green-plan adoption.

[6] Hollingsworth & Rudik (2018) empirically document a positive association between more stringent RPS standards and the wholesale supply of renewable electricity. Moreover, they also find a positive spillover effect where more stringent RPS standards in one state reduces fossil fuel electricity generation in other states.

[7] Nudges, as defined by Thaler & Sunstein (2008), refer to changes in the choice setting or architecture that can predictably alter behavior without forbidding available options or significantly changing the economic incentives. As such, nudges have the property of being liberty preserving in that they do not restrict the choice set of the choosers or the economic costs associated with the choices (Sunstein & Thaler, 2003; Camerer et al., 2003).

Prior research has documented many factors that can motivate people to engage in pro-environmental behaviors and the purchase of green-energy products (see Steg & Vlek, 2009; Herbes & Ramme, 2014; Steg et al., 2014 for relevant discussion and reviews of this literature). Among the various factors, psychological motivations have shown to be very important; for instance, altruistic and biospheric values, normative concerns, and moral appeals or obligations have been linked to pro-environmental behaviors. These psychological motivations provide a plausible channel through which information interventions could impact plan choice. Steg & Vlek (2009) discuss how informational strategies, which they define as "being aimed at changing perceptions, motivations, knowledge, and norms, without actually changing the external context in which choices are made" (p. 313), can be instrumental in promoting pro-environmental behavior by "targeting" psychological motivations. Steg & Vlek further postulate that "informational strategies can be aimed to increase actors' knowledge so as to heighten their awareness of environmental problems and of the environmental impacts of their behavior, and/or to increase their knowledge of behavioral alternatives and their pros and cons. It is assumed that new knowledge results in changes in attitudes, which in turn will affect behavior" (p. 313). Regarding power-plan decisions, we argue that providing salient information about the advantages of a certain plan (or the disadvantages of the alternative plan) can be persuasive by appealing to these psychological motivations, ultimately impacting plan choice. Moreover, we anticipate the efficacy of these information interventions to be relatively high in the choice between green and gray plans, relative to other energy choice domains, since choosing to participate in the green plan is relatively convenient and inexpensive (Steg & Vlek, 2009; Steg et al., 2014).

Based on results from 1,838 respondents over two distinct samples and 21,384 plan-choice scenarios, we find that nudging respondents with information about the attributes relating to the electricity-generating source significantly impacts plan choice. Specifically, providing pro-green information (*advantages* of green and/or *disadvantages* of gray) significantly increases green plan adoption over the gray plan alternative (holding the expected monthly price constant) by roughly 18%-26% relative to the baseline rate of green plan adoption (with neutral information). Conversely, pro-gray information (*disadvantages* of green and/or *advantages* of gray) significantly decreases green plan adoption by roughly 11%-18% relative to the baseline rate. Importantly, our main results regarding the impact of the information interventions are generally robust across different levels of monthly price premium for the green plan. Moreover, the estimated magnitude of the information intervention is proportional to an estimated magnitude resulting from a $4 change in the monthly price premium of the green plan. Thus, nudging respondents by providing information about the advantages and/or disadvantages associated with the energy source of a given plan results in both a statistically and economically significant impact on adoption rates of the green-power plan.

We also find that different "types" of respondents react differently to the information intervention. In particular, more educated respondents appear to be more sensitive to pro-green information and less sensitive to pro-gray information; thus, more educated people are more "nudge-able" into adopting the green plan. In terms of environmental attitudes, respondents who report being more pro-environmental are less responsive to the pro-green information and more responsive to the pro-gray information; the implication here is that respondents who are more concerned with the environment are less inclined to choose the green plan after receiving some information that the green plan is not all that good, or that the gray plan is not all that bad. Lastly, we find that respondents who report already being a participant in a green-power plan (at their current electric utility) effectively show no significant response to both the pro-green and pro-gray information; this suggests that this type of information intervention nudge might be more effective when targeted toward conventional gray plan participants or new customers.

In 2016, the EIA reported that electric power generation accounted for roughly 40% of total U.S. energy consumption, and that the residential sector accounted for roughly 21% of energy consumption; globally, about 20% of energy demand stems from residential energy demand (Brounen et al. 2013). Given the sizable share of total energy consumption arising from residential electricity usage, in combination with the global movement toward a greater reliance on renewable energy sources as a means to combat global warming, curb greenhouse gas emissions, and facilitate sustainability, it is important to better understand residential consumers' preferences and the possible factors that influence their adoption of voluntary green-power plans. Much of the prior research relating to residential adoption of green power, which is discussed in the next section, has focused on the price premium associated with the green plan. Not surprisingly, the size of the green price premium is an important determinant in shaping consumers' (planned) decisions to purchase green power. While conventional economic levers (e.g., lowering prices, altering incentives, imposing regulation) can be effective in increasing the adoption of green plans, they can also be costly and inefficient from a total welfare perspective.[8] Our results suggest that, as an alternative, nudging in the form of providing targeted information about the advantages of renewable power generation and/or the disadvantages of conventional gray-power generation can sizably increase the take-up of voluntary green-power plans; moreover, such information

[8] See Madrian (2014) and Loewenstein & Chater (2017) for more general discussions regarding conventional economic policy interventions in markets, and the possible advantages and benefits of using non-conventional interventions or nudges to shape behavior.

interventions could be implemented at a relatively low cost and without some of the inefficiencies and choice constraints associated with conventional economic policies.

From a green-power marketing standpoint, utility companies have the ability to advertise many different factors associated with their green-power plans. Herbes & Ramme (2014) analyze the webpage content of 600 different green-power plans in Germany, and they find that many do advertise the environmental benefits of the plan and appeal to the psychological "warm glow" benefits of how renewable energy helps fight climate change and lower CO_2 emissions.[9] Given that utility companies seem to actively engage in providing information to potential customers about the advantages of their green-power plans, a natural and important question arises as to whether, and the extent to which, different information marketing approaches are effective at stimulating demand for voluntary green-power programs. Our results suggest that such pro-green marketing efforts can indeed be effective at increasing the take-up of voluntary green-power plans. Providing clear and salient information about the advantages of renewable electricity and/or the disadvantages of gray electricity can be a cost effective means of increasing participation in voluntary green-power programs, especially for new customers or existing gray plan customers.

Our study contributes to the recent and growing literature focusing on how non-price nudges can influence energy consumption behaviors (e.g., Allcott & Mullainathan, 2010; Croson & Treich, 2014; Kunreuther & Weber, 2014; Allcott, 2016 for reviews of this literature). Much of the research in this area has focused on conservation efforts and energy/electricity usage behaviors. We complement this literature by considering how information nudges impact people's "upstream" decision of whether to participate in voluntary green-power programs. Given the focus of governments and other regulating bodies around the world to reduce GHG emissions and curb global warming, it is important to think about feasible methods to promote growth in renewable energy. As such, within the residential sector, not only must we consider how nudges can impact energy usage and conservation, but also how they can impact plan selection. Promoting the voluntary adoption of green-power plans through non-price, information interventions can be feasible, economical, and welfare-enhancing; thus, our study is an important contribution to the possible applications of using nudges to motivate consumers to make more environmentally friendly energy decisions.

2 Review of Related Literature

While the literature related to the adoption and use of renewable energy spans many domains, we focus our review primarily on the existing literature related to residential electricity usage and the adoption of

[9] Casual observation of webpages of Green-e, green-power certified programs (https://www.green-e.org/), reveals that many utilities within the U.S. provide similar information on the benefits of their green-power plans.

green power, as this most closely relates to our study. In addition, we also review the literature on non-price interventions–nudges–in the domain of energy consumption. The clear focus of regulating bodies on promoting renewable electricity, in combination with the greater availability of voluntary green-power plans offered by utilities, has garnered substantial research attention aimed at identifying factors that influence consumer demand and take-up of such plans.

Not surprisingly, much of the prior research related to residential green power adoption has focused on the role of the price premium. Even less surprising, many studies have found that the price premium is an important determinant in consumers' decisions to adopt a green-power plan, with higher price premiums resulting in lower adoption (e.g., Menegaki, 2008; Ma et al., 2015; and Sundt & Rehdanz, 2015 for reviews of this literature).[10] That said, using various techniques and sampling procedures, most prior studies in this domain tend to consistently estimate a positive willingness to pay (WTP) among residential consumers to purchase plans where (at least some of) the power is generated from renewable sources. For example, Goett et al. (2000), Roe et al. (2001), Borchers et al. (2007), Longo et al. (2008), Scarpa & Willis (2010), Cicia et al. (2012), Gracia et al. (2012), Kaenzig et al. (2013), and Cardella et al. (2017) use choice experiments to document a positive WTP for green power. Similarly, Champ & Bishop (2001), Zarnikau (2003), Whitehead & Cherry (2007), Wiser (2007), Diaz-Rainey & Ashton (2008), Bollino (2009), Yoo & Kwak (2009), Mozumder et al. (2011), and Oliver et al. (2011) use contingent valuation approaches to document a positive WTP for green power (Oerlemans et al., 2016 review this literature and conduct a meta-analysis). While the WTP estimates vary across studies (Sundt & Rehdanz, 2015), they tend to be clustered in the range of $5-$15 per month. While the primary motivation of our paper is not to estimate WTP for green power, the results from our survey indicate that 37% of all plan choices were for the green plan when the price premium ranged from $5-$15, which is generally consistent with the findings of these prior studies. As such, our paper provides additional supporting evidence of a positive WTP for green power.

Besides the price premium, several prior studies have also documented other factors relating to the plan attributes and the characteristics of the consumer that can impact preferences toward adopting green power (see Oerlemans et al., 2016 for a review). In terms of plan attributes, Borchers et al. (2007) and Kaenzig et al. (2013) find that the specific type of generating source (e.g., wind, solar, biomass, hydro, etc.) can impact preferences for green power. Relatedly, Bergmann et al. (2006) find that environmental impact, wildlife impact, pollution, and job creation all influence an individual's decision to adopt a

[10] Wiser et al. (2005), Mewton & Cacho (2011), Conte & Jacobsen (2016), and Dagher et al. (2017) use actual plan participation data to estimate the impact of price premiums on green participation behavior (among other factors of interest), and find that price premium negatively impacts green participation. Although, all three studies estimate that the green premium is relatively price inelastic, suggesting that adopters of green plans are not very price sensitive.

green-power plan. Lastly, Cardella et al. (2017) find that the price volatility of the plan (holding constant the green price premium) can impact plan selection. In terms of consumer characteristics, Ek (2005) finds that individuals who are more environmentally conscious have a more positive attitude toward wind power, and Clark et al. (2003) and Kotchen & Moore (2007) find that pro-environmental respondents were more likely to have enrolled in a green power program, while Mozumder et al. (2011), Oliver et al. (2011), Cicia et al. (2012), Gracia et al. (2012), and Amador et al. (2013) find that more environmentally conscious people have a higher WTP for green power. Income has also been shown to be positively related to preferences and willingness to pay for green power adoption (Clark et al., 2003; Borchers et al., 2007; Kotchen & Moore, 2007; Longo et al., 2008; Bollino, 2009; Yoo & Kwak, 2009; Mozumder et al., 2011; Oliver et al., 2011; Conte & Jacobsen, 2016). Conte & Jacobsen (2016) also show that more educated customers are more likely to enroll in voluntary green-power programs. Lastly, Bergmann et al. (2008) document differences in green power preferences between urban and rural households.

More recently, there has been a growing interest in how non-price interventions, or nudges, can influence energy consumption behavior.[11] Much of this literature focuses on end usage of residential consumers and possible mechanisms for fostering conservation behavior. Informative discussions of these different types of interventions and their effectiveness, and reviews of the relevant literature are provided by Abrahamse et al. (2005), Steg (2008), Steg & Vlek (2009), Allcott & Mullainathan (2010), Croson & Treich (2014), Kunreuther & Weber (2014), and Allcott (2016). Within this domain, providing usage feedback (typically though smart metering) has been shown to promote conservation behavior (e.g., Gans et al., 2013; Houde et al., 2013; Schleich et al., 2013; Jessoe & Rapson, 2014; and Delmas et al., 2013; Ramos et al., 2015 for reviews). Providing users with information about peer consumption and cues of social norms has also been shown to be effective in reducing energy consumption (e.g., Schultz et al., 2007; Allcott, 2011; Ayres et al., 2013; Costa & Kahn, 2013; Allcott & Rogers, 2014; Delmas & Lessem, 2014; Allcott & Kessler, 2018; see Abrahamse & Steg, 2013 and Ramos et al., 2015 for reviews). Setting usage goals is also effective in reducing usage (e.g., McCalley & Midden, 2002; Abrahamse et al., 2007; Loock et al., 2013; Harding & Hsiaw, 2014).

More in the spirit of the type of nudge we consider in our study, several papers have examined the impact of various types of information provision on energy conservation behavior and other pro-

[11] The growing research interest in how, and the degree to which, nudges can impact behavior spans well beyond energy consumption behavior. There is substantial literature on how nudges can impact behavior across a host of other domains including, but not limited to: financial planning, retirement planning, education, healthcare, and risky behaviors. We refer interested readers to Johnson et al. (2012), Madrian (2014), Benartzi et al. (2017), Loewenstein & Chater (2017), and Loewenstein et al., (2017) for interesting discussions and reviews of this literature.

environmental behaviors. For example, Asensio & Delmas (2015) find that providing information about negative health effects and pollution associated with electricity production reduces household usage. Ito et al. (2017) find that "moral suasion" in the form of providing a motivational information statement that conservation is needed during peak times leads to lower usage.[12] Reiss & White (2008) and Costa & Gerard (2015) find that public campaigns calling for conservation are effective in reducing residential electricity usage.[13] Ek & Soderholm (2010) find that providing information about cost savings associated with energy conservation does result in less energy use,[14] while Gilbert & Zivin (2014) document a similar finding where sending spending reminders to the household decreases usage. Ungemach et al. (2017) find that providing information about the environmental attributes of a car (i.e., greenhouse gas rating) increases the likelihood of choosing a more fuel-efficient car. These prior studies suggest that providing information in a variety of different forms can influence energy consumption behavior. That said, these prior studies have focused on usage and conservation efforts, while our study complements this prior work by examining how information impacts the upstream decision of households on whether to opt into participating in a voluntary green-power plan.

We are aware of a few prior studies that have looked specifically at how non-price interventions can impact the plan choice between conventional and green power alternatives. Most closely related to our study, Momsen & Stoerk (2014) use a choice experiment to examine the impact of several different types of nudges (e.g., priming, mental accounting, framing, decoy effects, social norms, and defaults) on the decision to choose the green plan versus the conventional gray plan alternative. Of particular relevance, one of their implemented nudges involves *subtly* "priming" respondents by asking them to either write down everything they know about the link between energy production and climate change, or reassemble statements about the same relationship; they find that this pre-intervention does not increase take-up of the green plan. Of all the nudges they consider, only the default nudge of having the green plan pre-selected increases take-up. This is consistent with the studies by Pichert & Katsikopoulos (2008) and Sunstein & Reisch (2013), who also find that defaulting the green plan increases participation, relative to the conventional plan. In our study, we examine how providing direct and salient information about the advantages and/or disadvantage of the plans impacts green plan adoption,

[12] Ferraro & Price (2013) document a similar effect where providing an appeal for water conservation significantly reduce monthly water usage.

[13] Cutter & Neidell (2009) document a similar effect relating to public transit use where the "Spare the Air" campaign in the San Francisco Bay Area decreased traffic volume and increased public transit use. However, Holladay et al. (2015) find little evidence that appeals for conservation efforts reduce energy usage and CO_2 emissions.

[14] Allcott & Taubinsky (2015) document a similar effect of providing information about costs and other factors on the decision to purchase CFL lightbulbs.

which more closely resembles the marketing efforts of many utilities offering voluntary green plans and other green marketing organizations.

Lastly, while not specifically related to energy-plan choice, there is a body of literature looking at the effect of energy-efficient labeling (e.g., Energy Star) on consumer purchase behavior (see Banerjee & Solomon, 2003 for a review of these programs). Generally, this research suggests that labeling products as more energy efficient and/or cost effective increases the willingness to pay for such appliances (e.g., Shen & Saijo, 2009; Ward et al., 2011; Houde, 2017) and, ultimately, the adoption of such appliances (Newell et al., 1999; Sanchez et al., 2008). However, the effect of such labeling may vary based on the specific content of the label and how it is presented (e.g., Newell & Siikamäki, 2014; Ungemach et al., 2017), or even characteristics of the consumer such as political affiliation (Gromet et al., 2013) and other demographic characteristics and attitudes (Ward et al., 2011). In essence, providing information about the environmental attributes of electricity generation of a given power plan could be viewed as "labeling"; thus, based on the findings from these prior studies suggesting that energy-efficient labeling can increase adoption of durable goods, we suspect that labeling a green plan in a positive light as being more eco-friendly would similarly increase voluntary adoption of the green plan.

We examine how providing consumers with information about the environmental and production attributes associated with generating electricity from a given source impacts their decision to adopt a green-power plan. In doing so, we complement the existing literature aimed at deepening our understanding of factors that can impact residential demand for green energy. Additionally, our paper considers another application – participation in green power programs – of how non-price nudges can be used to influence energy choices and promote pro-environmental behavior. The results of our study provide valuable insights regarding possible changes in energy consumption patterns in response to both regulatory changes and green power marketing aimed at promoting the adoption of green power.

3 Experimental Survey Design

We designed an online survey, which was developed and administered through Qualtrics, and embedded a choice experiment where respondents were asked to make a series of choices between a conventional gray-power plan and a renewable green-power plan. In total, 1,838 respondents completed the survey in February and December of 2016. Prior to making their plan choices, respondents systematically received different information about the electricity generation of either one or both plans. This enables us to empirically identify the impact of the provided information on the take-up rate of the green plan. After completing the plan choice scenarios, respondents were asked a series of self-reported questions relating to their current electric utility, their attitudes toward the environment, and other general demographic characteristics (e.g., gender, age, income, and education).[15] Specifically, respondents were asked questions about whether they are currently responsible for paying their own electricity bill, whether their current utility offers any green-power plans, and whether they participate in a green-power plan. For elicitation of general environmental concerns, we use the 15-item New Ecological Paradigm instrument (Dunlap et al., 2000; Kotchen & Reiling, 2000). We also include two 5-point, Likert-scale questions to specifically measure each respondent's general concerns for electricity being generated from a renewable source and being generated in a manner that minimizes the impact on the environment.

3.1 Choice Experiment of Electric Power Plan

In the experimental component of the survey, respondents were simultaneously presented with information on two hypothetical plans offered by a local electric utility, and they were asked to select which plan they *would* select to provide electricity for their residence. For each plan, respondents received information about: (i) generating source of the electricity, and (ii) average expected monthly price. A sample choice set is presented in Figure 1.[16]

[Insert Figure 1: Example Choice Scenario]

The two plans were labeled **Plan A – Conventional Electricity** and **Plan B – Green Electricity.** The generating source for the conventional plan was described as being produced by either coal or natural gas, while the generating source for the green plan was described as being produced by either wind or solar.[17] Each choice set always consisted of one gray plan and one green plan option. Across choice sets, the average expected monthly price for the green plan took one of three possible values: (i) $105/month, (ii) $110/month, or (iii) $115/month, while the average expected monthly price for the gray plan was always normalized to $100/month. This manipulation of expected monthly prices for the green plan is equivalent to a monthly premium of the green plan of $5, $10, or $15, respectively. These specific values of the price premium were chosen to be consistent with actual observed and documented average

[15] Importantly, and as we would expect, a post-hoc examination reveals virtually no differences in the measured respondent demographics, characteristics, and attitudes across the nine different information manipulations. Specifically, a series of ANOVA tests reveals no statistically significant effects of the information manipulation on any of these collected measures. As such, our randomization to information manipulation was successfully achieved.

[16] As part of a separate research project, Cardella et al. (2017), we also manipulated the monthly price volatility as one of the attributes of each plan. Monthly price volatility for each plan was presented to respondents in the form of a price distribution table that displayed the possible monthly prices and the corresponding percent chance of each price occurring, as depicted in the sample choice set in Figure 1. In total we considered five different price volatility manipulations, which are reproduced in Supplemental Appendix A. Given the primary research question of this study, which is the effect of informational nudges on plan choice, we collapse the price volatility dimension of the choice set and present results that are aggregated over the different price volatility levels. However, all of our main results presented in Section 4 are robust if we disaggregate the data and look at the informational effects within each level of price volatility; in other words, the monthly price volatility of the plan does not moderate the informational effects.

[17] We specifically chose wind and solar for the type of green electricity generation based on previous work by Ek (2005), Borchers et al. (2007), Gracia et al. (2012), Kaenzig et al. (2013), and Ma & Burton (2016) suggesting that consumers generally have a more positive attitude about these two sources of renewable energy generation.

premiums of green power programs (Bird et al., 2002; Bird & Sumner, 2010), as well as within the general range of estimated willingness to pay for green power (e.g., Roe et al., 2001; Zarnikau, 2003; Borchers et al., 2007; Wiser, 2007; and Mozumder et al., 2011).[18]

Because of the large number of choices in the full factorial design, we implemented a blocked, orthogonal, fractional factorial design with 48 distinct choice sets divided into four blocks of 12 choices.[19] In the experimental component of the survey, respondents were randomly assigned to one block and presented with all 12 corresponding choice sets. Respondents were asked to choose their preferred plan in each choice set, from which we estimated the main effects. To add context to the decision, respondents were advised to assume they would be committed to their plan for a period of at least a year, that all pricing information provided for each plan is projected based on the usage of a typical consumer, and that they should assume they are a typical consumer. Respondents were then presented with a sample scenario and required to correctly answer four comprehension-check questions before proceeding to ensure adequate understanding of the task. After passing the comprehension-check questions, respondents then proceeded to the choice experiment component of the survey and made their preferred plan choice in each of the 12 choice scenarios.

3.2 Plan Information Manipulation

The main manipulation of this study involved the information respondents received prior to the plan-choice experiment. Before viewing each of the 12 choice scenarios, we provided respondents with *six* information statements pertaining to either the *advantageous* or the *disadvantageous* attributes associated with generating electricity from the given source. The statements centered on the environmental impacts, relative costs, production efficiency, and health impacts. The idea was that information about advantages of a given energy-generating source was meant to frame that corresponding plan in a positive light (i.e., positive nudge), while information about the disadvantages was meant to frame that corresponding plan in a negative light (i.e., negative nudge). A list of the specific information statements that were used is provided in Supplemental Appendix B.

For the gray plan, the information statements about the advantages include: its abundance, its continuous production, its relative low cost, its ease of storage, and its relative efficiency; the corresponding disadvantageous statements include: its nonrenewable properties, its generation of greenhouse gases and pollutants, environmental damages, and possible health hazards. Conversely, for

[18] Furthermore, inspection of green-power programs certified by Green-e (https://www.green-e.org) and listed on their website reveals that most programs advertise a price premium of the green plan in the range of $5-$15/month, with an estimated base rate of $100/month for a standard customer.

[19] Our main-effects, full factorial design, consisted of $3 \times 5 \times 5 = 75$ choice sets, which included the three price premiums and five possible price-volatility levels for each of the plans as described in Footnote 15. The FACTEX and OPTEX procedures in SAS v9.4 were used to generate the orthogonal, fractional factorial design.

the green plan, the information statements about the advantages include: its non-depleting nature, its non-emission of greenhouse gases or other air pollutants, its reduced dependence on foreign oil trade, and its non-dependence on fresh water resources; the corresponding disadvantageous statements include: its intermittency, its large land requirements that can disturb ecosystems, its difficulty to store, and its relative inefficiency and higher cost. Lastly, we also had a baseline, *neutral* information condition, where respondents were presented with *six* generic statements about energy and electricity including: average electricity usage per household, transmission and distribution, and prices.

We implemented a between-groups design where respondents were randomly assigned to one of the following nine treatments, which include the eight possible combinations that span the different information conditions that could be presented plus a baseline information condition:

Baseline: Given neutral information about electricity

Positive Green (PosGreen): Given information on advantages of green plan

Negative Green (NegGreen): Given information on disadvantages of green plan

Positive Gray (PosGray): Given information on advantages of gray plan

Negative Gray (NegGray): Given information on disadvantages of gray plan

Positive Green + Negative Gray (PosGreen+NegGray): Given information on advantages of green plan *and* disadvantages of gray plan

Negative Green + Positive Gray (NegGreen+PosGray): Given information on disadvantages of green plan *and* advantages of gray plan

Positive Green + Positive Gray (PosGreen+PosGray): Given information on advantages of green plan *and* advantages of gray plan

Negative Green + Negative Gray (NegGreen+NegGray): Given information on disadvantages of green plan *and* the disadvantages of gray plan

The *Baseline* condition establishes the benchmark level of green plan adoption in our sample, around which we can then evaluate the effect of the informational nudge conditions on the adoption rate of the green plan. The four single information conditions–*PosGreen, NegGreen, PosGray, NegGray*–allow us to investigate the impact of providing targeted information on the attributes of the generating source of energy for one plan. Intuitively, the *PosGreen* and *NegGray* conditions are "pro-green" nudges that are targeted toward promoting the adoption of the green plan. Conversely, the *NegGreen* and *PosGray* conditions are "pro-gray" nudges that are targeted toward promoting the adoption of the gray plan. In terms of the four dual information conditions–*PosGreen+NegGray, NegGreen+PosGray, PosGreen+PosGray, NegGreen+NegGray*–we are interested in how providing information on the attributes of both plans impacts adoption of the green plan. Specifically, for the *PosGreen+NegGray* condition, is there a cumulative pro-green nudge effect that may increase green plan adoption relatively more than just the *PosGreen* or *NegGray* conditions. Likewise, for the *NegGreen+PosGray,* is there a cumulative pro-gray nudge effect that may decrease the adoption of the green plan relatively more than just the *NegGreen* or *PosGray* conditions. For completeness of the factorial design, the *PosGreen+PosGray* and *NegGreen+NegGray* conditions enable us to explore how "ambiguous" informational nudges impact choices. Namely, if we promote the advantages of both the green and gray plans, as in *PosGreen+PosGray,* then what will be the net effect on green plan adoption; similarly, if we promote the disadvantages of both the green and gray plans, as in *NegGreen+NegGray,* then what will be the net effect on green plan adoption.

We acknowledge that the six statements presented likely do not describe all attributes associated with electricity production from the given source. That said, our aim was to provide information that highlighted either the possible advantages or disadvantages of electricity generation from renewable green power generation or conventional gray power generation; moreover, we included information about several different attribute domains. As such, we can gain insights into how either the promotion of the green plan and/or dissuasion of the gray plan (and vice versa) impacts the overall adoption of voluntary green-power plans. Importantly, by also varying the price premium of the green plan across choices, we are able to compare the magnitude of the information effects relative to the magnitude of the price impacts.

3.3 Information Manipulation Check

It is important to first verify that the information conditions impacted perceptions of the plans in the intended ways. To do so, we recruited an independent student sample of 136 respondents (who did not participate in the choice survey) to evaluate the statements. A detailed description of the procedure and additional results are presented in Supplemental Appendix C.

For the six neutral statements that comprised the *Baseline* condition, we asked respondents to rate whether each statement supported conventional, hydro-carbon electricity or renewable, green energy. Responses where on a 7-point Likert scale (1=supporting hydro-carbon electricity; 4=neutral; 7=supporting green electricity). For each respondent we averaged their responses over the six statements to generate a composite rating of the block of statements; the mean composite was 3.63 and the median was 3.83, suggesting that these six statements pertaining to general electricity facts were indeed viewed as being relatively neutral, as intended.

We implemented a similar approach for validating the information statements pertaining the green and gray plans. Participants were either presented with all the information statements about the green plan or the gray plans (in random order), and then asked indicate where the statement was a positive or negative property. Responses where, again, on a 7-point Likert scale (1=very negative; 7=very positive). For the green plan, the six statements that comprised the *PosGreen* condition had an average composite rating of 5.70, while the six statements that comprised the *NegGreen* condition had an average rating of 2.90. Importantly, these averages are both significantly different from the neutral scale rating of 4 ($p < .001$ in both instances). For the gray plan, the six statements that comprised the *PosGray* condition had an average composite rating of 5.41, while the six statements that comprised the *NegGreen* condition had an average rating of 2.33. Again, both of these average measures are significant different from the neutral scale rating of 4 ($p < .001$ in both instances).

Based on the responses from the sample of independent evaluators, the information manipulations were effective at conveying the desired information. Namely, the set of information statements aimed at promoting the advantages of the green plan or the gray plan were, in fact, evaluated positively. On the other hand, the set of information statements aimed at promoting the disadvantages of green plan or the gray plan were, in fact, evaluated negatively.

3.4 Participant Sampling

Our survey utilized two distinct samples, totaling 1,838 respondents. The first sample is a representative panel generated by Qualtrics Panels, LLC. For this sample, we restricted participation eligibility to individuals responsible for paying their electricity bill. After the initial screening, this sample consisted of 1,150 respondents: 69% of the sample was female, the age profile was essentially normally distributed with a median age range of 35-44 years, and over 900 distinct zip codes were reported. All participants who completed the survey were compensated directly by Qualtrics (79% overall response rate). The second sample consists of business school students. Participants were recruited via email from a large database of students who enroll to participate in research studies.[20] A total of 688 students completed the survey: 50% of the sample was female, and the median age range was 18-24 years. The students were not required to be responsible for paying their own electricity bill, although we did ask respondents this question, and 64% indicated in the affirmative.

Considering a separate student sample, in addition to a more representative sample of adult utility customers, is useful for several reasons. Most notably, students represent the next generation of electric utility consumers; hence, better understanding their (potentially different) attitudes and behavior toward green-power adoption, as well as the factors that can influence their energy choices, is crucial for informing policy aimed at stimulating the adoption of green-power alternatives and predicting future

[20] This subject pool utilizes a research credit system, whereby participants receive research credits for participating in research studies. These credits count toward satisfying requirements in the specific classes that they are enrolled in. The research pool system offers non-research alternatives, so participation remains voluntary. In essence, the research credit acts as compensation in same way paying a fixed monetary amount to survey respondents would do.

trends of residential electricity consumption. Moreover, Gossling et al. (2005) document evidence that students generally have a positive attitude toward green power, which suggests that they may be the population most likely to consider green- power alternatives. Relatedly, Mills & Schleich (2012) find that university education increases the stated importance of energy conservation. Therefore, students might be the most susceptible to information nudges aimed at promoting the adoption of green power. That said, using only a student sample may overstate preference for green power and, possibly, bias the estimates of the overall information effect. Together, the results from the student sample combined with the Qualtrics panel provide more robust inferences regarding the impact of providing informational nudges on the adoption of voluntary green-power plans.

4 Results

For each respondent, we observe their preferred plan choice for each of the 12 choice sets.[21] All respondents were treated with one of the nine possible information conditions outlined in Section 3.2. Our primary focus is on estimating how these informational nudges impact the respondents' choice of the green plan and, moreover, how the magnitude of these effects compare to the estimated effect of changes in the green price premium.

4.1 Comparison of Qualtrics Panel Sample and Student Sample

Recall, our survey utilized two distinct samples: (i) a representative Qualtrics panel of 1,150 respondents, and (ii) the RSRP student sample of 688 respondents. We first compare response behavior across the two samples. Aggregated over all choices, respondents from the Qualtrics panel chose the green plan 36.9% of the time, while respondents from the RSRP student sample chose the green plan 37.3% of the time; this difference is not statistically different (t-test: p = .773).[22] In addition, a factorial ANOVA reveals no significant main effect of the RSRP student sample (p = .807) or interaction between the student sample and the information condition (p = .516) on green plan choice. In our view, this is sufficient to conclude that there are no concerning sample differences with regard to respondent behavior. As a result, we pool the data across both samples for the remainder of the analysis to provide

[21] As part of IRB compliance, we did not implement forced response. As such, it was possible for respondents to not make a selection in all 12 choice sets. However, 94% of respondents did make a selection in all 12 choice sets. Because of the small fraction of non-responses, we end up with slightly fewer (21,384) observed choices than the total number of all choices sets (1,838 X 12 = 22,056). We include all choice observations in the data, although our results are robust if we include only those respondents that answered all 12 choice sets.

[22] Because each subject makes multiple plan choices, we create a subject-level measure that is simply the proportion of choices for the green plan. When necessary, all statistical testing in the remainder of the analysis is performed using this conservative, subject-level measure of green plan choice, which ensures independence of observations across each information condition. However, if we assume independence of all choices, a Chi-squared test similarly reveals no significant difference in green plan choices across the two samples (p = .538).

a larger sample size, additional power, and more robust inference regarding the main results that are gleaned from the response data; when appropriate we control for sample in all regression analysis.[23]

4.2 Overall Effect of Information Manipulation on Green Plan Choice

We proceed by examining the effect of the information conditions on respondents' decisions to adopt the green plan. Figure 2 displays the overall impact of the pre-choice, information intervention by plotting the aggregate percentage of green plan choices across the different information conditions (with error bars representing 95% confidence intervals of the mean). The information conditions are grouped into pro-green (*PosGreen*, *NegGray*, *PosGreen+NegGray*), pro-gray (*NegGreen*, *PosGray*, *NegGreen+PosGray*), and ambiguous (*PosGreen+PosGray*, *NegGreen+NegGray*) categories. Everything is in reference to the *Baseline* information condition, which resulted in an aggregate green plan adoption rate of 36.2%. Several interesting patterns in the data emerge from Figure 2. Importantly, there are clear impacts of the information conditions on the adoption of the green plan, which are jointly significantly different (ANOVA: $p < .001$).

[Insert Figure 2: Impact of Information Conditions on Adoption of Green-power Plan]

Looking first at the pro-green information conditions, we see from Figure 2 that all three conditions increased the adoption of the green plan. Specifically, 43.7% of choices were for the green plan in the *PosGreen* condition, 45.6% in the *NegGray* condition, and 42.7% in the *PosGreen+NegGray* condition. Comparing to the *Baseline* rate of 36.2%, all three pro-green conditions yield a significantly higher adoption rate of the green plan (p = .002, p = .003, p = .031, respectively). Moreover, the difference in the proportion of green plan choices between the *PosGreen* and *NegGray* conditions is small and insignificant (p = .664), suggesting that both are similar in their effectiveness. Lastly, the proportion of green-plan choices in the *PosGreen+NegGray* is very similar to the *PosGreen* and *NegGray* conditions, which suggests little evidence of a cumulative information effect.

In terms of the three pro-gray conditions, those intended to promote the advantages of the gray plan and/or the disadvantages of the green plan, we see that each decreased the adoption of the green plan (i.e., increased the adoption of the gray plan). The proportion of choices for the green plan were 29.6% in the *NegGreen* condition, 32.1% in the *PosGray* condition, and 28.9% in the *NegGreen+PosGray* condition, although, only *NegGreen* and *NegGreen+PosGray* are significantly different from the *Baseline* of 36.2% (p = .042, p = .032, respectively). Similar to the pattern that emerged with the pro-green condition, we see little difference between the *NegGreen* and *PosGray* conditions (p = .580).

[23] All our main results regarding the impact of the information conditions on green plan choice are qualitatively robust is we analyze each of the two samples separately. Hence for brevity we report the pooled results.

Likewise, there appears to be little cumulative pro-gray information effect, if any, as the proportion of green choices in the *NegGreen+PosGray* is not significantly different from either the *NegGreen* (p = .595), or the *PosGray* (p = .381) conditions.

Lastly, we examine the two ambiguous information conditions – *PosGreen+PosGray* and *NegGreen+NegGray*. From the right two bars in Figure 2, we see that the proportion of green plan choices was 39.7% in the *PosGreen+PosGray* condition and 34.6% in the *NegGreen+NegGray* condition. Neither of these are different from the *Baseline* (p = .203, p = .733, respectively), nor from each other (p = .159). Thus, as we would expect, providing an ambiguous nudge seems to have little effect on the decision to adopt the green-power plan.

To more rigorously examine the impact of information on respondents' propensity to adopt the green plan, we estimate a logistic regression model with green plan choice as the binary dependent variable. The logistic regression enables us to directly estimate the impact of the information conditions, price-premium, and other socio-demographic variables on the likelihood that the green plan is chosen. To account for the possible serial correlation stemming from the fact that each respondent made multiple plan choices, we clustered standard errors at the respondent level. Table 1 presents the results for several different specifications.[24] In each specification, we include eight indicator variables for the treated information conditions, relative to the *Baseline* condition as the excluded condition. We report marginal effects for the model evaluated at the means of each variable. We include an indicator RSRP=1 for respondents in the RSRP student sample to control for any possible sample differences; however, as seen in Table 1, the RSRP indicator is insignificant in all specifications, further supporting our claim that there are no substantial subject pool differences in responses.

[Insert Table 1: Estimated Logit Model with Green Plan Choice as Dependent Variable]

Looking at Table 1, we see that the estimated information effects generally mirror those depicted in Figure 2. The three pro-green conditions – *PosGreen, NegGray, PosGreen+NegGray* – all have a positive and statistically significant effect on green plan choice (column 1); moreover, this effect is stable and robust after controlling for a host of respondent characteristics (column 2) as well as the price premium associated with the green plan (columns 3 and 4). In terms of the magnitudes of the effects, the estimated marginal effects for these pro-green conditions in the full model (column 4) range from .058 (for *PosGreen+NegGray*) to .078 (for *PosGreen*). None of the estimated effects across these pro-green

[24] We present the results from a logit model with clustered standard errors at the respondent level as our preferred specification, as it allows us to include socio-demographic variables as controls (which do not vary over choices at the individual level). However, our main results regarding the impact of price volatility and price dispersion are robust to alternative specifications, including a probit model and linear probability model. Our main results are also robust and stable if we alternatively estimate a random effects logit, or to the inclusion of respondent fixed effects.

conditions are significantly different from each other, suggesting similar effectiveness. Our data indicate that nudging respondents by providing information on the advantages of green electricity production and/or the disadvantages of gray electricity production increases adoption of the green plan by as much as 7.8 percentage points relative to the *Baseline* condition of neutral information, which corresponded to a roughly 22% increase from the *Baseline* rate.

In terms of the pro-gray conditions – *NegGreen, PosGray, NegGreen+PosGray* – Table 1 reveals that all three have a negative impact on green plan choice, although this estimated effect is significant only for the *NegGreen* and *NegGreen+PosGray* conditions (column 1); furthermore, this pattern is robust across the inclusion of respondent characteristic controls and the price premium (columns 2-4). The magnitude of the estimated marginal effects from the full model in column 4 are -.052 for *NegGreen* and -.077 for *NegGreen+PosGray* (not significantly different from each other). Thus, nudging respondents with negative information about green electricity and positive information about gray electricity decreases take-up of the green plan by as much as 7.7 percentage points relative to the *Baseline* condition, which corresponds to a roughly 21% decrease from the *Baseline* rate.

Table 1 reveals no significant impact of the two ambiguous conditions – *PosGreen+PosGray, NegGreen+NegGray* – on the decision to choose the green plan, which is consistent with the aggregate results depicted in Figure 2. Thus, providing respondents with opposing information about either the advantages or disadvantages associated with both green and gray electricity production doesn't appear to largely impact green plan adoption, as expected.

Conventional economic theory as well as prior research suggests that the price premium associated with the green plan should be an important determinant in the decision to adopt the green plan, and our data confirm this to be true. Namely, from columns 2 and 4 of Table 1, we see that the *$10 price premium* and *$15 price premium* indicators both have large and significant negative impacts on green plan choice. The estimated marginal effects imply that moving from a $5/month price premium to a $10/month price premium reduces the likelihood of selecting the green plan by 10.9 percentage points, while moving to a $15/month price premium reduces the likelihood by 23.1 percentage points. Assuming linearity in the price effect, this implies that each $1 increase in the monthly price premium of the green plan reduced take-up of the green plan by roughly 2 percentage points.

Lastly, we briefly report on the results regarding the respondent characteristics included as controls in Table 1. Of the included demographic variables – *male, education, income,* and *children* – only *education* and *children* have significant effects; namely, higher levels of self-reported education are associated with an increase in green plan selection, while respondents who report having children are less likely to adopt the green plan. Not surprisingly, respondents who reported being enrolled in a plan where at least some of the electricity is generated from a green source, *green plan customer*, are significantly more likely to adopt the green plan. Consistent with prior studies mentioned in Section 2, we do find that pro-environmental attitudes positively relate to choosing the green plan. To generally measure pro-environmental attitudes, we include the score for the New Ecological Paradigm, *NEP scale,* and this measure enters positively and is statistically significant. We also include a more specific Likert-scale measure of the importance that electricity be generated in a renewable manner, *green electricity*. This measure also has a positive and significant effect on green plan choice; as we would expect, respondents who think renewable electricity is important are more likely to choose the green plan, all else equal.

While the price difference between the green and gray plans is clearly important in explaining the selection of the green plan, our results suggest that providing information about the attributes of the electricity-generating source also impacts choice.[25] Importantly, our data enable us to compare the magnitude of the information nudges relative to the magnitude of the green price effect. In particular, providing pro-green nudges about the advantages of green electricity production or disadvantages of gray electricity production increases adoption of the green plan by as much as 7.8 percentage points, while opposite pro-gray nudges can decrease green plan adoption by as much as 7.7 percentage points. To put this in relative context, these estimated effects are roughly equivalent in magnitude to the effect of a $4/month change in the price of the green plan.

4.3 Price Premium and Response to Information

Next, we examine if, and to what extent, the magnitude of the price premium of the green plan impacts how people respond to the information nudges. To do so, we disaggregate the choice data by price premium and compare green plan adoption across information conditions. For brevity, we focus specifically on the comparison between the lowest price premium ($5/month) and highest price premium ($15/month). Figure 3 separately displays the aggregate percentage of the green plan choice across information conditions for the $5 (Panel A) and $15 (Panel B) price premiums (with error bars representing 95% confidence intervals of the mean). From Figure 3, some key differences emerge between the $5 and $15 price premiums. A factorial ANOVA reveals a highly significant main effect of

[25] As part of the post-survey questionnaire, we asked participants if their current electric utility uses any green energy sources. Of the 1,838 total respondents, 308 (16.8%) reported *Yes.* It is reasonable to think that some, if not all, of these respondents received information about the advantages of green energy and/disadvantages of gray energy from their utility. As such, the information intervention in this study might have been less effective on this subgroup. Importantly, however, our main results regarding the aggregate impact of the information conditions on green plan adoption are robust if we exclude the 308 respondents whose current utility uses green energy; Supplemental Appendix D re-produces Figure 2 excluding all choices made these 308 respondents. From the figure, we see that the baseline rate of green plan choice is essentially unchanged (35.1%), and the change in green plan adoption associated with the other eight main information condition essentially mirrors those in Figure 2 for the entire sample.

price premium (p < .001) and information condition (p < .001), as well as a significant interaction between the premium and the information condition (p < .001) on green plan choice. In Table 2, we separately report the results for the full logistic regression of green plan choice for $5, $10, and $15 price premium levels.

[Insert Figure 3: Impact of Information Conditions by Price Premium]

Comparing between the $5 price premium and $15 price premium, we see some differences emerge in terms of the effectiveness of positive versus negative information. In particular, when the premium is $15, respondents seem to be relatively more responsive to the negative information (in both the pro-green and pro-gray cases) compared to the corresponding positive information. In the pro-green case, the *NegGray* condition increased choice of the green plan by 10.2 percentage points from the *Baseline*, while the *PosGreen* condition comparably increased choice of the green plan by only 3.9 percentage points; this difference in green plan choice is significant between the *NegGray* and *PosGreen* conditions (p = .007). Moreover, based on the results of the logistic regression reported in Table 2, only the *NegGray* condition significantly increased green plan choice relative to the *Baseline* level at the $15 price premium. Similarly, in the pro-gray case, the *NegGreen* condition decreased choice of the green plan by about 6.8 percentage points from the *Baseline*, while *PosGray* led to essentially no change in choice of green plan; this difference between *NegGreen* and *PosGray* is also significant (p < .001). Again, only the *NegGreen* condition significantly reduced green plan choice relative to the *Baseline* level. Thus, the negative information about either the green plan or the gray plan evokes a stronger behavioral response at the high $15 price premium for the green plan.

[Insert Table 2 – Estimated Logit Model with Green Plan Choice as Dependent Variable by Price Premium]

Conversely, at a $5 price premium, respondents seem to be relatively more responsive to positive information compared to the corresponding negative information. Specifically, in the pro-green case, the *PosGreen* condition increased the choice of green plan by 10.6 percentage points, while the *NegGray* condition increased it by only 5.5 percentage points; this difference between the two conditions is significant (p = .037). Moreover, the logistic regression result in Table 2 reveal that only the *PosGreen* condition significantly increased green plan choice relative to the *Baseline* level at the $5 price premium. A similar pattern emerges for the pro-gray case, where the *PosGray* condition decreased green plan choice by 8.9 percentage points, while *NegGreen* decreased it by only 5.6 percentage points, although this difference between the two is not significant (p = .190). However, only the *PosGray* condition significantly reduced green plan choice relative to the *Baseline*. At the low $5 price premium for the green plan, positive information (especially about the green plan) seems to evoke a stronger response.

Lastly, in the ambiguous case, a similar pattern emerges in the comparison of the *PosGreen+PosGray* and *NegGreen+NegGray* conditions across the low- and high-price premiums. In particular, the *PosGreen+PosGray* condition resulted in relatively more green plan choices compared to the *NegGreen+NegGray* condition for both the low \$5 price premium (p = .025) and the high \$15 price premium (p = .007). Here the data seem to suggest that if respondents receive negative information about both plans, they are more likely to just opt for the cheaper conventional plan compared to receiving positive information about both plans. While there does not appear to be a differential response comparing across the two ambiguous conditions between the low and high price premium, there is a "level effect" that emerges. Specifically, if we consider how behavior changes relative to the *Baseline*, then the two ambiguous nudge conditions result in higher rates of green plan choice at the \$15 price premium compared to the \$5 price premium.

Overall, the data suggest that the cost of the green plan, relative to the gray plan, can be an important factor in determining the differential effectiveness of information nudges. When the voluntary green plan is not *too* expensive, then highlighting the positive attributes of green electricity generation would be most effective in promoting adoption of the green plan. Conversely, if the green plan is relatively expensive, then highlighting the negative aspects of gray electricity generation seems to have more bite; perhaps appealing to some implicit degree of moral wrongdoing by choosing the "bad" gray plan is more effective in overcoming the relatively high price premium of the green plan. The other side of this story is that when the green plan is expensive, then information about the possible disadvantages of renewable electricity can really handicap its adoption; here, it seems people jump at the opportunity to justify not paying the premium for the green plan if the green plan is really "not all that good".

4.4 Respondent Characteristics and Heterogeneous Responses to Information

Table 1 shows that some of the individual respondent characteristics significantly impacted the decision to adopt the green plan. While this direct effect is certainly of interest, it is also important to think about how different "types" of respondents might differentially respond to the information nudges. Specifically, we consider how respondents' level of income, education, and general environmental attitude impact their responses to the information nudge. For both income and education, we classify respondents into two group: (i) *higher* if they are above the median, and (ii) *lower* if they are at or below the median. For environmental attitude, we use the NEP scale and again stratify respondents into two groups based on their score relative to the median; respondents with NEP scores above the median are said to be *more* environmental, and those with NEP scores at or below the median are *less* environmental. Lastly, we also consider whether respondents are enrolled in an existing green plan at their current utility company. To streamline the presentation of the data and analysis, we aggregate over all information conditions within each given nudge condition: pro-green, pro-gray, and ambiguous. Moreover, for this sub-sample analysis, we use only the Qualtrics panel, where we have sufficient variation in respondent characteristics of interest (e.g., income, education, and existing green plan customer) for meaningful analysis.[26] Figure 4 presents the data on green plan choice for each of the three types of information nudges, broken down by respondent characteristics. Because the *Baseline* level of green plan choice differs based on how respondents are categorized (e.g., *more* environmental vs. *less* environmental), Figure 4 reports the *% change* in aggregate green plan choice, relative to the corresponding *Baseline* level. We also perform sub-sample analysis, and the logistic regression results of green plan choice for each sub-sample are reported in Supplemental Appendix D.

[Insert Figure 4: Impact of Information Conditions by Respondent Characteristics]

Looking first at respondent income, Panel A of Figure 4 reveals very little difference in how lower- and higher-income respondents are affected by the information intervention. Both income groups show a large positive response to the pro-green information conditions, a large negative response to the pro-gray conditions, and a small positive response to the ambiguous conditions. There is a significant main effect of information condition (ANOVA: $p < .001$), but the interaction between information condition and income is not significant (ANOVA: $p = .578$). So while higher-income respondents may be more inclined to purchase the green plan, there is little statistical evidence that higher-income respondents *differentially* react to information. Looking next at education level, Panel B reveals some differences in how more-educated respondents react to the information intervention compared to less-educated respondents. Indeed, there is a significant main effect of education (ANOVA: $p < .001$), and interaction between education and information condition (ANOVA: $p < .001$). In particular, we see that more-educated respondents are relatively more likely to choose the green plan after receiving the pro-green information, while less-educated respondents are much less likely to choose the green plan after receiving the pro-gray information. Moreover, more-educated respondents seem to view the ambiguous information as supporting green-power and, consequently, significantly increase their adoption of the green plan after receiving the ambiguous information. Possibly one way to interpret this is that less-educated respondents are more *skeptical* or cautious regarding green-power; hence, they do not show as large of a positive response to pro-green nudges, show a much larger negative response to the pro-gray nudges, and also negatively respond to the ambiguous nudges.

[26] Not surprisingly, the majority of the student sample have very low incomes and, by construction, have roughly the same level of education. Moreover, the local electric utility that provides electricity to the bulk of these students does not offer a green plan; thus, only 16 student respondents reported being existing green plan customers.

Panel C of Figure 4 compares how respondents with different environmental attitudes respond to the information. It is evident that environmental attitudes (as measured by the NEP scale) impact how the information intervention impacts green plan choice; there is a significant main effect of environmental attitude (ANOVA: $p < .001$), and interaction effect of environmental attitude and information condition (ANOVA: $p < .001$) on green plan choice. Specifically, less-pro-environmental respondents are more responsive to the pro-green information and show a larger increase in green plan adoption, compared to the more-pro-environmental respondents. However, the opposite is true for the pro-gray information. Namely, more-pro-environmental respondents exhibit a stronger negative response to the pro-gray conditions. The intuition here is that individuals who are more concerned about the environment are less likely to be influenced by pro-green information, as this information likely just confirms their existing beliefs. At the same time, individuals with more concern for the environment are more responsive to pro-gray information; if it is revealed that the gray plan is not that bad or the green plan is not that good, the more-pro-environmental respondents exhibit a larger decrease in green plan adoption.[27]

Lastly, Panel D of Figure 4 compares the behavior of existing green plan customers versus non-existing green plan customers. Importantly, we see a significant difference in how these two groups react to the information intervention (ANOVA: $p < .001$). As we would expect, existing green plan customers are much less responsive to both the pro-green and pro-gray information interventions, in that neither appear to impact the green plan adoption rates for the existing green plan customers. Conversely, the non-existing green plan customers show a large positive response to the pro-green conditions and a large negative response to the pro-gray conditions. The main implication here is that individuals who are not existing green plan customers are much more "nudge-able" in that their behavior is more influenced by the pre-choice, information intervention.

5 Discussion and Conclusions

There is a global concerted effort, especially from regulating bodies, to promote growth in renewable energy. Furthermore, residential electricity usage accounts for a sizable share of overall energy demand. As such, deepening our understanding of the possible factors that can influence consumers' attitudes and choices to adopt voluntary green-power plans versus conventional, hydro-carbon plans is critically important to the progression of renewable energy and the evolution of energy production and

[27] As expected, the more-environmental respondents have a much higher Baseline level of green plan adoption (45%) compared to the less-environmental respondents (30%). However, even if we consider absolute changes from the baseline, a similar result emerges. Namely, the pro-green information results in only a 4 percentage point increase in green plan adoption for more-environmental sample compared to an 11 percentage point increase for the less-environmental sample. Correspondingly, the pro-gray information results in a 14 percentage point decrease in green plan adoption for the more-environmental sample compared to only a 3 percentage point reduction for the less-environmental sample.

consumption. The aim of this study is to contribute to this understanding by examining how non-price, information nudges impact residential consumers' preferences for adopting voluntary green-power plan.

In particular, we carry out a choice experiment where respondents choose between a conventional *gray-power plan* (e.g., electricity generated from coal or natural gas) and a renewable *green-power plan* (e.g., electricity generated from wind or solar). Prior to making their plan selections, we implement an information intervention. Specifically, we systematically vary whether respondents receive: (i) a *pro-green* information nudge, where they receive information about the advantages of green power and/or the disadvantages of gray power, or (ii) a *pro-gray* nudge, where they receive information about the disadvantages of green power and/or the advantages of gray power. Based on the observed choice data, we are able to identify how these information interventions impact reported adoption rates of the green plan relative to a *baseline* rate of adoption. Importantly, we also systematically vary the green-price premium across choice sets, which enables us to compare the magnitude of the information effects relative to the magnitude of the price effect.

Based on the results from over 1,800 respondents and 21,000 plan choice scenarios, we document sizable and statistically significant effects of the information interventions on adoption rates of the green plan. Notably, the pro-green information nudges increase green plan choice by 6-8 percentage points, relative to the 36% baseline rate of adoption. Conversely, the pro-gray information nudges decrease green plan choice by 5-8 percentage points relative to the baseline. Based on our estimates of the magnitude of the price effect, the magnitude of the information nudges are roughly proportion to a change in the green plan price premium of \$3-\$4 per month. Moreover, our results are generally robust across different levels of price premium for the green plan. Although, at a relatively low green-plan premium (\$5/month), we find that positive information about the green plan is more effective at promoting green plan adoption compared to negative information about the gray plan. Whereas, at a relatively high premium (\$15/month), we find that negative information about the gray plan is much more effective at increasing green-plan choice compared to positive information about the green plan. Additionally, at the high price premium, negative information about the green plan results in a much larger decrease in green plan adoption relative to positive information about the gray plan.

Given the hypothetical nature of the choice experiment, it is possible that there is some reporting bias and/or experimenter demand effects in the stated preferences to adopt the green plan; presumably in the direction of higher levels of green plan adoption. Thus, as a disclaimer, some caution needs to be taken when interpreting treatment effects associated with the information nudges. Importantly, however, we identify our main information treatments effects relative to a baseline level of green plan adoption where neutral information was provided. Therefore, if we make the reasonable assumption that any green bias (if it exists) is uncorrelated with the information interventions, our estimated treatment effects relative to the baseline remain valid. Moreover, by varying price premium of the green plan in this hypothetical choice setting, we have a way to interpret the magnitude of the information effects *relative* to the price effect. As such, even if the absolute size of the information effects are possibly inflated, our result suggest that information nudges can sizably impact green plan adoption in relative comparison to reasonably sized changes in the green price premium.

Overall, we view our study as contributing to and extending the extant literature aimed at identifying the possible factors that influence consumers' decisions to adopt green-power plans. Much of this prior literature has focused on price of the green plan or other conventional economic levers; namely, lowering the price of the green plan or raising the incentive to adopt the green plan will increase demand for the green plan. While prices and incentives are important determinants, they alone deliver an incomplete view. Our results suggest that non-price interventions can also play an important role. Specifically, nudging people by providing information (pre-choice) about the advantageous and/or disadvantageous attributes of electricity generation associated with green and gray plans can significantly impact demand for voluntary green-power plans. From a descriptive perspective, our results can be informative for better understanding the possible factors that can impact growth of renewable energy and the overall electricity generation moving forward.

The results from our study have important green-power marketing implications. Namely, a plausible mechanism that electric utilities could use to increase the take-up rate of voluntary green-power plans is the provision of beneficial attributes associated with renewable electricity generation. Dagher et al. (2017) find that take-up of green-power plans is lower for new subscribers compared to existing customers. The findings from our study suggest that when marketing to new customers, utilities can "nudge" new customers to adopt the green plan by providing salient information about the benefits of the green plan. Relatedly, our results further suggest that such information nudges would be more effective if utilities target people who are not already green power customers. Alternatively, this could also cut the other way with utility companies being able to discourage customers from switching to an alternative green plan through pro-gray nudges. Regardless, our study suggests that this type of pre-selection, information intervention can be a useful strategy for utilities to steer new customers toward the most profitable plans. As renewable electricity generation becomes cheaper, via increasing efficiency from advancements in renewable energy technologies, this strategy would imply steering customers toward the green plans.

Our study can also be informative for renewable energy policy. Sustaining continued growth in renewable energy technology and production infrastructure hinges on continued increases in consumer demand for green products. Among these, increasing the demand for residential, green electric power can be impactful for increasing overall renewable energy production as a share of total energy production. Our results suggest that policies aimed at providing more salient information about the environmental and social benefits of green-power generation, and/or the costs of gray-power generation could increase adoption of voluntary green-power plans, thus stimulating overall growth in the renewable energy sector. An example would be to mandate that electric utilities provide (transparent) information disclosures of energy generating sources and the associated environmental impacts. In essence, mandating a type of "eco-labeling" for electric utility plans could increase take-up of green-power plans in the same way eco-labeling has promoted adoption of more energy-efficient durable goods. Moreover, promoting residential adoption of green-power plans through such information nudging might be preferred to conventional economic polices (e.g., subsidies, tax breaks, mandates) since nudges have the (desirable) property of being libertarian or choice-preserving. Furthermore, using information nudges to motivate people to choose green plans might be aligning choices more in the direction of people's preferences for greater reliance on renewable energy; in this sense, such nudges would fall under the category of being libertarian paternalistic (Thaler & Sunstein, 2008).

More generally, non-price nudges have been touted by many academics, practitioners, and policy makers as effective instruments for shaping behavior. Compared to conventional economic policies, nudges typically involve much lower costs. Case in point, various types of nudges (e.g., usage feedback, peer comparisons, social norms, and moral suasion) have been shown to be, at least mildly, effective in promoting energy conservation. Viewed through a broader lens, these conservation nudges are often regarded as being useful from a pro-environmental and sustainability standpoint. That said, recent work by Allcott & Kessler (2018) and Allcott & Greenstone (2017) suggests that there can be *indirect* costs associated with nudging conservation that are incurred when people change their behavior, which are typically not accounted for in welfare analysis of such non-price interventions. However, we argue that when it comes to electric power-plan choice, there are likely to be small (and possibly zero) indirect costs associated with choosing a green plan over a conventional plan (because from the perspective of the residential customer, once they choose the plan, their actual usage behavior is presumably not impacted by how the energy is being generated). We conclude by positing that nudging the "upstream" decision of consumers to adopt voluntary green-power plans might be a more attractive means for promoting the broader pro-environmental/sustainability energy agenda. Thus, from a welfare perspective, if we want to reduce greenhouse gas emissions and make improvements on climate change, we might be better served focusing on using nudges to motivate people to adopt voluntary green-power plans as opposed to trying to get them to conserve conventional hydro-carbon power.

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Figure 1: Sample Choice Scenario

PLAN A – CONVENTIONAL ELECTRICITY		PLAN B – GREEN ELECTRICITY	
Generating Source: Coal or Natural Gas		Generating Source: Wind or Solar	
Possible Monthly Price	**Chance of Price**	**Possible Monthly Price**	**Chance of Price**
$93	15%	$98	10%
$100	70%	$108	80%
$107	15%	$118	10%
Average Expected Monthly Price: $100		**Average Expected Monthly Price: $108**	

Figure 2: Impact of Information Conditions on Adoption of Green-power Plan

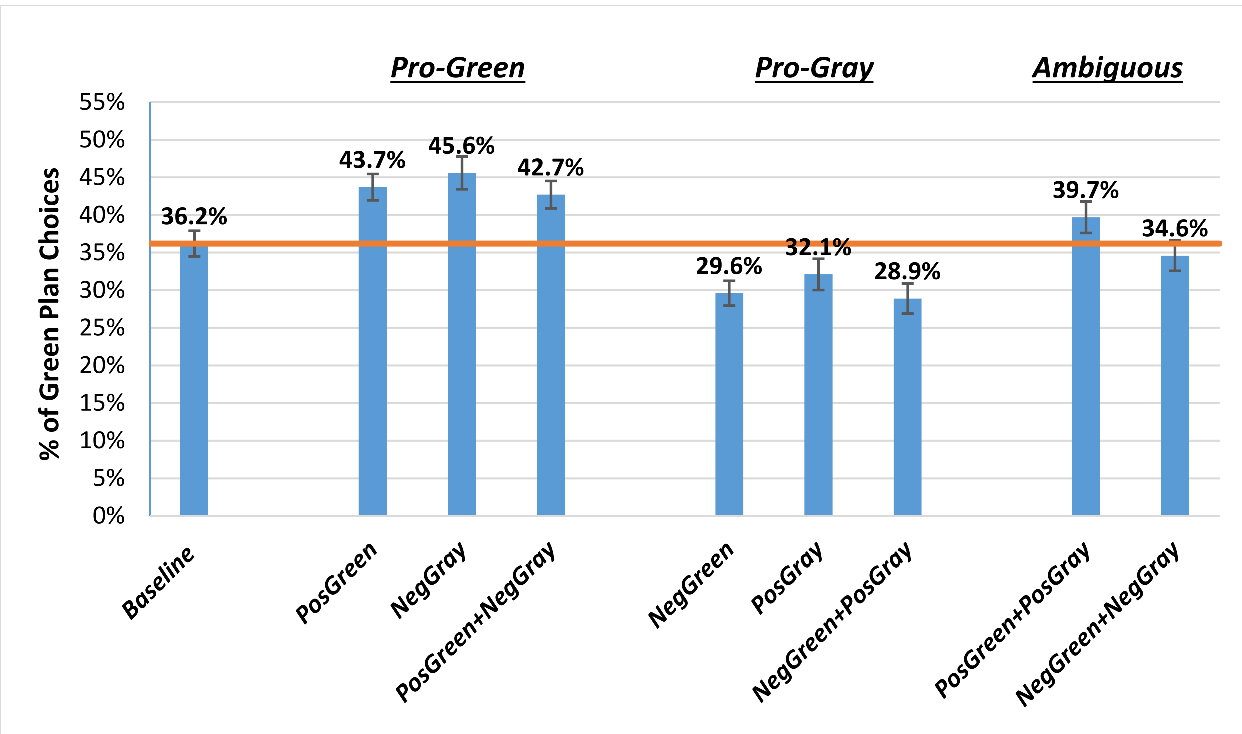


Figure 3: Impact of Information Conditions by Price Premium

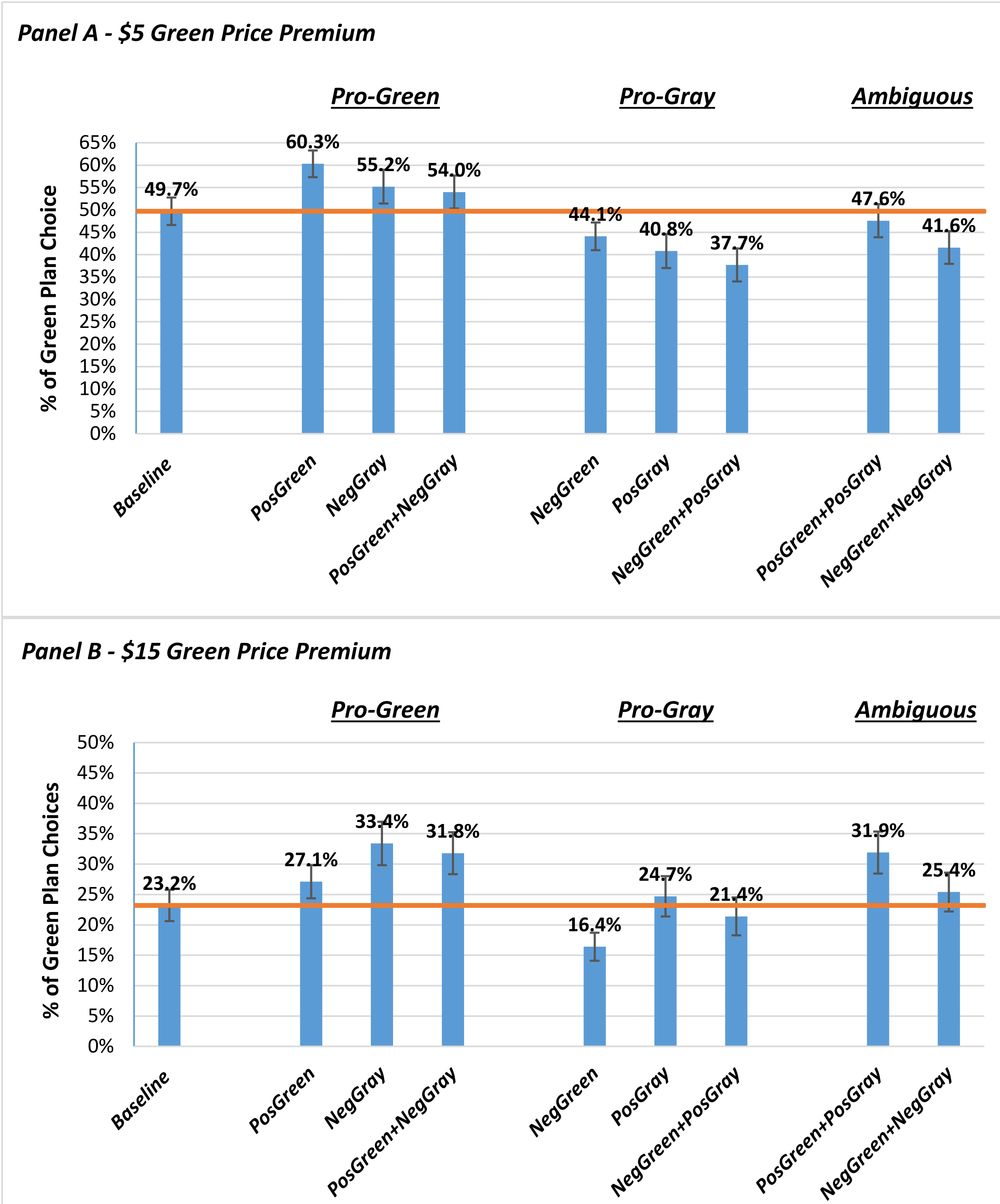


Figure 4: Impact of Information Conditions by Respondent Characteristics

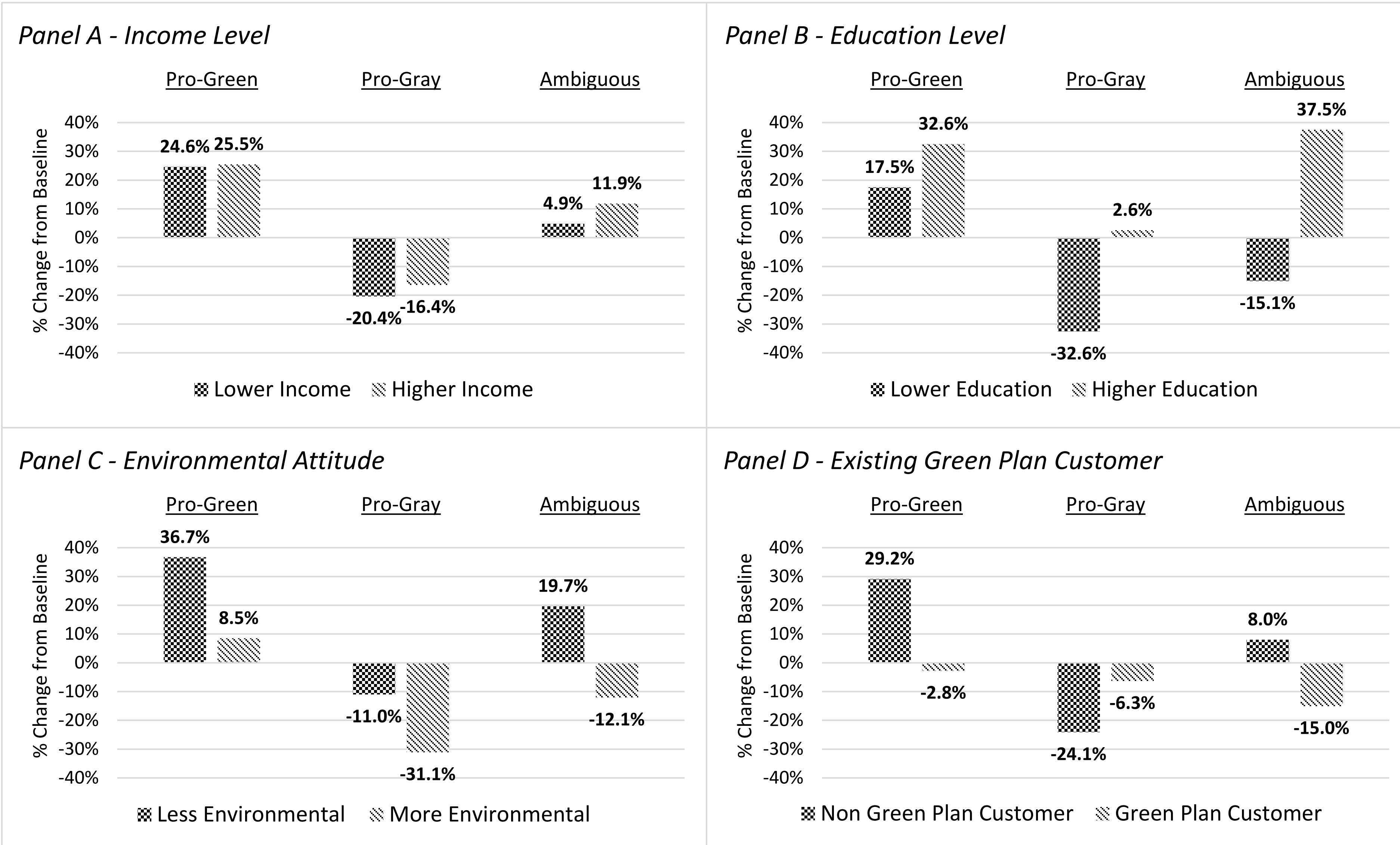


Table 1 – Logit Models with Green Plan Choice as Dependent Variable

	Dependent Variable: *Green Plan Choice*			
	1	2	3	4
PosGreen	.073***	.078***	.073***	.078***
	(.027)	(.025)	(.027)	(.025)
NegGray	.092***	.076**	.092***	.076**
	(.033)	(.032)	(.033)	(.032)
PosGreen+NegGray	.065**	.058*	.065**	.058*
	(.032)	(.031)	(.032)	(.031)
NegGreen	-.069***	-.052**	-.069***	-.052**
	(.026)	(.025)	(.026)	(.025)
PosGray	-.039	-.040	-.039	-.040
	(.034)	(.032)	(.034)	(.032)
NegGreen+PosGray	-.074**	-.077**	-.074**	-.077**
	(.034)	(.032)	(.034)	(.032)
PosGreen+PosGray	.037	.033	.037	.033
	(.032)	(.031)	(.032)	(.031)
NegGreen+NegGray	-.012	-.012	-.013	-.012
	(.032)	(.031)	(.032)	(.031)
$10 Price Premium			-.109***	-.109***
			(.006)	(.006)
$15 Price Premium			-.231***	-.231***
			(.008)	(.008)
Male		-.013		-.013
		(.016)		(.016)
Education		.016***		.016***
		(.006)		(.006)
Income		.005		.005
		(.004)		(.005)
Children		-.045**		-.045**
		(.022)		(.022)
Green Plan Customer		.050**		.050**
		(.025)		(.025)
NEP Scale		.002**		.002**
		(.001)		(.001)
Green Electricity		.080***		.080***
		(.010)		(.009)
RSRP	.008	-.007	.008	-.006
	(.016)	(.020)	(.016)	(.020)
Block Dummies	Yes	Yes	Yes	Yes
Respondent Clustering	Yes	Yes	Yes	Yes
N	21,384	21,258	21,384	21,258

Notes: This table reports the results of a logit regression with green plan choice as the binary dependent variable. Marginal effects are reported with standard errors in parentheses.
*** denotes statistical significance at the 1% level; ** denotes significance at the 5% level.

Table 2 – Logit Models with Green Plan Choice as Dependent Variable (by Price Premium)

	Dependent Variable: *Green Plan Choice*		
	$5 Price Premium	$10 Price Premium	$15 Price Premium
PosGreen	.112***	.084***	.042
	(.032)	(.030)	(.029)
NegGray	.048	.111***	.067**
	(.039)	(.037)	(.034)
PosGreen+NegGray	.046	.064*	.063*
	(.038)	(.035)	(.033)
NegGreen	-.038	-.060**	-.067**
	(.032)	(.031)	(.032)
PosGray	-.082**	-.040	.001
	(.037)	(.037)	(.036)
NegGreen+PosGray	-.111***	-.078**	-.037
	(.039)	(.037)	(.036)
PosGreen+PosGray	-.013	.044	.065**
	(.037)	(.035)	(.033)
NegGreen+NegGray	-.066*	.022	.008
	(.038)	(.035)	(.034)
Respondent Controls	Yes	Yes	Yes
Block Dummies	Yes	Yes	Yes
Respondent Clustering	Yes	Yes	Yes
N	7,096	7,064	7,098

Notes: This table reports the results of a logit regression with green plan choice as the binary dependent variable. Marginal effects are reported with standard errors in parentheses.
*** denotes statistical significance at the 1% level; ** denotes significance at the 5% level.

Appendix A – Price Volatility Manipulations

Price Volatility Manipulation	Possible Monthly Price	Chance of Price	Variance	Range
Low Volatility (LV)	- $5 $0 + $5	5% 90% 5%	2.5	$10
Medium Volatility/Low Dispersion (MV-LD)	- $15 $0 + $15	20% 60% 20%	90	$30
Medium Volatility/High Dispersion (MV-HD)	- $30 $0 + $30	5% 90% 5%	90	$60
High Volatility/Low Dispersion (HV-LD)	- $15 $0 + $15	40% 20% 40%	180	$30
High Volatility/High Dispersion (HV-HD)	- $30 $0 + $30	10% 80% 10%	180	$60

Notes: This table displays the five specific price volatility manipulations we used with the corresponding variance and range of each price distribution, as part of the larger data collection process. All the prices displayed in the table are depicted relative to the expected monthly price of each plan; therefore, changes in the premium of the green plan just shifted the entire price distribution by the amount of the price premium, which does not change the variance or range of the distribution.

Appendix B – Copy of Information Statements

Panel A – Information about Conventional Gray Electricity Generation		
	Advantages	Disadvantages
	• There is an abundance of coal and natural gas • The electricity that is generated is continuous during peak times • It is a relatively cheap and reliable energy source • It is versatile and can be used in a variety of applications and different environments • It is easy to store and transport coal and natural gas to electricity-generating facilities • Modern coal and natural gas power plants are very energy efficient	• Are nonrenewable sources of energy that deplete over time • Emits greenhouse gases into the atmosphere • Emits harmful substances like sulfur dioxide, which can lead to acid rain • Environmental damage is associated with mining coal and obtaining natural gas • Mining coal is dangerous and hazardous to the health of miners • Over 500 gallons of fresh water are used per megawatt hour of electricity generated
Panel B – Information about Renewable Green Electricity Generation		
	Advantages	Disadvantages
	• No limit to the energy sources in the future • Doesn't contribute to greenhouse gas emissions • Doesn't produce air pollution that can be harmful to humans • It is a domestic source of energy, reducing our nation's dependence on trade • It is beneficial to rural economies • Doesn't use freshwater resources	• It doesn't provide a continuous source of electricity (sun doesn't always shine and the wind doesn't always blow) • Requires large areas of land to be disrupted, potentially damaging ecosystems • Often developed long distances from where the electricity is needed, requiring the construction of transmission lines • Difficult to store and transport the energy • Expensive relative to conventional sources • Pollution and emissions are generated during the manufacturing process
Panel C – Information about Electricity Generation		
	Neutral	
	• According to the U.S. Energy Information Administration, the average U.S. household used 11,000 KWh of electricity in 2014 • Space cooling and lighting account for about 25% of the total U.S. residential electricity use • There are more than 450,000 miles of high-voltage transmission lines in the U.S to move electricity from the generating source to the end user • The U.S. EIA estimates that in 2013, 5% of generated electricity was lost in transmission and distribution • The average price for electricity in the U.S. is $0.12 per KWh • The price of electricity varies throughout the day and throughout the year	

Appendix C – Information Intervention Manipulation Check

As part of the experimental design, respondents were provided with information about either: (i) positive or negative information about the gray plan, (ii) positive or negative information about the green plan, (iii) some combination of positive or negative information about both plans, or (iv) neutral information (generic facts about electricity). This information intervention was in the form of a block of six statements pertaining to attributes associated with the electricity generated from the given source. Our aim was to provide information that highlighted either the possible advantages or disadvantages of electricity generation associated with renewable green power generation or conventional gray power generation. The specific statements that were used for each manipulation are presented above in Appendix B. To verify that the collection of statements in each condition incited the desired perception about the corresponding plan, we tested the manipulation on an independent sample (n = 136) of participants drawn from the same business school student population who completed the choice-based experiment (although no respondents participated in both tasks).

We implemented the following survey procedure. All participants were shown the collection of six neutral statements about electricity facts that comprised the *Baseline* condition. There were then instructed to think about whether the statement is supportive of: (i) conventional, hydro-carbon electricity generation (e.g., coal or natural gas), (ii) renewable, green electricity generation (e.g., wind or solar), or (iii) neutral, and then indicate their response on the Likert scale from 1 to 7 provided (1=supporting hydro-carbon electricity; 4=neutral; 7=supporting green electricity). In addition, participants were also shown either all twelve statements pertaining to the green plan (six from *PosGreen* and six from *NegGreen*) or all twelve statement pertaining to the gray plan (six from *PosGray* and six from *NegGray*). They were then instructed to indicated on a Likert scale from 1 to 7 whether each statement was positive or negative (1=very negative; 7=very positive).

Several measures were implemented to minimize order affects. First, we randomized whether respondents rated the six neutral statements first or the twelve gray/green plan statements first. Second, we randomized the order of the twelve gray/green plan statements such that advantageous and disadvantageous statements were mixed together. Third, we considered four different blocks (each with a different order of the statements) and tested for block effect (which we didn't find any significant effects). The average scaled evaluation of each statement, as well as the overall, respondent-level average across all six statements is provided in the tables below:

Evaluation of Neutral Information Statements (N= 136):

Statement	Average Ranking 1=ProGray; 7=ProGreen 4=Neutral
[1] According to the U.S. Energy Information Administration, the average U.S. household used 11,000 KWh of electricity in 2014	3.44
[2] Space cooling and lighting account for about 25% of the total U.S. residential electricity use	3.85
[3] There are more than 450,000 miles of high-voltage transmission lines in the U.S to move electricity from the generating source to the end user	3.49
[4] The U.S. EIA estimates that in 2013, 5% of generated electricity was lost in transmission and distribution	3.51
[5] The average price for electricity in the U.S. is $0.12 per KWh	3.60
[6] The price of electricity varies throughout the day and throughout the year	3.92
Overall Respondent-level average over all six items	**3.63**

Evaluation of Gray Plan Statements (N=79)

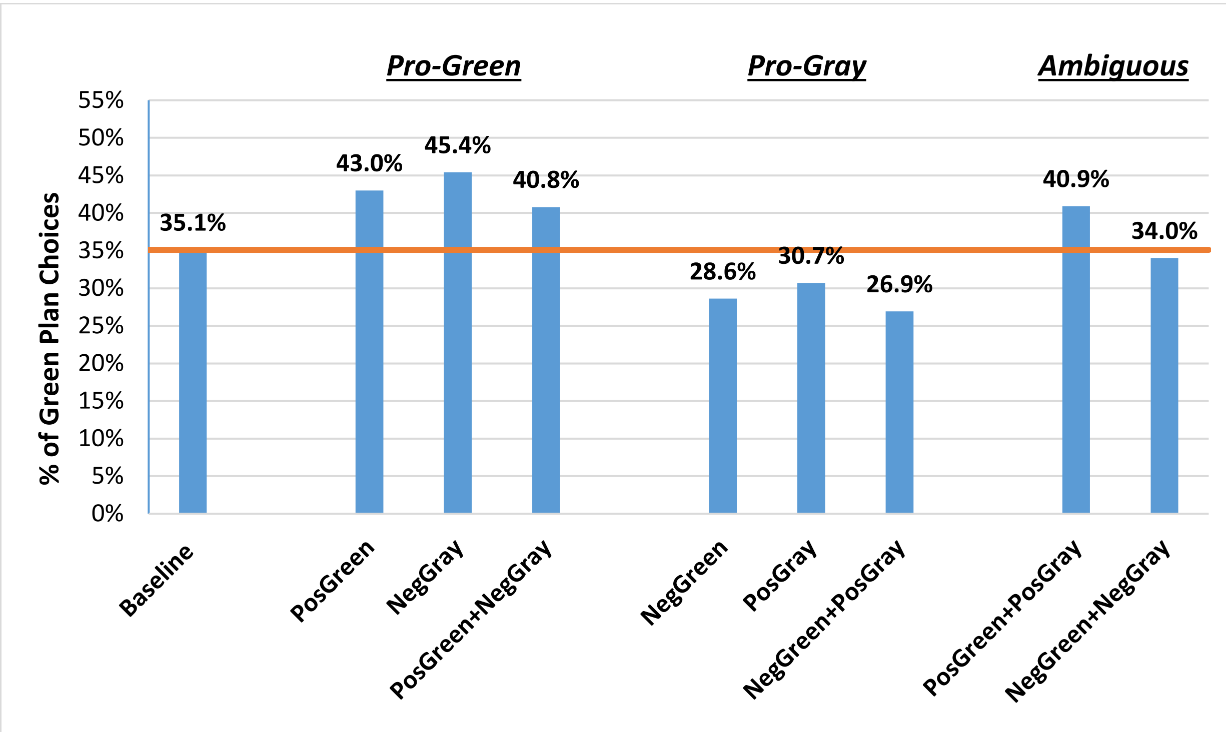
Statements	Average Ranking 1=Negative; 7=Positive 4=Neutral
Advantages (PosGray condition) 1) There is an abundance of coal and natural gas	5.20
2) The electricity that is generated is continuous during peak times	4.82
3) It is a relatively cheap and reliable energy source	5.82
4) It is versatile and can be used in a variety of applications and different environments	5.63
5) It is easy to store and transport coal and natural gas to electricity-generating facilities	5.30
6) Modern coal and natural gas power plants are very energy efficient	5.61
Overall Respondent-level average over all six *PosGray* items	**5.41**
Disadvantages (NegGray condition) 7) It is derived from nonrenewable sources of energy that deplete over time	2.52
8) It emits greenhouse gases into the atmosphere	2.35
9) It emits harmful substances like sulfur dioxide, which can lead to acid rain	1.85
10) Environmental damage is associated with mining coal and obtaining natural gas	2.42
11) Mining coal is dangerous and hazardous to the health of miners	1.97
12) Over 500 gallons of fresh water are used per megawatt hour of electricity generated	2.86
Overall Respondent-level average over all six *NegGray* items	**2.33**

Evaluation of Green Plan Statements (N=57)

Statements	Average Ranking 1=Negative; 7=Positive 4=Neutral
Advantages (PosGreen condition) 1) No limit to the energy sources in the future	5.93
2) Doesn't contribute to greenhouse gas emissions	5.81
3) Doesn't produce air pollution that can be harmful to humans	6.14
4) It is a domestic source of energy, reducing our nation's dependence on trade	5.58
5) It is beneficial to rural economies	5.77
6) Doesn't use freshwater resources	5.00
Overall Respondent-level average over all six *PosGreen* items	**5.70**
Disadvantages (NegGreen condition) 7) It doesn't provide a continuous source of electricity (sun doesn't always shine and the wind doesn't always blow)	3.16
8) It requires large areas of land to be disrupted, potentially damaging ecosystems	2.16
9) The electricity is often generated long distances from where the electricity is needed, requiring the construction of transmission lines	3.47
10) It is difficult to store and transport the energy	3.12
11) It is expensive relative to conventional sources	3.14
12) Pollution and emissions are generated during the manufacturing process	2.35
Overall Respondent-level average over all six *NegGreen* items	**2.90**

Appendix D – Additional Analysis

Impact of information conditions on adoption of green-power plan *excluding* those participants who reported that their current utility uses green energy



Sub-sample Analysis: Estimated Logit Model with Green Plan Choice as Dependent Variable

	Dependent Variable: *Green Plan Choice*							
	Income Level		Education Level		Environmental Attitude		Existing Green Customer	
	Low	High	Low	High	Less	More	No	Yes
Pro-Green	.090*	.071	.062	.077	.104**	.031	.092**	.001
	(.047)	(.048)	(.045)	(.050)	(.044)	(.055)	(.036)	(.081)
Pro-Gray	-.047	-.097*	-.114**	-.024	-.026	-.130**	-.084**	-.019
	(.049)	(.050)	(.046)	(.053)	(.046)	(.054)	(.038)	(.081)
Ambiguous	.029	.017	-.049	.096*	.065	-.051	.037	-.078
	(.049)	(.056)	(.048)	(.055)	(.047)	(.058)	(.040)	(.087)
$10 Price Premium	-.092***	-.078***	-.103***	-.061***	-.084***	-.092***	-.093***	-.055**
	(.010)	(.014)	(.010)	(.013)	(.011)	(.012)	(.008)	(.025)
$15 Price Premium	-.164***	-.192***	-.169***	-.181***	-.164***	-.191***	-.181***	-.147***
	(.012)	(.019)	(.013)	(.018)	(.014)	(.016)	(.011)	(.011)
Respondent Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Block Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Respondent Clustering	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8,388	4,820	8,143	5,065	7,151		11,057	2,151