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Determining Effect of Defaults on Grid Parity

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Abstract

Human activities emitting greenhouse gases (e.g. carbon dioxide) are the main cause of observed warming since the mid-20th century. Because a large fraction of human emissions are from conventional power sources it will be important to adopt carbon neutral technologies such as alternative energy sources (IPCC, 2013). Grid parity is the point at which alternative energy sources reach a levelized cost of electricity that is less than or equal to conventional power sources (Ueckhardt, 2013). It is thought that once it is reached alternative energy will be adopted en masse (Yang, 2010). But this concept ignores marketplace choice and default decision making. The purpose of this study was to determine if marketplace choice in the presence of defaults would impact consumer's decisions when grid parity exists. The study was a replicate study of previous work conducted by Pichert and Katsikopolous (2008). This was a multivariate study with two scenarios and three conditions. The study showed that defaults tend to impact consumer decisions when grid parity exists. Though grid parity will be a powerful incentive for alternative energy implementation, defaults in the presence of marketplace choice will likely be an important factor to examine to smooth any transition.

Introduction

In their 2013 report on climate change, the Intergovernmental Panel on Climate Change found that it is extremely likely that human activities are the main cause of observed warming since the middle of the 20th century. A majority of the observed warming was found to be a result of human induced increases in greenhouse gas concentrations, a large fraction of which results from conventional power sources releasing carbon dioxide (a greenhouse gas) into the air (IPCC, 2013). Alternative energy has the potential to mitigate this warming trend because it is carbon neutral (Heath and Burkhardt, 2011). Carbon neutral refers to those energy sources that release a negligible amount of carbon dioxide into the air during their normal operation.

Alternative energy describes energy sources that are alternatives to conventional power (Penn State 2013) and can also be called green energy (Sunstein and Reisch, 2013). Two common alternative energy sources are wind and solar power, otherwise known as variable renewable sources (VRE) (Ueckerdt, Hirth, Luderer, and Edenhofer, 2013). Conventional power is a term used for energy sources that derive their energy from the combustion of fossil fuels and the nuclear fission of uranium (EPA, 2013) and may also be referred to as gray energy or grid-supplied energy (Pichert and Katsikopoulos, 2008). Alternative energy sources are considered to have a low impact on the environment relative to conventional energy sources (Penn State, 2013). In this way, they can be differentiated from renewable energy sources which can potentially have marked environmental effects; i.e. hydroelectric power can have negative environmental impacts with regards to fisheries and land use (EPA, 2013).

Green energy is becoming an established alternative to conventional power sources. In 2011 energy derived from wind power was found to constitute about 2.1% of global electricity

production (ObservER, 2012). In 2012, worldwide electricity produced annually from solar power reached about 100 gigawatts (GW), with projections suggesting that number to rise to 330 GW by 2020. For reference, 100 GW is equal to about 16 conventional power plants (Frishberg, 2013). Green energy sources are also ranked as the fastest growing energy source in the world at about 2.5% per year (U.S. Energy Information Administration, 2013).

Grid parity is when green energy sources reach a levelized cost of electricity (LCOE) that is less than or equal to purchasing grid-supplied electricity. LCOE is a metric that allows for the comparison of VRE and grid-supplied electricity (Ueckhardt, 2013). It is also considered to be the point at which a large-scale change in generation to alternative power sources will occur (Yang, 2010). While grid-parity remains elusive for many regions in the world, research suggests that some green energy technologies have reached it. For example, solar power systems have achieved grid parity in certain locations (Branker, 2011). Determining if grid parity has been achieved is mainly dependent on conventional electricity prices in the area, the level of incoming solar insolation, and the presence or absence of meaningful state incentives (Swift, 2013).

Grid parity focuses primarily on the economic and policy side of the alternative energy issue. It supposes that an economic incentive will be enough to facilitate a wholesale switch from gray energy to green energy. But the idea of grid parity largely ignores certain factors that are important to gauging whether a switch will take place. These factors are choice in the market place and human behavior.

Many communities around the world are now offered a choice between energy suppliers, typically with one supplier providing gray energy and another green (Sunstein and Reisch, 2013). This ability to choose is already established in the United Kingdom, several U.S. states,

Germany, and various other countries (Pichert and Katsikopoulos, 2008). It's important to point out that choosing green or gray energy does not affect the energy the household actually receives. Pichert and Katsikopoulos (2008) indicate that it makes a difference in investment flows; "the idea is that increasing demand for green power will result in fewer conventional fuels and more environmentally benign energy sources being used" (p. 64). In countries that offer a choice between energy suppliers, gray energy is typically offered as the default and green energy the alternative (Pichert and Katsikopoulos, 2008).

According to Brown and Krishna (2013), a default is the option given to a consumer without their consent or knowledge; a preselected option that is received if they do not do anything. Behavioral studies have shown that when dealing with defaults people tend to keep them, even if an alternative is more preferable or economically sound (Sunstein and Reisch, 2013; Sunstein and Thaler, 2003). Defaults have been used in many contexts, from insurance marketing to organ donorship (Johnson and Goldstein, 2003; Sunstein and Thaler, 2003).

Organ donation opt-in and opt-out programs illustrate evidence of a default effect. Opt-in programs involve a situation where an individual must register or choose to be an organ donor themselves whereas opt-out programs are virtually identical but have the default choice as being a donor (Pichert and Katsikopoulos, 2008). Austria is a country that uses an opt-out program and has organ donation consent rates of about 99.8%. In Germany, a culturally similar country with an opt-in program, consent rates are only about 12% (Johnson and Goldstein, 2003).

The strength of the default effect appears to be positively correlated with a lack of knowledge, that is, people likely stay with what they have because they have little knowledge about it or the process as a whole (Pichert and Katsikopoulos, 2008). Or, as Sunstein and Thaler

(2003) point out, it may be that they are knowledgeable of the default but know relatively little about the alternative. In this case, whether something is ‘better’ or ‘worse’ doesn't factor in until the person choosing has a well established knowledge level.

The following, while not a concise list, can be considered major reasons for why the default effect occurs. The first is suggestion, otherwise known as an implicit suggestion or endorsement (Pichert and Katsikopoulos, 2008; Sunstein and Reisch, 2013; Sunstein and Thaler, 2003). The second is what is known as inertia and procrastination (Sunstein and Reisch, 2013; Sunstein and Thaler, 2003; Johnson and Goldstein, 2003). The third is called the endowment effect (Pichert and Katsikopoulos, 2008; Sunstein and Thaler, 2003). And the last is called loss aversion (Sunstein and Reisch, 2013).

Suggestion is when defaults are seen by consumers as an explicit recommendation by entities that are seen as having more authority or knowledge; as the choice most people make or the product best suited for most people (Pichert and Katsikopoulos, 2008). When faced with a decision to change from a default most people seem to believe that whatever entity placed the default did so due to sensible information (Sunstein and Reisch, 2013). Further, the default may be seen as something that most people do, taking on the role of a social norm (Sunstein and Thaler, 2003).

Inertia and procrastination are sometimes described as an effort tax and involve the person acting on the default making a proactive decision to reject the default and choose the alternative (Sunstein and Reisch, 2013). Even small actions can become overly taxing due to procrastination or forgetfulness (Sunstein and Thaler, 2003). Further, whether effort is involved in a default decision can be enough for people to actively decide to stick with the default that has

been given to them (Sunstein and Reisch, 2013) while accepting what is offered as a default requires relatively less effort (Johnson and Goldstein, 2003).

The endowment effect attempts to explain how people value objects or things with which they are endowed. The endowment effect says that when something becomes someone's possession they often expect to sell or get rid of that thing at a higher price than they might otherwise be willing to pay to get it in the first place (Kahneman, Knetsch, and Thaler, 1990). Defaults can create an endowment effect (Sunstein and Thaler, 2003). Pichert and Katsikopoulos (2008) conducted a study that illustrated the endowment effect with regards to defaults where establishing a green default caused people to avoid choosing alternative options or to request a high amount of compensation to do so (Pichert and Katsikopoulos, 2008).

Similarly, loss aversion, as defined by Yechiam and Hochman (2013), is "the notion that losses have greater subjective weight than equivalent gains" (p. 213). It causes people to avoid loss even if corresponding gains equal or exceed potential losses (Johnson and Goldstein, 2003). Whether something is a gain or loss is determined by whatever the default is (Sunstein and Reisch, 2013).

The purpose of this study was to determine the relationship between defaults and grid parity. This relationship is important to establish because the survival and continued increase in use of green energy systems will be necessary to reduce the emission of greenhouse gases. This relationship was examined through a quantitative study based on previous work by Pichert and Katsikopoulos (2008). The research question was: Will marketplace choice in the presence of defaults impact consumer’s decisions when grid parity exists? It is important to note that it is assumed that marketplace choice will continue to be a prevalent factor in the energy sector.

Based on the discussion presented above, the following null hypothesis (H0) and research hypothesis (RH) was generated:

H0: There is no pattern of relationship between the default conditions and the consumer's choices.

RH: There is a pattern of relationship between the default condition and the participant's choices such that when gray energy is the default consumers will choose it over green energy more often than when green energy is the default or when neither are the defaults. This pattern will be seen in the population represented by the sample and will be tested within the context of grid parity (i.e. when both companies will charge identical rates).

Methods

This study, aside from one alteration key to the hypothesis, replicated previous work conducted by Pichert and Katsikopoulus (2008) in Germany. The study they conducted was a multivariate analysis with three treatments and two scenarios. The study they designed was a decision study that prompted participants to choose between two different power providers.

Pichert and Katsikopoulus (2008) focused on young adults, based off on German marketing research. This marketing research indicated young adults are largely more aware than their older counterparts of their flexibility in choosing power providers. Pichert and Katsikopoulus (2008) claimed this is because young adults of Germany move around frequently, are more aware of their energy source alternatives, and have a better idea of how to register using the Internet. Young adults, in this case, are arbitrarily regarded as those people aged between 18 and 35. Because no research could be found indicating the same is true in the United States, a

convenience sample will be used. This sampling technique is also beneficial because, on average, it is fast, inexpensive, and relatively easy. Age was only restricted by the e-mail list being used.

Table 1 summarizes the three conditions and two scenarios. Participants were given three conditions, as in the previous study (Pichert and Katsikopoulus, 2008). However, the three treatments were not identical to those in the earlier study. In one condition, the green energy source (Source) was given as the default. In another condition, the default choice was the grey energy source (Falcon). The final, neutral condition offered no default. This was done both as a control and as a way of offering further comparison.

Table 1 Graphical representation of study conditions and scenarios.

	Gray Condition	Green Condition	Neutral Condition
Scenario 1 (Falcon)	Gray energy default	Gray energy alternative	Gray Energy
Scenario 2 (Source)	Green energy alternative	Green energy default	Green Energy

The two scenarios were roughly modeled off of what Pichert and Katsikopoulus (2008) offered to their participants. In this hypothetical situation, the participants have just moved into an apartment and are prompted via a flyer to choose between a grey and green energy provider; scenario one and scenario two, respectively. The key change to their study here was with regard to price in the two scenarios. Rather than having one hypothetical power company offer a higher price electricity source in one scenario than the other power company in the other scenario, both power companies will offer the same prices. See Figure 1 for a sample survey script that participants in the gray condition would have answered.

Imagine a situation in which you are to move into a new apartment. Upon moving in you receive a notice from an electric power supplier named Falcon Energy. The letter indicates that by moving in to your apartment you have become a Falcon customer: "We at Falcon Energy are proud to be responsible for the energy supply in this area. We offer our customers low-priced monthly electricity prices. Your monthly premium is $40 dollars a month." You are also prompted to give some personal information and the letter informs you that your confirmation letter will be in the mail shortly.

After a few weeks you receive a flyer in your mail advertising electricity from Source Energy: "Were you aware that you can switch electricity supplier? Source Energy sells competitive, clean electricity generated from renewable energy sources. Protect the climate and environment and switch to Source! Your monthly premium will be $40 dollars a month."

What do you do?

- ○ Stay with Falcon Energy.
- ○ Switch to Source Energy.

Indicate your agreement with each phrase below.

	Strongly Agree	Moderately Agree	Neutral	Moderately Disagree	Strongly Disagree
Companies like Source Energy are NOT the cause of detrimental pollution.	○	○	○	○	○
Source Energy damages the environment less than Falcon Energy.	○	○	○	○	○
Green energy is the prime emitter of greenhouse gases into the environment.	○	○	○	○	○

Figure 1 Gray condition survey script.

A manipulation check was used to validate the treatment scenarios. This was a series of additional questions that prompt the participant to answer a series of questions using a Likert-type scale. The overall goal of the manipulation check was to ensure that the experiment participants consistently see the green option as more environmentally positive than the grey option.

The sample size of this study was 90 individuals. The study was conducted online through SurveyMonkey.com and the resulting data analyzed with SPSS analytical software. Surveys were emailed to students listed on the University of Nebraska-Lincoln, Environmental Studies program email list and elsewhere. This was assumed to ensure a populace that was reasonably knowledgeable about green and gray energy.

Results

Table 2 shows the contingency table for the study variables. Participants' energy provider choices were not evenly divided between the two energy company choices (Figure 2). Table 2 shows that, as hypothesized, the presence of defaults tended to impact consumer decisions when grid parity exists. There was a statistically significant relationship between the variables, $X^2(2) = 21.35$, $p < .001$. Table 2 illustrates omnibus chi-square results for each condition.

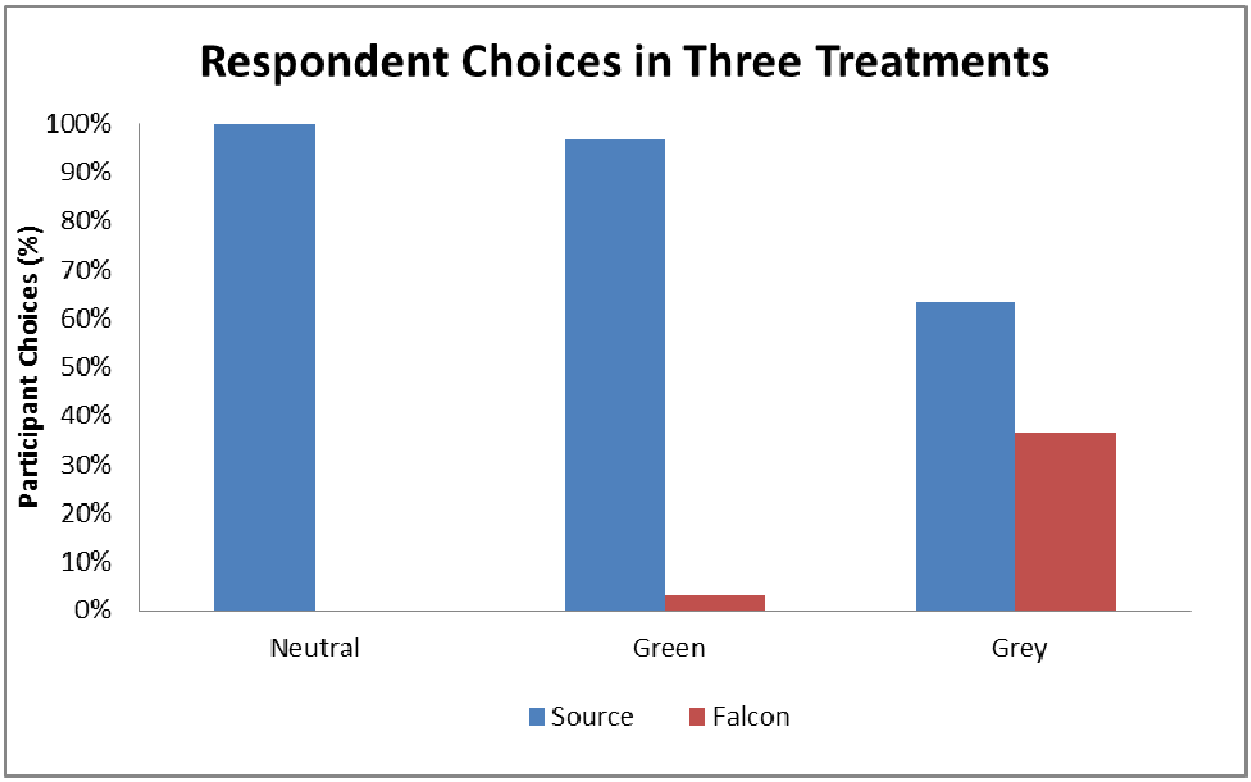

Figure 2 Representation of respondent choice by each of three conditions. Illustrates the idea that defaults might still be relevant even when electricity prices are lower.

Table 2 Omnibus Chi-square results for each of three conditions.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.346	2	0.000
Likelihood Ratio	22.483	2	0.000
Linear-by-Linear Association	17.258	1	0.000
N of Valid Cases	90		

Because the p-value obtained from chi square analysis of the data is less than .001, the H0 was rejected. Therefore it was concluded that the pattern of the relationship between the variables in the sample is strong enough to allow the assertion that there is a relationship between them in the population represented by the sample.

Pairwise comparisons, summarized by Table 3, revealed additional information about the three conditions. There was a significant relationship between the neutral and gray conditions, $X^2(1) = 13.469$, $p < .001$, such that, as hypothesized, when the gray energy provider was offered as the default, participants chose it over green energy more often than the neutral condition. In addition, there was a relationship between the green and gray condition, $X^2(1) = 10.416$, $p < .005$, such that, as hypothesized, when the gray energy provider was offered as the default, participants chose it over green energy more often than the green condition. There was no significant relationship between the neutral and green conditions, $X^2(1) = 1.106$, $p > .05$.

Table 3 A summary of pairwise comparison results.

Conditions Compared	Pairwise Chi-square	P-value	Significant Relationship
Neutral/Green	1.106	p > .05	No
Neutral/Gray	13.469	p < .001	Yes
Green/Gray	10.416	p < .005	Yes

Manipulation checks given to participants revealed that their average level of agreement with the statement "Companies like Source energy are not the cause of detrimental pollution" (M = 2.38, SD = 0.92) was significantly different from the hypothesized value of 3, t(89) = 6.424, p > .001. In a similar vein, participants' average level of agreement with the statement "Source energy damages the environment less than Falcon energy" (M = 2.41, SD = 1.02) was significantly different from the hypothesized value of 3, t(89) = 5.501, p > .001. Lastly, participants' average level of agreement with the statement "Green energy is the prime emitter of greenhouse gases into the environment" (M = 1.86, SD = 1.06) was significantly different from the hypothesized value of 3, t(89) = 10.288, p > .001. For the sake of meaningful analysis the aforementioned question was flipped (e.g. answers of 5 changed to 1, strongly disagree to strongly agree). All of these questions tended towards the proper direction; to the left of neutral (3), or agreement.

The manipulation checks confirmed that participants generally were aware of the status and position of Source and Falcon energy; i.e. that Source was intended to be seen as an environmentally friendly option and that Falcon was not. The checks also confirmed that participants saw green energy how it was intended to be seen; that is, as the version of energy

that is healthier for the environment. Because of these affirmations, it can be said that a large source of potential error has been eliminated.

Discussion

As hypothesized, participants in the gray condition chose Falcon energy more often than any of the other conditions and there appears to be a statistical possibility that the one reason that occurred is due to the sway or pull of defaults (Figure 2). This can be seen in the pairwise comparisons that reveal the gray condition is different than both the green and neutral conditions (Table 3), although it is not explicitly clear that defaults were the sole cause of discrepancies in choice. A preference towards green energy may have played a role in this situation; e.g. in the gray condition it may be that the alternative was perceived to be green, hence more attractive than the gray energy source.

The difference between the neutral and gray condition revealed during pairwise comparisons gives credence to the notion that defaults had some role to play in the observed increase in frequency of participants choosing Falcon energy. The difference between the green and gray conditions also underscores this possibility: if defaults had no effect, given the data at hand, expected results would reveal that all participants choose the green energy provider more or less equally. Additionally, pairwise comparison would reveal no relationships between the variables.

The lack of a significant relationship between the neutral and green conditions suggests that defaults and company allegiances (towards the green provider in this case) had a collinear relationship and therefore both “pulled” participants to choose the green provider. While the

green energy provider was offered as the default in the green condition it cannot be reasonably said that default status was the exclusive reason participants chose the green provider.

The possible reason defaults still held sway even when price was of no more concern can be explained using some of the reasons traditionally cited to describe the occurrence of the default pull: suggestion or endorsement and inertia (Sunstein & Reisch, 2013). Participants could have understood the flyer as suggesting that Falcon is the right choice and that suggestion could be strong enough to allow a person to overlook what is perceived to be an environmentally friendly alternative charging the same price. Additionally, the participants could have simply been unwilling to put forth the effort required to change their answer preferring instead to get the decision over with in as small amount of time as possible.

Results indicated that, in areas that have instituted marketplace choice, defaults could adversely impact the predicted large scale shift in generation from gray energy sources to green energy sources when grid parity arrives in earnest. While the effect would most likely not equate to consumers choosing gray energy over green energy solely when it is offered as the default, it is possible that the gray energy provider would be selected often enough to adversely affect green energy investment flows.

Conclusion

The presence of a gray default will most likely affect consumer's choices even when price is inconsequential. Given that greenhouse gas concentrations need to be lowered, default effects could adversely affect the implementation of green energy sources as they arrive at grid parity. Lag in implementation would occur due to a siphoning of capital by a gray default. Though it wouldn't take all of the investment flow because consumers would still pick green

energy providers where price is inconsequential, it likely wouldn't have to garner a majority in order to cause problems.

Where marketplace choice is present, the results of this study indicate that a smoother transition from gray to green energy could be engineered by manipulating defaults. Green energy could be designated as the default energy provider, possibly even before grid parity arrives, which likely would lead to an increase in investment as people act on the default. This investiture would then begin to spur the growth of the green energy industry even further, possibly reducing the need for new gray energy plants as well as for continuing to use the old ones. As green energy becomes more ubiquitous and gray energy fades, greenhouse gas levels in the atmosphere would eventually plateau and then descend.

In order to explore the effects of defaults on grid parity or energy choice in general it would be important to, in the future, study a population that is more representative. This would mean that the sample size of any future study would need to be increased to levels proportionate to the population being studied. In addition, the effect that age, gender, income status, and various other factors have on energy choice and the default need to be explored by gathering demographic information. For example, a person's age might reasonably affect their perception of the word "green" with regards to environmental friendliness. This information could then be compared to a more robust set of manipulation checks in order to ferret out trends in the data.

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