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Consumer willingness to pay for water conservation in the framework of renewable energy projects

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BY

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BA Economics, New Mexico State University, 2007

THESIS

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ABSTRACT OF THESIS

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This research focuses on consumer valuation of the benefits associated with renewable electricity generation, specifically for water conservation. Previous contingent valuation studies in this area conclude that consumers are willing to pay for these benefits, but do not explicitly consider the environmental benefit of water conservation. The impact of this benefit is tested for a unique sample of New Mexican consumers by performing a split-sample study with a treatment variation in the benefit related information given to the respondent. The study is performed using the Internet survey mode for a sample population of 2000 University and University Hospital Staff. A response rate of 33.75% allows for 675 complete observations available for estimation.

Willingness to pay is calculated following the Hanemann (1984) approach for different model specifications that adjust for certainty responses. These WTP measures are used to test for a significant difference between versions. I find that consumers do have an increased willingness to pay for the water conservation benefits of renewable energy projects in the full model as well as models adjusted for certainty.

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Chapter 1: Introduction

Issues of electricity generation and energy security have become increasingly important in recent years. This research will focus on consumer valuation of renewable electricity generation, specifically the increased willingness to pay for water conservation associated with non-traditional electricity generation. Are consumers willing to pay for increases in renewable capacity as a part of an electricity company's portfolio? If so, what amount are they willing to pay and more specifically, what factors influence this willingness to pay?

Previous contingent valuation studies conclude that consumers are willing to pay for the benefits associated with increased renewable energy generation (Bergmann et al., 2008, Ek and Soderholm, 2008, Longo et al., 2008, Menegaki, 2008, Wiser, 2007, Zarnikau, 2003). The primary, but not only, benefit discussed in these studies is reduced air pollution. The specific question posed in this research project will focus on the southwestern U.S. consumer by giving the survey respondent information about another benefit associated with renewable energy: water conservation. The issue of water usage for the purpose of electricity generation has not been prevalent in the literature, but is becoming increasingly recognized[1]. Although this benefit may not be as important for

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[1] Projects such as the Energy-Water Nexus at Sandia National Laboratories are focusing on the link between energy and water- both the water needed for electricity generation and the energy needed for treatment and distribution of water. This program is a large-scale federally funded project conducting research and development on sustainability of freshwater supply and energy.

populations in other regions, in the southwest- where water is often scarce- it may prove to be a very valuable benefit.

Contingent Valuation methods arose as a means to place values on non-market goods in the developing American West and elsewhere, and have since become very popular in valuing all types of public goods. Such methods use stated preference survey data to estimate a total economic value- or consumer willingness to pay- that captures both use and non-use values for an environmental or other public good. In this case, consumer preferences for water conservation are addressed by conducting a split sample survey where one group of respondents is provided information about the water conservation benefits of renewable electricity generation and one is not.

The primary focus of this study is to address the importance of water conservation within the framework of electricity generation. The results in this area may be applied to many different populations. Other findings of the study, such as the general willingness to pay measure, however, may be very limited by the sample population. A very specific sample population is used from which to draw participants, consequently results are biased toward the specific demographic that make up this population. The goal of this research, therefore, is to fill a gap in the literature that avoids specifically addressing water conservation benefits associated with renewable energy projects, not to elicit a general WTP value.

This thesis proceeds as follows: Chapter 2 discusses an introduction into the current issues of renewable electricity generation as well as some specific information about developments in the state of New Mexico. Chapter 3 will discuss relevant stated preference studies both in the form of contingent valuation and choice experiments from the literature in order to establish a background for this study. In Chapter 4, the design and implementation of the study survey will be discussed. Chapter 5 will introduce and expand upon methodology and the estimation approach to be taken. Analysis of survey data as well as descriptive statistics and response rates will be presented in Chapter 6. Finally, Chapter 7 makes some concluding remarks about the insight that can be gained from this research

Chapter 2: Wind Power Developments

Concerns about water scarcity and greenhouse gas (GHG) emissions have increased with the impinging impacts of global climate change in the recent years. As a result, many countries have decided that increasing the percentage of energy created from renewable sources is an important means for energy security and decreasing air polluting emissions. While the United States has not been a leader in implementing policies to curb green house gas emissions, through campaign ideals and the outlined 2009 stimulus package the current administration promises to make green energy a priority. Understanding the past development of and future potential for such markets is essential in achieving goals in energy improvement. The following sections will discuss wind energy and its potential in New Mexico as well as developments in green energy markets.

2.1 Why Wind Energy?

Technological advancement has made even coal-based generation cleaner than it was in the past, especially in terms of harmful emissions such as SO_2, but electricity production is still a large contributor to CO_2 pollution. In 2007, the Department of Energy reported electricity generation emitting 2433.4 million metric tons of CO_2, 41% of the total US output that year (Department of Energy, 2007). With the recent ruling by the EPA about the human health impacts of GHG (EPA, 2009) as well as constant reminders of the environmental impacts of GHG through news of changes in weather patterns, intense wildfires, and melting glaciers it has become a priority for the new administration to address the issue of GHG emissions. There are many ways in which this issue can be addressed, one of which is by focusing on a decrease in emissions in the electricity industry. This can be achieved by increasing the use of renewable electricity generation.

Several sources of alternative energy may be less harmful to the environment than traditional sources. Alternative energy sources include solar, wind, biomass, hydroelectric, geothermal and nuclear power. Issues of cost effectiveness and safety may arise with any of these sources. Many worry about the disposal of nuclear waste and do not consider nuclear power to be an environmentally friendly source. Hydroelectric power also may produce adverse effects as it disrupts natural river ecosystems and raises difficult water rights issues. Biomass and geothermal generation technologies do not seem to be cost efficient at current prices and levels of technology. In New Mexico, and many other regions with similar climate and characteristics, solar and wind power are often considered the most promising potential renewable energy sources. The Renewable Energy Atlas of the West estimates New Mexico's solar and wind generation potential to be 104 and 56 billion kWh per year.

Wind power specifically is a good fit for New Mexico in a variety of ways. High potential generation capacity has already been mentioned. The costs associated with wind power generation for creating new capacity are very competitive with developing new traditional generation capacity (MARKAL MATTER, 2008). There are also potential economic gains from this development, primarily through long-term operational jobs and short-term construction jobs. Analysis by the US Department of Energy (2008) estimates the direct economic benefit of a 1,000 mega-watt increase in development of renewable capacity in New Mexico to be $1.1 billion dollars.

For southwestern states, facing increasing water supply issues, there is an additional benefit to the use of wind energy generation: water conservation. The California Wind Energy Association reports that the generation of 1-kilowatt hour of electricity using conventional generation uses approximately 300 gallons of water. Using wind generation to produce the same amount uses only 1/1000 of a gallon of water (California Wind Energy Association, 2009). In New Mexico, annual water usage for electricity generation is roughly equivalent to the public usage for Albuquerque- the largest metropolitan area in the state (Southwest Research Information Center, 2001). Substantially decreasing this usage would clearly be an important benefit to New Mexico.

The benefits of including wind energy capacity in the New Mexican utility portfolio seem plentiful. There may also, however, be concerns of potential negative impacts of wind farms. Some of the possible problems that have been associated with wind electricity generation are prices, visual quality, noise, land usage, erosion, effects on wildlife, effects on birds, and increased potential for wildfires (New Mexico Energy Minerals and Natural Resources Department, 2009). Technological development has addressed many of these issues so that most recent wind turbines are more wildlife friendly than previous models. New Mexico is known for its vast amounts of un-developed lands, many of which would be optimal settings for wind energy developments. Changes in technology are also quickly addressing price differences and making wind electricity generation increasingly competitive with traditional sources. Potential future cap-and-trade policies, discussed on a national scale by the Obama administration and regionally by the Western Climate Initiative, would also help make wind power more profitable when compared to traditional sources. Although additional research may be helpful in mitigating concerns about the negative impacts of wind energy generation, most consider them to be outweighed by benefits.

2.2 Renewable Portfolio Standards and Green Pricing

Over the past two decades, many states and electricity utilities have adopted programs to decrease their reliance on fossil fuels by increasing renewable energy capacity. The majority of these programs fall into two categories: renewable portfolio standards (RPS), adopted by state governments, and green pricing programs, provided by private utility companies. In recent years, New Mexico has become a leader in supporting renewable energy by implementing RPS legislation, offering green pricing programs and nearly matching the federal tax credit for renewable capacity[2].

The renewable portfolio standard is a policy where state governments require electric utility providers to meet a certain level of electricity generation capacity in renewable resources by given time-frame deadlines. As of 2007, the Department of Energy reported 32 states having RPS policies. Many of these programs offer the ability to "trade" requirements between providers. Essentially, if one supplier cannot meet the required percentage, they can "purchase" additional capacity from another company who has generated above the requirement. Due primarily to the state's role in the program, RPS policies have seen varying levels of success. For a policy to be successful, the state must develop a system with efficient tracking and monitoring of compliance. Although RPS have been very successful in some states, such as Texas where the state mandate has

[2] New Mexico offers a 1-cent per kilowatt-hour tax credit for all renewable capacity over 20 megawatt-hours. The federal government offers 1.5 cents per kilowatt-hour.

rapidly propelled growth in the development of renewable generation, for others it may be difficult to design and costly to implement.

In recent years, New Mexico has passed legislation to implement a renewable portfolio standard. In 2004, the state decided to implement an RPS requirement of 1% renewable sources by 2006. The goal of this legislation was to meet 10% by 2020. In the 2007 legislative session, the state decided to up this requirement to 20% by 2020 with intermediary goals of 10% by 2011 and 15% by 2015 (NM Senate Bill 43, 2009). This legislation also requires portfolio diversification by 2011 where at least 20% of renewable generation must be wind based. Considerable progress has been made towards these New Mexican legislative goals.

Green pricing programs have become a popular means for electric utility providers to increase their capacity of renewable generation and, in states with RPS policies, to meet their annual requirements. There are a few different types of green pricing programs and variance in success for each. The general idea behind this type of program is that the electric utility company makes renewable energy available to its customers at an increased premium. As of 2007, multiple utility companies in 40 states offer green pricing programs to their customers. The programs have seen varying success with participation rates ranging from less than 1% to 20%, with the median being in the lower region (United States Department of Energy, 2009). New Mexico has become a leader with the success of The Public Service Company of New Mexico's, hereafter PNM, Sky Blue program, which was ranked 8th in the United States in 2006 with around 3% customer participation (PNM Sustainability Report, 2006). The way this specific program works is by PNM offering its customers 100 kWh blocks of energy for an increased premium of $1.69. A customer can chose to buy up to 90% of their monthly usage in renewable energy, so long as it is done in the 100-kWh blocks.

Green pricing programs have become increasingly popular, but due to specific program provisionary terms, they may not capture the entire amount that a customer is willing to pay for an increase in renewable energy generation. Previous research anticipates over 50% participation rates, even if at only at the lowest offered level of participation (Zarnikau, 2003). As mentioned above, not even the most successful program in the country has this level of participation. There may be a number of reasons that this is true. Consumers may not trust that the utility company is actually spending the money in renewable generation. They may also be subject to a peer effect- they are less motivated to participate in a voluntary program where others are not participating. Green pricing programs have helped many states to increase their usage of renewable energy sources. Due to the voluntary nature of programs and low levels of consumer involvement and support, however, mandates such as the RPS may be more effective in reaching policy goals.

2.3 Increasing Consumer Involvement

Increasing consumer involvement may be an important strategy for increasing the success of renewable energy programs. Companies across the mid-western and southwestern regions of the United States are recognizing the opportunity for wind power developments on farm and ranch lands. New Mexico has vast amounts of open space, much of which is used as cattle ranch land, which is favorable for wind farm sites. Creating consumer involvement by leasing from these ranchers, as opposed to buying up large portions of land, could be an opportunity for increased support as well as improvement in the profitability of New Mexican cattle ranches.

While consumer involvement by landowners may be an important opportunity in rural areas, an issue that may spark the interest of urban consumers is the role of renewable electricity generation in water conservation. Water conservation may prove to be a much more important issue than the air quality benefit that is traditionally associated with renewable generation techniques for consumers in New Mexico, which is known for its clear (rather than smoggy) blue skies, but very dry climate. The following section will discuss the results of previous valuation studies looking at renewable energy issues to set a precedent for the original study done in this research, which will add the issue of water conservation to the valuation scenario.

Chapter 3: Establishing Demand for "green electricity"

Increasing interest in renewable energy and a clear need for cost-benefit analysis has lead to a substantial literature in many different areas relating to "green" energy. A considerable portion of economic literature in this area examines the willingness to pay for renewable energy as determined by contingent valuation techniques. Previous studies have found that consumers do have an increased willingness to pay for electricity generated by renewable technologies as opposed to that created by traditional techniques (Bergmann et al, 2008; Ek and Soderholm, 2008; Longo et al., 2008; Menegaki, 2008; Wiser, 2007; Zarnikau, 2003).

It is important to understand that in the case of renewable energy, the increased willingness to pay value is the result of a variety of benefits that the consumer associates with renewable energy including, but not limited to, increased air quality, job creation, and preservation of scarce resources. In this study, therefore, a set of goods is valued, this set being composed of the positive externalities, environmental and non-environmental, created by the increase in renewable, and/or decrease in traditional, electric generation. The following section will analyze the techniques used in a series of dichotomous choice and choice experiment contingent valuation approaches focusing on valuing renewable energy. These studies will be used to draw conclusions about three primary aspects: understanding the recommended policy provisionary terms, establishing a general willingness to pay for renewable energy, and building expectations for the influence of specific demographic variables.

3.1 Policy Provisionary Terms

In the late 1990's, learning more about the possibilities of renewable energy generation became an important issue to the United States government. The Office of Energy Efficiency and Renewable Energy at the U.S. Department of Energy funded a large-scale contingent valuation study conducted by Ryan Wiser at the Lawrence Berkeley National Laboratory. Many technical reports and published articles have developed from Wiser's research in the area including an article, published in 2007 in *Ecological Economics*, focusing primarily on the different possibilities for provision of renewable energy. The format used was a split-sample single-bounded dichotomous-choice contingent valuation survey. The survey was mixed-mode, conducted by both telephone and mail to a random sample of US citizens with a final sample size of 1574- a 45% response rate. When compared with census data, the sample was found to be representative of the general United States population.

Wiser focuses on the difference in WTP for four provisionary scenarios. The first required a mandatory increase in electric bills of all customers, funds from which were to be collected and spent by the government on renewable energy projects. The second consisted of voluntary payments collected and spent by the government. The private utility company collected the payment for the third and fourth scenarios, the difference between the two being voluntary versus mandatory payment. Wiser performs four pair-wise tests to determine which scenarios are statistically preferred. He finds that under private provision, a collective payment elicits a higher mean willingness to pay and that under collective payment private provision elicits a higher mean WTP. The other two pair-wise comparisons show no statistical significance. These results suggest that collective (mandatory) payment with private provision is the best policy approach to encouraging renewable energy. This aligns with economic theory by showing that consumers understand the free-riding effect. Wiser finds that with the expectation (in this case the concrete knowledge of the mandatory payment) that others will pay, consumers show increased WTP measures. Thus, consumers prefer a provision rule or policy where free riding is impossible.

Wiser's findings intuitively align with economic theory and were very relevant to policy-maker decisions about renewable energy in the late 1990's and early 2000's. There may be issues, however, with the statistical validity of his results. Because this is a split-sample survey with four different scenarios there needs to be an extremely large sample size in order for the research to be valid. Each split sample in this study has a sample size between 318 and 336. Individually, these are rather small samples. There is no mention of this problem in the version of Wiser's paper published in Ecological Economics; however, is addressed in the full research report, which states, "Because we do not pool scenario responses in this analysis, however, the sample size for each regression is significantly reduced. Statistical power is therefore also lower, and only variables that have substantial impacts on the results are likely to be found statistically significant" (p. 51). Although this may be a problem, it seems safe to say that while the exact WTP measures may not be useful, the preference for a mandatory privately provided policy over other alternatives can be correctly inferred from this research.

Wiser also finds that individuals who are willing to pay often expect others to do the same. These findings make it clear that participation expectations are influential to WTP decision-making. This may be a reason that voluntary payments strategies have had even lower participation in real world policy settings than in hypothetical settings as mentioned earlier along with the introduction of green pricing programs. It may be necessary to use collective payment vehicles in order to prevent under-provision of the public good caused by consumers stuck in the “I observe low participation by others, therefore I do not participate” cycle.

3.2 Establishing a Willingness to Pay for Renewable Energy

Increasing popularity of renewable energy generation is a recent issue in the United States. In Europe, however, this change has been taking place for many years. Many countries in the EU have a very high percentage of energy generated from renewable resources. Leading countries include Portugal, Austria, Denmark and Sweden with over 30% of their country’s total electricity generation renewable (European Union Energy Portal, 2009). This is very impressive when compared to the mere 7% of total electricity that is generated by renewable resources in the United States (Energy Information Administration, 2009).

The more advanced stage of the renewable electricity market in Europe has made countries there prime targets for contingent valuation studies in the area. The next three studies are choice experiment exercises by European researchers focusing on renewable electricity markets in the UK, Sweden, and Scotland. They focus on specific attributes of a renewable energy policy rather than the provisionary terms of the policy. The first is a more traditional contingent valuation study focusing directly on WTP for specific attributes, while the second investigates the underlying motivation behind the WTP. The third study investigates the difference between the preferences of urban versus rural respondents and may be important to help us to consider differences between the urban sample and the rural residents of New Mexico.

The first of these studies takes place in Bath, England and consists of a series of 300 in-person interviews. Different from many studies, Longo et al. (2008) essentially use a "bottom-up" approach. The consumer is not asked their WTP for an increase in renewable generation capacity, but for a decrease in negative attributes. As discussed earlier, a variety of benefits exist that a consumer may associate with renewable energy. Longo et al. (2008) focus on four primary attributes. These attributes are: percentage reduction in greenhouse gas (GHG) emissions, energy security in terms of length of shortages of energy supply, employment in the energy sector, and the cost of policy. The questions are set up as a choice experiment where the respondents are asked to choose A, B, or the status quo option. The survey has six versions each consisting of six choice experiment scenarios. The payment mechanism is a quarterly increase on the electricity bill and, although it is not specifically noted, the payment appears to be a mandatory, or coercive payment, in line with that suggested by incentive compatibility research (Carson and Groves, 2007).

Longo et al. (2008) find the mean WTP for a 1% decrease in GHG emissions per year is £29.65 ($56.34) and £0.36 ($0.68)[3] to decrease energy shortages by one minute per year. The employment attribute showed very small WTP; however, policies focusing on the previous attributes that also increased employment were strongly preferred to those that did not. These valuations are calculated into the average value of a 1-ton

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[3] Conversions from GBP to USD are made using an exchange rate of 1.9, an estimated average of the rate during the time frame of Longo et al.'s research.

decrease in CO_2 and are much higher than previous studies. The authors explain this difference with three possibilities. There may be differences in the WTP of residents of the UK versus residents of the US. As mentioned earlier, Europe is at a very difference stage in its development of renewable electricity markets and this may have an impact on consumer preferences. The population of Bath is also wealthier than the average resident of the UK. Finally, this study is very recent, published in 2008, and consumer awareness in recent years may have effectively increased willingness to pay.

This study also compiles a few helpful tables of results from other studies in the literature, taking place mostly between 2000 and 2003. The research reviewed varies across CV and CE techniques and use different specific component characteristics to analyze benefits. The first of these tables looks at the mean WTP per year. As mentioned earlier, these studies define what they are valuing in very different ways. These values are not expected to be comparable, but some understanding of the value respondents place on different aspects of this issue can be gained.

The authors then set up another table valuing a 1-ton decrease in CO_2. These values must be calculated from the individual studies- for example one study looks at a 1% decrease in a particular county, so the authors figure out the value using that countries total emissions output. These results are now somewhat comparable and are what the authors use to evaluate their findings against previous work. The calculated WTP per ton decrease in CO_2 vary from \$39 to 967, with a mean of \$354.60 and a median of \$227. Interestingly, the lowest amounts are the American studies while the higher take place in the United Kingdom. From this very large range of WTP values, the conclusion that the hypothetical scenario as well as the specific population sampled will have a very large impact on WTP values can be made.

Ek and Soderholm (2008) conduct a split-sample choice experiment across Sweden. Their research focuses on the underlying behavioral forces responsible for WTP values, specifically moral and social norms. The variation between the two surveys has to do with the information provided about current participation. One version is presented with low participation rates and the other with exaggerated participation rates. The participant then responds to a series of three binary choice experiments (each with one "green" and one "brown" option). The participation rate was 32%, leaving the researchers with 655 responses, which supply 1965 observations. A few methods are used to test for self-selection bias including comparing demographics to those of the population as a whole and dropping the top 25% of NEP (New Environmental Paradigm) scores. They find that women and the elderly over-respond but estimate the effect in results to be minimal.

Ek and Soderholm find that both moral and social norms play an important role in consumer preferences but that the two are difficult to distinguish from one another. They also find the NEP, PCE (perceived consumer effectiveness) and personal responsibility scores to be highly significant in predicting the consumers' choice to support green energy. Interestingly, the only significant socio-demographic variable is age. This may be because of the use of the NEP scale, as it tends to capture many demographic aspects. Other research has consistently found education, income and gender to be significant (Longo et al., 2008; Menegaki, 2008; Wiser, 2007; Zarnikau, 2003) and oftentimes whether the respondent has children is significant as well. These findings are consistent with other literature regarding the importance of participation of others (Wiser, 2007) that suggests a mandatory policy type is preferred over a voluntary one.

Another interesting finding in this study is the percentage of consumers who either consistently chose either all “brown” (53%) or all “green” (8%) responses for each of the three experiments. It seems that this is telling us that the variation in prices has little effect on the acceptance of the policy; only 39% changed their responses depending on the bid amounts. An individual is either willing or not willing to pay for green electricity, regardless of reasonable bid amounts. This finding may have to do with the chosen variation in bids, but also seems to reflect a general protest response to the policy scenarios. More information on these responses seems necessary.

The final study to be presented in this section was done by Bergmann et al (2008) and focuses on the difference between the preferences of urban versus rural residents. The researchers focus on a five specific attributes of a renewable energy policy: landscape impact, wildlife impact, air pollution, job creation, and price. The sample consists of 828 observations taken from sets of four choice experiments from 207 respondents. The sample over-represents rural dwellers for an adequate basis of comparison, so the “whole sample” estimations are not representative of the entire Scottish population.

The interesting differences found in this study relate to the creation of jobs in the energy sector. This was the most one of the most highly valued aspects for rural dwellers, but not significant for urban dwellers. This finding supports the status of rural life as well as the development of renewable energy projects in Scotland. These areas are facing rapid rural-to-urban migration[4] as agriculture is no longer a profitable means of living. Most renewable energy projects in Scotland are located in rural areas. Job creation in renewable energy projects, therefore, is important to these residents because it allows them to maintain a rural lifestyle instead of looking to urban areas for employment.

This is interesting to the situation at hand because it brings to light another important aspect of renewable electricity generation growth in New Mexico. New Mexico has a significant amount of agricultural output. Cattle ranching is the largest economic output of all private industries in 25 percent of New Mexican counties (NMSU RITF, 2009). This rural population may have significantly different preferences for renewable energy projects. The research done for this paper will focus on preferences for water conservation for a select urban population to be discussed in section 4.5. This population is clearly not an adequate sample of the population of the state of New Mexico. The research done by Bergmann et al. (2008), however, allows us to discuss some predictions about what differences may be seen between this sample and the rest of the state.

An abundant literature of contingent valuation studies involving consumer willingness to pay for cleaner electric generation exists. It seems, however, that the nature of this preference is constantly changing. Many studies use very specific sample populations in areas where preferences may be significantly different from those of

[4] Bergmann et al. (2008) cite a 3% decrease per year in rural population in Scotland.

consumers in New Mexico[5]. There may also be information effects as American consumers become increasingly aware of environmental issues and the potential benefits associated with renewable energy technologies. Answers to a specific dichotomous choice policy question may depend upon many aspects of what a respondent perceives to be his or her current financial standing. If uncertainty is introduced into this perception, such as with the current economic downturn, revealed and stated preferences may be altered. Preferences of consumers 10 years ago, the time at which much of the survey data for many recent papers was collected, may be somehow structurally different than it is today. This paper will focus on capturing the importance of water issues to southwestern consumers as well as looking at such changes.

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[5] Longo et al. (2008), for example, studies consumers in a specific region of the United Kingdom. It may be possible to calibrate a model such as is produced in this research and estimate some WTP measure by incorporating demographic data from our area of interest. If the entire preference structure is different, however, this may produce an extremely inaccurate result.

Chapter 4: Survey Construction and Design Issues

Contingent valuation has become increasingly popular since the methods introduction in the late 1970's. There is a constantly expanding literature discussing the local provisional methodology used for conducting such studies. A seminal paper published in 1979, during the early stages of contingent valuation studies, by Bishop and Heberlein touches on many of the theoretical issues tied to this technique. Bishop and Heberlein discuss the "hypothetical valuation" technique and address issues of "gamesmanship", social psychology, and issues with the hypothetical nature of the technique.

Recent literature addresses these same components, but under slightly different titles. Gamesmanship- or strategic response- refers to the situation where a respondent does not reveal their true preferences because of an alternative strategic goal. A respondent may overbid if they perceive their response having some effect on supply in order to ensure that they will later have the opportunity to purchase. A respondent may also perceive having an influence on the actual fee they will later have to pay- thus understating their true value. Hypothetical bias is one of the most important issues with contingent valuation techniques. Bishop and Heberlein argue that the hypothetical nature of the question scenario many not reveal preferences that are representative of actual market behavior.

Continuing literature recognizes that the elicitation format being hypothetical is the source of strategic response behavior; because a respondent knows about the hypothetical nature of the scenario, he/she may respond strategically. Social psychology literature has looked at the difference between what people say they will do (or have done) and what they do (or did) and found that there is in fact a large difference. This is in line with the two issues discussed previously. Bishop and Heberlein (1979) suggest that environmental economists can learn a lot from sociology in terms of ways to efficiently design and implement contingent valuation studies. Since the publication of this early paper, extensive research has been done to mitigate the effects of each of these concerns, primarily focusing on the problems that arise with hypothetical scenarios. The following chapter on survey design and implementation will follow this literature in order to design the best possible survey scenario. The design of this study closely follows the process recommended by Boyle (2003) in the "Steps in Conducting a Contingent Valuation Study". This section will provide validation for project decisions during each step taken following what has been found in previous contingent valuation studies. A copy of the final design of survey and focus group questionnaire are available in Appendix 1.

4.1 Contingent Valuation Scenario

There are several distinct steps in designing the contingent valuation scenario. These steps include defining the variation to be valued, selecting an appropriate response format, and designing the policy levels and fees. First, the specific variation to be valued must be defined.

To ensure that the issue at hand is adequately addressed, it is necessary to identify and specifically define the change that is being valued; both prove to be somewhat difficult in this case. The survey questions are focused directly on electricity generation, a privately marketed good, but the valuation will be for the changes in environmental quality associated with using that good, in this case, the change associated with using renewable electricity generation instead of traditional generation techniques. This environmental quality change is not a change in an individual aspect of quality; it is the bundle of benefits that the consumer associates with renewable electric generation. This bundle includes all benefits discussed previously: an increase in air quality, decrease in water usage and increase in energy security, as well as any other benefits perceived by the consumer.

Once the variation is well defined, the response format that best mimics the hypothetical policy change at hand is selected. The primary response formats used in contingent valuation studies are variations of open ended, payment card, and dichotomous choice questions. Early contingent valuation research focused primarily on open-ended question types, but as researchers began to identify problems with such responses, other response formats, such as dichotomous choice, have become increasingly popular. Dichotomous choice formats offer incentive compatible scenarios and align well with the nature of actual voting procedures. For this reason, a referenda vote using dichotomous choice responses has become a primary format for valuation questions.

Although Boyle (2003) states that using dichotomous choice is a “safe approach” in response format, he also discusses some potential problems. These include anchoring- where a respondent “anchors” their valuation to high bid amounts that are given to them, “good citizen” voting- where a respondent votes on what he thinks others will want rather than his personal preferences and yea saying- where the respondent answers “yes” at any bid amount. Acknowledging these potential problems, dichotomous choice will be the response method used in this survey. It will be used not only because of its alignment with incentive compatibility, but also because of the realistic nature of DC referenda voting scenario questions (Carson and Groves, 2007).

Dichotomous choice responses allow for variation in payment amount by offering different survey versions with a different fee for each. The interval over which the fees vary in this survey is based on a combination of responses to an open-ended valuation question in a small focus group and the findings of previous studies. The focus group results found an average WTP of $8.75 per month and a median of $5 per month. The mean in previous studies tends to be a little lower, but the median higher. Longo et al. (2008) site multiple contingent valuation and choice experiments looking at a variety of policies (Bately, 2001; Bergmann, 2006; Champ and Bishop, 2001; Goett et al., 2000; Roe et al., 2001; Wiser, 2003). These studies find a mean willingness to pay of $4.81 per month with values ranging from $1.36-8.20. Keeping this information in mind, the initial bid amounts will be at five levels varying by $2.50 around the anticipated median of $7.50. This is consistent with the literature, which recommends a small number of bid points within a tight range of the median value (Alberini, 1995). Advanced survey techniques made available by the online software used for the implementation of this survey allow the researcher to monitor initial responses and adjust as necessary. Based on early responses, which showed higher than anticipated willingness to pay, the original bid amounts were varied by adding an additional level at $25 and adjusting the $5 version to a bid level of $15. These levels allow the study to maintain adequate information about the upper bound of the WTP distribution and will be discussed further in the survey response section.

Incentive compatibility literature recommends using a referendum tax voting scenario as respondents view it to be a realistic scenario, and because they will be personally affected by the mandatory payment, respondents are most likely to reveal their true value. Wiser (2007) finds the collective payment scenario to be ideal for optimizing contributions and customer preference. A proposed collective payment referenda question should elicit the most accurate and useable measurement of consumers WTP. Following these guidelines, the final valuation question is as follows:

> *6. The state government is considering a few ways in which to support renewable energy. One option is a program where each residential and commercial customer would be required to pay a $X surcharge on his or her monthly electric bill. This surcharge will be collected through your local electric utility company and used for investment into renewable energy projects. This amount correlates to an approximate 300 kWh generated from renewable energy sources instead of fossil fuels per customer per month. Your contribution will prevent emission of 462 pounds of CO_2 and the use of 141 gallons of water every month. Remembering that all homes and businesses in the state will be required to pay the same amount if the policy were to be adopted, would your household support the adoption of this proposed monthly surcharge of $X for the next 5 years? ($XX annually)*
>
> *a. Yes, go to question 7*
>
> *b. No, go to question 8*

Boyle (2003) describes the necessity of allowing a "0" response and screening for misleading "no" responses. To do this, a follow up question for all "no" responses asking the respondent to signify why they answered in the way that they did is included. The options allow the respondent to signify if they would not pay anything for the proposed policy, “0” response, or if the payment proposed is just too high. These options also allow for “protest” type responses in which the respondent does not agree with the provisionary terms, thus responding “no”, even if they would like to support renewable energy.

A follow up question for the “yes” responses will also be included. This question is a certainty interval, which allows the data collector to control for uncertain responses. Controlling for uncertainty in this manner has been shown to decrease the potential upward hypothetical bias which may be present in contingent valuation studies by essentially controlling for yea-saying behavior (Little and Berrens, 2004). Respondents are likely to be unfamiliar with valuation exercises and may have a tendency to respond “yes” when they are unsure of their answer. In this case, the focus is on uncertainty in the “yes” responses and the assumption that “no” responses are certain, as found in the literature (Berrens et al., 2002, Loomis and Ekstrand, 1998), is made. This suggests following an asymmetric uncertainty model and adjusting only “yes” responses is appropriate. Thus, the data is recoded such that uncertain “yes” responses are treated as “no” responses. This allows for empirical estimations at different certainty levels, correcting for possible bias associated with uncertain responses. This follow up will also help to increase the validity and fit of the final empirical model.

4.2 Defining Information Scenarios

The information component of the survey provides the respondent with the necessary information about the scenario in which the valuation question takes place. It is important that this information adequately defines a realistic scenario so that the respondent can appropriately state their willingness to pay. For this study, the information component is also essential to set up the variation between survey versions.

The first part of the information section is to describe what item the consumer is valuing. In this scenario, the consumer is valuing the bundle of benefits associated with renewable electric generation. This bundle is quantified using data from PNM's 2006 Integrated Resource Plan to calculate the decreased CO_2 and water usage for the anticipated median dollar amount payment of $7.50. The information about this bundle of goods is varied over survey types to understand the effect of additional information in a general sense and of the importance of water conservation to the consumer. Understanding the influence of this additional information about the water conservation benefits of renewable electricity generation is the primary focus of this research, thus adequately developing the information scenario is very important.

A focus group conducted with a small sample population of undergraduate students showed that the average respondent had only a general understanding of the benefits of renewable electricity generation, and little or no understanding of current policy measures[6]. This information was incorporated into the survey design, which focuses on giving the respondent concise but thorough information on the issue at hand.

The next piece of information to be provided to the survey respondent is the method of provision. Carson and Groves (2007) discuss the issue of incentive compatibility in reference to provisionary arrangements. Voluntary payment scenarios encourage strategic responses on the part of the survey respondent. The reasoning here is that if the payment is voluntary, and the survey does not tie one to participation, it is

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[6] The focus group responses are listed in Table 1 of Appendix 3.

optimal to state preferences other than the respondents true preferences. The strategy is to over-state the response in order to guarantee existence of the program and the option of participation in the future. Mandatory payment scenarios, on the other hand, are incentive compatible because if the policy is adopted the respondent will be tied to participation. In this scenario, it is optimal to state no more than what the respondent is actually willing to pay because they will be required to make the actual payment.

The scenario designed for this specific survey will include an incentive compatible mandatory payment. The actual payment will be made through the monthly utility bill where funds go directly to the utility provider. The mandatory payment made to the private firm is the preferred scenario consistent with research by Wiser (2007).

The question will set up a referenda vote with the characteristics described above to further the realistic policy application of this scenario. The decision rule will be a simple majority vote to align with common referenda voting scenarios. The anticipated policy period will be five years, in order to maintain realism in the policy scenario. Too long of a policy may not seem credible to consumers because of the constant changing nature of politics, but too short of a time frame will seem unrealistic because it will not allow for any changes to be made on the part of the utility company.

4.3 Development and Design of Questionnaire

After the valuation section is complete, it is important to design the remainder of the survey in order elicit information that will complement the valuation scenario. It is also important to keep the interest of the respondent by asking questions in the reading portions to target understanding. The first portion of this survey provides a warm-up section for the respondent. In this section, the respondent will be asked general questions that help them to begin considering the costs and benefits associated with renewable electricity generation. Once these warm-up questions are complete, the respondents will continue on to the valuation scenario and question.

The third section of questions is aimed at creating an environmental ranking score for the individual respondents. The New Environmental Paradigm, commonly referred to as NEP, scale will be used to create this variable. The NEP scale was initially developed by Dunlap and Van Liere in 1978 and then updated in 1992. Since this time, it has become a very popular measure for evaluating environmental preferences in economics and other social sciences. The scale includes questions relating to five different aspects through which respondents may develop environmental preferences. These aspects include recognizing the following: the limits to growth, that humans are not the only important living beings, the fragility of nature's balance, the application of the constraints of nature to humans and the possibility of an ecological catastrophe. This scale for valuing environmental preferences will be included before the demographic section and will be a useful and thorough measure for considering consumer demographics.

The final section of the questionnaire consists of a basic set of demographic variables. It includes common variables such as gender, income and education. The survey sample was from the population of staff at the University of New Mexico. While recognizing that this population is likely to be very different from the average New Mexican consumer, demographic variables can help us to better understand where these differences lie and to determine the determining factors of a respondent agreeing to the policy terms.

4.4 Experimental Design

A few different data collection modes are discussed in the literature. The primary survey modes include survey by mail, survey by phone, and in-person interviewing. Each has specific strengths and weaknesses. The most common survey mode in the literature is mail, primarily because it is most cost-efficient. A relatively new mode of survey that is becoming increasingly popular in the literature is the online or internet survey. Online surveys face similar problems to the ones faced in mail-based and central location surveys, such as limited information and limited samples, but they are also even less costly. Studies using this format in mixed mode samples have found no significant difference in the data collected between the internet mode and other similar survey modes (Li et al, 2008, Olsen, 2009).

The contingent valuation survey designed for this research was implemented via online survey technologies, specifically the OPINIO software recently purchased by the University of New Mexico[7]. This set up is appropriate for a few reasons. Online survey mode is very inexpensive, and has a quick turnover rate as far as the amount of time needed the survey to get to the participant and then back to the survey administrator. Online surveying can also decrease the time spent on data collection as the server generally has collection methods built in. Although the requirement of internet provision to the survey participant may cause sample bias in other situations, for the sample population at hand- a specific University population- internet access is a common and necessary career requirement.

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[7] Additional information on the use of OPINIO is available in Appendix 2.

Survey implementation follows the general design recommended by Dillman (2006) in "Mail and Internet Surveys: The Tailored Design Method" for internet surveys and consists of four total contacts. The initial contact is a half page flier sent to the respondents' campus mail stop code informing them of the study and that they have been selected to participate. The second contact is an email survey invitation individualized for each respondent to avoid multiple responses. The third and fourth contacts are reminder notices, also sent via email, which include the survey link. These reminder notices were sent at least one week apart from each other at various times and days of the week to encourage strong participation rates.

In order to take full advantage of the nature of the Internet survey, the invitation notices were sent in two waves. This allows the researcher to analyze initial results and adjust survey design where necessary. As mentioned earlier, because of the very high number of "yes" responses, it was necessary to increase the bid level for one scenario and eventually to add an additional bid at the upper end of the bid range. After this change was made, the bid scenarios consisted of $2.50, $7.50, $10.00, $12.50, $15.00 and $25.00.

4.5 Sample

The unique nature of this study allows us to use a readily available population for data collection. The goal of this research is to address the impact of water conservation on WTP, not the overall WTP, for a specific renewable energy policy. The sample population is chosen understanding that it will generate a biased overall willingness to pay, but will be adequate for testing to determine if information on water conservation causes a significant change in responses. This sample was randomly drawn from the University of New Mexico's Staff Directory, which includes all university and university hospital staff.

The original population sample size of 2000 was calculated following recommended procedures used in previous literature for a split sample survey with a predictive power of 80% at 0.20 degree of significance. Depending on the final participation rate, a sample size of 2000 allows us to end up between 0.20 (65% participation) and 0.30 (30% participation) from the true value. This level of significance improves the quality of results. Final response rates and other issues with the sample population will be discussed in chapter 6. The following chapter will discuss how the collected survey data is used to arrive at the final WTP estimations.

Chapter 5: Theoretical and Methodological Framework

To address consumers' valuation of the water conservation benefits associated with renewable energy generation using data collected through implementation of the survey outlined in Chapter 4, an empirical model is developed based upon the random utility model. This allows the derivation of a measure of consumer willingness to pay that is consistent with utility theory. The Hanemann (1987) approach is followed to model discrete choice responses. The following section will begin with an introduction to utility theory and the Random Utility Model, and close with an outline of the model used for this research along with some expectations for this model.

5.1 Utility Theory and the Random Utility Model

Basic consumer theory tells us that an individual will choose to consume the bundle of goods from which he gains the most utility within his budget constraint. Some level of utility is gained from public goods, for which the individual does not explicitly pay to consume. Although there is no defined price for these goods, they do hold value. Stated preference research aims at specifically defining this value and modeling the variables that influence an individuals' preference for a specific non-market good. In this research, the public good being valued is all of the benefits that the individual associates with a specific renewable energy policy. The specific aim of this research is to determine if influencing the respondent to consider the water conservation benefits of increasing renewable energy generation has a significant effect on their willingness to pay.

The individuals' value for the increase in environmental quality can be defined as the following compensating variation:

$$U^0(q^1, p, y - WTP_c) = U^0(q^0, p, y) \quad (1)$$

where q_0 represents the initial level of quality and q_1 represents some increased level of environmental quality. The individuals willingness to pay for the difference in quality, ceteris paribus, is represented by the WTP measure and shown as a decrease in income, y. It is important to note that as this is applied to all consumers, rather than just one individual, a random error component should be added to adjust for heterogeneity among consumers that cannot be modeled structurally in the econometric model. The error component will be added in equation (2).

5.2 Hanemann Method

The modeling approach will closely follow the two-step method presented by Hanemann (1987). One issue with this method is that the coefficients on variables are scaled and therefore must be interpreted as such. In the Hanemann approach, the coefficient of the bid and other covariates is β/σ. Since σ cannot be identified direct calculation of marginal effects is impossible. Cameron (1989) developed an econometric model where the coefficient of the bid is simply $1/\sigma$, thus permitting the scale factor to be identified. This method is somewhat more complex but allows for full identification of the marginal effects and has become popular in the literature. Recognizing that the two estimation approaches result in equivalent WTP estimates, and because the sample does not allow for the numerical values of coefficients to have useful empirical meaning, the Hanemann approach is used in estimation.

The first step of the Hanemann approach is to appropriately model the data. This is done by using a logit or probit model with the binary yes/no dichotomous choice response as the dependent, right-hand side variable. The logit model is used for the estimation done in this research. The following section will outline this approach following Haab and McConnell (2003). The decision process, where CV represents the response to the contingent valuation question, is defined below:

$CV_i = 1$ ("yes") if $WTP_i \geq BID_i$

$CV_i = 0$ ("no") otherwise

For the respondent to benefit from the policy, thus answer "yes", his or her utility after the change in quality adjusting for the decrease in income by subtracting the bid, b_i, must be greater than his or her original level of utility.

$$u_1(y_i - b_i, z_i, \varepsilon_{1i}) > u_0(y_i, z_i, \varepsilon_{0i}) \qquad (2)$$

Therefore, the probability that a respondent answers "yes" equals the probability that u_1 is greater than u_0.

$$\Pr(yes_i) = \Pr(u_1(y_i - b_i, z_i, \varepsilon_{1i}) > u_0(y_i, z_i, \varepsilon_{0i})) \qquad (3)$$

The logistic distribution of ε has mean 0 and variance $\pi^2 \sigma^2_L/3$. Normalizing by σ_L creates a logistic variable with mean 0 and variance $\pi^2/3$.

$$\Pr(yes_i) = \left[1 + \exp(-(\alpha z_i / \sigma_L - \beta b_i / \sigma_L))\right]^{-1} \tag{4}$$

Parameters are estimated using the maximum likelihood method. Here, let T represent the sample size and define $I_i=1$ if respondent i answers "yes" and 0 otherwise. The likelihood function becomes:

$$L(\alpha, \beta | y, z, b) = \prod_{i=1}^{T} \left[\left[1 + \exp\left(-\left(\frac{\alpha z_i}{\sigma_L} - \frac{\beta b_i}{\sigma_L} \right) \right) \right]^{-1} \right]^{I_i} \left[1 - \left[1 + \exp\left(-\left(\frac{\alpha z_i}{\sigma_L} - \frac{\beta b_i}{\sigma_L} \right) \right) \right]^{-1} \right]^{(1-I_i)} \tag{5}$$

Maximization generates parameter estimates that are scaled by $1/\sigma_L$. The parameter vector β^* and data vector X_i are defined as:

$$\beta^* = \{ \alpha / \sigma, -\beta / \sigma \} \tag{6}$$

$$X_i = \{ z_i, b_i \} \tag{7}$$

The log likelihood function for the linear random utility logit model becomes:

$$\ln L(\beta^* | y, X) = \sum_{i=1}^{T} I_i \ln \left[\left(1 + e^{-(X_i \beta^*)} \right)^{-1} \right] + (1 - I_i) \ln \left[1 - \left(1 + e^{-(X_i \beta^*)} \right)^{-1} \right] \tag{8}$$

The second step in the Hanemann approach is to estimate willingness to pay. The equation for calculation is as follows and can also be found in Chapter 2 of Haab and McConnell (2003). Where α represents the estimated coefficients on the independent variables excluding the bid, β represents the coefficient on the bid variable and z_i is the vector of the individuals' demographic characteristics:

$$E_{\varepsilon}(WTP_i | \alpha, \beta, z_i) = \frac{\alpha z_i}{\beta} \tag{9}$$

Note from equation 6 that the Hanemann approach leaves us with variable coefficients that are scaled terms where σ_L, the scale term, is unknown. Therefore, as mentioned previously, the coefficients found in the logit model tables cannot be used to directly calculate the marginal effects of independent variables.

It is important to note that using the estimation approach in equation 9 does not place a lower bound on WTP measures. Theoretically, it makes sense to truncate the model at 0, as no respondent should have a negative WTP for the policy. The method recommended by Hanemann (1989) and commonly used in the literature (Kotchen and Reiling, 2000, Loomis et al., 2000, etc.) when making the assumption of non-negative WTP values is outlined below.

$$E(WTP) = (\frac{1}{\beta_1}) * \ln(1 + \exp^{\beta_0}) \tag{10}$$

β_1 is the coefficient on the bid amount and β_0 is constructed from the coefficients on the explanatory variables such that:

$$\beta_0 = \alpha_1 \text{ var}_1 + \alpha_2 \text{ var}_2 + ... + \alpha_k \text{ var}_k \tag{11}$$

An alternate method used to ensure strictly positive WTP values is to use the natural logarithm of the bid variable in the logistic equation and then to take the exponential of the estimated WTP following equation 9. In chapter 6, the logistic models of these two versions are compared to determine which has better fit and should be used for estimation.

When using either method of truncation it is important to note that truncation tends to overestimate WTP. This is especially true of mean values, therefore the focus is on median estimates, which tend to be more stable as they are not as influenced by extreme outliers. Results of both mean and median estimates are reported in Chapter 6.

5.3 Hypotheses

Once an appropriate econometric model is set up, the hypotheses to be tested can be stated. The most important hypothesis to this research is the difference between survey versions where one version includes information about water conservation and one does not. This will be set up as a dummy variable in the data where survey responses for versions with the additional water conservation information (*WCINFO=1*) are coded "1", and responses without this information (*WCINFO=0*) are coded "0". I hypothesize that the additional information about water conservation will elicit a higher willingness to pay from the respondent. The hypotheses below are tested against the null hypothesis of no effect.

$$
\begin{aligned}
&H_1 : \beta_{WCINFO} > 0 \\
&H_2 : (WTP)_{WCINFO=1} > (WTP)_{WCINFO=0}
\end{aligned}
\tag{12}
$$

As well as evaluating the water information component, hypothesis tests will be used to examine the socioeconomic variables that are related to an individuals' willingness to pay. Table 1 describes each of the independent variables and how they are collected as well as descriptive statistics and will be referred to in Section 6.2.

Table 1: Descriptive Statistics

Variable	Type	Description	Mean	Standard Deviation
MALE	Binary Dummy	Ņ1Ó= male, Ņ0Ó= female	0.34433	0.47549
AGE	Continuous	Age of respondent: Broken into categorical segments for modeling	46.67052	11.07447
BILLPAY	Binary Dummy	Ņ1Ó= yes, the respondent is directly responsible for his/her electric bill, Ņ0Óotherwise	0.92131	0.26934
CHILD	Binary Dummy	Ņ1Ó= yes, the respondent does have children, Ņ0Óotherwise	0.65279	0.47642
HEALTHCARE	Binary Dummy	Ņ1Ó= yes, the respondent works in the healthcare industry, Ņ0Óotherwise	0.54584	0.49825
POL	Likert Scale	Ideology: Ņ1Ó= very liberal, Ņ2Ó= somewhat liberal, Ņ3Ó= somewhere in between, Ņ4Ó= somewhat conservative, Ņ5Ó= very conservative	2.67338	1.06073
MEDIANINC	Continuous	Household income information was collected as a categorical variable. The midpoints of each category were used to create a continuous variable for modeling purposes. The available categories were: <$20,000, $20,000-40,000, $40,000-60,000, $60,000-80,000, $80,000-100,000, $100,000-120,000, $120,000-140,000, >$140,000	73709.68	39257.32
GRAD	Categorical Dummy	*GRAD* = "1" if the respondent has obtained a graduate degree, "0" otherwise. Education information was collected as a categorical variable. Available categories include: some grade school, high school diploma/GED, some college, Associates or Technical degree, Bachelors degree, Graduate degree	0.36063	0.48052
NEP	Series of Likert Scale	The NEP score is calculated by summing the answers to a series of 15 likert score questions. Thus the scores can range from 15 to 75.	55.09246	9.42469
GPKNOW	Binary Dummy	Ņ1Ó= yes, the respondent knows about a green pricing program available in his/her area, Ņ0Óotherwise	0.44089	0.49684
GPPART	Binary Dummy	Ņ1Óyes, the respondent participates in this program. Ņ0Óotherwise	0.16947	0.37543

These variables will be used as covariates in the model to incorporate aspects of consumer heterogeneity to better explain differences in WTP. The characteristics that are expected to show significance are income, education level, gender, age, children (*CHILD*), political ideology (*POL*) and NEP score (*NEP*). Previous studies show positive relationships with WTP for income, education, male and children. Consumers who consider themselves more conservative have been found to have a lower WTP. Age has also been found to be significant, but generally only in categorical responses where the age group "over 60" has a lower WTP[8]. The following hypotheses define the expected findings as consistent with the literature and will be tested against an alternative of no effect:

$$
\begin{aligned}
&H_3 : \alpha_{INC} > 0 \\
&H_4 : \alpha_{MALE} > 0 \\
&H_5 : \alpha_{CHILD} > 0 \\
&H_6 : \alpha_{GRAD} > 0 \\
&H_7 : \alpha_{POL} < 0 \\
&H_8 : \alpha_{NEP} > 0
\end{aligned} \tag{13}
$$

Although consistency with the literature is expected, there may be regional variations that affect this dataset. Any changes as far as demographic expectations could be influential to the literature and interesting in terms of policy-making tactics, however, this statement must be conditioned upon the fact that a convenience sample is used and it

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[8] Expectations for demographic variables are taken from Longo et al. (2004), Wiser (2007) and Zarnikau (2003).

may be the cause of variations. This chapter has outlined methodology and designed hypotheses to be tested. Next, the sample data is analyzed following this framework.

Chapter 6: Results of the Contingent Valuation Scenario

The following section provides a summary of the survey data collected as well as empirical estimations for WTP. Specifically, it reports the final response rates, discusses issues with protest and certainty follow up questions and, overall, gives a general description of the demographic make up of the sample. I also test for consistency between the two survey-version samples and look at questions regarding environmental attitude and concerns. Finally, I present empirical conclusions including testing the chief hypothesis concerning the importance of information about water conservation.

6.1 Response Rate

As mentioned in the previous section, the sample size of 2000 for this survey was calculated based on a minimum 30% participation rate. Unfortunately, only approximately 1800 of the respondent listings included valid email addresses. To maintain the same level of minimum validity, the 1800 person sample must have a minimum participation rate of 33%. This response rate is also affected by incomplete responses. Table 2, below, provides a description of the various response rates depending on the inclusion of incorrect contact information as well as incomplete responses excluded in empirical estimations.

Table 2: Response Rates

Description	Count	Version 1/2	Response Rate	Adj. Response Rate *
Total Responses	757	379/378	37.90%	42.10%
Complete Responses	675	339/336	33.75%	37.50%

* Adjusted response rate accounts for the incorrect email addresses (survey invitations that were never received by respondents) by using total size of 1800 rather than 2000.

The response rate for this research is not unusual for this type of study. It is at the lower end of the anticipated response rates, but is still considerably larger than 30%. Incorporating uncertain responses will be done by recoding the data and will allow use of the entire data set.

6.2 Descriptive Statistics and Environmental Attitudes

As mentioned in the sample population selection, the sample was chosen primarily for availability purposes. It has some clear weaknesses in terms of its descriptiveness of the general population[9]. Many of these differences may be attributed to the high education levels required to work in many areas of the healthcare industry, in which 54% of the respondents are employed. There may also be effects of a self-selection bias, as educated individuals are likely to have higher environmental preferences and may enjoy participating in academic research.

The income and education level of the average participant is very high. According to the U.S. Census Bureau, the mean household income level in Bernalillo County in 2005 was $42,600. The median respondent in this sample classified his or her

[9] A summary of descriptive statistics is available in Table 1 in Section 5.3.

household in the $60-80,000 bracket. In this sample, 67% had at least a Bachelors degree and 36% had a graduate degree. Only 32% of the population in Albuquerque, and a smaller portion in New Mexico, hold a Bachelor's degree according to 2000 Census Data. This sample clearly misrepresents the greater population in the area in income and education, two important indicators of preferences.

It is important to note that while the education and income of the respondents is unusually high, the political and environmental responses are moderate. The mean political variable was calculated on a five point likert scale where 1 represents "very liberal" and 5 represents "very conservative". The mean of 2.7 tells us that the respondents are slightly liberal, but not extremely biased towards liberalism. The NEP and other environmental scores also show moderate results[10]. There is also a high participation rate in green pricing programs (*GPPART*) among respondents. In this data, the participation rate in green pricing programs is 17%. As mentioned earlier, PNM reports a 3% total participation rate for 2006. This may be an indicator of additional bias in the sample, or of respondents' possible over-statement of their "green" behavior.

6.3 Testing for Sample Bias

It is clear from Table 2 that the number of responses for each survey version was very similar- complete responses for Version *WCINFO=0* and *WCINFO=1* totaled 339 and 336. Just because the response count is similar, however, does not mean that there are no differences between the two sample populations. To make sure that no significant

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[10] The NEP score is to compared to that found in the literature. Kotchen and Reiling (2000) classify NEP scores ranging from 50-59 as "moderate".

sample biases exist each variable was tested depending on version using a simple t-test at a 95% confidence level. No significant differences were found for any of the demographic or warm-up questions. The model is also split by version to make sure there are no extreme differences between specifications of the logistic model[11]. Because no sample bias is found, the responses are modeled jointly and then tested for differences between WTP by version. Testing between the empirical WTP estimations will be used to discuss the differences between versions found for the dichotomous-choice contingent valuation question.

6.4 Logit Model and Hypothesis Testing

Once an accurate understanding of the data set is developed, it is possible to begin to utilize an economic model to predict overall willingness to pay. To do this, the logit model, as defined in Chapter 4, is estimated using variables that have been anticipated to help predict the respondents' answer to the valuation question. After finding the best fitting model, estimates of WTP may be calculated. The following equations define the variables to be used in the logistic model, with and without the use of the logarithm of the bid for estimation.

$$\text{Prob}(Yes) = f(BID, WCINFO, LNEP, UNDER30, GRAD, GPPART, GENDER, CHILD) \quad (14)$$

$$\text{Prob}(Yes) = f(LBID, WCINFO, LNEP, UNDER30, GRAD, GPPART, GENDER, CHILD) \quad (14')$$

[11] Separate models and corresponding WTP values are reported in Appendix 4.

Test results for correlations between variables revealed a strong relationship between income groups and education level, which is to be expected, as well as between NEP score and political ideology. To adjust for correlation issues only one education variable (*GRAD*) is used to capture education and income effects and the natural log of NEP (*LNEP*) to capture political and environmental ideology. Table 3 shows the results from the logit maximum likelihood estimation for each equation, modeled on the full data set with no adjustments for certainty. This table is used to determine which of the models has better fit and should be used for WTP estimation.

Table 3: Logit (Full Model)

Variable	Parameter Estimate (_/_)	z-statistic	Variable	Parameter Estimate (_/_)	z-statistic
BID	-0.09367	-6.29***	*LBID*	-0.9174	-6.48***
WCINFO	0.13889	0.81	*WCINFO*	0.1704	0.99
LNEP	2.79078	5.54***	*LNEP*	2.7532	5.42***
UNDER30	0.49815	1.68*	*UNDER30*	0.5107	1.73*
GRAD	0.2979	1.62	*GRAD*	0.3023	1.64
GPPART	0.6204	2.49**	*GPPART*	0.5761	2.31**
MALE	0.08843	0.49	*MALE*	0.1205	0.66
CHILD	0.10616	0.56	*CHILD*	0.0844	0.45
CONSTANT	-10.05337	-4.96***	*CONSTANT*	-8.8951	-4.35***
Observations: 675			Observations: 675		
Log-Likelihood: -402.446			Log-Likelihood: -399.685		
Pseudo R^2: 0.1073			Pseudo R^2: 0.1135		
Correctly classified: 67.11%			Correctly classified: 67.11%		

* significant at 90%, ** significant at 95%, *** significant at 99%

Table 3 determines which model is appropriate to use for WTP estimations. The model using *LBID* has a slightly higher Pseudo R^2 value, and thus better fit. Using *LBID* also makes sense because helps to keep the magnitudes of the variables similar. All other variables, except for *LNEP*, are dummy variables with values of either "0" of "1". Using numbers as high as 25 in the *BID* variable may have a negative influence on fit. For these reasons, I use the second logistic model- using LBID- for WTP estimation. Results following the truncation method suggested by equation 10 and using the *BID* variable are reported in Appendix 5.

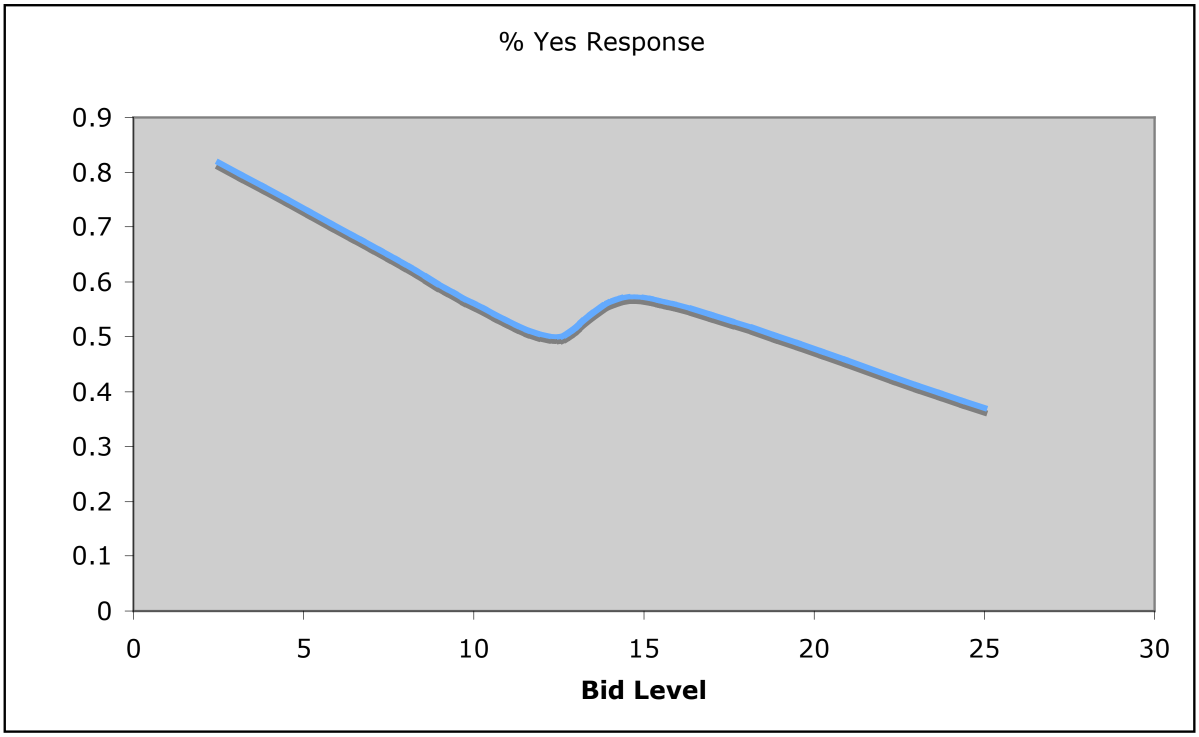
The initial hypothesis, H1: $\beta_{WCINFO} > 0$, can also be tested from Table 3. The coefficient on *WCINFO* is positive in sign, as expected, but it is not significant. This allows for the rejection of H1 and conclusion that survey version is not a significant determinant of respondent behavior. A likelihood ratio test between the model including the *WCINFO* variable with its interactions and the model excluding *WCINFO* draws the same conclusion. This conclusion remains throughout all variations in model \specification.

Hypotheses on demographic variables are also tested from Table 3. The empirical model shows expected signs on all demographic variables. The variables *GENDER* and *CHILD* are not found to be significant. The most significant of the other explanatory variables are *BID* and *LNEP*. The NEP score may capture the individuals' environmental preferences and is thus an important indicator of their acceptance of a renewable energy program.

It is logical that the bid amount have a large impact on the probability a respondent answers "yes"; in fact if it was not so we would be unable to accurately model the data. The Figure 1 models the probability of “yes” at the varying bid amounts. Although there is a somewhat unusual upward hump at the $15 bid level, the probability follows the general downward trend expected with this type of data. It would be ideal for the right tail in this graph to come closer to approaching 0. Higher bid levels would have allowed this to happen. Lacking these higher bid points, the assumption that the right tail follows a consistent downward trend is made.

The spike in Figure 1 around a bid level of $15 may justify testing the fit of a mixed logit model. This type of model would allow for two sets of consumers defined by a certain characteristic- in this data set possibly representing high and low income groups- where consumers within each group share homogeneous characteristics that when modeled separately allow for better fit of the empirical model. Although Figure 1 points to the possibility of a mixed model, for this paper I focus on a general logit model and leave further specifications for future research.

Figure 1: Probability of answering "yes"



6.5 Testing for Information Effect and WTP Estimates

Although H1 has already been found insignificant, analysis of the estimated WTP values by version (H2) has yet to be reported. This section will solve for WTP values in general, test for a significant difference between versions, and look into alternative models and measurements to increase reliability.

6.5.1 Full Model

Mean WTP is calculated using the parameters of the logistic model shown in Table 3 and following the alternative truncated model as presented in Chapter 5 using the following equation:

$$E_{\varepsilon}(WTP_i|\alpha,\beta,z_i)=\frac{\alpha z_i}{\beta} \tag{9}$$

As discussed previously, this model estimates strictly positive WTP values. Using *LBID* requires taking the exponential of the estimation following equation 9. Two additional methods for WTP estimation are presented in the Appendix. The more common truncated model, recommended by Hanemann (1989), as presented in equations 10-11 is estimated in Appendix 5. An additional model specification allowing for negative WTP values with estimation following equation 9 is presented in Appendix 6. These alternative models allow analysis of consistency throughout various model parameters. Estimated WTP values for the model with the best fit, using *LBID*, are presented below.

Table 4: WTP (Full Model using LBID)

Model	Mean WTP	95% CI	Median WTP	95% CI
Joint	20.199	19.1043-21.2934	16.1691	15.1725-17.2199
WCINFO = 0	17.5409	16.1607-18.9212	14.4773	13.3482-15.9160
WCINFO = 1	22.8808	21.2205-24.5410	18.3561	17.0331-20.4066

The mean, and median, WTP is clearly much higher than the previous median of $7.50 as anticipated from previous research and focus group response. While discussing other model specifications, it is important to note that the median WTP value tends to be more stable with a tighter confidence interval than the mean. This measurement, therefore, is a more accurate measure of WTP values. From the estimation of WTP in Table 4, there seems to be a clear difference between versions. This is discussed in detail in section 6.7 by testing for a significant difference in WTP based upon the information about water conservation given to the respondent.

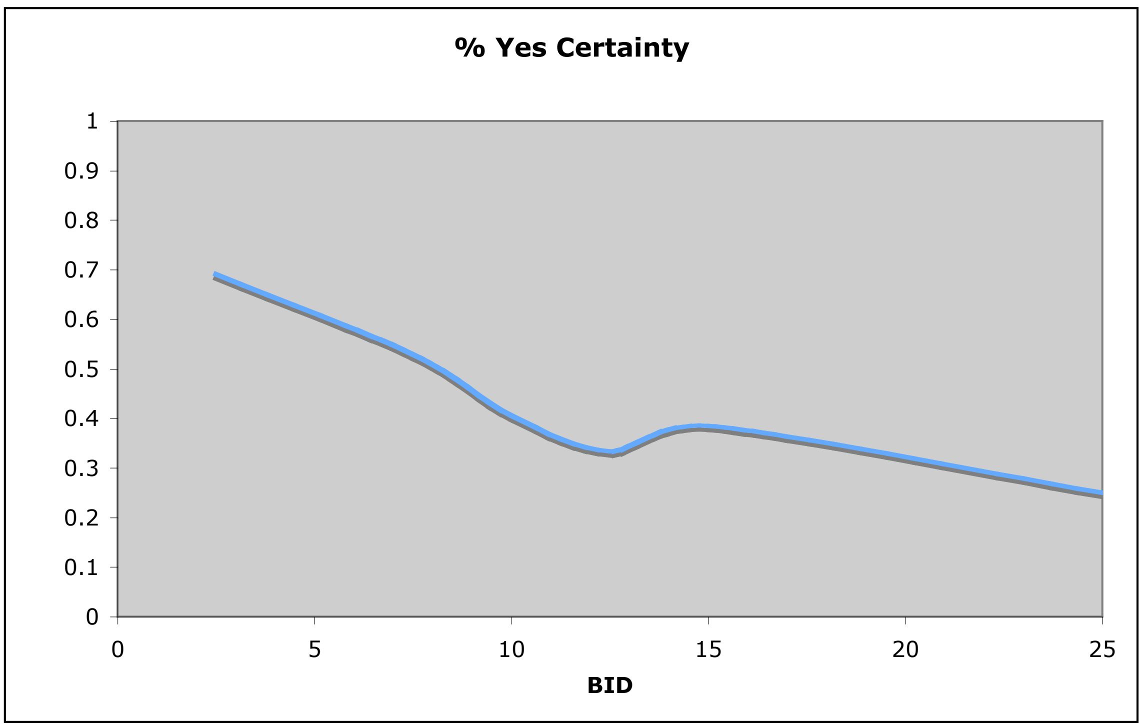
Finding a means of mitigating any potential hypothetical bias has become an important concern in the literature. Morrison and Brown (2009) classify three techniques used in the literature to do this: cheap talk, follow-up certainty scales, and dissonance minimization. They find the later two to be the most important for minimizing hypothetical bias. The following section presents models incorporating adjustments for certainty.

6.5.2 Adjusting for Certainty

Adjusting for certainty of “yes” responses should improve the fit of the logistic model and alter final WTP values downward avoiding upward bias created by yea-saying and uncertain responses. Certainty responses were collected in the form of a likert scale question ranging from 1- “very uncertain” to 5- “very certain”. According to summary done by Morrison and Brown (2009), selection of a cut off value remains somewhat arbitrary in the literature. In this paper, I present various levels of certainty, but focus on estimates using the level 4 “certain” following Li et al. (2009) who use the mean certainty value as the breaking point (mean certainty level in this data set is 4.097). Using this level, the data is recoded following the asymmetric uncertainty model (Loomis and

Ekstrand, 1998) such that all responses with a certainty of at least 4, “certain” and “very certain” responses, are coded as “1” or “yes”. All responses less than or equal to 3, the neutral response, are recoded as “0” or “no” responses. Other levels of certainty are calculated in a similar manner. Figure 2, below, shows the direct impact of this adjustment on the percentage of “yes” responses and the “fat tails” problem created by yea saying.

Figure 2: Probability of answering “yes” at Certainty ≥ 4



The logistic certainty models are reported in Table 5 and the WTP estimates in Table 6. Increasing the level of certainty improves the fit of the model as suggested by a slight increase in pseudo R^2 values. It is interesting to note that the significance of demographic variables is sometimes inconsistent across the variations in certainty levels.

Including the certainty response in this way allows for estimation of a conservative measure of WTP that helps to mitigate uncertain, yea-saying behavior. When calculating WTP, adjusting for certainty decreases mean estimates. This makes intuitive sense because responses are being moved from the “yes” to “no” category. The level 5 certainty estimations find very low WTP values. This is consistent with the literature in that many researchers have found the highest certainty level in their data sets to be too restrictive (Li et al., 2009, Champ et al., 2007, Johannesson et al., 1998). As mentioned above, the focus is on the second column of estimations, where certainty is at least 4. These estimates will be considered a conservative lower bound estimate of WTP.

Table 5: Logit Model, Certainty Levels using LBID

	Certainty = 5		Certainty ³ 4		Certainty ³ 3		Certainty ³ 2	
Variable	Parameter Estimate (_/_)	z-statistic	Parameter Estimate	z-statistic	Parameter Estimate	z-statistic	Parameter Estimate	z-statistic
LBID	-0.9671	-7.18***	(_/_) -0.9106	-7.05***	(_/_) -0.9262	-6.77***	(_/_) -0.8710	-6.34***
WCINFO	0.0886	0.45	0.2236	1.32	0.2119	1.25	0.1932	1.14
LNEP	3.4864	5.35***	2.8899	5.47***	2.4321	4.89***	2.4429	4.92***
UNDER30	-0.6459	-1.64	0.1587	0.56	0.4657	1.63	0.5071	1.74*
GRAD	0.4272	2.13**	0.2923	1.64	0.3653	2.02**	0.3212	1.77*
GPPART	0.3634	1.50	0.6420	2.80***	0.4567	1.92*	0.6201	2.53**
MALE	0.4085	2.02**	0.1279	0.72	0.1258	0.70	0.1327	0.74
CHILD	0.3486	1.64	0.3608	1.94*	0.0944	0.51	0.0736	0.39
CONSTANT	-13.6878	-5.18***	-10.3484	-4.86***	-7.7997	-3.89***	-1.8632	-3.92***
Observations	675		675		675		675	
Log-Likelihood	-326.4007		-410.2533		-410.9541		-407.6834	
Pseudo R2	0.1456		0.1195		0.1072		0.1049	
Correctly Classified	78.07%		66.37%		66.37%		65.93%	

* significant at 90%, ** significant at 95%, *** significant at 99%

Table 6: WTP Estimates, Certainty Levels using LBID

	Certainty = 5		Certainty ≥ 4		Certainty ≥ 3		Certainty ≥ 2	
	Mean WTP	95% CI	Mean WTP	95% CI	Mean WTP	95% CI	Mean WTP	95% CI
Joint	3.0958	2.9094-3.2823	9.4778	8.9314-10.0240	15.8262	15.0645-16.5878	19.0504	17.9704-20.1305
WCINFO = 0	2.8095	2.5675-3.0516	7.8741	7.2442-8.5041	13.4641	12.5387-14.3895	16.2657	14.9277-17.6037
WCINFO = 1	3.3847	3.1028-3.6666	11.0956	10.2317-11.9595	18.2093	17.0470-19.3716	21.8600	20.2084-23.5116
Difference	0.5752		3.2215		4.7452		5.5943	
	Median WTP	95% CI	Median WTP	95% CI	Median WTP	95% CI	Median WTP	95% CI
Joint	2.3964	2.2451-2.5837	7.3515	6.8098-7.8332	13.2435	12.4258-13.9945	15.1015	14.0846-15.8788
WCINFO = 0	2.1866	1.9473-2.3728	6.1852	5.7320-6.7445	11.3932	10.7629-12.2980	12.9477	12.0996-14.5860
WCINFO = 1	2.6143	2.3964-2.8831	8.5696	7.9749-9.5418	15.4205	14.2354-16.9162	17.3450	15.8305-18.9717
Difference	0.4277		2.3844		4.0273		4.3973	

6.6 Analysis of "no" Responses

The response format designed in the survey questionnaire also allows respondents to signify a reason for "no" responses. This consideration is necessary for a few reasons. First, it is essential to allow for respondents to provide a "0" response (Boyle, 2003). According to the findings of Morrison and Brown (2009), allowing for justification of "no" responses as a form of dissonance minimization discourages yea-saying behavior and helps to mitigate hypothetical bias.

Allowing for these options also allows for additional discussion of "no" responses by the researcher. In this situation, the data contains a very large percentage of respondents who signify their reason for answering "no" as a reason unassociated with the dollar amount of the bid. For example, many respondents either disagreed with the provisionary nature of the policy or would prefer usage based payments rather than a flat rate fee. Some respondents replied that "no" saying that although *they* would be able to afford the payment, it would not be a fair amount to consumers with lower income levels. These respondents disagree with some aspect of the policy unrelated to bid amount and would not vote "yes" to this policy. They may have a high WTP for the environmental benefits associated with such a policy but disagree with specific terms of the hypothetical scenario presented.

Table 9 breaks up the "no" responses by version. It then separates out the "no" responses into the categories given in the follow up question asking respondents to explain their results. The possible scenarios are as follows:

8. (if no) There are many reasons for not participating. Of the reasons listed below, please select all that apply to you:

a. I support renewable energy, but I cannot afford to pay this additional charge

b. I believe the costs of renewable energy, at this surcharge, exceed the benefits.

c. I support renewable energy, but program participation should be voluntary similar to the current green pricing programs.

d. I support renewable energy, but the electric utility provider should pay for the changes.

e. I would need more information to make this decision.

f. other ________________________

When looking at the percentages in Table 7, it is important to note that the respondent has the option to denote as many of the given reasons as he or she wishes and to fill in an open ended "other" response. Option (b.) relating the costs and benefits of renewable energy is omitted from the table below as less than 10% of no responses selected this as a reason for their response. The *PROTEST* dummy was created following analysis of options a. - e. and *OTHER* responses to denote those respondents who protest some aspect of the specific hypothetical scenario presented to them by this research. Note that this explanation is not the same as the typical definition of general protest response as seen in the literature.

Table 7: Description of ŅNoÓ Responses by Version

***WCINFO* = 0**			***WCINFO* = 1**		
Percent "no"	Reason		Percent "no"	Reason	
0.4442	*INCOME*	0.282	0.4061	*INCOME*	0.4525
	VOLUNTARY	0.237		*VOLUNTARY*	0.2387
	PROVISION	0.3371		*PROVISION*	0.2915
	MORE INFO	0.3178		*MORE INFO*	0.3342
	OTHER	0.3252		*OTHER*	0.2994
	PROTEST	**0.5415**		***PROTEST***	**0.43**

A few interesting patterns can be observed from this table. Overall *WCINFO* = 0, has a higher percentage of protest responses than the version which includes information about the additional benefit. The highest contributing "no" factor for *WCINFO* = 1 respondents is an income constraint. For *WCINFO* = 0 respondents, disagreement with provisionary terms is the most common reason for a "no" response. It is possible that the additional information given in the water conservation scenario helps to eliminate some protest responses. The respondents who are exposed to the additional water conservation benefits may respond to the hypothetical policy scenario in a more positive way even if their final policy answer is "no" because the bid surpasses their income constraint. A more in depth break down of these responses by bid is show in Appendix 3.

To further understand the interesting role of protest responses, the correlation matrix between *PROTEST* and the other independent variables is analyzed. A few hypothesis tests are also conducted to determine which demographic variables play an important role in determining if a participant is prone to a protest response. These tests allow the definition of a specific consumer who is more likely to protest the unique policy scenario given in the contingent valuation question. This consumer has a significantly lower NEP score, considers him/herself to be more politically conservative, and is older than the average respondent. Interestingly, income was not correlated with protest responses nor did hypotheses tests on income variables show significance.

6.7 Testing between Versions

A basic understanding for the logistic model, as well as the range of WTP estimates associated with the data has been developed. The important result of this research, however, is not the overall WTP measure- but the difference between versions accounting for information about water conservation. The calculations of WTP for each model as shown above allow for us to notice that there does seem to be some difference between *WCINFO* = 0, the original version, and *WCINFO* = 1, the version with information about water conservation. The following table presents results from testing hypothesis 2 stated in equation 10 for a difference between versions in each model. These calculations are done using a simple t-test at the 5% level of significance and are reported in Table 8. It is clear that there is a significant increase in the WTP among participants responding to *WCINFO* = 1.

Interestingly, the result found here, failure to reject hypothesis 2, does not align with the rejection of hypothesis 1 in section 6.4. Although many model specifications were explored during this research, this may be a signal of further issues within the data set that have not yet been recognized. A promising method for future research is the convolutions method recommended in the literature (Poe et al., 2005) to test for differenced between WTP estimations.

Table 8: Testing Hypothesis 2: $(WTP)_{WCINFO=1} > (WTP)_{WCINFO=0}$

Model	t-value	SatterthwaiteÕs df	$\Pr(T > t)$
1: Full	4.8649***	650.250	1.0000
2: Certainty = 5	3.0450***	657.080	0.9988
3: Certainty ³ 4	5.9267***	613.933	1.0000
4: Certainty ³ 3	6.2824***	639.610	1.0000
5: Certainty ³ 2	5.1771***	644.077	1.0000

* significant at 90%, ** significant at 95%, *** significant at 99%

Chapter 7: Concluding Remarks

The results reported in Table 8 support the chief hypothesis of this research and show that water conservation is an important benefit of renewable energy projects to the consumers sampled in this study. This sample, however, is clearly limiting in terms of the scope of the population that it represents. The sample is also limited by its' high number of protest responses. These responses have been discussed and seem to represent a specific demographic of consumer that is likely to protest to the given policy scenario. It may be important for future researchers to better capture reasoning behind such responses in order to adequately correct for them. The limitations of the sample do not allow for us to place a valuation amount on the renewable energy policy defined. It does, however, allow for us to conclude that water conservation is important to the consumer.

Information about water conservation may be an important means to gaining public support for renewable energy projects and facilitating marketing efforts of green pricing programs. This information may be especially useful in regions that are prone to drought and where consumers are wary of water scarcity issues. The role of water conservation may also vary in importance to rural and urban consumers. Rural consumers, who were found to have an increased WTP for renewable energy projects by Bergmann et al (2008), may have increased benefits from water conservation as many of these consumers rely on agriculture to make a living. This scenario might suggest that New Mexicans outside of the urban sample used in this research have similar or possibly increased WTP measures for *WCINFO=1* over *WCINFO=0*.

There are many benefits associated with renewable energy, many of which have been studied in great detail. This research shows that water conservation does play an important role and should be included in further research of this nature. The significance of the water conservation version also demonstrates the importance of the information scenario in contingent valuation studies. The researcher may provide as much or little information as he or she chooses. Understanding the biases that may be created by influencing a respondent with an abundance of supportive or critical information may prove interesting to survey design.

This data set also leaves many opportunities for further modeling efforts. A mixed model specification may be useful to adjust for the hump in “yes” responses. Modeling techniques used to adjust for fat tails such as the pinched tail model (Ready and Hu, 1995) may also be useful. Since the conclusions made from hypotheses 1 and 2 do not reinforce each other, alternate methods for testing the differences between versions, such as the convolutions method as recommended by Poe et al. (2005), may be helpful in further validating the results of this research.

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Appendix I: Survey design

Consumer Preferences Regarding Renewable Energy in New Mexico

Most electricity generation has negative impacts on the environment. Two such impacts relate to air pollution and water usage.

-Energy generation is responsible for around 50% of all CO_2 pollution in the state of New Mexico.

-Traditional coal fired plants in New Mexico use over 17 billion gallons of water per year for cooling.

Renewable energy generation can cause a decrease in these environmental damages. Wind power is the most promising source of renewable energy generation in New Mexico. Electricity generation from wind creates virtually no air pollutants and has limited water requirements.

Section 1: Attitudes about Energy Generation

The following questions are designed to understand your preferences and attitudes toward different electricity generation options. There are no right or wrong answers; we would like to better understand your thoughts about electricity generation, specifically the use of renewable resources in generation.

1. In meeting the state's overall electricity needs, how important is each of the following?

Statement	Not At All Important		Somewhat Important		Very Important
Low costs to all consumers	1	2	3	4	5
Reliable electricity service	1	2	3	4	5
Increasing the use of renewable energy generation	1	2	3	4	5
Energy efficiency programs	1	2	3	4	5

2. How much do you know about the environmental impacts of electricity generation?

Nothing	1	2	3	4	5	A Lot

3. There are several ways to reduce the environmental impacts of electricity generation.

How important is each of the following to you?

Statement	Not At All Important		Somewhat Important		Very Important
Energy Efficiency- Reducing the amount of electricity used by installing energy saving appliances etc.	1	2	3	4	5
Pollution Control- Reducing the pollutants emitted by coal and natural gas fired plants by installing filters and other pollution reducing technologies	1	2	3	4	5
Renewable Energy- producing electricity with wind turbines, solar power, geothermal, and biomass	1	2	3	4	5

4. How important is it to you that using renewable electricity generation may…

Statement	Not At All Important		Somewhat Important		Very Important
… be less harmful to the environment than other generation technologies	1	2	3	4	5
… conserve water	1	2	3	4	5
… increase energy security by decreasing reliance on any one type of fuel	1	2	3	4	5
… create new jobs	1	2	3	4	5

5. How concerned are you that renewable energy may…

Statement	Not At All Concerned		Somewhat Concerned		Very Concerned
… be more costly than other means of pollution control	1	2	3	4	5
… not be as reliable as traditional generation	1	2	3	4	5

… have unknown environmental drawbacks that need to be researched more thoroughly	1	2	3	4	5

Section 2: Paying for Renewable Energy

Many utility companies across the United States participate in what are known as "green pricing" programs. These programs allow customers to voluntarily pay a monthly premium on their electric bills in order to support renewable energy generation. The electric utility company uses the gains from these donations to increase its renewable generation capacity. Green pricing programs generally see low participation rates, thus resulting in only low levels of funding for clean energy generation. Many states have imposed minimum standard policies in order to increase generation using renewable resource technologies.

6. Are you aware of any type of green pricing program offered by your electric provider?
   a. Yes
   b. No

7. Do you participate in any type of green pricing program offered by your electric provider?
   a. Yes
   b. No

The state government is considering whether and how to support renewable energy in the future. The next questions intend to determine whether households are willing to pay for renewable energy.

Answers to these questions may influence future policy, so we ask you to take some time in your response. There are no right or wrong answers to these questions. We want to know your preferences for future funding of renewable energy.

8. The state government is considering a few ways in which to support renewable energy. One option is a program where each residential and commercial customer would be required to pay a $-- surcharge on his or her monthly electric bill. This surcharge will be collected through your local electric utility company and used for investment into renewable energy projects. This amount correlates to an approximate 450 kWh generated from renewable energy sources instead of fossil fuels per customer per month. Your contribution will prevent emission of 707 pounds of CO_2 and the use of 211 gallons of water every month.

Remembering that all homes and businesses in the state will be required to pay the same amount if the policy were to be adopted, would your household support the adoption of this proposed monthly surcharge of $-- for the next 5 years? ($-- annually)

a. Yes, go to question 9

b. No, go to question 10

9. (if yes) How certain are you of your answer?

a. Completely Certain

b. Certain

c. Somewhat Certain

d. Uncertain

e. Very Uncertain

10. (if no) There are many reasons for not participating. Of the reasons listed below, please circle all that apply to you:

a. I support renewable energy, but I cannot afford to pay this additional charge

b. I believe the costs of renewable energy, at this surcharge, exceed the benefits.

c. I support renewable energy, but program participation should be voluntary similar to the current green pricing programs.

d. I support renewable energy, but the electric utility provider should pay for the changes.

e. I would need more information to make this decision.

f. other ________________________

Section 3: Environmental Opinions (NEP)

The following set of questions is commonly used to better understand environmental attitudes. Again, there are no right or wrong answers- we are hoping to better understand your opinions.

11. Do you agree with the following statements?

Statement	Strongly Agree		Unsure		Strongly Disagree
We are approaching the limit of the number of people the earth can support.	1	2	3	4	5
Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
When humans interfere with nature, it often produces disastrous consequences.	1	2	3	4	5
Human ingenuity will insure that we do not make the earth unlivable.	1	2	3	4	5
Humans are severely abusing the environment.	1	2	3	4	5
The earth has plenty of natural resources if we can just learn how to develop them.	1	2	3	4	5
Plants and animals have as much right as humans to exist.	1	2	3	4	5
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	1	2	3	4	5
Despite our special abilities, humans are still subject to the laws of nature.	1	2	3	4	5
The so-called “ecological crisis” facing humankind has been greatly exaggerated.	1	2	3	4	5
The earth is like a spaceship with very limited room and resources.	1	2	3	4	5
Humans were meant to rule over the rest of nature.	1	2	3	4	5
The balance of nature is very delicate and easily upset.	1	2	3	4	5

Humans will eventually learn enough about how nature works to be able to control it.	1	2	3	4	5
If things continue on their present course, we will soon experience a major ecological catastrophe.	1	2	3	4	5

Section 4: Demographic Information

12. Gender:

a. Male

b. Female

13. Age:

14. Zip Code: What is your 5-digit zip code?

15. Do you pay your electric bill, or is it included in rent or paid by another member of your household?

a. Yes, I pay it.

b. No, someone else does.

16. Do you have children?

a. Yes

b. No

17. Do you work in the medical/healthcare industry?

a. Yes

b. No

11. Education Level: Please note your level of educational attainment

a. Some grade school

b. High School Diploma/GED

c. Some College

d. Associates or Technical Degree

e. Bachelors Degree

f. Graduate Degree

14. Without the influence of party identification, where do you rank yourself politically?

a. Very liberal

b. Somewhat liberal

c. Somewhere in between

d. Somewhat conservative

e. Very conservative

16. Household Income Level: Which of the following best describes your annual pre-tax household income level in 2008?

a. < $20,000

b. $20,000-40,000

c. $40,000-60,000

d. $60,000-80,000

e. $80,000- 100,000

f. $100,000-$120,000

f. $120,000-$140,000

g. >$140,000

Focus group questions

Consumer Understanding of Energy Issues Facing New Mexico

The following questions are designed to determine your preferences and understanding of electricity generation options. There are no right or wrong answers; we would like to better understand your thoughts about electricity generation, specifically the use of renewable resources in electricity generation.

1. How much do you know about the environmental impacts of electricity generation?

Nothing 1 2 3 4 5 A Lot

2. There are several ways to reduce the environmental impacts of electricity generation. How important is each of the following to you?

Energy Efficiency- Reducing the amount of electricity used by installing energy saving appliances etc.

Not Important 1 2 3 4 5 Very Important

Pollution Control- Reducing the pollutants emitted by coal and natural gas fired plants by installing filters and other pollution reducing technologies

Not Important 1 2 3 4 5 Very Important

Renewable Energy- producing electricity with wind turbines, solar power, geothermal and biomass

Not Important 1 2 3 4 5 Very Important

3. New Mexico has recently implemented a Renewable Portfolio Standard (RPS), which requires electric utilities to supply a certain percentage of their electricity from renewable generation. The state goal is “20 by 20”, referring to 20% of generation by the year 2020. How much do you know about this policy?

Nothing 1 2 3 4 5 A Lot

4. Many electric suppliers in New Mexico currently offer “green pricing” programs to their customers in order to help meet the RPS. This type of program allows consumers to make a voluntary payment as a percentage of their electricity bill to help support renewable energies. How much do you know about this type of program?

Nothing 1 2 3 4 5 A Lot

5. Do you participate in a program similar to the one described above? Briefly, explain why or why not?

6. Would you support a policy in which each electric utility customer would be required to pay an additional monthly fee to help utility companies support renewable energy development? If so, what dollar amount would you consider as a reasonable monthly fee?

7. Please discuss any additional thoughts and/or ideas about using renewable electricity generation that you find important.

Appendix 2: OPINIO

The survey implemented in this research was conducted over the internet via the OPINIO survey hosting site. This resource is a recently adopted program purchased by the University of New Mexico and run through university Information Technology Services. It is available for use by students, faculty, and staff of the University of New Mexico and UNM Hospital free of charge pending attendance at an introductory workshop presented by ITS. I would like to use this section to make a few notes about the use of this program:

- The OPINIO software has been desinged for use on university campuses. Its options provide anonymity to survey respondents, and is in accordinance with univeristy Institutional Review Board policies.
- Although it may be possible on the OPINIO software, the level of training available did not allow for the use of a randomized bid component. This would have been a very useful component to add to this research. Instead, the survey was conducted as twelve seperate versions- six bid levels with and without additional water conservation information.
- The OPINIO software allows for the used to upload any set of contact information data. This being said, it is possible to use for both on and off-campus research.
- Invitation design allows for the researcher to design invitations and reminders as well as the dates and times they are to be sent. This feature is useful, as it allows for reminders to be sent automatically and only to those participants who have yet to respond.

- As a new university resource, some errors were experienced within this aspect of the software. At the invitation stage of research, all subsequent designed reminders were sent. This meant multiple e-mails for many respondnets leading to frustration and spamming of messages- potentially influincing participation rates. This error was reported to ITS and the bug has been corrected.
- Overall, the OPINIO program is very user friendly. Support and workshops provided by the university were found to be very helpful. The program will surely prove to be a great resource for reserach being done in affiliation with the university.

Appendix 3: Additional Tables

Table 9: Focus Group Results, Summary

Question	Mean Value	Median Value
1	2.5	3
2a	4.3	4.5
2b	4.1	4.5
2c	4	4
3	1.5	1
4	1.9	1
6	8.75	5

Table 10: Description of ŅNoÓResponses by Version and Bid

	WCINFO=0			WCINFO=1		
Bid	Percent "no"	Reason		Percent "no"	Reason	
$2.50	0.1806	Income	0.1538	0.1846	Income	0.4167
		Voluntary	0.3846		Voluntary	0.1667
		Provision	0.2308		Provision	0.0833
		More Info	0.3846		More Info	0.25
		Other	0.3077		Other	0.4167
		Protest	**0.6923**		**Protest**	**0.3333**
$7.50	0.44	Income	0.1818	0.2933	Income	0.4091
		Voluntary	0.2273		Voluntary	0.1364
		Provision	0.2727		Provision	0.2727
		More Info	0.2727		More Info	0.3182
		Other	0.4545		Other	0.4091
		Protest	**0.7727**		**Protest**	**0.3636**
$10.00	0.4921	Income	0.2258	0.3833	Income	0.4348
		Voluntary	0.0968		Voluntary	0.3478
		Provision	0.4194		Provision	0.3043
		More Info	0.2581		More Info	0.5217
		Other	0.3226		Other	0.0435
		Protest	**0.5484**		**Protest**	**0.3478**
$12.50	0.4776	Income	0.4375	0.5273	Income	0.4483
		Voluntary	0.2813		Voluntary	0.4138
		Provision	0.375		Provision	0.3448
		More Info	0.375		More Info	0.3103
		Other	0.3125		Other	0.2759
		Protest	**0.375**		**Protest**	**0.4828**
$15.00	0.4638	Income	0.375	0.3944	Income	0.5357
		Voluntary	0.25		Voluntary	0.25
		Provision	0.4063		Provision	0.2143
		More Info	0.3438		More Info	0.4286
		Other	0.2813		Other	0.3571
		Protest	**0.4063**		**Protest**	**0.4643**
$25.00	0.6111	Income	0.3182	0.6538	Income	0.4706
		Voluntary	0.1818		Voluntary	0.1176
		Provision	0.3182		Provision	0.5293
		More Info	0.2727		More Info	0.1765
		Other	0.2727		Other	0.2941
		Protest	**0.4545**		**Protest**	**0.5882**

Appendix 4: Split Model Estimations

Instead of estimating the model jointly, I split the data by version, *WCINFO*, and estimate the logistic models separately. The estimation of WTP is done following the model used in the body of the paper, using *LBID*.

Table 11: Separate Logit by Version

WCINFO=0			*WCINFO=1*		
Variable	Parameter Estimate (_/_)	z-statistic	Variable	Parameter Estimate (_/_)	z-statistic
LBID	-0.88335	-4.68***	*LBID*	-0.96539	-4.43***
LNEP	2.69107	4.05***	*LNEP*	2.7702	3.50***
UNDER30	0.3041	0.73	*UNDER30*	0.75746	1.76*
GRAD	0.17209	0.68	*GRAD*	0.43337	1.60
GPPART	0.37939	1.16	*GPPART*	0.86163	2.17**
GENDER	0.03095	0.12	*GENDER*	0.24228	0.88
CHILD	-0.00083	0	*CHILD*	0.20094	0.71
CONSTANT	-8.54578	-3.19***	*CONSTANT*	-8.90225	-2.79***
Observations: 339			Observations: 336		
Log-Likelihood: -206.80148			Log-Likelihood: -191.62026		
Pseudo R^2: 0.1040			Pseudo R^2: 0.1226		
Correctly classified: 64.01%			Correctly classified: 69.64		

* significant at 90%, ** significant at 95%, *** significant at 99%

Table 12: WTP Separate by Version

Model	Mean WTP	95% CI	Median WTP	95% CI
WCINFO = 0	16.8827	15.7840-17.9813	14.8147	13.7711-16.1804
WCINFO = 1	24.0732	21.9294-26.2170	17.8312	15.4177-19.3985

Appendix 5: Hanemann (1989) Method for Truncation

This method for truncation uses the logit model without taking the logarithm of the BID such that:

$$\text{Prob}(Yes) = f\left(BID, WCINFO, LNEP, UNDER30, GRAD, GPPART, GENDER, CHILD\right) \quad (14)$$

Willingness to Pay is calculated as described in chapter 5:

$$E(WTP) = (\frac{1}{\beta_1}) * \ln(1 + \exp^{\beta_0}) \quad (10)$$

Where β_1 is the coefficient on the bid amount and β_0 is constructed from the coefficients on the explanatory variables such that:

$$\beta_0 = \alpha_1 \text{ var}_1 + \alpha_2 \text{ var}_2 + ... + \alpha_k \text{ var}_k \quad (11)$$

In this case:

$$\beta_0 = \alpha_1 WCINFO + \alpha_2 LNEP + \alpha_3 UNDER30 + \alpha_4 GRAD + \alpha_5 GPPART + \alpha_6 GENDER + \alpha_7 CHILD + \alpha_8 CONSTANT \quad (11')$$

Table 13: WTP (Full Model, Hannemann Truncated Approach)

Model	Mean WTP	95% CI	Median WTP	95% CI
Joint	18.7748	18.3624-19.1872	18.6204	17.9615-18.9862
WCINFO = 0	17.7854	17.2124-18.3585	17.5767	17.0864-18.3862
WCINFO = 1	19.773	19.1962-20.3499	19.3566	18.7715-20.1968

Table 14: Logit Model, Certainty Levels Hannemann Truncated Approach

	Certainty = 5		Certainty ≥ 4		Certainty ≥ 3		Certainty ≥ 2	
Variable	Parameter Estimate (_/_)	z-statistic	Parameter Estimate	z-statistic	Parameter Estimate	z-statistic	Parameter Estimate	z-statistic
BID	-0.1214	-6.44***	(_/_) -0.1027	-6.67***	(_/_) -0.0979	-6.58***	(_/_) -0.0916	-6.21***
WCINFO	0.0573	0.30	0.1889	1.12	0.1776	1.05	0.1609	0.95
LNEP	3.5406	5.45***	2.9416	5.60***	2.4808	5.02***	2.4909	5.04***
UNDER30	-0.6574	-1.68*	0.1382	0.49	0.4523	1.57	0.4957	1.70*
GRAD	0.4170	2.09**	0.2867	1.61	0.3605	2.00**	0.3178	1.75*
GPPART	0.3986	1.66	0.6824	2.97***	0.5010	2.11**	0.6628	2.70**
MALE	0.3887	1.94*	0.1006	0.57	0.0945	0.53	0.1022	0.57
CHILD	0.3641	1.73*	0.3770	2.04**	0.1168	0.63	0.0953	0.51
CONSTANT	-14.7140	-5.57***	-11.4387	-5.40***	-8.9744	-4.52***	1.9876	-4.52***
Observations	675		675		675		675	
Log-Likelihood	-329.039		-412.595		-413.33		-409.614	
Pseudo R2	0.1387		0.1145		0.102		0.1007	
Correctly Classified	77.78%		65.78%		66.22%		65.78%	

* significant at 90%, ** significant at 95%, *** significant at 99%

Table 15: WTP Estimates, Certainty Levels Hannemann Truncated Approach

	Certainty = 5		Certainty ³ 4		Certainty ³ 3		Certainty ³ 2	
	Mean WTP	95% CI	Mean WTP	95% CI	Mean WTP	95% CI	Mean WTP	95% CI
Joint	6.2456	6.0075-6.4838	12.6833	12.3435-13.0230	16.8149	16.4637-17.1660	18.2703	17.8723-18.6683
WCINFO = 0	5.9227	5.5969-6.2485	11.6989	11.2412-12.1565	15.7702	15.2899-16.2505	17.2284	16.6805-17.7764
WCINFO = 1	6.5714	6.2256-6.9172	13.6765	13.1945-14.1585	17.8688	17.3792-18.3584	19.3215	18.7633-19.8797
Difference	0.6487		1.9776		2.0986		2.0931	
	Median WTP	95% CI	Median WTP	95% CI	Median WTP	95% CI	Median WTP	95% CI
Joint	5.8031	5.5461-6.0534	12.1847	11.7039-12.6584	16.6335	16.1479-17.0483	17.9798	17.3991-18.3610
WCINFO = 0	5.5282	5.0813-5.8311	11.3278	10.7462-11.6936	15.7416	15.1291-16.1672	16.9927	16.3458-17.7134
WCINFO = 1	6.0021	5.7761-6.5719	13.0251	12.5558-13.6925	17.5492	16.9516-18.3534	18.8668	18.0443-19.6469
Difference	0.4739		1.6973		1.8076		1.8741	

Table 16: Testing Hypothesis 2: $(WTP)_{WCINFO=1} > (WTP)_{WCINFO=0}$

Model	t-value	SatterthwaiteÕs df	$\Pr(T > t)$
1: Full	4.8084***	672.917	1.0000
2: Certainty = 5	2.6859***	670.265	0.9963
3: Certainty ³ 4	5.8525***	670.876	1.0000
4: Certainty ³ 3	6.0187***	672.626	1.0000
5: Certainty ³ 2	5.2636***	672.646	1.0000

* significant at 90%, ** significant at 95%, *** significant at 99%

Appendix 6: Alternative Model of WTP: Allowing for Negative WTP Values

This section provides an alternative estimation of WTP values that allows for negative WTP values. The logistic model followed is the one reported in Appendix 4. This model uses equation 9, which allows for negative WTP values, for estimation:

$$E_{\varepsilon}(WTP_i | \alpha, \beta, z_i) = \frac{\alpha z_i}{\beta}$$

It is important to note that although mean estimates are significantly decreased after allowing for negative WTP values, median estimates are more stable for many of the model specifications. The main hypothesis of this research, that water conservation plays an important role in consumer valuation of a renewable energy project- as tested in Hypothesis 2 (Table 10), remains consistently significant throughout many of the model versions. The following tables illustrate the results of this estimation and align with the tables presented for the truncated model.

Table 17: WTP Full Model, Allowing for Negative WTP

Model	Mean WTP	95% CI	Median WTP	95% CI
Joint	16.3506	15.8309-16.8702	16.5693	15.7656-17.0111
WCINFO = 0	15.0999	14.3601-15.8399	15.2908	14.6801-16.2849
WCINFO = 1	17.6123	16.9041-18.3205	17.455	16.7522-18.4516

Table 18: WTP Estimates, Certainty Levels Allowing for Negative WTP

	Certainty = 5		Certainty ³ 4		Certainty ³ 3		Certainty ³ 2	
	Mean WTP	95% CI	Mean WTP	95% CI	Mean WTP	95% CI	Mean WTP	95% CI
Joint	-0.1281	-0.6201-0.3639	8.9975	8.5064-9.4886	14.2751	13.8242-14.7259	15.6043	15.0992-16.1093
WCINFO = 0	-0.8135	-1.5189-(-0.1083)	7.5569	6.8616-8.2522	12.9323	12.2976-13.5670	14.2706	13.5573-14.9839
WCINFO = 1	0.5635	-0.1182-1.2452	10.4510	9.7895-11.1126	15.6298	15.0198-16.2398	16.9499	16.2606-17.6391
Difference	1.3770		2.8941		2.6975		2.6793	
	Median WTP	95% CI	Median WTP	95% CI	Median WTP	95% CI	Median WTP	95% CI
Joint	0.1823	-0.3341-0.6704	8.9056	8.2257-9.5630	14.4007	13.7929-14.9143	15.6427	14.9186-16.1128
WCINFO = 0	-0.3705	-1.31235-(0.2376)	7.6837	6.8258-8.2109	13.2786	12.4925-13.8172	14.4061	13.5795-15.3117
WCINFO = 1	0.5715	0.1288-1.6396	10.0635	9.4218-10.9576	15.5281	14.7948-16.5002	16.7310	15.7225-17.6727
Difference	0.9420		2.3798		2.2495		2.3250	

Table 19: Testing Hypothesis 2 : $(WTP)_{WCINFO=1} > (WTP)_{WCINFO=0}$

Model	t-value	Satterthwaite's df	$\Pr(T > t)$
1: Full	4.8250***	671.959	1.0000
2: Certainty = 5	2.7615***	672.416	0.9970
3: Certainty $\geq$ 4	5.9317***	671.623	1.0000
4: Certainty $\geq$ 3	6.0280***	672.163	1.0000
5: Certainty $\geq$ 2	5.3133***	672.397	1.0000

* significant at 90%, ** significant at 95%, *** significant at 99%

Appendix 7: STATA code

```
clear
#delimit;
cap log close;
insheet Version Bid Cost Reliable Renew Efficient EnvImpact
DIeff DIpc DIrenew Renv Rwater Rsec Rjob Rcost Rreli
Rresearch GPknow GPpart CV certainty NY Ninc Ncost Nvol
Nprov Ninfo Nother protest NEP Gender Age Zip billpay child
healthcare high somec tech ba grad pol inc0 inc20 inc40
inc60 inc80 inc100 inc120 inc140 lowinc medinc highinc
medianinc using C:\DATA1.csv;

/*Summary Statistics, Correlation*/
summarize;
summarize if version==1;
summarize if version==0;
correlate lnep gender age billpay child healthcare high
grad pol medianinc;

/*Generate age categories*/
generate under30=0;
replace under30=1 if age<=30;
generate over65=0;
replace over65=1 if age>=65;
generate lnep=ln(nep);
generate lbid=ln(bid)

/*Logit Model*/
logit cv lbid version lnep under30 grad gppart gender
child;
estat clas;
```

```
/*Define Matrix of Coeffs*/
matrix define coeff = e(b);
scalar define blbid = coeff[1,1];
scalar define bversion = coeff[1,2];
scalar define blnep = coeff[1,3];
scalar define bunder30 = coeff[1,4];
scalar define bgrad = coeff[1,5];
scalar define bgppart = coeff[1,6];
scalar define bgender = coeff[1,7];
scalar define bchild = coeff[1,8];
scalar define cons = coeff[1,9];
matrix list coeff;
matrix coeffT = coeff';
matrix list coeffT;

/*Estimating WTP*/
set matsize 800;
gen cons=1;
mkmat lbid lnep under30 grad gppart gender child cons,
matrix(Z);
mkmat lbid, matrix(B);
matrix wtp = ((matrix(Z)*coeffT)-(blbid*matrix(B)))/-blbid;
generate wtp2=0;
replace wtp2=exp(wtp);
svmat wtp2;
sum wtp2;
centile wtp2;
ci wtp2, level(95);
ttest wtp2, by (version) unequal level(95);

/*Adjusting for Uncertainty ≥ 4*/
```

```
generate cv3=0;
replace cv3=1 if certainty>=3;
generate cv4=0;
replace cv4=1 if certainty>=4;
generate cv5=0;
replace cv5=1 if certainty==5;
logit cv4 bid version lnep under30 grad gppart gender
child;
```

/*Allowing for Negative WTP*/

```
logit cv bid version lnep under30 grad gppart gender child;
estat clas;
matrix define coeff = e(b);
scalar define bbid = coeff[1,1];
scalar define bversion = coeff[1,2];
scalar define blnep = coeff[1,3];
scalar define bunder30 = coeff[1,4];
scalar define bgrad = coeff[1,5];
scalar define bgppart = coeff[1,6];
scalar define bgender = coeff[1,7];
scalar define bchild = coeff[1,8];
scalar define cons = coeff[1,9];
matrix list coeff;
matrix coeffT = coeff';
matrix list coeffT;
set matsize 800;
gen cons=1;
mkmat bid lnep under30 grad gppart gender child cons,
matrix(Z);
mkmat bid, matrix(B);
matrix wtp = ((matrix(Z)*coeffT)-(bbid*matrix(B)))/-bbid;
svmat wtp;
```

```
sum wtp;
centile wtp;
ci wtp, level(95);
ttest wtp, by (version) unequal level(95);
```

/*Truncated WTP*/

```
gen bnot = bversion*version + blnep*lnep + bunder30*under30
+ bgrad*grad + bgppart*gppart + bgender*gender +
bchild*child + cons;
gen wtp2 = (1/(-1*bbid))*ln(1+exp(bnot));
sum wtp2;
centile wtp2;
ci wtp2, level(95);
ttest wtp2, by(version) unequal level(95);
```