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Green for Green
Willingness to Pay for Renewable Energy in Buncombe County

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Abstract

Nonrenewable energy production results in negative environmental ramifications including water and air pollution, habitat and landscape degradation, and long term global climate impacts. These environmental impacts are externalized so neither energy producers nor consumers are responsible for the full social costs of energy. Most energy consumers are unable to determine how their energy is generated or how much they pay for energy, so traditional energy markets do not reveal whether or not consumers would be willing to internalize these external costs by paying more for renewable energy technologies. A pilot study was conducted using a contingent valuation survey to determine if Buncombe County residents would be willing to pay more for renewable energy than for traditional Nonrenewable energy. The results show that 64.1% of respondents are willing to pay more for renewable energy on their monthly power bills. This information could be helpful for policy makers in assessing the appropriateness of North Carolina renewable energy standards. This information could also provide a basis from which to launch environmental campaigns supporting renewable energy. Finally, the data could be used by Progress Energy as they attempt to market energy rate increases.

1. Introduction

North Carolina recently adopted standards requiring that energy producers meet a certain percentage of consumer's energy needs with renewable energy (RE). These standards were implemented to foster the development of RE technologies in light of the negative impacts associated with nonrenewable energy (NRE) technologies. However, RE is more costly than NRE, and due to the monopolistic nature of energy markets it is unknown whether consumers in Buncombe County North Carolina are willing to pay the costs associated with an increase in RE. Using a contingent valuation survey, Buncombe County residents were asked how much more, if any, they were willing to pay on their energy bill for renewable energy. The results of this pilot study could be useful for state policy makers, environmental organizations, energy producers, and businesses that provide products or services associated with renewable energy technologies.

1.1. Renewable Energy and Energy Efficiency Portfolio Standards

On August 20, 2007, North Carolina legislators implemented the Renewable Energy and Energy Efficiency Portfolio Standard (REPS) with the signing of Session Law 2007-297.[1] The REPS was designed to stimulate research and development for RE technologies so that they might become economically competitive with conventional nonrenewable energy (NRE) alternatives.[2] Renewable Energy refers to energy supplied from natural resources which are continually replenished, whereas nonrenewable energy is derived from natural resources that are not replenished at a continual rate.[3] The current REPS requires investor owned utilities (IOUs) to meet energy

demand using at least 3% renewable energy by 2014 using a combination of solar energy, wind energy and swine and poultry waste as biomass.[4] Using a recent estimate of the market cost per kilowatt hour (kWh) associated with coal-based energy (the primary source of energy for Western North Carolina), and the cost per kWh associated with solar energy, this standard would result in an 8.5% increase in the cost of producing energy for this region (refer to *Figure 1*).

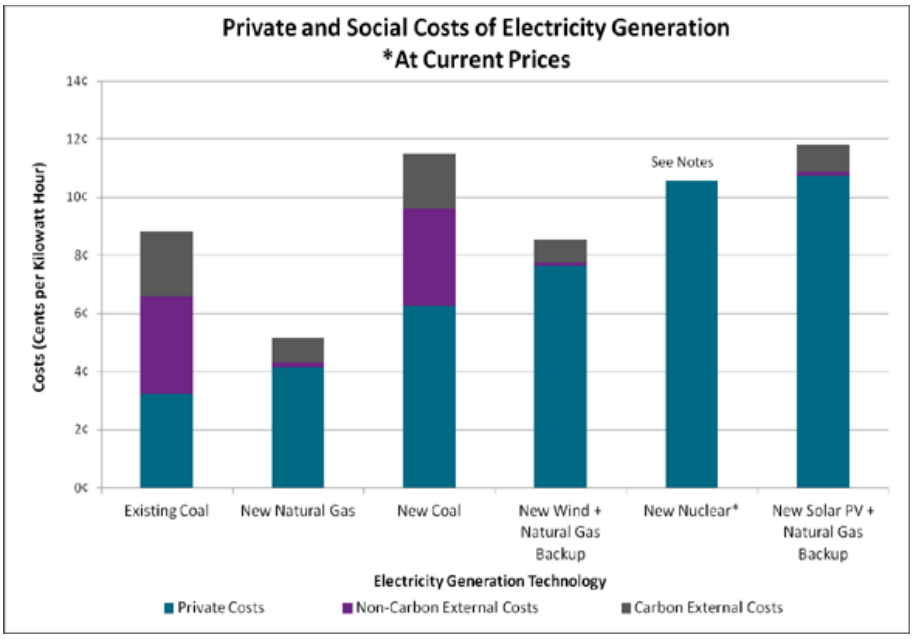

Figure 1[5] Private and social costs of electricity generation at current prices

1.2. Energy Market Barriers

Along with 27 other states across the nation, North Carolina adopted renewable energy standards because there are significant factors which impede the expansion of RE technologies, otherwise known as market barriers.[6] One market barrier is the uncompetitive market price of RE alternatives because most are in relatively early stages of development and research when compared to incumbent NRE technologies.[7] The National Academy of Science estimated that the private cost (cost incurred by industry or the consumer) of new wind energy is greater than two times the private cost of existing coal-based energy, at approximately 7.5¢ and 3.0¢ per kWh respectively (refer to *Figure 1*)[8]. The private cost of solar is estimated to be more than three times the private cost of coal at nearly 11¢ per kWh.[9]

Another prominent market barrier for RE is due to the presence of negative externalities, which occur when certain environmental costs are not reflected in the private cost of energy.[10] Externalities, or external costs, manifest as the discrepancy between social costs, the total costs faced by society, and private costs.[11] These externalities can manifest in the form of environmental degradation, global climate change, decreased energy security, or damage to human health.[12] To the extent that the ultimate consumer of energy only incurs the private cost, or fails to compensate people that are directly or indirectly harmed by energy production, he/she does not face the true social cost of energy.[13] Thus energy consumers are receiving inaccurate price signals, prompting them to consume more NRE than is efficient. RE technologies also have externalities, however the estimated cost of externalities for coal far exceed those associated with solar or wind at an estimated 6.0¢, 1.0¢, and 0.7¢ per kWh respectively (refer to *Figure 1*).[14] If private costs were made to reflect social costs through the internalization of externalities, new wind technology would be less costly than existing coal technology and solar would be far more financially competitive.

1.3. Consumer Preference for Renewable Energy

Given the high external costs associated with NRE, most developed nations recognize the advantage of transitioning to RE.[15] Notwithstanding, the transition to RE is highly dependent on the affordability of these technologies and

consumer willingness to pay (WTP) for the advantages of RE.[16] Unfortunately, consumer preferences cannot be expressed within traditional energy markets because energy provision is a natural monopoly: a market structure in which one firm serving the entire market is more efficient than multiple firms.[17] Because it is a natural monopoly, energy provision, which began as an unregulated competitive industry at the end of the nineteenth century, was eventually regulated in the form of "franchise monopolies," where the government grants exclusive rights for energy provision to a sole provider.[18] For example, the investor owned utility known as Progress Energy has been granted a franchise monopoly for Western North Carolina, thus they are the only utility that can provide energy to this region.

Franchise monopolies offer certain efficiencies for energy markets. For example, this approach avoids the costs involved in duplicating the infrastructure necessary to provide energy if there were multiple producers.[19] There are inefficiencies which arise as a result of monopolistic energy provision as well. For instance, consumers are unable to choose which company they receive their energy from because there is only one provider allowed to distribute energy for any given region. Because there is no competition among energy producers, consumers are unable to express their WTP for energy derived from alternative RE sources.[20] As long as consumers are unable to reveal their preferences through energy markets, legislators, regulators and energy producers lack the information necessary to ensure the efficient provision of energy.

1.4. Contingent Valuation Method

When consumer preferences cannot be revealed through traditional market interactions, economists often rely on stated preference (SP) data to discover the WTP for goods and services.[21] Stated preference data is acquired by asking people what economic value they attach to a non-market good or service in a hypothetical market.[22] One way to collect SP data is the contingent valuation (CV) method, which asks individuals directly how much they would be willing to pay for a good or service that is not represented in traditional markets.[23] The CV method was introduced in 1947 by S.V. Ciriacy-Wantrup to address the difficulty in attributing a value to goods and services which lie outside of traditional markets.[24] The method was disregarded by some economists who felt that certain limitations to CV created an unreliable pricing mechanism.[25] For example, survey respondents may respond dishonestly to questions, may be misled by the phrasing of the questions, or may not understand the information provided about the good or service in question, leading to survey results that are an inaccurate reflection of WTP.[26]

The CV method became far more popular in the wake of the Exxon Valdez oil spill in 1989. Following this disaster, the National Oceanic and Atmospheric Administration (NOAA) convened a panel of economists (including Nobel laureates Robert Solow and Kenneth Arrow) to assess the validity of estimates derived using the CV method.[27] The panel concluded that it would be a suitable mechanism by which to establish an approximate value for the ecosystem functions lost following the disaster, and a CV study was launched to assist in estimating reparations[28].

This method has been widely used in environmental economics to attribute value to many environmental commodities such as air quality, water quality, and ecosystem functions.[29] In a CV study commissioned in part by the US Department of Energy, it was found that approximately half of US respondents were willing to pay more for RE, and this percentage increased when respondents were informed of the costs and benefits associated with various methods of energy production.[30] Another CV study found that the average US respondent was willing to pay a 13% energy bill premium for RE.[31]

1.5. WTP for Renewable Energy in Buncombe County

Prior to this study, no CV research had been conducted in Buncombe County North Carolina to provide an estimate of the WTP for RE. Buncombe County is an interesting place to conduct such a study because the coal-fired power plant which supplies energy to Western NC is located within the county. Emissions from coal-fired power plants can be injurious to human health and the environment, and most strongly affect those living and working in close proximity to the plant.[32]

Therefore, citizens of Buncombe County may have a heightened sense of concern about NRE which could impact their WTP.

Residents of Buncombe County, particularly Asheville, have demonstrated a demand for environmentally friendly goods and services and an interest in sustainable living. Within the next year Asheville is expected to have more Certified Green restaurants per capita than any city in the US.[33] More than 400 homes with Energy Star or Healthy Built certifications have been purchased within the last 9 years in Buncombe County, and eco-friendly housing developments are being constructed in anticipation of burgeoning demand for sustainable living.[34] The area also

plays host to several large-scale environmentally focused events, such as the Organic Growers School and the Southern Green Living Exposition. And, as one of National Geographic's "Adventure Town" destinations, Asheville and the surrounding Blue Ridge Mountains attract tourists and outdoor enthusiasts with ample opportunities for hiking, rock climbing, rafting, fishing, camping, and bird-watching, all of which demonstrate an appreciation for thriving and diverse landscapes and ecosystems.[35]

Given this unique combination of location and demonstrated preferences for environmentally conscious recreation, services and commodities, it is hypothesized that Buncombe County residents would be willing to pay a premium on their energy bill every month for RE. By providing a snapshot of Buncombe County WTP for RE, this information could be applied to an evaluation of the appropriateness of the REPS.

2. Methodology

Using the CV method, a pilot study was launched in September, 2012 to assess the WTP for renewable energy in Buncombe County. A total of 218 Buncombe County residents completed a survey entitled "Electricity Preference Survey" asking how much they were willing to pay per month on their energy bill to switch from NRE to RE (a copy of the *Electricity Preference Survey* is available from author upon request). The survey included basic demographic questions with questions regarding opinions about NRE and existing NC renewable energy standards. The survey also contained a question about the respondent's primary news source, which was used as a proxy for political affiliation. To avoid the high costs associated with mail-out surveys, survey results were collected through social media sites, tailgate markets, local colleges and various neighborhoods and thoroughfares throughout Buncombe County. Approximately 42% of the surveys were conducted door to door in various Buncombe County neighborhoods, 27% were collected at Asheville Buncombe Technical Community College, 17% were collected at tailgate markets, 9% were collected from the faculty at the University of North Carolina Asheville, and 5% were collected on Facebook. Surveys were collected from the 30th of September, 2012 until the 20th of November, 2012.

It is important to note that the following survey results are biased and are not representative of the entire population of Buncombe County. This was a convenience sample, so rather than randomly selecting respondents they were selected from locations that were reasonably accessible for research. Bias is likely because colleges contain primarily younger individuals who are often not yet responsible for energy bills, or who may have differing perspectives on RE than older individuals. Those who attend tailgate markets are generally interested in sustainability issues, and therefore may have been more inclined than other groups to demonstrate a WTP for RE. The survey was voluntary, so self-selection bias may have occurred if those who chose to take the survey had differing opinions regarding RE than those who chose not to take the survey. Response bias is possible as the survey may have included leading questions or respondents may have been misled or confused by questions.

3. Survey Results

3.1. Respondent Demographics

Respondent Demographics are compared with those for Buncombe County in *Table 1*. Median age for survey respondents was 30 while the actual median age for Buncombe County is 39. There was roughly a $10,000 difference between the median income for respondents and median income for Buncombe County residents, while there was only a marginal discrepancy between Buncombe County gender demographics and those of survey respondents. Those respondents with children living within the household represented 27.9% of those surveyed. Respondents represented several locations throughout Buncombe County including Arden, Asheville, Black Mountain, Fairview, Montreat, Swannanoa, Weaverville, Woodfin, Barnardsville, Biltmore Lake, and Leicester. Asheville residents comprised the largest group represented by respondents (38%) while residents of Barnardsville, Biltmore Lake, & Leicester comprised less than 1% of respondents.

Table 1. demographic information

	Respondents	Buncombe County
Median Age	30	39
Median Income	$35,000	$44,190
Male	51%	49%
Female	49%	51%

3.2. Public Concern Regarding Nonrenewable Energy

Respondents were asked about their level of concern regarding the various externalities associated with traditional NRE technologies, including depletion of natural resources, immediate impacts on the environment, aesthetic impacts, long-term environmental impacts, and health-related impacts. Response options ranged from "not at all important" to "extremely important." Results for public concern surrounding NRE are demonstrated in *Figure 2*. Roughly 75% of respondents felt that the depletion of natural resources was a "very important" or an "extremely important" concern for them. Immediate environmental impacts (such as air or water pollution) were an "extremely important" concern for 49% of respondents, while 56.2% felt that long term environmental impacts were an "extremely important" concern. Most respondents, 62.7%, felt that health related impacts of NRE technologies were an "extremely important" concern. Overall, respondents placed slightly less importance on the issue of visible impacts of NRE technologies.

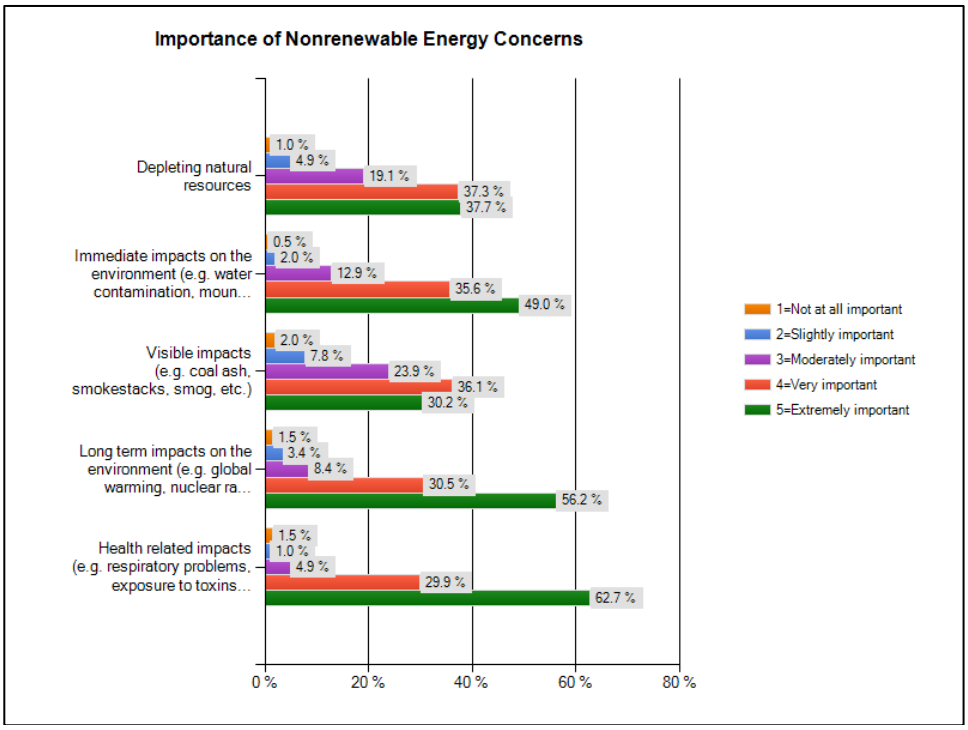

Figure 2. Importance of nonrenewable energy concerns

3.3. Public Perception of NC Renewable Energy Policy

Respondents were asked to express whether they felt that the NC renewable energy standard was appropriate. As displayed in *Figure 3*, of the 218 respondents, 66% felt that the REPS was too low. Another 13.7% expressed that

the standard was appropriate, and 0.5% responded that the REPS was too high, while 19.5% responded that they did not know whether or not the REPS was appropriate. Of those who did not feel that the REPS should be increased, the majority cited concerns about increasing energy costs, followed by many who felt that it would be unrealistic to increase REPS given existing RE technologies, and who did not feel that the state should regulate renewable energy standards. Very few felt that there was not enough evidence that RE is better than NRE.

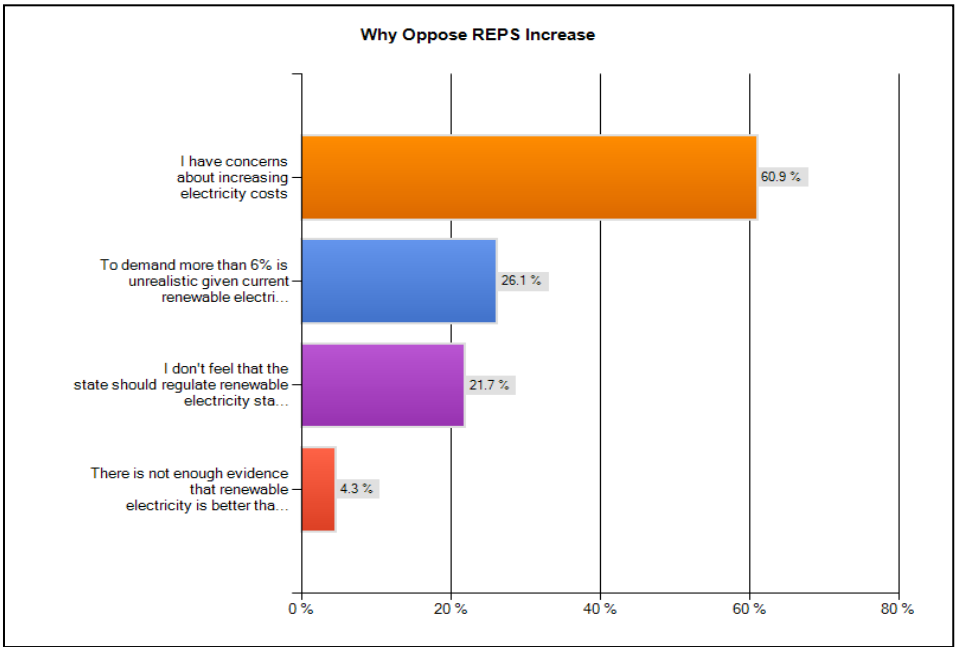

Figure 3. Why oppose REPS increase

3.4. Willingness to Pay for Renewable Energy

Of the 218 respondents, 64.1% would be willing to pay more on their energy bill every month for renewable energy (refer to *Figure 4*). As displayed in *Figure 5*, 31.8% of this group would be willing to pay an additional 10$/month for renewable energy. Another 26.5% stated that they would be willing to pay an additional $15/month for RE, and 19.7% said that they would be willing to pay an additional $25/month. The average WTP among those who were willing to pay a premium for RE was $15, which represents a 16.3% price increase on the respondents' average monthly utility bill of $92.03. Factoring in a WTP of $0 for those who responded "no" or "maybe" to the WTP question, the average WTP for all respondents was approximately $9, representing a 9.8% price increase on respondents' average monthly utility bill.

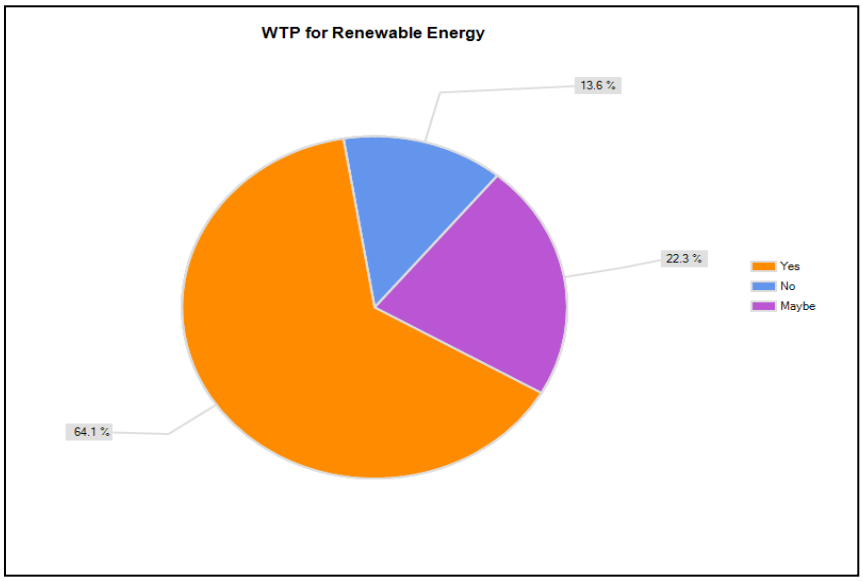

Figure 4. Willingness to pay for renewable energy

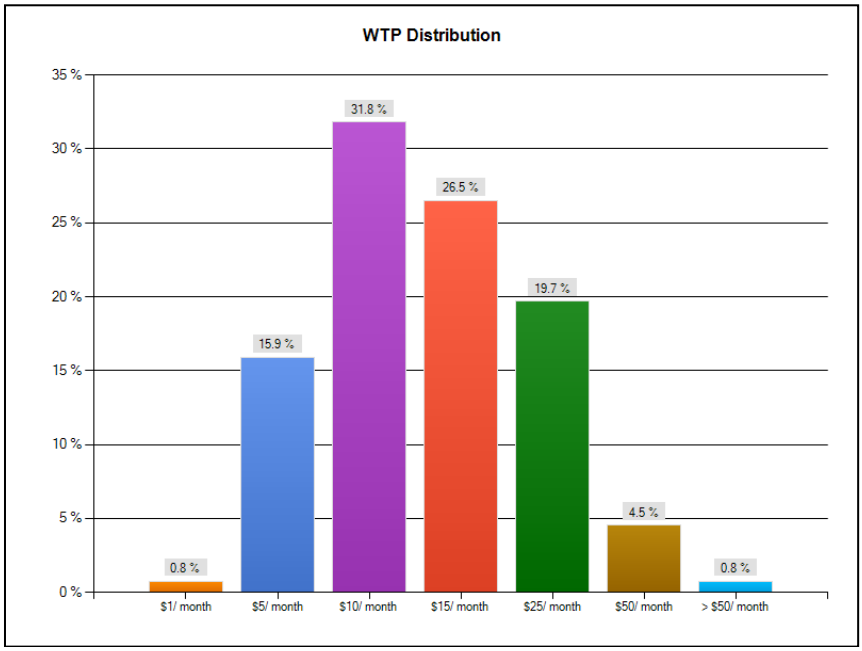

Figure 5. Willingness to pay distribution

A small minority of 13.6% were unwilling to accept an increase in their monthly energy bill for renewable energy (refer to *Figure 4*). As displayed in *Figure 6*, 56% of this minority felt that they could not afford an increase in their monthly energy bill, 40% felt that it was not their responsibility to pay more for renewable energy, and 24% of expressed that they while they understood the benefits of RE, they are not willing to pay for those benefits. Only 8% of those unwilling to pay a premium for RE felt that they would prefer to voluntarily give money to an organization that directly promotes RE production, and 0% would prefer to pay more in taxes to subsidize RE generation.

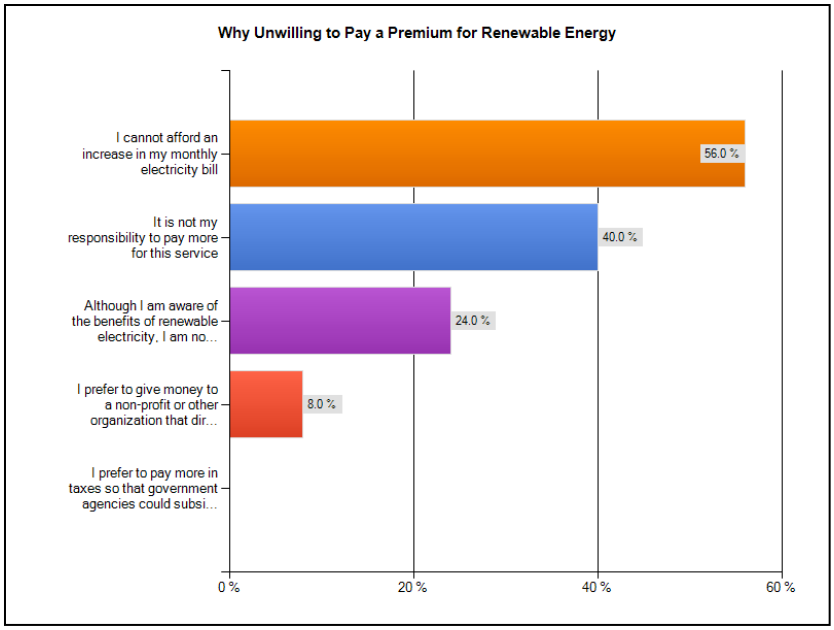

Figure 6. Why unwilling to pay a premium for renewable energy

Approximately 22.3% of all respondents replied that they may be willing to pay more for RE under certain conditions (refer to *Figure 4*). Of this group, 75.8% said that they would be willing to pay more for RE if they knew they could afford the price increase, followed closely by many who would be willing to pay more if they knew that their money would go directly to renewable energy production rather than profits. Roughly half said that they would be willing to pay more now for renewable energy if they knew that doing so would make renewable energy more affordable in the future, and 39.4% said they may be willing to pay more if they knew more about the costs and benefits of different types of energy. The distribution of these results is illustrated in *Figure 7*.

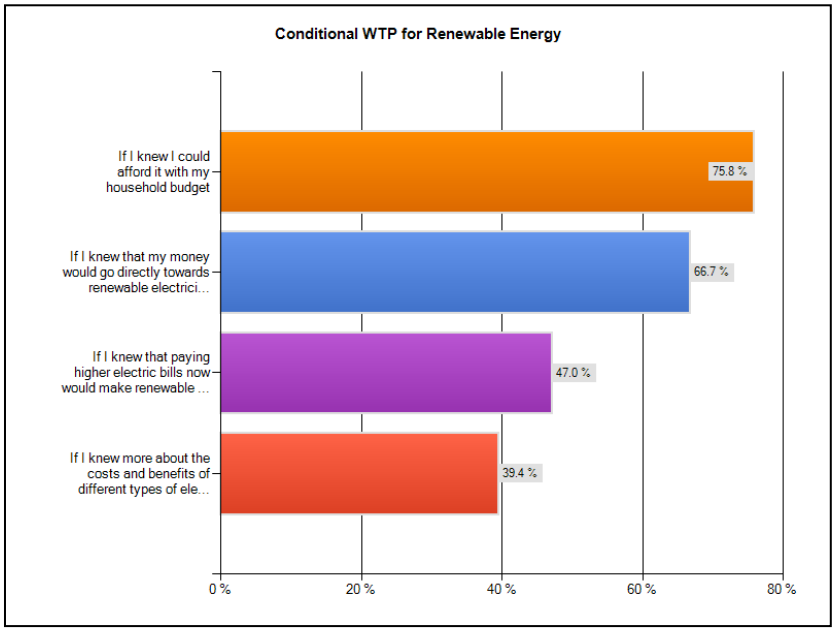

Figure 7. Conditional willingness to pay for renewable energy

4. Discussion

As was hypothesized, a majority of the 218 Buncombe County respondents stated a WTP for renewable energy with only a small minority who would be completely unwilling to pay a premium for renewable energy. The survey data also reveals intriguing relationships between respondent WTP and respondent demographic information.

4.1. Primary news source & WTP for Renewable Energy

One of the most notable relationships was between WTP and news source. Roughly 92.6% of those respondents who turned to NPR as a primary news source were willing to pay a premium for renewable energy. This percentage drops to 74.1% for those who tune into CNN, 66.7% for NBC and WLOS (local news) watchers, 57.1% for those who get their news from internet sources, 53% for those who turn to various printed media for news, and 29.4% for Fox news watchers.

While not tested for statistical significance, this trend suggests that news source may be somehow related to WTP for renewable energy; however the direction of causation is undetermined. It could be a result of self-selection bias, where those with a WTP for RE are more likely to respond to the survey, or more likely to watch/ listen to certain news sources. A study published in the Journal of Communication suggests that politically liberal individuals tend to tune in to NPR and CNN for their news, whereas politically conservative tend to tune into Fox news.[36] Based upon this phenomenon, the "What is your primary news source?" survey question was designed as a proxy for political affiliation. In recent decades, Democrats tend to be more supportive environmental policies than Republicans, which may help to explain why those who tune into more conservative news sources would have a lower WTP for RE than those who tune in to liberally affiliated news sources.[37]

4.2. Income & WTP for Renewable Energy

Within these survey results, income plays an interesting, if unexpected role in the WTP for renewable energy. Those who expressed a WTP a premium for renewable energy had an average household income of $49,700 (calculated using the midpoint of given income intervals). Those who stated that they would not be willing to pay a premium for renewable energy had an average household income of $55,886. This suggests that, for respondents, an increase in income does not increase the WTP for renewable energy, and may in fact have a negative impact upon WTP. This result could be attributable to the "environmental inequality" phenomenon that results from discrepancies in income, employment, or education.[38] Environmental inequality manifests when certain disadvantaged groups are exposed disproportionately to environmental risk factors, often putting these groups at significantly higher risk for environmental health effects.[39] Therefore, those with higher incomes may feel that they have the resources to avoid the negative environmental externalities associated with NRE production, whereas those with lower household incomes might have an incentive to prevent environmental externalities.

4.3. Children & WTP for Renewable Energy

Of those respondents with children under the age of 18 living within their household, 56% stated that they would be willing to pay a premium for renewable energy, and 16% said they would be unwilling. However, 68% of those without children stated that they would be willing to pay a premium for renewable energy, while only 12% said that they would be unwilling. This suggests that, among this study's respondents, those without children within the household are more willing to pay a premium for renewable energy than those with children. It could be that those with children within a household feel that they have more pressing economic concerns associated with child rearing, and thus discount the costs associated with NRE which may seem less immediately apparent or pertinent.

5. Implications

This survey data suggests that most respondents are willing to pay a 16.3% premium for RE, and, on average, respondents overall are willing to pay a 9.8% premium for RE. Both exceed the estimated 8.5% increase in energy cost associated with the 2014 REPS, which suggests that the REPS may not be appropriate for all energy consumers

in NC. This pilot study could serve as a launching pad for more extensive follow-up studies, the results of which could be widely applied. District representatives could use this type of data to encourage the re-evaluation of the North Carolina REPS, possibly voting to alter the standards in accordance with consumer WTP.

Environmental organizations like the Sierra Club could use this type of data as a basis for planning and implementing public awareness campaigns about the costs and benefits of NRE and RE. Using this type of research to understand what factors influence the decisions of energy consumers, these organizations could more effectively target key demographics. They could also use the data to apply pressure on policy makers to adjust standards in accordance with consumer WTP. Businesses such as Southern Energy Management, who design and implement solar energy projects for individuals, businesses and governments, could use WTP data for effectively marketing their services.

Progress Energy could use consumer WTP data as a reflection of the preferences of their consumer base or investor base, and could plan their energy portfolio accordingly. Consumer preference information could also prove useful as energy producers market energy rate increases. Progress Energy, for example, could include flyers with monthly bills explaining what portion of rate increases are associated with increasing RE. This would improve transparency and possibly help those consumers who are willing to pay for renewable energy feel that they are receiving a valuable service for the additional cost.

6. Conclusion & Suggestions for Future Research

Energy generation is wrought with negative environmental externalities resulting in energy market failure. Furthermore, the monopolistic nature of energy provision leaves consumers with no ability to express their preferences about energy production. The majority of Buncombe County respondents indicated through a CV study that they would be willing to pay a premium for RE that would exceed the estimated costs associated with the 2014 REPS. Policy makers, energy providers, and environmental organizations could use this survey data as a basis for public awareness campaign implementation, marketing approaches, and planning for future development and promotion of RE technologies. If properly interpreted and utilized, results from this study and future renewable energy contingent valuation studies could reduce inefficiencies in energy markets and, in so doing, effectively moderate negative environmental impacts to promote a healthier environment for current and future generations.

It is recommended that future research in this area be conducted randomly throughout North Carolina for results that are representative of all individuals who are impacted by the REPS. Longitudinal studies are also recommended to observe how consumer preferences change in correlation with other social, political or economic trends. It is recommended that future researchers use detailed energy price data from Progress Energy rather than referring to national energy price averages, as this might offer a more realistic estimate of anticipated energy costs. Finally it would be interesting to conduct a more extensive follow-up survey which would include information about the costs and benefits of the various types of energy production to observe whether WTP for RE changes with awareness of the externalities associated with energy production.

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