Consumer Preferences for Solar Energy: A Choice Experiment Study

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Executive summary

As the urgency of climate change rises, electricity generation in the U.S. is rapidly moving towards integrating more renewables into the system. This is due to several factors including cost competitiveness, consumer preferences, and state and federal policies, such as federal tax incentives, renewable portfolio standards (RPSs), and state level subsidies for solar energy. While these policies have been researched extensively, in this paper we investigate consumer preference and willingness to pay toward renewable energy. Consumer preferences may impact the type of renewable energy utilized, as well as state-determined RPS requirements.

We implement a discrete choice experiment survey to gain understanding of consumer preferences and their preference heterogeneity. We conduct the survey in New Mexico, a state with RPS and great potential for renewables, particularly in solar where it ranks third in the U.S. for that potential. Focusing on the consumers of the state's major utility, our choice experiment considers an increase in renewable energy and preference for different types of solar energy. We control for location heterogeneity (i.e., rural vs. urban), as well as exposure to solar installations. In addition to gauging households' willingness to pay for higher level of RPS, we assess households' attitudes towards smart meters in New Mexico.

We find that, on average, respondents are supportive of increasing the RPS level, prefer the extra RPS to come from solar farms rather than rooftop solar, and are supportive of smart meter installation (especially when they access electricity consumption and price information through an in-home display or via the internet). Our respondents are also willing to pay a premium for policies that encourage reduction in water consumption by fossil fuel for electricity generation. Additionally, rural respondents are statistically significantly more supportive of solar farm improvement than urban respondents, while urban respondents are more supportive of rooftop solar. We observe that distance to nearest solar installation (solar farm and/or rooftop solar) affects preferences toward different types of solar energy. Moreover, our results suggest that there exists a distance decay effect for only solar farm. Lastly, we find that respondents with pro-environmental behavior (captured by the New Environmental Paradigm (NEP) scale) are more supportive of policies that are environmentally friendly. This research extends the literature by differentiating solar energy types, assessing preferences on smart meter, and incorporating distance to solar installation through actual distance data rather than an artificially-introduced distance through the survey instrument.

As far as marginal willingness to pay (MWTP) values are concerned, our respondents exhibit a MWTP of $.45/month [$0.35–$0.57] and $0.76/month [$0.52–$1.07] for each 1% increase in the

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current level of RPS and the share of rooftop in RPS respectively. Given the MWTP and status quo level of RPS, we can extrapolate that our respondents are willing to pay a premium of $27/month to achieve an 80% RPS. This amount is equivalent to a 36% increase in New Mexico's average current electricity bill. As RPS level increases, our respondents' MWTP for rooftop (solar farm) decreases (increases). For each 1 gallon/person/day (2 million gallons/day[4]) reduction in water consumed by fossil fuel to generate electricity, our respondents are willing to pay a $4.77/month [$6.28, $3.55] on top of their current electricity bill. As indicated earlier, New Mexicans are supportive of smart meter as long as the information is communicated either online or via an in-home display and are exhibiting MWTP of $7.14/month [$3.52, $11.29] and $7.96/month [$4.31, $12.05] respectively. Further, for each score higher than the NEP average, *ceteris paribus*, respondents are willing to pay an extra $0.06/month and $0.04/month for 1% increase in RPS and rrooftop respectively. Similarly, for each score higher than the NEP average, respondents accept to pay $0.50/month, $1.23/month, and $0.75/month to reduce water consumption by fossil fuel by 2 million gallons/day, install smart meter and access information either online or via an in-home display respectively. Lastly, our findings are consistent with the literature; rural and urban respondents do not exhibit a statistically significantly positive willingness to pay for RPS if they are 12 km and 9 km away from rooftop solar respectively.

Policies that consider everyone the same are not appropriate, as we find statistically significant differences between rural verses urban perspectives toward renewable energy, especially solar energy. Efficient energy policy requires technological efficiency and economic viability. It is also necessary that public acceptance, spatial and worldview heterogeneity be considered. For regulators considering new RPS policies or altered RPS levels, or utilities considering solar installations, the results provide improved information on consumer preferences, heterogeneity of response, and marginal willingness to pay for solar energy.

Keywords: Renewable Portfolio Standard; Solar Energy; Stated Preference; MWTP; Choice Experiment Survey; Spatial Heterogeneity; Distance Decay.
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4 Multiplied by New Mexico population;.