The Impact of Location and Proximity on Consumers' Willingness to Pay for Renewable and Alternative Electricity: The Case of West Virginia

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Introduction

West Virginia is a coal based state with 95% of net electricity generated using coal. In 2015, West Virginia will implement the Alternative and Renewable Energy Portfolio Standards Act (ARPS). At least 10% of electricity supplied to consumers has to be generated from renewable and/or alternative energy sources. Energy sources have varying attributes. In this research, we examine two likely energy sources, wind and natural gas, to meet the ARPS.

Since an individual's residential location relative to an existing electricity facilities impacts attitudes and willingness to pay (WTP) for renewable electricity [1], we examine the impact of location relative to existing wind and coal-fired power plants on preferences and WTP for renewable and alternative electricity in West Virginia.

Objectives

The objectives of this study are:

1. To assess preferences, attitudes and factors that influence consumer choice for renewable and alternative electricity in West Virginia.
2. To quantify consumers' WTP for alternative and renewable electricity and to assess how WTP values vary with proximity a hypothetical and existing electricity generating facility.

Methods

Eligible population sample for this study were all primary electricity bill payer. Using both online and mail survey modes, 3000 households were randomly selected from Monongalia County and Grant County, West Virginia(1500 from each county). The survey was conducted between November 23, 2013 and March 31, 2014. The effective survey response rate for Grant and Monongalia Counties were 35% and 27% respectively.

A labeled forced choice experiment survey (No opt out or status quo option present) was utilized to elicit respondents' choices and derive WTP values. Three attributes of a hypothetical electricity generation facility to be built within the county of the respondent were included in each choice set. These include:

1. **Energy source:** Wind and natural gas (used as labels)
2. **Proximity:** Three categories of proximity of respondents residence to a facility (near, moderate and far distance)
3. **Cost:** Additional fee to be added to respondents' monthly electricity bill.

A mixed logit model was used to estimate the utility function of a choice between electricity generated from wind and natural gas. All random parameters were assumed to be normally distributed. Cost parameter was fixed and WTP was calculated using a random normally distributed simulation based on mean parameter estimates and standard deviations of the sampled population [2].

Study Area

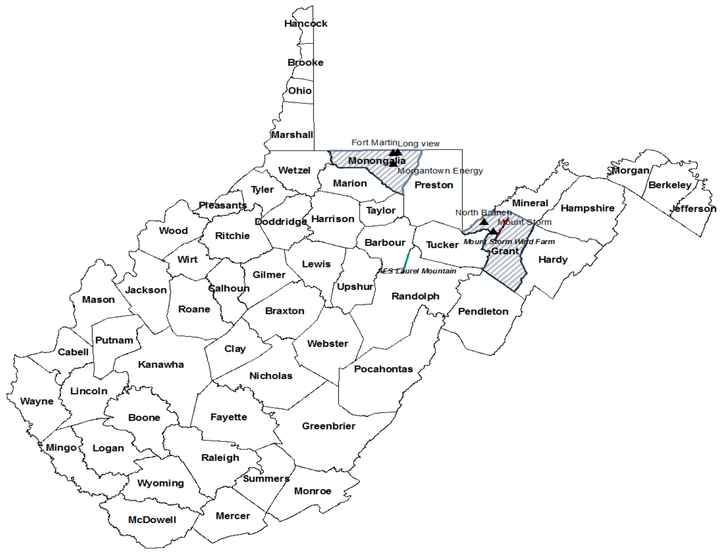

Figure 1: MAP of WEST VIRGINIA: MONONGALIA AND GRANT COUNTY SHADED

In order to assess the impact of existing electricity generation sources on choice and WTP to pay for renewable and alternative electricity, two counties in West Virginia with different characteristics in terms of type of existing electricity generation source present were chosen for this study (Figure 1).

- **Monongalia County** – A county with three coal fired power plants
- **Grant County** – A county with both a wind farm and two coal fired power plants

Preliminary Results

Table 1 : Implicit Price (WTP) for Electricity Generated from Wind or Natural Gas at Moderate or Far Proximity from a Respondent's Residence (Base is Near Proximity).

VARIABLE	MONONGALIA COUNTY	GRANT COUNTY
	Mean WTP Per Month in USD (95% Confidence Interval)	
WIND_MODERATE	1.078 (1.00 , 1.16)	-1.370 (-1.59 , -1.15)
WIND_FAR	4.317 (3.60 , 5.03)	2.991 (2.91 , 3.07)
NATURAL GAS_MODERATE	-2.362 (-2.37 , -2.35)	-2.565 (-3.01 , -2.12)
NATURAL GAS_FAR	6.813 (6.36 , 7.27)	5.131 (5.11 , 5.16)

Note: Proximity Description
Near: Within 2 miles of residence and within sight
Moderate: Between 2 to 19 miles (medium visibility)
Far: At least 19 miles or greater from residence (out of sight)

Discussion of Results

OBJECTIVE 1

- Given the option to choose between electricity generated from wind or natural gas, wind was the most preferred option in both Monongalia (62%) and Grant (60%) Counties.
- Less than 25% of respondents in both counties were familiar with the ARPS.
- Support for the ARPS policy was higher in Monongalia County (41%) than Grant County (30%)

OBJECTIVE 2

- Separate and pooled models were estimated. A LR test rejected the null hypothesis that individual county models were equivalent to a pooled model of both counties ($X^2_{23} = 82.7$).
- As expected, parameter estimates for the cost variable were negative and statistically significant in both county models.
- An alternative specific constant for a choice of wind was positive and statistically significant in both county models. This result indicates that respondents derive higher utility from electricity generated from wind relative to natural gas.
- In both county models, parameter estimates for far proximity to a natural gas power plant or a wind farm were positive and statistically significant.
- Parameter estimates for a variable that captured whether a respondent already can see a wind turbine (Grant County) or a coal power plant (Monongalia County) from their residence were negative and statistically significant in their respective models.
- All mean WTP estimates (Table 1) were statistically different from zero. A negative estimate implies compensation is required while a positive estimate implies a respondent is willing to pay a positive premium on their electric bill.
- Based on the 95% confidence intervals from Table 1, respondents were willing to pay a higher premium, on average, to locate a natural gas power plant at a farther distance compared to locating wind turbines at a farther distance.
- Respondents in both counties required compensation to locate a natural gas power plant at moderate distance.
- Even though respondents in Monongalia County were willing to pay a positive premium ($1.08 per month) to locate wind turbines at moderate distance, Grant County respondents required compensation (-$1.37 per month) to locate wind turbines at a moderate distance. This was a clear indication of the impact of existing electricity generation facilities present in each county.

References

1. Navrud, S., and K.G. Braten. 2007. "Consumers' Preferences for Green and Brown Electricity: a Choice Modelling Approach." *Revue d'Économie Politique* (5):795.
2. Hensher, David A., John M. Rose, and William H. Greene. *Applied choice analysis: a primer*. Cambridge University Press, 2005.