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Rural wind farm development: Social, environmental and economic features important to local residents

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ABSTRACT

The research problem was to examine residents' perceptions of personal costs and benefits in terms of social, environmental or economic features that influence support of or resistance to wind farm development in four rural communities in eastern Michigan. Data were collected from residents using a mail questionnaire, which included twenty-one Likert-style questions inquiring about perceived impact statements of wind farm development in the community. The analysis indicated that there were both differences and similarities in the perception of wind farm impacts on the rural communities. More specifically, the results of the Akaike information criterion test indicated that there was substantial support for nine of the twenty-one variables in support of wind farm development. The contribution of this study recognizes the importance of noneconomic perspectives of wind farm development where turbine construction had not yet been fully exploited. In particular, the data lend support for the use of Social Exchange Theory and further exploration of its applicability in renewable energy investigations.

1. Introduction

Wind energy development is becoming increasingly relevant in a global effort to combat climate change. Wind energy could provide up to one-fifth of the world's energy demands by the year 2030 [1]. The Global Wind Energy Council [2] reports that the United States was second, behind China, in newly installed wind energy developments in 2011. The United States government is advocating for the installation of more renewable energy facilities to replace the reliance on foreign oil. To facilitate wind developments, the state of Michigan created The Clean, Renewable and Efficient Energy Act (PA 295) of 2008, which established a Wind Energy Resource Zone board to identify regions in the state with the highest wind potential. Huron County, located along the shores of Saginaw Bay and Lake Huron, was one such location. Two wind farms were consequently constructed in eastern Michigan; a 46 turbine, 69 MW wind farm in Bingham Township (hereafter referred to as township #1) and a 32 turbine, 52.8 MW wind farm in Oliver Township (hereafter referred to as township #2) [3]. In the years since, controversy has continued as evidenced by newspaper articles (referencing social, environmental and economic variables), public meetings in the local government and the results of this research.

In 2010, two new wind districts were proposed in the same Huron County and a petition was filed to put this decision on a ballot for residents to confirm the creation of the wind districts. Proponents said "future wind developments will bring jobs, increase local tax revenue and help the environment, " while opponents declared that "the proposals will open the door to thousands [of] turbines in the Thumb, and future developments will cause health problems, increase utility prices, lower property values and harm esthetic value of Huron County" [4]. Those voters residing in townships under County zoning (50% or 14 out of the 28 townships in the County) were allowed to vote on the two wind proposals that were in county-zoned areas, and each passed by more than a total of 600 votes across the voting townships. According to the Huron County Building and Zoning Department, as of June 19, 2012, there were a total of 78 turbines currently in operation throughout the county with an additional 82 wind turbines being constructed in 2012. The Building and Zoning Department reported 160 turbines in operation with a total nominal output of 252.4 MW and expect an additional 158 turbines to be constructed and in operation (318 turbines in total) by January 2014 [5].

If wind farms are to be a prominent source of renewable energy and economic growth in Michigan, residents' perceptions should be

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understood to the same extent as turbine siting setbacks and allowable decibel levels. To understand the perceived costs and benefits in the local wind farm area, this research utilized Social Exchange Theory as a framework to acknowledge positive and negative perceptions of wind farms in rural communities and those efforts that may compensate local residents for actual and perceptual losses and more equitable development of additional wind farms.

1.1. Public perceptions

As communities are approached with a proposal for developing a wind farm, local opposition greatly slows the process of moving forward. Even though wind energy is generally accepted in principle, it is not uncommon for opposition to exist when facilities are actually developed. NIMBY (Not-In-My-Backyard) has long been the term that is used to explain any and all local opposition to any development in a community. In recent years, the term NIMBY has come under close scrutiny from researchers looking to explain what else may be driving local opposition [6–8].

In general, public support for wind development is high [7–9]. Researchers, however, are addressing the social gap that emerges because "despite high levels of public support for onshore wind development in principle, specific projects often experience local opposition" (Jones & Eiser, 2009, p. 4610). Research in this area has found that the over-used term of NIMBY is generally not applicable as the dominant and only reason that local opposition exists. NIMBYism alone cannot describe local opposition in the face of the general acceptance of wind energy. Recent studies have suggested that lack of community involvement in the planning stages, uncertainty regarding the proposals, and rural place attachment are just some factors that continually become apparent in resistance of wind development (Jones & Eiser, 2009; 2010; Swofford & Slattery, 2010). The question remains as to what is driving support or opposition to planned projects. What social, environmental or economic features are influencing residents' support of wind farm development in rural communities? Based on local knowledge and interviews, we hypothesize that economic factors would be predominant in influencing support of wind farm development.

2. Social exchange theory

Social exchange theory (SET) can aid in the explanation of the interaction between individuals in the environment. This theory includes a "collection of explanations, propositions and hypotheses, embodying certain assumptions about social behavior" [10]. SET suggests that people exchange, interact or evaluate based on the costs and benefits accrued in doing so [10,11]. Some, however, may view inadequacies within SET in understanding the full dynamics of the human dimension [11,12]. SET is imbued with social psychology and social perspectives that explain social change and stability as a process of negotiated exchanges between parties [10]. SET can explain how residents perceive their personal benefits and how this influences their perceived costs; these can be social, economic or ecologic in form. In the case of renewable energy projects, NIMBY has often been used to describe the resistance in the form of local opposition in the face of general approval, yet has been challenged as being too simplistic. SET, conversely, allows for reactions, either real or perceived, to be weighed against each other to predict a final action; SET helps explain the support and opposition to wind farms. For example, human attitudes are formed by the use of the subjective cost-benefit analysis and the comparison of alternatives; this can help to explain why some people are open to wind farms and some are not. To some landowners with contracts, the economic benefits outweigh any social or environmental costs, however other studies [12,13] have listed other factors (e.g., unity of the environment and relationship between the land and daily lives) that may influence behavior.

3. Methods

3.1. Study area

Huron County is located in the "thumb" area of Michigan, which is surrounded on three sides by water – Saginaw Bay and Lake Huron. The county has a total land area of 2134 square kilometers [824 square miles], which is 360 square kilometers [139 square miles] greater than the average square kilometers [miles] for the other 82 counties in the state. Huron County ranks as one of the top agricultural counties in Michigan based on total value of agricultural products sold [14]. Some of the major crops grown include corn, navy beans, sugar beets, wheat and alfalfa, while major enterprises include dairy and livestock production. Land prices and crop yields have had lows and highs over the years, and some industry related to auto parts manufacturing have failed or scaled down production considerably, while recreation and tourism based on coastal assets are underperforming. Huron County, however, is an ideal setting for the tourism industry because of the natural beauty and ideal topography with fertile farm land and close proximity to the lakeshore. Although small manufacturing firms and tourism are included in the county's industry portfolio, agriculture remains one of top four industries in the County [15,16].

In applying SET in a rural, agricultural area undergoing rapid renewable energy development, the area studied was comprised of four townships in Huron County, Michigan. Related to the 2008 and 2012 wind farm proposals and developments, two of the townships (#1 and #2) contained operating wind farms and two coastal townships, Rubicon (hereafter referred to as township #3) and Sand Beach township (hereafter referred to as township #4), were used as comparison sites (Fig. 1). The townships are roughly a 9.5 km-by-9.5 km (6 mile-by-6 mile) square, with the exception of the coastal townships where a border would be an undulating coastline. If a turbine were placed on the edge of a township, the farthest distance that any homeowner in that township would be located is over 9.5 km [6 miles]. This allows for turbine viewing in virtually all areas of a particular township. The coastal comparison townships were not adjacent to those townships with existing turbines; the shortest distance between the townships with turbines and the comparison townships is over 9.5 km [6 miles]. Topography, trees and other man-made structures obscure the view of some turbines for homeowners in this area, otherwise wind farms are very visible.

The wind farm boundaries (wind zone overlays) in townships #1 and #2 differ in shape: one boundary is in the shape of a square (township #2) and the other in an inverse 'U' shape (township #1). A wind zone overlay indicates the approved area for the placement of wind turbines (Fig. 1). The topography in township #2 is relatively flat while rolling hills exist in township #1 making the turbines placed on the peak of the hills more prominent in the landscape. In addition, the number and type of wind turbines are different in the two townships. Township #1 is the larger of the two – utilizing 46 GE model 1.5 MW turbines, while Township #2 utilizes 32 Vestas model 1.65 MW turbines. The two wind farms were managed by different companies and their transparency in conducting business with landowners and the general public varied.

3.2. Data collection/analysis

The study format comprised of interviews by implementing a small snowballing sample, of local stakeholders ($n = 11$) followed