The Invisibility of Wind Turbine Property Tax Benefits in Michigan
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Abstract

While the transition to renewable energy at national and global scales is largely motivated by the need to address climate change, economic benefits are at the forefront for many communities hosting renewable energy infrastructure. In the U.S., a potentially significant community-wide economic benefit comes in the form of property tax payments made by renewable energy developers. Using a mixed methods study of nine Michigan townships which host utility-scale wind farms, we explore the extent to which these tax benefits are visible to community members. Evidence from tax records shows that wind turbines contribute to a large increase in property tax base. However, while local officials in wind turbine communities see the benefits from increased property tax revenue, most residents of these townships do not see an improvement in township services as a result of that increased revenue. This paper offers insights as to how states, who control the property taxation of renewable energy infrastructure, might better align tax structures associated with renewable energy to make these payments more visible to the communities which host that infrastructure.

1. Introduction

While an increased use of renewable energy may bring any number of benefits—to the environment, human health, economy—to states and nations, the primary benefit that renewable energy power plants bring to the communities which host them are economic (Brannstrom et al., 2011; Slattery et al., 2012; Sovacool & Lakshmi Ratan, 2012). These include economic benefits that accrue at both the individual and community level. At the individual level, there are payments made to landowners who host turbines on their property and, occasionally, direct payments to nearby residents (Fast et al., 2016; Garcia et al., 2016; Jacquet, 2012; Walker et al., 2014). At the community level, the economic benefits might take the form of community ownership, donations to local organizations, negotiated impact fees paid to local government or community groups, job creation, or property tax payments (Jossi, 2018). Choice experiments have found that residents say they prefer community-level payments to individual payments (Garcia et al., 2016; Hoen & Rand, 2017). But to what extent do residents in communities with windfarms connect community-level payments to the wind development? This paper specifically looks at property tax payments, examining the extent to which the size of the payment and use of the funds impact public perceptions in nine Michigan townships which host wind developments.

2. Literature review

Though there are many factors that impact public acceptance for wind energy (Rand & Hoen, 2017; Sovacool & Lakshmi Ratan, 2012; Swofford & Slattery, 2010), economic factors loom large. As a result, there has been much academic work focusing on these community-level economic benefits (Bidwell, 2013; Walker & Baxter, 2017). Despite being commonly touted in the popular press as a key economic impact of wind development, there is very little scholarly literature on the connection between wind development and property taxes. In part, this may be because the property tax—and its application to industrial equipment—is rather

unique to the American context (Eckstein & Tanzi, 1964; Fisher, 1996; Hale, 1985). As a result, it rarely appears in the comparatively larger body of European literature on social and economic impacts of wind turbines, which has instead focused more on community ownership (Musall & Kuik, 2011; Phimister & Roberts, 2012; Warren & McFadyen, 2010) and more voluntary/negotiated community-level payments.

In the growing body of American literature, there are a number of references to property taxes providing host communities with economic benefits (Becca & Scott, 2018; Godby et al., 2018; Slattery et al., 2012). However, there has been limited empirical work that focuses specifically on taxation issues, especially within the context of community acceptance. Instead, most of the US studies on wind energy and tax revenues have used economic models (Greene & Geisken, 2013; Loomis et al., 2016; Slattery et al., 2011) or integrated impact assessment tools (Leistritz & Coon, 2009) to estimate annual tax revenue and net economic impacts from wind projects. Other studies have reported actual and projected property tax revenues based on current property tax rates (Kahn, 2013; Loomis et al., 2016).

There has also been a small amount of research on how state and local tax policy affects potential wind-related revenues. Kahn (2013), for example, finds that Texas' "Robin Hood policy" that allocates tax revenue from richer to poorer school districts throughout the state diminished the additional positive impact that the revenue could have had on districts with large wind projects. Haggerty et al. (2014) similarly observes that the amount of potential wind-related local tax revenue in the Western US is highly uneven, less as a result of varying wind potential, and more because of varying tax incentives for wind developers, state-level tax abatements, and differing tax rates. Black et al. (2014) suggest that state-level tax incentives for wind developers has been a point of contention among state officials due to the concern that they would diminish tax revenue as a whole, but cites Idaho's removal of tax rebates for the wind industry as a cause for stalling future wind development. This suggests that effective tax policy is a balancing act—of being not so high as to discourage wind development, but high enough to provide local communities with benefit.

Though the implications of tax policy on public acceptance for wind development are implied, few authors have looked directly at the connection. Through a Q-method study done in Texas, Brannstrom et al. (2011) concludes that multidimensional support for wind energy in the county stems from the residents' notion that it brings local economic benefits including—but not limited to—tax revenues. Stafford and Hartman (2012) further find that being able to tell a compelling story of tangible economic benefits is crucial to gain support for a wind project, and suggest that local government officials use wind-derived tax revenues for activities that complement broader community values: for example, the value of local children's education in a district where schools are typically underfunded. Whether that is actually happening has not been fully studied. Kahn (2013) finds major improvement in the public school system in West Texas, where wind-related tax revenue increases have led to decreased student/teacher ratio. Similarly, Sowers (2006) demonstrates that interviews in Iowa show high support for turbines, due to their contribution to tax revenues, especially for schools and roads. Wind development had high support even among those not directly compensated. Greene and Geisken (2013) suggest, though, that residents near Oklahoma wind farms severely underestimate the annual tax revenue from the wind development by over half of its actual

value, attributing this to minimal public awareness of how the revenues are being used in the community.

Given these contexts in the realm of community knowledge, economic considerations, and tax revenues, it is clear that all of these elements contribute to a deeper understanding of public perceptions regarding wind development. This paper focuses on the intertwined connections between these variables, and how they manifest themselves in nine townships with wind farms across Michigan. Specifically, this paper addresses the question: Does the relative size of economic impact and the use of revenue affect a community's perceptions of economic impacts from wind development? This paper first seeks to quantify the economic impact of wind on Michigan communities that host wind farms by considering how the construction of the turbines have impacted their tax revenues. Furthermore, results from interviews with community officials and surveys of residents are presented, providing, respectively, insights as to how local governments are using wind revenue, and whether people are realizing the value of these revenues.

3. Background on tax policy and wind development in Michigan

First, it is necessary to understand the context of Michigan's tax policy regarding wind energy. Although local governments set their own property tax rates, Michigan has a governor-appointed State Tax Commission that sets statewide rules for how the tax base is to be calculated, including through providing guidance to local assessors on the valuation of taxable property. The State Tax Commission clarified in May 2008, roughly when the first utility-scale windfarms in Michigan came online, that wind energy systems should be taxed as industrial personal property and that the taxable value of the land—the real property on which the windfarm sits—should not change as a result of the wind development (STC, 2008).

Michigan has a number of categories of industrial personal property, each with its own multiplier table reflecting the STC's sense of how the initial cost of the asset should change over time to reflect the market value—related to, but not identical to, how the equipment depreciates. Assessors, however, do have discretion to base their assessments on alternate information in making their assessment (Michigan State Tax Commission, 2018). The current tax table for wind energy systems, established in 2014, suggests that the taxable value for each wind turbine is based on its original construction cost, with a multiplier table applied that adjusts this figure downward every year for the first ten years (Treasury, 2020). In year ten and beyond, the current table calls for taxing at 30% of the initial value.

It should be noted, however, that this tax treatment has changed over time. Prior to the passage of the state's first renewable portfolio standard in 2008, wind developers could ask local governments for a partial tax abatement on the turbine's taxable value. While the abatement would lead to reduced payments in the first decade of the wind project, it also had the effect of property tax payments starting while the project was in construction, rather than the year after it became operational. But of more importance, the multiplier table itself was modified three times between 2010 and 2014, often leading to more swift declines in the taxable value—meaning local governments would receive less tax revenues over the life of a wind development (Wind Energy Stakeholder Committee, 2018). Local officials in most of the Michigan communities with wind turbines jointly hired an attorney to press the STC to revoke the change (Drier, 2015); negotiations are on-going, now six years later. Additionally, many

local tax assessors subsequently chose to base their assessments on a previous multiplier table, which led wind developers on more than half of the wind turbines in the state to appeal their assessments to the Michigan Tax Tribunal (Creenan, 2019). While most of these appeals have subsequently been settled, the coalition of local governments which host windfarms has continued to advocate for tax changes both before the STC and the state legislature.

Second, it may be helpful to understand how the nine townships in this study fit into the overall arc of wind development in the state. While two 900kW turbines were erected in northern Michigan in 2001, the first large wind developments in the state did not fully come online until 2008. Since then (as of the end of 2019), Michigan has deployed 2,139 MW of wind energy (see Figure 1). These windfarms span 40 townships, the sub-county units of government which often set the land use rules which govern wind development, and which also are a beneficiary of property taxes.

Seven of the nine townships in this study are in Michigan's "thumb"--the agricultural region north of metro Detroit that boasts the state's greatest onshore wind potential, but also has recently seen some harsh resistance to wind development.[1] The other two townships (Townships A and F) included in this study were purposively selected for having projects of a similar scale but in a different landscape, not so dominated by agriculture but more by recreational land uses. The townships studied have been sorted based on the size of the wind project, from Township A with 5 turbines to Township I which hosts 88 turbines.

4. Methods and Results

To paint a full picture of the visibility of wind energy tax revenues among landowners in windfarm communities, this paper pieces together three different types of information, gathered from three different methods, but all revolving around the same nine Michigan townships which host utility-scale wind turbines. First, we quantify the economic impact of wind development by reviewing tax rolls from each of these townships to understand how wind development impacted local tax revenues. Second, we draw upon interviews with local government officials to gain insights into how these revenues are being used. Finally, in a third method we analyze data from a mail survey of residents to understand their perceptions of the impact the windfarm is having on local government services in their community. For clarity, we provide details of each method followed immediately by the results of that method. After taking each method in turn, the discussion section synthesizes the findings across these methods.

4.1 Tax Data

The first method aims to answer the question: what is the economic impact from wind development in these townships' tax base?

4.1.1 Methodology

Data was obtained from the Michigan Department of Treasury website for the nine townships from 2005 to 2016. This range of dates, spanning more than a decade, was chosen

[1] The names of the townships are excluded from this article in order to protect the anonymity of the local officials who provided interviews.

as it predates wind development but runs until the year that the survey described in Section 4.3 was conducted.

The primary pieces of data are State Equalized Values (SEV)—that is, the final determination of taxable value—of both real property and personal property for the nine townships from 2005 to 2016. Any windfarms developed after 2008 would be added as industrial personal property. Recall from section 3 that prior to 2008, local governments could provide a tax abatement on the personal property tax to wind development. If offered, the taxable value would not appear as SEV industrial personal property, but on the Industrial Facilities Tax (IFT) Roll. Five of the nine townships had wind farms listed under the IFT roll. Each of these three property tax sources—SEV of real property, SEV of personal property, and IFT—combined represent the total property tax base.

It is expected that the impact that wind development has on property tax revenues would be a function both of how large the windfarm investment is, but also how large the existing tax base is. In order to understand the magnitude of impact that wind farm tax revenues had across townships, these values were graphed and compared along the same scale. Markers were added to demonstrate the years in which wind turbines went live in each township. It should be noted that the change in tax base from facilities on the IFT roll consistently appear two years earlier than those on the SEV. This is due to the nature of the Industrial Facilities Exemption as an incentive for construction; the IFT value is added when construction of the wind turbines begins, in contrast to the SEV, which is added when the turbines go into operation.

4.1.2 Results

Overall, the data signals the significant economic impact associated with the addition of wind turbines into a township. Figure 2 shows that wind turbine development in these townships led to significant growth in taxable value, both in absolute terms and as a percentage of the initial total tax base in 2005. While there are some difference between the townships, the absolute value of the change generally scales with the number of wind turbines installed. The jump in SEV industrial personal (shown in blue) and IFT (shown in yellow) is modest in townships A-C, but more significant in townships G-I, for example. Further, there is clearly a link between turbines coming online (denoted with the dotted vertical lines) and the rise in taxable value.

There are some variations, though, largely due to tax policy. One of the key differences is the timing and shape of the tax base surge between townships with older windfarms on the IFT rolls and those in communities where the taxable value is part of the industrial personal property list. In the former group (which includes township B and G, for example), the surge occurs two years before the turbines are operational, whereas in the other communities, the increase occurs in line with the onset of turbine operation. Furthermore, the taxable value for those projects on the IFT roll is flat—the value stays the same over time—whereas the SEV for the personal property decreases over time, in accord with the STC multiplier table.

Notably, though, there are differences both in absolutely value of change, and the impact that it has on the townships' tax base. Over the over the 11 year period, the total tax base of these townships grew from 13% to 589% of their initial value, as summarized in Table 1. Not all of that increase, however, is directly attributable to wind development. Even so, the ratio of the portion of the tax base attributable to wind compared to the 2005 total tax base

ranges from 0.16 to 4.06, not insubstantial sums. While there is a strong correlation (R^2 = 0.928) between this ratio and the number of turbines in the township, the impact is most notable on townships that have a relatively smaller tax base to start out with. Take, for instance, Township I and Township G. Both saw roughly the same amount of wind turbine investment ($132M), but because Township I's initial tax base was less than half of Township G's, the ratio of wind development revenue to total taxable value is twice the size.

Relatedly, Townships E and F demonstrate how growth in non-wind turbine taxable value can dilute the impact that wind turbines may have. Both of these township host 24 turbines, and both saw a similar rise in the SEV of industrial personal property. When turbines came online in Township E in 2012, they more than doubled Township E's 2005 tax base, whereas in Township F, the ratio was only 0.67. However, given the rise of Township E's tax base more generally over that decade, in 2016 wind value was only 20% of Township E's tax base in 2016 compared to 25% of Township F's.

Another thing to note in these graphs is the nearly across-the-board rise in non-wind taxable value over this time period. While non-wind values were steady outside of the Thumb (in Townships A and F) and only rose slightly in Township G, in all other townships non-wind taxable value more than doubled—and in some cases, tripled—over this time period. It is possible that the increase in real property values, while marked as "non-wind here," may be linked to wind development, as previous research in these communities has found landowners with wind leases are putting those moneys back into their homes, outbuildings or land which are taxed as real property (Mills, 2018).

4.2 Local official interviews

While the previous section established that wind developments significantly increase the tax base of townships in Michigan that host them, this section aims to understand how the subsequent property tax revenues are put to use.

4.2.1 Methodology

Information on the use of wind energy property tax revenues was identified by conducting semi-structured interviews with the local officials elected to lead each of the townships in the study. The primary executive branch official in Michigan townships is an elected township supervisor, who is roughly the equivalent of a city mayor. Once the nine townships were identified, an online member directory of the Michigan Townships Association was used to contact the township supervisor in each to arrange for an interview at a time and location of the interviewees' choice. Most interviews took place at the township office or the supervisor's home, as not all townships have halls, and most were conducted in the spring and summer of 2014. Seven of the nine township supervisors agreed to be interviewed.

The questions in the interview were all open-ended, and proceeded from a semi-structured interview guide. Taxation was only one of many topics covered in the interviews, which ranged from 45 minutes to 2 hours. Audio recordings of the interviews were transcribed and thematic codes were applied using NVivo software.

4.2.2 Results

Township officials were overwhelmingly positive about the impact of the additional tax revenue generated by the wind turbines in their jurisdictions. Given that most of these jurisdictions have relatively small tax bases with limited commercial or industrial development,

any additional revenue makes a significant impact on their budget. In the words of the Township C supervisor, "Being a small township we don't generate that terribly, terribly much money. So [wind turbine tax revenue] is a big impact."

Supervisors in the townships that received the most wind investment were particularly effusive in discussing the impacts. Township I described it as "a nice shot in the arm for us," while Township G suggested "would we survive without them [wind turbines]? Absolutely. But we're surviving better with them." The supervisor in Township H spoke to the need to prepare for the influx in tax revenue: "It's just something that we as a township never had to look at that kind of increase in such a short time span. It's—all of a sudden it—we're looking at how to set up accounts so that we've got money available for future contracts and everything else." The only township official who said there was no discernable impact on tax revenues was from Township A which had only five turbines, including two that had received tax abatements. The supervisor in Township B, which also only had five turbines, similarly noted that it did not make too much of a difference but also added, "it helps…anything helps".

Because the tax bills paid by wind developers are not differentiated from other property tax revenues, few of the interviewees could point to specific projects made possible by the additional revenue. In the words of one, "It goes all over, just the same as any other tax money." Most of these townships offer few public services and spend nearly all of their money on road maintenance, regardless of whether or not they receive wind turbine revenue. Four interviewees mentioned that they planned to increase road maintenance with the additional money, with the money either going to graveling unpaved roads or resurfacing paved roads. One interviewee estimated the revenue from turbines would allow them to resurface about one extra mile of road a year, while another said it would pay for graveling one mile of road per year. None had plans to pave previously unpaved roads which are ubiquitous in these townships, citing very high costs of such an activity compared to maintaining the existing roads.

There were two exceptions to the general trend, though. Township G recounted that the new revenue allowed the township to purchase a new ambulance and a new fire truck worth "close to $400,000." And the supervisor in Township E said that the township was planning to add additional services, for example, "pay[ing] for garbage pickup or provid[ing] another service that they [landowners] are currently having to pay [for] themselves."

In four interviews, local officials were asked whether there were any plans to reduce millage rates as a result of the new revenue. None of the officials said their township had made any changes to millage rates, nor did they have any plans to do so in the future. Township I, which had seen taxable value increase five-fold as a result of wind development reasoned, "right at this point we're at the all-time high," and so a reduction in millage rates would only make sense if it were temporary. In Township H, where the idea appears to have been most seriously considered, the supervisor noted that Michigan tax law requires that a reduction in the millage rate apply not just to owners of real property, but also to the taxable value of the wind turbines. As a result, any tax rate reduction "is going to benefit the wind companies a lot more than a person with a house [who] might save 30, 40 bucks [a year]."

4.3 Landowner surveys

This third element of the research design aims to understand the extent to which community members in the nine townships with windfarms connect wind development and improvements to local government services in their community.

4.3.1 Methodology

Community perceptions were determined using a mail survey of all owners of agricultural or residential property in each of the nine townships.[2] The sample frame was constructed from the property tax database in these townships, obtained from the county equalization office. Given that some townships had as few as 200 landowners in total, the survey was sent to everyone in the sample frame to avoid sampling error that might arise from having such small subpopulations (Isaac & Michael, 1981). After omitting duplicate addresses, surveys were sent to 3,024 unique addresses. Formatting and survey administration were conducted according to best practice (Dillman et al., 2009), with multiple contacts, personalized communications, and a $2 pre-paid incentive (Groves & Couper, 1998; Mills, 2019). In total, 1,534 valid surveys were returned, a response rate of 50.7% using AAPOR RR2 methodology (AAPOR, 2016). The survey was conducted in June and July 2016.

The four page survey included a range of questions about landowners' perceptions of the individual and community-wide impacts of wind development (CLOSUP, 2016). The data reported here—on the impacts on township services and roads in the township—come from two questions using the same prompt: "Thinking about the wind turbines in XXX Township, what effect do you think they have had on..." Since these impacts could be positive, due to new resources, or negative, particularly in the case of roads, where construction could result in additional wear-and-tear on local roads, respondents were given a 5-point Likert scale: greatly improved, somewhat improved, neither improved nor worsened, somewhat worsened, greatly worsened.

4.3.2 Results

Overall, the majority (73%) of landowners in the nine windfarm townships responded that township services had neither improved nor worsened as a result of wind development. While only 5% said that township services had worsened, just 22% said that services had improved, this despite the significant positive impact that most townships supervisors thought the windfarms were having. While the actual dollar value of the tax impact largely scales from Township A with only five turbines to township I with 80 turbines, there is little evidence of this in the survey responses shown in Figure 3, with 14% of residents in Township A reporting improved services compared to 27% in Township I (correlation $R^2 = 0.05$). Instead, what is most notable is Township E, where 60% of landowners say township services have improved. This is more than double the positive responses in Township G, the township with the second highest recognition of improved township services. Recall from the previous section that these were the only two townships where the supervisor noted a special use of funds: the introduction of trash collection in Township E and a new ambulance and fire truck in Township G.

Instead, most township supervisors noted that the tax revenues received from wind development went into the general fund, which is primarily used to maintain roads. Landowners were somewhat more likely to perceive improvements to local roads, with 27%

[2] To be clear, the unit of analysis is the property owner, an entity that is sometimes a single person but more often a group (e.g., spouses, siblings, parent and child, or business partners).

survey respondents noting improvements in local roads as a result of wind development. Even so, a majority (60%) said local roads neither improved nor worsened, while 12% said wind development had had a negative impact on roads.

While Figure 4 shows that there are variations between townships in terms of perceived impacts on roads, there is not a lone outlier. Township E, which was the outlier for the previous analysis, does have the highest percentage of landowners who note improvements to roads (53%) but within the margin of error compared to Township I (52%). Townships A and F, the two townships outside of the Thumb, have the lowest percentage of landowners who say that local roads have improved. But by contrast, there are greater percentages of respondents in the Thumb who note worsened road conditions as a result of wind development. Furthermore, there is only a weak correlation ($R^2 = 0.39$) between the number of wind turbines and perceived improved or worsening road conditions.

Looking at benefits to roads and township services combined, overall just 33% of landowners saw any improvement to either roads or township services. This ranged from 28% in Township A to 72% in Township E (see *Table 2*). In only four of the nine townships did a majority of residents see an improvement in roads and/or township services, and again there is little correlation ($R^2 = 0.22$) between the number of turbines in a township and the visibility of these improvements to residents.

5. Discussion

Wind energy projects—and, increasingly, utility-scale solar projects—are often pitched by developers to communities as an economic development opportunity, not just for individual property owners who lease land to developers, but also for the entire community in the form of property tax payments. Our analysis of property tax records and interviews with local officials in nine Michigan townships which host wind turbines confirms that wind infrastructure provides a significant boost to the local tax base. Even so, this boost is largely invisible to community members, with fewer than half of those across these townships saying that any sort of local service had improved.

The aggregate data, though, mask important township-level differences. In particular, the findings from Township E are most instructive. This township stands apart as the only community where a majority of residents perceived an improvement in township services. And even when expanding the survey analysis to looking more broadly at a specific local service—maintenance of local roads—landowners in Township E were significantly more likely than those in other communities to attribute improvements to wind energy development.

Township E does not have a particularly large wind development; like Township F, it hosts 24 turbines, significantly fewer than Township I's 80 turbines or even Township H's 56. While Township E's tax base was the second fastest growing of the nine, much of that increase was not directly attributable to wind development, and the question that was posed to residents was whether *wind development* improved or worsened township services. What makes Township E stand out, we believe, is that it was the only township of the nine to introduce a new service—trash collection—in a community where residents previously had to contract individually with a private hauler. Most other township supervisors noted that revenues went into the general account to fund incremental improvements to existing township services, especially road maintenance. Even in Township G, the only other township

that pointed to a specific outlet for the wind revenues, there was no new "service" offered, but instead the purchase of new emergency equipment.

That these incremental improvements in local communities would go unnoticed is not unique to Michigan. Recall, that Greene and Geisken (2013) found the same to be the case for tax revenues in Oklahoma. And it may just be human nature that the average citizen does not realize how much it cost to maintain public infrastructure. Even so, this gap between the actual impact of wind revenue and public perception is problematic if at least one of the goals of these payments is to provide communities with tangible community-wide benefits. Furthermore, this gap is not anticipated by the local officials in these communities. When asked in interviews what connection, if any, they see between the taxes paid by wind developers and public opinion about the wind farm, three of the seven township supervisor interviewees said they believe the tax revenues impact how landowners without wind leases feel about wind energy. One interviewee said that while he "wouldn't go so far" as to say that the tax revenues are the key to community acceptance, he believed they were "right close to the top." Another specifically noted that while most of his constituents are farmland owners who receive direct wind-related income, he feels that he has a responsibility to ensure that the benefits are more widely distributed. "If we can show that through the added increase [in tax revenue] that some dollars are coming in for road improvement," he said, "it all helps."

If the predominant way that townships are using the income, though, is not visible to these community members, it is helping? Should, perhaps, more townships follow Township E's lead and introduce a new service? While we did not pose this question directly to most township supervisors—primarily because the survey came after the interviews, so it was unclear at the time of the interviews that there was such a marked difference in Township E compared to the others—it did come up in some interviews. Township supervisors were generally reluctant to take on new long-term expenses due to the state tax code, under which the taxable value of wind projects falls to 30% over a ten-year period. Similar to the argument given about reducing the overall tax rate, township officials said they were reticent to take on the new service and not be able to afford it ten years out, requiring either discontinuing the service or raising taxes to cover the costs, neither of which seemed political tenable options.

That wind tax revenues decline over time is not universally true across states, but is instead a function of tax policy design. While an ad valorem property tax with this declining structure is the most common approach across states (American Wind Energy Association & Polsinelli PC, 2017), it is not the only way to levy a property tax on wind turbines. Some states, including Minnesota and North Dakota, have an alternate tax based on generation capacity or energy production, which tends to create a tax revenue stream that is more level over time, making it easier for local officials to plan for revenues. Other states, including Texas and Iowa, allow local governments to negotiate a "payment in lieu of taxes" (or PILOT), which often affords them flexibility in setting both the amount of total tax revenues and the shape of the tax revenue stream. This tax structure has the added benefit of locking in a taxation agreement between the developer and local government, providing more certainty to both in the case of changing state policies, as noted in Section 3 happened multiple times in Michigan. But these negotiated payments may also create information imbalance, with local governments who may only ever negotiate one PILOT agreement lacking information on developers' ability to pay.

Whether these alternate approaches *do* allow for the tax payments to be more visible—either as a result of a more level income stream resulting in new services or by, perhaps creating a public discussion about community priorities in the process of negotiating a PILOT agreement—is yet unknown. Providing an answer, though, does not require an experiment based on "hypothetical" tax scenarios; the natural experiment that is our federal system, with each state's tax policy slightly different, provides natural variation. That future research might also ascertain public perceptions of the share of revenues between different units government. In Michigan—and most states—the township is not the only level of government funded by property tax revenues. Michigan ad valorem property tax revenues also fund county governments, special districts (for example, library or additional public safety services), and a statewide K-12 education fund. This research would suggest that the larger the unit of government—both in terms of overall tax base and geographical scope—the less likely additional wind revenues will create a noticeable impact among residents in a host community. That, too, is a testable hypothesis for future research.

6. Conclusion

While this paper—and, indeed, much of the social science literature on energy—has focused on wind energy, the findings are no less relevant for other types of energy infrastructure. A transition toward renewable energy will require a massive build-out of both utility-scale wind and solar projects, as well as transmission. Opposition to proposed projects and the role of economic benefits associated with this build-out may well mean increased attention on tax policy. This is especially the case with utility-scale solar, a relatively new land in most states, so which may not be contemplated in existing state property tax codes. But even for "old" infrastructure like transmission lines, where state tax policy has long been established, new challenges in siting may call into question the economic benefits that accrue to communities that host this infrastructure, and the visibility of those benefits to community members.

To some extent, the taxation of renewable energy is a zero sum game: energy developers undoubtedly pass the costs of development—whether the costs of the equipment, land leases, or tax bills—on to buyers of that power, who ultimately pass it on to consumers in the form of their electricity bills. Even so, given the primacy of economic considerations to those communities that host this infrastructure, and a growing call for distributional justice of the economic benefits, there is clearly a need to ensure that there is "something in it" for host communities. While much of Europe utilizes host community benefits agreements, the property tax structure within the U.S. is built to help extract these community-wide benefits. Our research on the taxation of wind energy begs the question: if these benefits are invisible to community members, are they really benefits at all?

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Figure 1. Existing and Proposed Utility-Scale Wind Projects in Michigan

Data Source: misoenergy.org; usgs.gov; Map by Abigail Randall

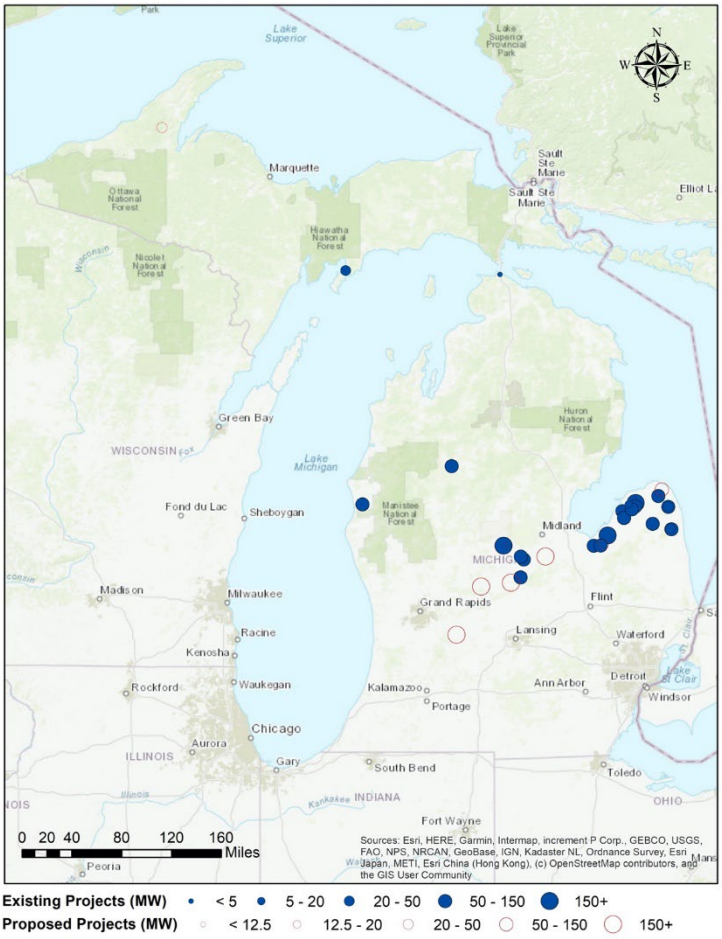

Figure 2. Tax Base change by township, 2005 to 2016

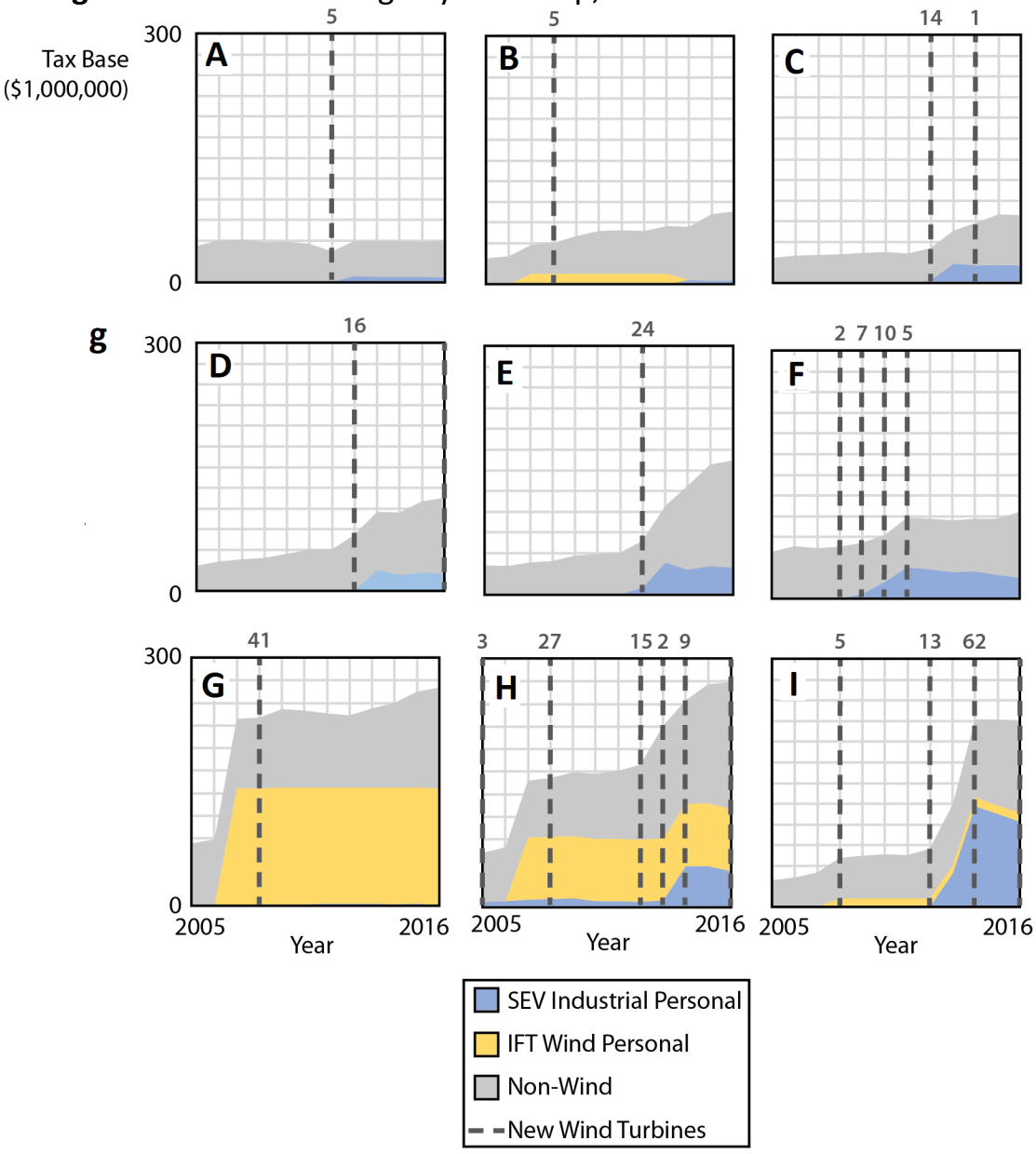

Table 1. Comparison of Tax Base change, by township

	# turbines	Tax Base 2005	Max Taxable Value of Wind (SEV+IFT)	% change of total tax base 2005 to 2016	Ratio of Max Wind : 2005 Total Tax Base
Twp A	5	43,820,000	6,857,700	13%	0.16
Twp B	5	31,336,900	12,725,050	181%	0.41
Twp C	15	30,483,700	24,021,000	170%	0.79
Twp D	16	31,013,200	25,876,500	264%	0.83
Twp E	24	35,107,300	38,305,500	362%	1.09
Twp F	24	56,963,200	38,441,200	84%	0.67
Twp G	41	69,008,213	131,577,753	251%	1.91
Twp H	56	60,263,380	114,715,332	313%	1.90
Twp I	80	32,705,300	132,870,725	589%	4.06

Figure 3. Landowner Perceptions of the Impact of Wind Turbines on Township Services, by township

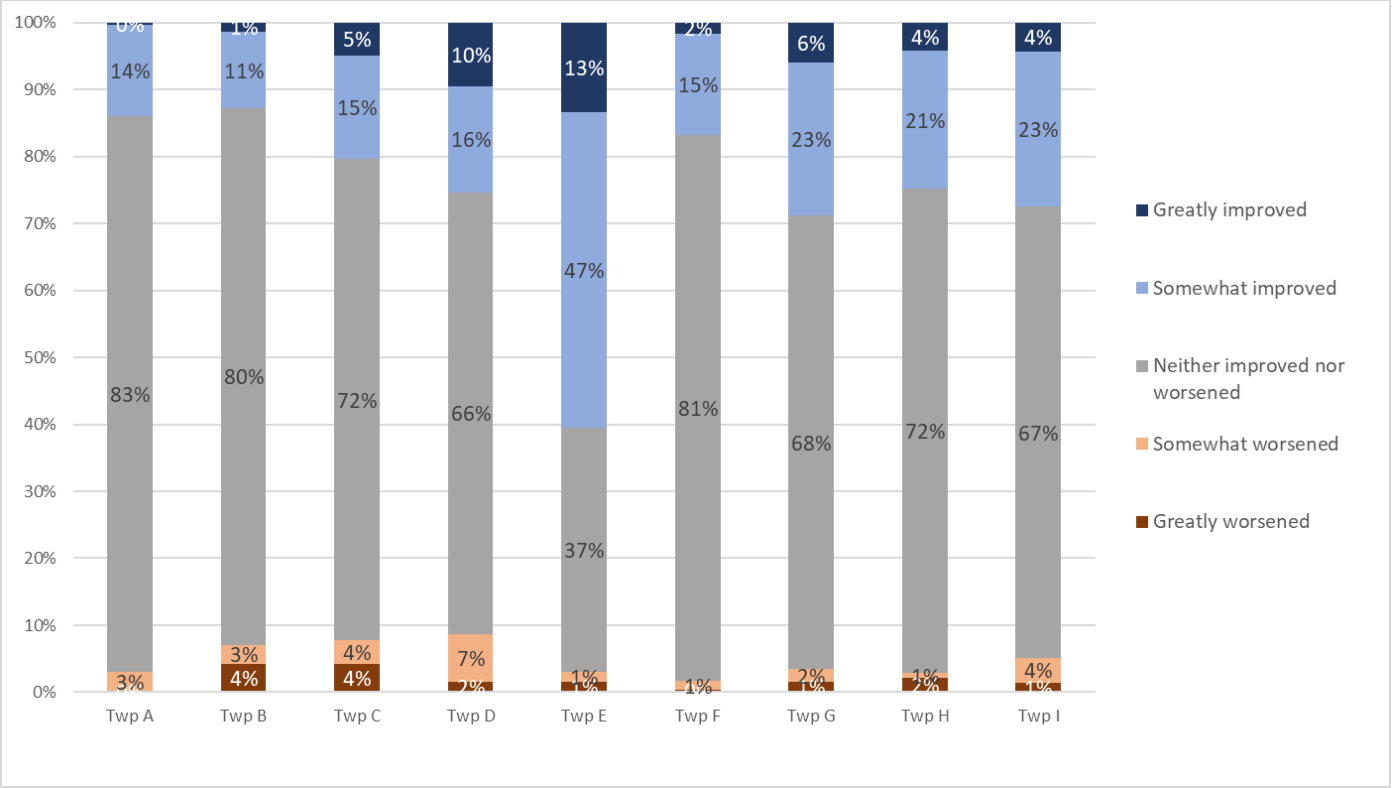
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Twp A
Twp B
Twp C
Twp D
Twp E
Twp F
Twp G
Twp H
Twp I
14%
11%
15%
16%
47%
15%
23%
21%
23%
83%
80%
72%
66%
37%
81%
68%
72%
67%
3%
3%
4%
4%
7%
1%
2%
1%
4%
5%
10%
13%
6%
4%
4%
Greatly improved
Somewhat improved
Neither improved nor worsened
Somewhat worsened
Greatly worsened

Figure 4. Landowner Perceptions of the Impact of Wind Turbines on Local Roads, by township

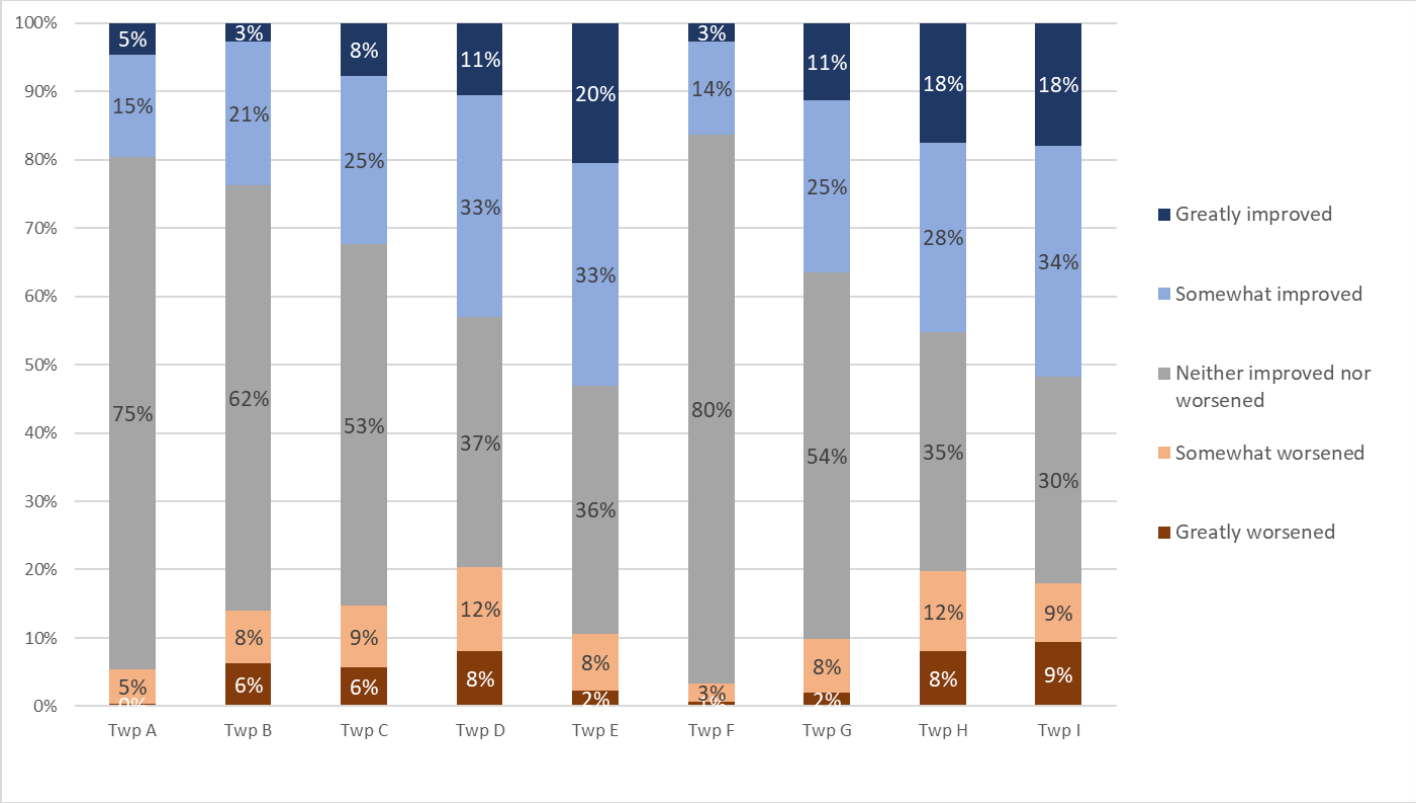

Table 2. Percentage of landowners who said township services and/or local roads improved as a result of wind development, by township

Township	# turbines	% respondents who noted improvement
Twp A	5	28.0%
Twp B	5	33.6%
Twp C	15	43.5%
Twp D	16	53.9%
Twp E	24	72.1%
Twp F	24	30.5%
Twp G	41	47.0%
Twp H	56	51.4%
Twp I	80	57.5%