Environmental Sociology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rens20

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To cite this article: Max Chewinski, Sven Anders & John R. Parkins (2023): Agricultural landowner perspectives on wind energy development in Alberta, Canada: insights from the lens of energy justice and democracy, Environmental Sociology, DOI: 10.1080/23251042.2023.2247627

To link to this article: https://doi.org/10.1080/23251042.2023.2247627

Published online: 15 Aug 2023.

ENVIRONMENTAL SOCIOLOGY
https://doi.org/10.1080/23251042.2023.2247627

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Agricultural landowner perspectives on wind energy development in Alberta, Canada: insights from the lens of energy justice and democracy

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ABSTRACT

The political and economic landscape of Alberta, Canada, is deeply affected by fossil fuel extraction, thus limiting progress toward energy transition. Although transition is slowed by resistance to renewable energy technologies, public perspectives on these projects are diverse, with localized sensitives that are often not well understood. To improve our understanding of support and opposition to wind energy development, we draw on concepts of energy democracy, distributive and procedural justice. Utilizing a factorial survey experiment, and latent class analysis to measure these concepts with a sample of 401 large-scale agricultural landowners, we identify three distinct groups of individuals with unique preferences that are grounded in how individuals view and support wind energy. Contrasting most respondents with moderate views on wind projects, we identify a distinct group of supportive landowners when community benefits are well defined. A third group is defined largely by opposition to wind energy whereby justice concerns are associated with distancing their land from the impacts of wind turbines. Our conclusions identify the value of careful and transparent project design in consultation with local communities and affected landowners to avoid opposition noted here and in previous studies.

ARTICLE HISTORY
Received 12 April 2023
Accepted 10 August 2023

KEYWORDS
Wind energy; landowners; distributive justice; procedural justice; vignette experiment; latent class analysis; energy democracy

Introduction

As a major contributor to energy transition, wind energy is expected to expand globally by 47% between 2021 and 2027, particularly in regions with stable policy frameworks and long-term revenue certainty (International Energy Agency 2022). Strong growth in wind energy is also predicted in several regions of Canada, with a nine-fold increase in capacity by 2050 under a net-zero scenario for electricity production (Canada Energy Regulator 2023). Yet, enduring landowner concerns regarding the installation of renewable energy infrastructure can slow or halt the pace of energy transition (Susskind et al. 2022). In the Province of Alberta, Canada, a fossil-fuel dominated economy with strong potential for renewable energy expansion (Barrington-Leigh and Ouliaris 2017), there are persistent media reports about local problems with renewable energy projects (Henderson 2022; Therien 2023). Even within regions of the province where wind energy is well established, there is declining support for wind power (Cummings 2022; Glen 2019). To address these challenges, researchers often highlight public engagement and local project attributes that can be designed and implemented in ways to address and overcome local opposition. This is the promise of academic work on topics including energy democracy and energy justice (Heffron 2022). But to what extent can these procedural and distributional remedies offer hope for the future of energy transition in a jurisdiction where oil and gas has dominated the political and economic landscape for decades? More specifically, in this study we seek to answer the following question: what are the characteristics of agricultural landowners who support wind projects, and what elements of wind project design and implementation are associated with this support?

Our analysis utilizes a factorial survey experiment with 401 large-scale agricultural landowners in Alberta, Canada, to answer this question. Based on insights from energy justice, energy democracy and wind acceptance scholarship, we utilize latent class analysis that identifies and documents distinct clusters and levels of support for wind energy development. As such, our analysis attends to forms of compensation, type of project ownership, and the potential negative impacts of wind turbines on surrounding communities that may complicate a landowner's decision to engage in wind power development. In the following section, we highlight key concepts in understanding public perspectives on renewable energy technologies and then introduce the empirical elements of this study. Next, we explain the results of our latent class analysis, revealing three groups of respondents and their preferences for wind energy development. Finally, we conclude with a discussion of our results, study limitations, future research opportunities, and implications for advancing a sociology of energy transition.

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Literature review

Energy justice refers to the equitable distribution of the benefits and burdens associated with the production and consumption of energy services and the representative inclusion of diverse stakeholders in energy decision-making processes (Sovacool and Dworkin 2014). Scholars identify a series of key energy justice concepts including: procedural justice, distributive justice, recognitional justice, restorative justice, and cosmopolitan justice (for an overview, see Heffron 2022). However, there is mounting evidence that procedural and distributive justice are particularly important for wind energy development in North America (Walker and Baxter 2017a), Europe (Jørgensen, Tegner Anker, and Lassen 2020), and nations in the Global South such as Brazil (Brannstrom et al. 2022).

Procedural justice describes meaningful planning and development opportunities that include the public in decision-making processes whereas distributive justice focuses on the allocation of benefits and negative impacts (Bidwell and Sovacool 2023). Some have argued that procedural justice is inseparable from distributive justice (Jørgensen, Tegner Anker, and Lassen 2020) while others have found that it is more important than distributive justice (Liebe, Bartczak, and Meyerhoff 2017). A key take-away from research is that procedural justice shapes local acceptance of wind farms (Liebe, Bartczak, and Meyerhoff 2017; Mills, Bessette, and Smith 2019). Three common measures of procedural justice are: public inclusion in planning processes; public influence in decision-making; and access to information about renewable energy development. Public inclusion in planning processes is often positively associated with wind farm acceptance (Liebe, Bartczak, and Meyerhoff 2017; Simcock 2016). Results of vignette experiments comparing German and Polish citizens indicates a significant relationship between wanting to be included in the planning process and the social acceptance of wind farms (Liebe, Bartczak, and Meyerhoff 2017). Closely linked to inclusion is the ability of the public to influence decision-making. Strong support for the role of public influence in social acceptance has been found in Germany (Lienhoop 2018) and the United States (Firestone et al. 2018). Lastly, the provision of information is linked to higher levels of wind farm acceptance (Langer et al. 2018).

In addition to procedural justice, measures of distributive justice are increasingly associated with social acceptance, including the allocation of positive and negative impacts associated with energy development. Benefits from wind energy projects are often financial and include a diverse range of compensatory schemes such as individualized lease payments to landowners hosting turbines, financial compensation to adjacent property owners, tax revenues for municipalities, and community payments or infrastructure investments (Lienhoop 2018; Walker and Baxter 2017a). Financial compensation, as a measure of distributive justice, has been found to be an important driver for the social acceptance of wind farms (Brannstrom et al. 2022; Jørgensen, Tegner Anker, and Lassen 2020).

Research from three wind-hosting communities (Maceió, Amarelas and Patos) in Brazil indicates that distributive justice measures (including financial compensation) are an important predictor of the social acceptance of wind farms, but this effect is highest in Patos where landowners received royalties (Brannstrom et al. 2022). This finding indicates that distributive justice is important for social acceptance, but not equally for all people. In a German study, Knauf (2022) shows that supporters and, to a lesser degree, citizens with weak preferences for wind farms consider financial benefits (distributive justice) to be important for social acceptance while this relationship is not as significant for opponents. Across country contexts, financial compensation measures of distributive justice have been important for shaping support/opposition to wind farm development. Taken together, distributive and procedural justice are two key concepts emerging from the energy justice framework that help explain social support for wind energy development.

In addition to these justice concerns, Rand and Hoen's (2017) comprehensive review of social science scholarship on wind acceptance indicates that support/opposition is also a function of project ownership, proximity to turbines, environmental attitudes, and place attachment. These variables are not always discrete but are often linked to issues of energy justice (e.g. energy democracy is linked to distributive justice). Among them, the umbrella concept of energy democracy is well-documented to be a crucial factor in social acceptance and is often assessed in terms of the structure of project ownership. Energy democracy describes an energy sector, system, or project marked by popular sovereignty (citizens as stakeholders/accountholders); participatory governance (inclusive and transparent decision-making); and civic ownership of renewable energy development and transmission/distribution infrastructure (Szulecki 2018). Research indicates that more democratic modes of ownership are important for the social acceptance of wind farms (Baxter et al. 2020; Hogan et al. 2022). Scotland, for example, is a global leader in community ownership models, and research comparing three communities with distinct ownership models in the country reveal the importance of ownership for project acceptance (Hogan et al. 2022). Similarly, Bauwens and Devine-Wright (2018) show that Belgian cooperative members who form communities of place (COP) have more positive attitudes toward wind energy than both non-members

and members who form communities of interest (COI). The North American experience is quite different, however, because community-based forms of ownership are rare (Rand and Hoen 2017).

In addition to project ownership, the proximity hypothesis has received significant empirical attention in the wind energy literature (Larson and Krannich 2016; Rand and Hoen 2017). It states that those living closest to wind turbines tend to have negative perceptions of them (Devine-Wright 2005), but the evidence for the proximity hypothesis has been inconclusive (Adam, Olson Hazboun, and Howe 2021). Research on public acceptance of a wind farm in Cooke County, Texas, indicates that residents living closest to the wind farms had lower levels of support, while those living further away was associated with greater social acceptance (Swofford and Slattery 2010). However, other research drawing on a representative sample of Americans has found the opposite to be the case (Hoen et al. 2019). Similarly, in Germany, Langer et al. (2018) show that the distance between a respondent's place of residence and wind turbines does not significantly shape acceptance, regardless of whether respondents are actively against, ambivalent towards, or supportive of wind energy development.

As with the proximity hypothesis, research on the relationship between environmental attitudes and the social acceptance of wind farms has been unclear (Rand and Hoen 2017). Jacquet's (2012) survey of landowners located near wind farms in northern Pennsylvania indicates that greater environmental concern is associated with a decrease in support for wind farm development. Similar results have been found in emerging European wind markets. Research from Estonia, Switzerland, and Ukraine indicates that minimizing ecological impacts associated with prospective wind developments significantly increases social acceptance (Vuichard et al. 2022). But research with Utah residents suggests that pro-environmental attitudes are not associated with the public's willingness to have wind farms built near their homes (Larson and Krannich 2016).

Closely related to environmental attitudes is the role of place attachment in social support for wind farm development. Place attachment refers to the emotional bond established between individuals and their local environment. Place attachment includes connection to physical landscapes, but it also incorporates the identities, community relations, and meanings that are location specific (Devine-Wright and Howes 2010; Rand and Hoen 2017). Devine-Wright and Howes (2010) assess the relationship between place attachment and social acceptance in North Wales, UK and find that energy development threatens individuals' place attachment which encourages negative attitudes toward wind farm development. In another study, Firestone, Bidwell, et al. (2018) show that place attachment (attitude toward local beaches) and place identity (ocean as part of identity) do not significantly differentiate those who support or oppose the first US offshore wind project near Rhode Island and Block Island. Contexts in which strong place attachment and identity is ubiquitous may wash out the effects of these variables for social support.

Our research contributes to this body of research in three distinct ways. First, scholars have recently argued that most research is conducted outside of the dense wind energy regions of the US mid-west and the Canadian prairies in favor of novel locations that are often controversial or unique (Bessette and Crawford 2022). Our research provides a remedy for this mismatch by considering the predictors of social acceptance within a region of western Canada where renewable energy transition is underway, and the potential for wind power is substantial. Second, Bessette and Crawford (2022) note that the majority of articles reviewed (64%) on wind acceptance research in the United States and Canada have not explicitly identified a theory that informed data collection. Our survey and experimental designs are guided by energy justice theories related to procedural and distributive justice as well as other complimentary theories such place attachment. We examine multiple measures of both procedural justice (e.g. inclusion and influence), distributive justice (e.g. compensation for some and compensation for all), and place attachment (e.g. visual landscape and identity) that are utilized in previous research on the topic (Firestone et al. 2018; Walker and Baxter 2017b). Finally, given the contrasting results associated with predictors of social acceptance noted in the literature review, we seek to gain insights into these contrasting views through latent class analysis. Latent class models have become more common in wind energy research, but as Brennan and van Rensburg (2023, 3) note, few consider 'public preferences for renewable projects that provide local benefits or involvement.' Our approach allows us to identify and profile distinct groups of agricultural landowners whose support for, or rejection of, wind farms is driven by local benefits, involvement, and other key predictors of acceptance.

Study setting

Alberta hosts the third largest fleet of wind farms in the country, and this growth is driven by a series of federal and provincial policies. At the federal level, the 2002 Wind Power Production Incentive and the 2007 ecoENERGY for Renewable Power programs encouraged development by providing a subsidy for the first 10 years of approved operations (Noel et al. 2022). At the provincial level, a carbon pricing scheme and the introduction of the Renewable Electricity Program in 2015 accelerated the number of projects

Table 1. Attribute levels used in the vignette experiment.

Attribute	Levels
Location	On your property*
	On your neighbors' property
	On the other side of your county
Ownership structure	A private utility company*
	Your municipality
	A local cooperative
Neighbor compensation	Not receive any compensation*
	Also receive some compensation
	Receive equal compensation amounts as the landowner hosting the turbines
Inclusion	Only the landowners with turbines*
	All county residents
	Only the neighbors who are directly affected
Influence	Express concern about the project*
	Express concern and potentially sway
	Have direct say (e.g. through voting, public meetings)
Access to information	Will be confidential*
	Will be made available to some affected
	Will be publicly available

Note: * represents status quo wind farm attributes in the province.

in queue for development. This program resulted in nearly a 50% increase in installed wind capacity in Alberta (Hastings-Simon et al. 2022).

But as favorable sites for wind projects are destined to encroach on rural agricultural communities, opposition from landowners may stall progress towards a decarbonized future (e.g. Glen 2019; Henderson 2022). Recognizing these potential constraints on energy transition, researchers in Alberta have argued that making progress on wind energy development will require understanding and meaningfully engaging with local concerns (Afanasyeva, Davidson, and Parkins 2022). This study takes a similar view that energy transition will require careful consideration of rural landowner concerns as the primary hosts of future wind projects, particularly as the locations for new wind projects expand from the relatively concentrated region of southwest Alberta to southern and central regions of the province where the wind resource is strong.

Data and methods

Our analysis involves an online panel of Albertan agricultural landowners ($N = 401$), conducted between December 2018 and March 2019 by the market research firm *Kynetec*. A version of the dataset is available through *Borealis: The Canadian Dataverse Repository* (Parkins et al. 2021). Landowners that actively operated farms on at least ten acres of land and reported farm sales of more than $10,000 (CAD) in 2018 were invited to participate in the study via email. Participants received a twenty Canadian dollars incentive for participating in the twenty-minute study (see Patel et al. 2020 for more information about the dataset). Most respondents were located in southern and central regions of the province – areas that are far from the current concentration of wind farms in the southwest corner of the province (e.g. Pincher Creek and the Rocky Mountain foothills).

To identify preferences for wind project attributes among rural landowners, the study utilized a factorial survey experiment, also defined as a vignette experiment (Auspurg and Hinz 2015). In vignette experiments, respondents are repeatedly presented with descriptions of a specific situation – often a hypothetical scenario – that are randomly constructed from multiple attributes expressed at different ordinal levels following an experimental design. After reviewing each vignette, respondents are asked to provide an evaluation based on their level of support, acceptability, or agreement on a scale that ranges, for example, from completely acceptable to completely unacceptable.

In this research, landowners were asked to rate the acceptability of six hypothetical vignettes, each comprised of six wind project attributes expressed at three levels as presented in Table 1. These attributes were defined by theoretical considerations emerging from energy justice, energy democracy and social acceptance scholarship. We also drew on insights from previous research with Alberta landowners, who provided in-depth insights into the possibilities and concerns associated with wind farms in their communities (Afanasyeva, Debra, and John 2022).

Four of the six attributes in Table 1 are measures of energy justice. Three of these attributes reflect different measures procedural justice, including: community inclusion in planning, community access to information, and potential influence in shaping decisions. One attribute addresses distributive justice, which we measure as financial compensation. The two other attributes are ownership structure and proximity to the wind farms that have been documented to affect wind project acceptance in previous studies (Baxter et al. 2020; Swofford and Slattery 2010).

Prior to the experiment, participants read a script that set a baseline of understanding for the study. The script alerted respondents to the hypothetical nature of the scenarios while encouraging them to disregard

Table 2. Respondent sample descriptive statistics.

Variables	n	Mean (Sd)	Min	Max
Farm manager characteristics				
Gender (1=male, 0=female)	400	0.90 (0.30)	0	1
Age in years (1 = 18–24; 2 = 25–34; 3 = 35–44; 4 = 45–54; 5 = 55–64; 6 = 65–74; 7 = 75 or over)	397	4.84 (1.20)	2	7
Primary decision maker for this farm (1=yes, 2=no)	401	1.03 (0.17)	1	2
Political affiliation				
Conservative	281	0.70 (0.46)	0	1
Liberal	12	0.03 (0.17)	0	1
New Democratic Party (NDP)	17	0.04 (0.20)	0	1
Green	4	0.01 (0.01)	0	1
Other	35	0.03 (0.18)	0	1
Prefer not to say	56	0.13 (0.34)	0	1
Don't know	22	0.06 (0.23)	0	1
Farm structure				
Type of Farm (n)				
Crops (206), Livestock (47), Mixed (146)				
Size (in acres)	401	2982.53 (4063.85)	13	30500
Percent of household income from farming (1 = 0; 2 = 1–25; 3 = 26–50; 4 = 51–75; 5 = 76–100)	401	4.46 (0.89)	1	5
Views on energy				
Likelihood of installation of renewables (4-point scale: 1 = Very Likely; 4 = Very Unlikely)	342	2.76 (0.90)	1	4
Importance of Alberta's energy sector (5-point scale: 1=Not at all important; 5= Extremely Important)	401	4.09 (0.81)	1	5
Knowledge about wind energy (4-point scale: 1=Nothing at all; 4= Quite a bit)	401	2.52 (0.81)	1	4
Climate change concerns				
(5-point scale: 1=Strongly disagree; 5=Strongly agree)				
I am very concerned about climate change	401	2.89 (1.22)	1	5
We still do not know for sure whether climate change is real or caused by humans	401	3.55 (1.18)	1	5
Climate change will not be an issue here in Alberta	401	2.73 (1.11)	1	5
Alberta adopting renewable energy will help reduce climate change impacts	401	2.52 (1.26)	1	5

any potential concerns about project feasibility (e.g. health or environmental effects) that were identified within this study population prior to conducting the survey. By utilizing this script, we focused the attention of respondents on specific variables of interest to this study. An example vignette is provided below, with attribute levels in italics.

There is an opportunity for *a local cooperative* to develop a wind farm *on the other side of your county*. With projects like this, neighbors within 20 km of a turbine *will also receive some compensation*. *Only the neighbors who are directly affected* will have the opportunity to *express concern* about the project. Detailed financial reporting including compensation rates *will not be publicly* available.

Following each vignette, respondents were asked to rate the acceptability of this scenario on an 11-point scale (from −5 to + 5) based on the question '*Given this situation and the assumptions stated before, how acceptable or unacceptable does this wind energy development sound to you?*' Negative five was represented textually as 'completely unacceptable,' zero as 'neither acceptable nor unacceptable,' and positive five as 'completely acceptable.' Based on 401 respondents who rated six scenarios each, the following analysis is based on 2,406 evaluations with each unique vignette ($n = 141$) rated approximately 17 times.

After completing the vignette experiment, respondents answered a series of questions on established determinants of wind energy acceptance: experience with wind turbines, levels of agreement about common public concerns related to wind energy, subjective knowledge of wind energy, turbine effect on wildlife, noise pollution, landscape impacts, community conflict, and rising electricity prices due to wind energy development.

The analysis in this study uses a latent class regression model, a type of structural equation model, to statistically identify and document distinct clusters of rural landowners' support and rejection of wind energy. In latent class analysis, sets of multivariate observed variables (e.g. vignette attribute ratings) are related to sets of discrete latent variables, or latent classes. The latent class model estimates the conditional probability by which each case (e.g. respondent) is assigned to a specific class. *Latent Gold* (Statistical Innovations) software was used to estimate class membership probabilities based on probit regressions of respondents' vignette ratings as a dependent variable and the six vignette attribute levels of each scenario as explanatory variables. To gain a deeper understanding of the characteristics of the landowners in each class beyond the differences in their vignette ratings, we then performed descriptive statistical analysis and analysis of variance (ANOVA) tests to compare respondents' broader views on wind projects across classes, based on individual answers to select survey questions.

Results

Table 2 provides a snapshot of survey respondent characteristics including farm size, socio-demographic details, and attitudes. Our respondents represent large, commercial crop and livestock farms geographically distributed across Alberta. Respondents were mostly male (90%) with a median age falling within the 55–64 years old category, which is in line with the averages reported in the latest farm census (Government of

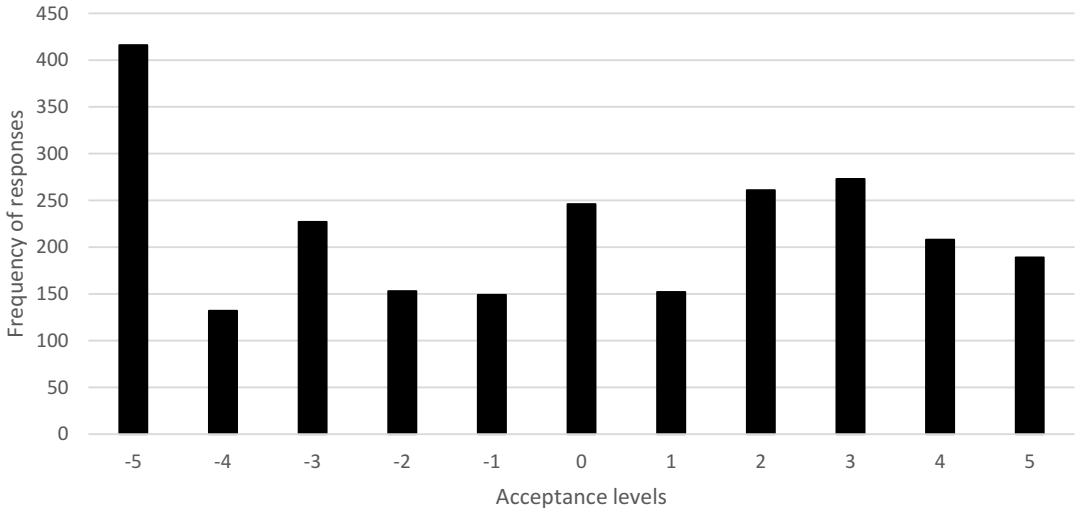

Figure 1. Vignette ratings, $n = 2406$.

Alberta 2018). Seventy percent of respondents expressed a conservative political party affiliation as indicated in Table 2. Descriptive statistics involving respondents' views on energy indicate a majority ascribing to the importance of the energy sector in Alberta (mean = 4.09) and less than half of respondents indicating they are likely to install renewables on their land (mean = 2.76). Landowners also indicated relatively low levels of concern for climate change (mean = 2.89) and a majority agreed that 'we still do not know for sure whether climate change is real or caused by humans' (mean = 3.55).

A visualization of vignette ratings across all 2,406 respondent evaluations is provided in Figure 1. A noticeable proportion of vignettes were rated as completely unacceptable (17%), but there was substantial variation in the levels of acceptability as illustrated in this figure. The most frequent acceptability rating levels of 2 and 3 accounted for 22% of all evaluations, whereas the highest rating of 5 was given to less than 8% of vignettes. Finally, the degree of non-participation in the experiment was minimal, with 30 respondents providing the same rating of completely unacceptable to all six vignettes that were presented to them. Since these responses may reflect a view that wind projects are unacceptable regardless of the factors presented in the experiment, we included all responses. Moreover, regardless of their inclusion, latent class model results remain robust.

Results of the latent class analysis reveal three statistically distinct classes, or groups of landowners based on their expressed acceptance (rating) of hypothetical wind projects. For each class, the estimates for individual vignette attributes point to the contrasting preferences that landowners have for wind projects in their communities. As such, Table 3 offers evidence of variation in landowner preferences for energy democracy, distributive and procedural justice, and proximity attributes. For example, Moderate Class (Class 1) members have no statistically significant preference for the location of wind turbines. The Favourable Class (Class 2) indicate lower support for wind projects if they are located 'on your property' and the Oppositional Class (Class 3) indicates higher support for wind projects if they are located 'on the other side of your county.'

Table 4 provides additional information about the specific characteristics of the landowners in each class. Based on ANOVA statistics to determine differences between means across classes, Table 4 adds to our understanding of key dimensions such as fairness, but the analysis also adds new information about contrasting attitudes toward economic and environmental impacts from wind farms across this landowner population. Questions in this table are ordered according to the F value, indicating the magnitude of statistical differences between class means in descending order. Using this approach, the largest distinction between the three classes is their response to the statement 'A wind farm would be a good thing for my county's local economy'. The Oppositional Class (on average) found this statement to be highly disagreeable compared to the other two classes with a mean rating of 2.05 on a 5-point Likert scale. In the following paragraphs, we discuss notable attributes of class membership, drawing on insights from Table 3 (latent class results) and Table 4 (class membership characteristics) to provide a more complete understanding of landowner perspectives on and acceptance of wind projects.

As Table 4 indicates, the Moderate Class (including 50% of respondents) holds tempered views about wind project development with mean responses typically falling between the Favourable and Oppositional Classes. For example, there is slight agreement that wind farms would be a good thing for the local economy (mean = 3.11 of 5) and that the community would be excited about a wind farm (mean = 0.15). One area where the Moderate Class stands out is in being less

Table 3. Latent class model results.

Concept	Vignette Attributes	Class 1: Moderate (*50% of sample*)	Class 2: Favourable (*27% of sample*)	Class 3: Oppositional (*23% of sample*)
Proximity	Location			
	on your property[a]	−.0300	.0058	−.0351
	on your neighbours' property	−.0016	−.0589**	−.0336
	on the other side of your county	.0314	.0531	.0687**
Energy Democracy	Ownership structure			
	private company[a]	−.035**	−.0603**	−.009
	your municipality	−.0001	.0341	.0136
	a local cooperative	.0351**	.0262	−.0050
Distributive Justice	Neighbor compensation			
	no compensation[a]	−.0884***	−.0794**	−.0936**
	also receive some compensation	.0745***	.1270***	.0116
	receive equal compensation	.0139	−.0475	.082**
Procedural Justice	Inclusion			
	only hosting landowners[a]	−.0856***	−.0571**	−.1333***
	all county residents	.0367**	−.0200	.0736**
	only those directly affected	.0489	.0771**	.0598
	Influence			
	express concern[a]	.0209	.0185	−.0115
	express concern/potentially sway	−.0177	−.0533*	−.0071
	have direct say	−.0032	.0349	.0186
	Access to information			
	confidential[a]	−.0434**	−.0117	−.0299
	made available to some affected	.0095	.0319	.0351
	will be publicly available	.034**	−.0203	−.0052
	Constant	.6198***	−.2453**	−.3745***

[a]Note: Represents the status quo for wind projects in Alberta.
*$p < .05$; **$p < .01$; ***$p < .001$.

trusting of the oil & gas industry (mean = 5.83 of 10). From Table 3 we learn that Moderate Class members are distinct in that they support co-operative ownership, but like the Favourable Class, they are inclined to oppose ownership of wind farms by private companies. The Moderate Class is also concerned about issues of distributive and procedural justice. These members prefer that the neighbours of those who host wind turbines should receive some compensation, that all county residents should be included in development processes, and that information should be publicly available. In summary, the Moderate Class represents a larger proportion of the sample, who are moderately concerned about the development of wind projects in Alberta and have no strong preferences for the location of wind turbines (location attributes were insignificant). Some wind project attributes are preferred as they relate to ownership of turbines, along with procedural and distributive justice concerns, and these preferences may be motivated by lower levels of trust in industry groups, such as oil & gas.

The Favourable Class represents 27% of respondents and is characterized by relatively favorable views of wind farm development if they are not located on the respondent's property. Table 4 shows that members score highest on statements that a wind farm would be good for the local economy (mean = 3.98) and that the community would be excited about a wind farm (mean = 0.44). This general pattern of responses indicates a more community-minded

Table 4. Characteristics of latent class membership based on test of significant difference between means using ANOVA and Tukey HSD.

Variable description	Class 1: Moderate Mean	Class 2: Favorable Mean	Class 3: Oppositional Mean	F Value	Min	Max
A wind farm would be a good thing for my county's local economy	3.11a*	3.98b	2.05c	458	1	5
Wind turbines are an environmentally-friendly technology	3.13a	3.9b	2.24c	307	1	5
Turbines spoil the beauty of rural landscapes	3.54a	2.7b	4.28c	281	1	5
Concerned about Community/neighbour conflict /neighbour conflict	6.55a	5.4b	8.74c	238	0	10
My community would be excited about a wind farm	0.15a	0.44b	0.04c	179	0	1
Fairness of the development processes	7.18a	5.81b	8.51c	133	0	10
How much do you know about wind energy	2.19a	2.74b	1.7c	132	0	4
How likely are you to install renewable energy technology on your land	2.73a	2.53b	3.09c	45	1	4
Fairness of the compensation payments	7.44a	7.01b	8.37c	34	0	10
My local community is an important part of who I am	3.87a	3.86a	4.21b	34	1	5
How much do you trust or distrust the oil & gas industry	5.83a	6.12b	6.74c	34	1	10
My land is a big part of my identity	4.31a	4.26a	4.58b	31	1	5
Very concerned about climate change	0.38a	0.46b	0.24c	28	0	1
Small farm	0.35a	0.38ab	0.22c	15	0	1

*Means with different letters denote statistically significant differences, at p .05.
Note: Class membership is defined by the latent class model reported in Table 3.

motivation for wind project development, and this is further reflected in member preferences for distributive and procedural justice. From Table 3, we learn that these Favourable Class members prefer that neighbors also receive some compensation and disprove of wind projects owned by a private company. Members in this group are distinct from other classes because they prefer that 'only those directly affected' should have an influence on project development. In summary, the Favourable Class supports wind projects if they are not developed on their land and are not privately owned, with no statistically significant preference for municipal or cooperative ownership schemes. They are concerned about compensation to neighbors but have tempered concerns about procedural justice whereby they believe that only those directly affected should be included in planning processes. This degree of inclusion, however, should not sway decisions. These preferences may reflect a motivation for community benefits that should not be diminished by specific landowner concerns.

The Oppositional Class is the smallest group (23% of respondents) with relatively more adverse views on wind projects in Alberta. Table 4 indicates that Oppositional Class members score lowest on statements that a wind farm would be good for the local economy (mean = 2.05) and that the community would be excited about a wind farm (mean = 0.04). In fact, they express the most concern about community conflict (mean = 8.74). Opposition to wind projects in this class is also driven by greater identification with the land (mean = 4.58), concerns that turbines spoil the beauty of the rural landscape (mean = 4.28), and lower levels of concern about climate change (mean = 0.24). Based on results from Table 3, these views are also reflected in Class 3's strong preference for placing wind projects on the other side of the county, meaning farthest away from their property. Unlike other classes, the Oppositional Class prefers neighbors to receive *equal* compensation. In other words, even if turbines are located on the other side of the county, equal compensation for all landowners is preferred. And like the Moderate Class, the Oppositional Class prefers all county residents to be included in project development processes. If wind projects are going to be developed, they should be built as far away as possible but developed with the inclusion of all landowners who each receive equal compensation. To summarize the main findings from Tables 3 and 4, we list the main attributes of each Class in Table 5 as a quick guide to the key insights.

A final aspect of our analysis illustrates the commonalities rather than the differences between class members. Whereas class membership is defined by statistically different preferences for ownership type or justice attributes in the vignette experiment, almost uniformly, all three classes show negative preferences for how wind farms are currently developed in Alberta. In other words, all membership classes are opposed to status quo wind farm attributes. For example, although the common approach to compensation in Alberta involves payments to landowners who host wind turbines, and no payments to neighbors, Table 3 indicates that when 'no compensation' is included in the scenario, for members of all three classes, the acceptability of the wind project scenario decreases significantly. Results are the same for procedural justice concerns where the status quo practice in Alberta involves confidential negotiations between wind project owners and landowners to establish the terms of lease payments. Similar results are noted with ownership preferences, where private companies are the

Table 5. Latent classes of agricultural landowners' preferences for wind farm attributes and associated concerns ($n = 401$).

Class 1: Moderate views *50% of sample*	Class 2: Favourable views *27% of sample*	Class 3: Oppositional views *23% of sample*
Wind farm preferences *	Wind farm preferences *	Wind farm preferences *
-Co-operatively owned	-Neighbors receive some compensation	-Turbines located on the other side of county
-Neighbors receive some compensation	-Only directly affected included	-Neighbors receive equal compensation
-All county residents included		-All county residents included
-Information publicly available		
Class attributes **	Class attributes **	Class attributes **
-Somewhat agree wind farms would be good for the county's local economy	-Agree wind farms would be good for the county's local economy	-Disagree wind farms would be good for the county's local economy
-Somewhat agree wind turbines are environmentally friendly	-Agree wind turbines are environmentally friendly	-Disagree wind turbines are environmentally friendly
-Somewhat agree wind turbines spoil beauty of rural landscapes	-Disagree wind turbines spoil beauty of rural landscapes	-Agree wind turbines spoil beauty of rural landscapes- Most concerned about neighbour conflict
-Somewhat concerned about neighbour conflict	-Least concerned about neighbour conflict	
-Somewhat agree community would be excited about a wind farm	-Agree community would be excited about a wind farm	-Disagree community would be excited about a wind farm
-Least trusting of oil & gas industry	-Somewhat trusting of oil & gas industry	-Most trusting of oil & gas industry
-Somewhat concerned about climate change	-Most concerned about climate change	-Least concerned about climate change

*Preferred wind project attributes as determined by a latent class model.
**Class-specific differences in respondent attributes determined by ANOVA (Tukey HSD, significant differences between means).

norm but are largely not preferred within wind project scenarios in this study.

Discussion

Overall, our results are consistent with other research that finds lower levels of interest in wind projects amongst rural respondents (Rand and Hoen 2017). But low interest should not be interpreted as opposition. We find that only the Oppositional Class (Class 3), which comprises 23% of the sample, is relatively more opposed to wind development. Most respondents hold moderate or favorable views towards developing wind energy (the Moderate Class and the Favourable Class, respectively). Similar levels of support have been found in wind farm communities in Nova Scotia, Canada, while greater opposition to wind development has been found in Ontario, Canada (Walker and Baxter 2017b). Across our three classes, we find support – and provide nuance – to energy justice research that focuses on the role of distributive and procedural justice in the social acceptance of wind power. Informed by this literature, we tested how well three measures of procedural justice (public inclusion in planning; public influence in decision-making; and access to information) and one measure of distributive justice (financial compensation) predict support for wind farm development.

Of the three measures of procedural justice, we found public inclusion in the planning process to be associated with support across all three classes of respondents. Public inclusion in the planning process has been found to be critical for social acceptance in other country contexts (Liebe, Bartczak, and Meyerhoff 2017; Simcock 2016). However, we found less support for the remaining two measures of procedural justice, signaling a departure from other research on issues of fairness within renewable wind energy development. Public influence in decision-making has been significantly and positively associated with wind farm acceptance in Germany (Lienhoop 2018), the United States (Firestone et al. 2018) and parts of Canada including Nova Scotia (Walker and Baxter 2017b). In our study, public influence in decision-making was not significantly associated with social acceptance for any of our three classes. In fact, for the Favourable Class (Class 2), support for wind farms decreased if the public were to potentially sway decision-making. This finding is surprising given the central role that public influence in decision-making plays in conceptualizations of procedural justice (Walker and Baxter 2017b). The lack of support for public influence among the Favourable Class may be motivated by beliefs about the promises of wind energy development for the broader community and a desire to limit the voices of a smaller minority who would not want to see wind projects developed in rural Alberta. It may also be the case that influence matters, but less so than other factors in the model, such as compensation and inclusion.

The final measure of procedural justice (access to information) had a positive and significant link with wind farm acceptance for the Moderate Class only. The lack of support for access to information across the three classes stands in contrast to patterns identified in the literature (Brennan and Van Rensburg 2016; Langer et al. 2018). Support for access to information amongst the Moderate Class may be a function of their views towards wind development; they are neither strongly opposed (Class 3) or favorable (Class 2) of wind projects and thus may need more information to make an informed decision.

Our results for distributive justice converge with much of the empirical research that financial compensation is key to social acceptance (Brannstrom et al. 2022; Walker and Baxter 2017a). All three classes identified in our research prefer one of two forms of distributive justice: neighbors receiving *some* compensation (Moderate and Favourable Classes) or neighbors receiving *equal* compensation (Oppositional Class). A preference among Oppositional Class members for equal compensation may result from higher levels of opposition to wind development, and as such, will only support such projects if they receive equal compensation to those who are hosting turbines on their land. The importance of distributive justice among all three classes in our research is similar to vignette experiment results in Germany. Knauf (2022) found that acceptance among supporters, citizens with weak preferences, and opponents was significantly and positively associated with distributive justice.

Despite limited or no support for two of our three measures of procedural justice, our results do indicate support for both procedural and distributive justice. For example, our results indicate a rejection of the status quo approach to wind development in Alberta. First, all three classes are against an approach to energy development that results in neighbors receiving zero compensation; instead, all classes prefer some form of distributive justice whereby neighbors are compensated. Second, all three classes are against including only landowners in the planning process; instead, all classes prefer some form of procedural justice whereby community members are included. Agricultural landowners in Alberta are signaling their preference for a more financially fair and inclusive process. In other words, an approach is more in line with energy justice rather than existing status quo practices of wind project development in Alberta.

Beyond energy justice, our research tested whether energy democracy and proximity to wind farms is associated with social acceptance. A growing body of scholarship finds that democratic modes of ownership,

such as community ownership, are positively associated with social acceptance (Baxter et al. 2020; Hogan et al. 2022). Our findings suggest that energy democracy is largely associated with wind farm acceptance. For example, the Moderate and Favourable Classes (77% of the sample) oppose wind farm ownership by a private utility company, with the Moderate Class explicitly preferring ownership by a local cooperative. That a large share of our sample supports more democratic forms of ownership, even if unspecified, indicates that agricultural landowners do not view status quo ownership models favorably. The positive association between energy democracy and social acceptance has been found in other country contexts, such as Scotland, where community ownership leads to greater levels of support for wind farms in the community as well as the building of additional turbines (Hogan et al. 2022).

Finally, we found support for the proximity hypothesis. The proximity hypothesis states that turbines located close to one's home are associated with negative perceptions while projects located further from one's home are associated with more positive perceptions (Devine-Wright 2005; Larson and Krannich 2016). We find that support for hypothetical wind farms decreases for Favourable Class members when they are close to their home (on their property) and support for wind farms increases for Oppositional Class members when turbines are located further away (on the other side of the county). In other words, half of our study respondents share positive perceptions of wind farms if they are further away from their homes. The other half of our respondents are not particularly concerned about proximity, and this lack of consensus mirrors most research that finds support for the proximity hypothesis to be inconclusive (Adam, Olson Hazboun, and Howe 2021; Rand and Hoen 2017).

Differences between classes on issues of proximity, energy justice, and democracy may be driven by attitudes towards wind farms, environmental and community concerns as well as issues related to place attachment. ANOVA and Tukey HSD results revealed that the two most supportive classes (1 and 2) who comprise the largest share of respondents (77%) tend to: agree about the local economic benefits of wind farms, agree turbines are environmentally friendly, express greater concern about climate change, express less concern about neighbour conflict and are less concerned about turbines spoiling the landscape. In contrast, respondents in the Oppositional Class tend to: disagree that wind farms benefit the local economy or are environmentally friendly, express the least concern about climate change, and express the most concern about turbines spoiling the landscape and contributing to conflict between neighbours. This pattern of responses supports existing research on the factors distinguishing supporters from opponents of renewable energy development. Supporters tend to have more positive attitudes towards wind farms and believe they are environmentally friendly (Larson and Krannich 2016). Researchers have also found that support for renewable energy more broadly is connected to climate change beliefs (Adam, Olson Hazboun, and Howe 2021). And in Ontario, Canada the visual impacts of wind turbines have been shown to be significantly associated with opposition (Stewart et al. 2016).

As with any research, there are limitations to our study. First, correlations that are documented in the ANOVA results offer partial insights that could be enhanced through interviews and focus groups in future studies. Second, our measure of distributive justice is limited to financial compensation, yet a more complete assessment of the concept would include other benefits such as discounted electricity prices or the impact of specific costs such as shadow flicker. Third, our assessment of social acceptability is based on hypothetical scenarios and are therefore somewhat disconnected from real life scenarios. Further longitudinal research can focus on landowner attitudes towards projects in Alberta and test other hypotheses such as the U-shaped curve of acceptability. This hypothesis suggests that attitudes toward wind farms shift from positive to negative during the construction phase, and then return to more positive attitudes after the project is completed (Wolsink, 2007). Finally, attitudes toward wind energy in Alberta may have shifted since 2019 when the survey was completed, and follow-up research on trends in social acceptability will be important as wind projects expand throughout the countryside.

Conclusion

Scholars have consistently noted that issues of energy justice (procedural and distributive justice) and energy democracy (project ownership) are important, interrelated, and enduring predictors of support for wind power (Baxter et al. 2020; Rand and Hoen 2017). We contribute to this body of research by profiling three distinct classes of agricultural landowners driven by varying concerns about democratic ownership and issues of justice in hypothetical renewable energy development. We suggest that differences on key project features may be driven by unique concerns related to distrust of the oil and gas sector, concerns about community benefits, and negative externalities associated with wind farm development. Our latent class analysis suggests landowners are not a homogenous group but are driven by different concerns that need to be considered by policymakers and renewable energy developers.

Attention to the heterogeneity of agricultural landowners also revealed consensus among our sample. Among all classes exists a uniform rejection of status

quo approaches to wind development that only include landowners in planning processes or result in landowners receiving zero compensation. We show that while context matters for energy transitions, issues of procedural and distributive justice cannot be an afterthought in the design and development of energy infrastructure. If issues of energy justice are ignored, we are likely to repeat inequalities of the existing energy system whereby landowners and communities are marginalized and disadvantaged in the process of planning and implementing energy infrastructure. This study helps to identify pathways to avoid such inequitable outcomes in the future energy system.

Acknowledgments

We are grateful to research collaborators including Monique Holowach and Jürgen Meyerhoff who were instrumental in designing the survey instrument. Special thanks to our research participants, who provided valuable insights into their experiences with wind farms. We also thank the anonymous journal reviewers, who helped improve the overall quality of this article. Funding for this study was provided by the Social Science and Humanities Research Council (project 435-2017-0281).

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The work was supported by the Social Sciences and Humanities Research Council of Canada [435-2017-0281].

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