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All's fair in love and WAR: The conduct of wind acceptance research (WAR) in the United States and Canada

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ABSTRACT

The number of studies examining social acceptance of wind energy in the United States and Canada has increased considerably since the 1980s. Here we conduct a methodological review of wind acceptance research (WAR) literature in response to four articles published in this journal. These include a recent synthesis of WAR by Rand and Hoen in 2017 recommending better incorporation of results into development practices and comparability of case studies; a 2020 investigation by Walsh and colleagues into potential research fatigue in unconventional oil and gas development research, and finally calls by Sovacool and others in 2014 and 2018 to increase the theoretical depth and reflection in energy social science. Using a systematic review of 114 WAR articles and an online survey of 41 corresponding authors, we investigate the location of WAR study sites, the success of different WAR designs and incentives, the disciplines and theories dominating WAR, and finally dissemination practices. Our results show that, outside national surveys, WAR is geographically concentrated in regions distant from the highest installed capacity and focus on projects that are novel, controversial, or unique to a specific region. We find little support for research fatigue. Additionally, most WAR lacks an underlying theory. We conclude by recommending greater qualitative analysis of study site selection criteria and greater integration of existing WAR theories and WAR with solar acceptance research. Finally, we urge scholars to ensure and communicate a clear purpose, value and financial benefit to WAR participants and meaningfully consider the broader community contexts examined.

1. Introduction

More utility-scale wind energy systems were installed in the United States (US) in 2020 than in any year previous, generating 8.4% of US electricity [1] and surpassing hydroelectric generation as the largest source of renewable energy in the US [2]. Even without the federal production tax credit's extension through 2021, wind energy remains cost-competitive with utility-scale solar photovoltaic (PV) and natural gas combined cycle [3], and the US Energy Information Administration [4] forecasts wind energy (12.2 GW) will trail only utility-scale solar energy (15.4 GW) in new capacity additions in 2021. In Canada, annual increases in wind energy capacity peaked in 2014 with 13.4 GW installed. Only 600 MW of wind was constructed in 2019; however, wind now accounts for over 5.1% of Canada's total electricity generation [5]. Continued growth of wind energy in both countries remains contingent upon the ability of developers to both site these systems on land either lacking high wind resource potential or existing grid and transmission capacity, and being able to find or generate support in communities [6]. Here we focus on this last element. But rather than examine the development process or community members' perceptions or attitudes—what has been termed more generally community acceptance of wind energy [7]—we use a mixed methods approach to examine the primary methods, study sites, and theories currently used in wind acceptance research (WAR), as well as the possibility that WAR participants may be experiencing research fatigue.[1] Our intent is to provide a critical review of the conduct of WAR and suggest next steps for wind acceptance researchers in the US and Canada moving forward.

The remainder of this paper is structured as follows: first, we present

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[1] We would like to acknowledge the problematic nature of the term *acceptance* and the normative power of the term more generally. Using this term and failing to meaningfully address the discrimination and injustice associated with past research examining it—and promoting it—has been rightfully criticized by Batel [8]. We are in no way suggesting community acceptance of wind energy is a normative ideal; however, using the terms *attitudes* and *perceptions* to define our review and paper was simply too restrictive.

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a brief overview of methods and sites of WAR in the US and Canadian literature, concluding with our rationale for examining research fatigue in the current study; in Section 2, we describe our research questions (Table 1) and our methods; in Section 3 we present our results, and finally in Section 4 we discuss the implications of our results and suggest next steps for wind acceptance researchers.

1.1. Methods and sites of WAR in US and Canada

Rand and Hoen [9] published their synthesis of North American WAR in this journal. In addition to identifying overall high support for wind and elucidating the impacts and perceptions that tend to mitigate or increase that support, they identified a number of methodological concerns. These included the need to better incorporate WAR into development practices, conduct more representative surveys examining WAR variables, oversample residents living near turbines, and enhance the comparability of WAR case studies. This last recommendation echoes earlier ones by Sovacool and others [10,11] to deepen and broaden energy research via increased rigor and interdisciplinary breadth. Some scholars have heeded that advice. A large nationally representative survey (n = 1705) of WAR variables conducted by Firestone and Kirk [12] not only oversampled US residents living within 8 km of turbines, but also presented residents an opportunity to compare wind to solar and conventional power plants. Wind was preferred to both hypothetical solar PV and conventional power plants. That same large survey showed that attitudes toward wind improved over time as residents self-selected into communities near existing turbines [13]; beliefs that a developer was open and transparent were the strongest predictor of current residents' perceptions of fairness [14]—and perhaps slowed emigration of opponents out of the community; and, annoyance over wind turbine noise was more a result of personal experience and visual perceptions than a result of the actual level of wind turbine noise [15]. Nationally representative online or Qualtrics surveys have also been conducted by Klick and Smith [16] and Peterson et al. [17] The former, a "roughly representative" survey, showed a lack of public understanding about wind (in 2008), while the latter showed the public may still be able to be influenced by new information and outreach about wind energy.

In the western US, Giordono et al. [18] examined 53 wind farm proposals across four states (California, Idaho, Oregon, and Washington), examining local newspapers and performing 84 in-person interviews. Their research suggested existing WAR may overestimate the previously theorized "social gap," or the difference between high public support for wind in national surveys and what had been identified as typically lower individual or community support at the project level [19]. Also in California, Hui et al. [20] surveyed 1965 residents via a Qualtrics sample to examine the acceptance of vertical-axis wind turbines compared to the more common horizontal-axis models. They found the former's visual aesthetics mattered little compared to their cost and reduced risk of harming birds.

Back in the US Midwest, Mills et al. [21] surveyed the same landowners twice across two years and in four wind communities in Michigan to examine how perceptions had changed since the turbines' construction. Residents who originally perceived a fair planning process had more positive perceptions years later, while those who initially perceived an unfair process had more negative perceptions—this type of longitudinal work, i.e., returning to wind communities to assess how attitudes and perceptions have changed, is rare but increasingly important. Jacquet and Fergen [22] conducted 36 in-depth interviews in three wind communities in Minnesota and South Dakota, determining the extent to which local ownership of wind farms affected development and whether wind farms reinforced a horizontal or vertical pattern of community [23]. Vertical patterns represent linkages between previously isolated communities' institutions and their nonlocal systems, while horizontal patterns denote "symbiotic relationships" between a community's institutions that increase community cohesion; wind farms tended to reinforce the latter [22].

In two townships in Delaware, 534 residents living near either a 2 MW wind turbine or a coal-fired power plant were sent a mail survey asking about their attitudes and perceptions of each, along with their willingness to pay to either remove or retain each facility [24]. Those authors [24] found that sound and aesthetics were perceived more negatively by those living near a coal plant, and the residents living near wind turbines had more positive attitudes.

A great deal of Canadian WAR has focused on how Ontario's Green Energy Act facilitated rapid renewable energy development. Walker, Baxter and others [25–28] have used mixed methods and grounded theory to study predictors of opposition. In one study including 26 interviews and a survey of 152 residents in two Ontario counties, they suggested researchers shift away from working to discredit impact claims and instead determine the conditions under which impacts arise [25]. In another, they used 54 in-depth preliminary interviews, 31 interviews of residents (albeit some in Nova Scotia) and 127 survey responses to explore the role of financial benefits (both the amount and distribution) in generating support for wind development [26]. Songsore and others [29–31] examined the complicated and constrained relationship between developers and communities resulting from the passage of the Green Energy Act., having conducted 6 semi-structured interviews with developers [29] and two content analyses, one of 1857 articles [30] and one of 599 articles [31], all examining different frames of analysis, e.g., political, economic, and health.

Since 2017, a good deal of acceptance research has also moved offshore. Firestone et al. [32] investigated factors underlying peoples' acceptance of the Block Island Wind Farm via surveys with 420 coastal Rhode Island and Block Island residents. They showed that participants' attitudes about wind energy in general and perceptions regarding the appearance of the turbines influenced their support of the project. Ferguson et al.'s [33] survey of 242 recreationalists along the Lake Erie shoreline (a proposal site for the long-debated Ice Breaker project) indicated that individuals' perceived impact on recreation was the greatest predictor of support for offshore wind development. Ferguson et al. [33] confirmed the results of 25 semi-structured interviews conducted by ten Brink and Dalton [34], which also showed that offshore wind is perceived to improve water recreation; in the latter's work, 88% of responses from Block Island fishers demonstrated the belief that the presence of turbines increased recreational fishing in the area.

Numerous studies using mail, online and in-person survey instruments demonstrate that a majority of respondents support both hypothetical and existing offshore wind development [32,33,35]. However, when asked to approximate other's support of offshore wind, respondents in one study, both those recruited via Amazon's Mechanical Turk marketplace, or MTurk, and those surveyed in-person on Block Island, underestimated significantly [35]. Sokoloski et al. [35] attributed this difference to the partial pluralistic ignorance effect among offshore wind supporters and a false consensus among offshore wind opponents. Regarding the former, despite not holding a particular belief, individuals sometimes assume the majority of others do (in this case supporters overestimating the level of opposition). Individuals can also sometimes falsely overestimate the prevalence of their belief among others (here again leading to overestimated opposition). This research shed light on how inaccurate perceptions of others' support or

Table 1
Research questions.

RQ1	To what extent does the geographic distribution of wind acceptance research (WAR) align with installed wind capacity and resource potential across the US and Canada?
RQ2	How are wind acceptance researchers identifying, recruiting, and collecting data from potential participants?
RQ3	To what extent does existing theory guide WAR?
RQ4	What actions are wind acceptance researchers taking to communicate their findings with research participants and wind communities?

opposition may unduly impact wind development decisions. Decision-makers have also been consistently criticized for failing to adequately reflect community members' voices throughout the development process, as demonstrated during interviews conducted in Saint-Valentin, Quebec [36] and in paper survey responses in Huron County, MI, US, [21]. The opposite also occurs. On Block Island, semi-structured interviews showed decision-makers worked to gain the community's trust via early and interactive forms of engagement, separating government and developer roles, hiring members of the community to be a point of communication, and using the public's input in decision-making—ultimately increasing support for the project [37].

1.2. Examining WAR research fatigue

A host of WAR studies have been conducted in the US and Canada both since and prior to Rand and Hoen's [9] synthesis and Sovacool and others' [10,11] call for greater depth and breadth. Here we update those syntheses by examining the extent to which more recent studies heed their advice, and we take an additional step. A recent paper in this journal and presentation by Walsh et al. [38] examined the extent to which research fatigue was occurring in communities undergoing unconventional oil and gas development. Such fatigue occurs when people of interest are overused in research and consequently their willingness to participate in research studies diminishes [39]. Walsh et al. [38] demonstrated its existence given that: i) some researchers expressed recruitment struggles in their manuscripts, ii) data collection was performed by different researchers at similar times, particularly at the peak of development activity, and iii) researchers relied heavily on the most accessible communities for gathering data. Consequences of research fatigue can be lower data quality, reduced participation, and participant distrust in researchers [39,40].

Here we investigate the extent to which residents in wind communities may be suffering from research fatigue by attempting to determine the location of WAR and understand the success of different methods in collecting data from participants. In addition to examining potential antecedents of research fatigue, our study also aimed to identify emerging themes related to research design and circulation, the theoretical work guiding WAR, the most common disciplines engaged in WAR, and the extent to which researchers are disseminating their findings to participants, policy-makers, developers and communities of interest.

2. Methods

2.1. Context and research questions

We examine the conduct of WAR across the US and Canada using a systematic review[2] of 114 studies and an online Qualtrics survey of American and Canadian wind acceptance researchers (n = 41) We address four research questions derived from the previous review of WAR by Rand and Hoen [9] and the study of research fatigue by Walsh et al. [38] (Table 1).

Our first research question, *RQ1*, asks, "To what extent does the geographic distribution of WAR align with installed wind capacity and resource potential across the US and Canada?" The greatest onshore wind resource potential, and majority of the installed wind capacity, exists in the US central plains and along North American mountain ranges [41,42], yet the extent to which WAR case studies are conducted there remains unclear. While considerable resource potential exists off the Atlantic and Pacific coasts [43], as well as the Great Lakes [44], only one offshore wind farm (Block Island Wind, RI) operates currently in North America. To answer *RQ1*, we use Esri's ArcMap 10.7.1, with source data gathered from the USGS, American Wind Energy Association, Lawrence Berkeley National Laboratory [45] and the Government of Canada [41] and overlay that data with WAR data collection events to determine their congruence. *RQ1* also allows us to examine the extent to which these collection events may be occurring in the same community multiple times, a potential precursor to research fatigue.

Our second research question, *RQ2*, asks "How are wind acceptance researchers identifying, recruiting, and collecting data from potential participants?" To this point, no systematic review exists identifying the principal methods used to conduct WAR specifically, which sites are selected, how participants are recruited, and the best practices for gathering responses from residents. To answer this question, we analyze the review sample and ask follow-up questions via our author survey. Determining response rates also offers insight into whether individuals, wind community residents in particular, may resist participating in WAR.

Our third research question, *RQ3*, asks "To what extent does existing theory guide WAR?" Despite the applied nature of most WAR, theoretical development is necessary to provide standardized guidance for analysis, offer sound explanations for phenomena, and expand bodies of knowledge to improve problem-solving [46]. The dominant theories deployed by wind acceptance researchers have not yet been systematically examined, if even counted. Here we focus on theories that have i) definition of terms, ii) circumstances where the theory can be applied, iii) relationships between variables, and iv) specific predictions to answer questions [46]. As with RQ2, here we conduct a close reading of the review sample to identify all theories used and ask follow-up questions regarding the inclusion of theory via our author survey. Similar to Sovacool [10], we also review the dominant disciplines employed in WAR via a review of scholars' departmental and disciplinary affiliations, completed using an Internet search of all co-authors identified and their departmental websites.

Finally, *RQ4* asks "What actions are wind acceptance researchers taking to communicate their findings with research participants and wind communities?" With this, we seek to identify how and to whom are the results of WAR being disseminated. We perform WAR with the goal of advancing existing knowledge, practices, and policies; however, such a goal requires the results of our work be shared outside academia and to practitioners, policy-makers, and community residents, and perhaps most importantly to the residents participating in our research initiatives. To answer RQ4, we examined the review sample for explicit mentions of dissemination efforts, and ask follow-up questions regarding those efforts via our author survey.

2.2. Systematic review of WAR

To answer our RQs, we performed a systematic review of the WAR literature, targeting studies that examined residents, government officials and developers' perspectives, attitudes, support, opposition, values, beliefs, or responses (collectively referred to as acceptance) toward wind energy in the US and Canada. Our review relied on Rand & Hoen's [9] bibliography and an Internet search of the Web of Science and Scopus databases. Papers were sought from all years up to December 31st, 2020, using a keyword search including ["acceptance," OR "perception," OR "attitudes," OR "support," OR "opposition," OR "public," OR "residents," OR "stakeholders"] AND ["wind" OR "wind energy," OR "wind farms," OR "onshore wind," OR "offshore wind"]. In total, 200 studies were identified with 114 of those relying on information obtained directly from or about participants. These included 108 journal articles, 3 dissertations, and 3 theses (see "Wind Acceptance Research (WAR) Systematic Review Data", Mendeley Data, V3, doi: 10.17632/zdhkbz6x2d.3 for the full dataset), all written between 1998 and 2020 (only 3 studies were published before 2005, and just under half (56) were published between 2016 and 2020). In order to be included in our

[2] Our review is "systematic" in that, like [9], it represents a comprehensive, unbiased (to the extent possible) and replicable summary of the state of knowledge of WAR and includes both quantitative and qualitative evidence [11]

review, researchers must have collected qualitative or quantitative data from or describing human participants regarding their acceptance of onshore or offshore utility-scale wind energy. Additionally, wind energy must be the primary energy system investigated, as opposed to being one of several different renewable energy systems. Systematic reviews, technical reports, economic analyses, and studies conducted outside of the US or Canada were not considered.

Each study was analyzed using Microsoft Excel and the following information was recorded: i) the location of the study, ii) data collection method(s), iii) target population(s), iv) response number(s) and rate(s), v) participant incentives, vi) explicit supporting theory(ies), and vii) method(s) of dissemination (if listed). These variables were coded for reoccurring themes and quantified for reporting purposes.

2.3. Author survey

Following the systematic review, we sent the 71 corresponding authors of the 114 studies included in our analysis an online Qualtrics survey to obtain additional information and clarification on subjects not explicitly stated in the written reports. The survey had 8 open-ended and multiple-choice questions, focusing on the three topic areas least reported on in our review: i) incentives for participants, ii) theory used, and iii) dissemination of results (see the full survey in the WAR Systematic Review Data: doi: 10.17632/zdhkbz6x2d.3). A follow-up email was sent to unresponsive participants two weeks after the initial email was distributed. Out of the 71 authors that were initially contacted, 21 responded (30%). A follow-up email reminder was sent to participants one week later. An additional 21 authors responded, for a total of 41 (58%), providing information on 67 of the 114 papers (59%) included in the systematic review. Data collected from these surveys was coded and quantified in Microsoft Excel and added to our systematic review. To minimize confusion between *our* study participants and participants from the 114 papers reviewed, we refer to the former as "authors." No incentives were provided to authors for their participation in the survey.

3. Results

3.1. Geographic distribution of WAR

One hundred and thirty-one locations were identified by the authors in our sample as unique data collection points, with 43 communities contributing to more than one published study (amounting to 173 data collections total). The most heavily studied wind regions lie on the Northeast coast of the US (Rhode Island, Massachusetts, and Delaware), in the Thumb region of Michigan, and in Ontario, Canada. For comparison, Fig. 1 shows the density of installed wind turbines across the US and Canada and Fig. 2 shows the location of WAR study sites by county in the US and Canada.

Locations identified as having been studied multiple times were often a result of researchers publishing multiple studies relying on the same dataset (e.g., [48,49]), rather than numerous unique data collection events (see Table 2). Nevertheless, Washington County in Rhode Island (e.g., Block Island Wind Farm) has experienced 9 data collection events [32,34,37,50–54], while Barnstable County in Massachusetts (e.g., Cape Wind) has experienced 5 [55–59]. Huron County in Michigan (e.g., Harvest Wind, Michigan Wind) has experienced 4 data collection events [21,60–62] and Lennox and Addington County in Ontario, Canada (e.g., Ernestown Wind Park, Wolfe Island Wind Farm) have each experienced 3 events [48,49,63].

3.2. WAR recruitment, incentives and research fatigue

Mailed surveys were the most common data collection method used by researchers, accounting for 29% of the total data collection strategies, followed by in-person interviews (21%) (Table 3). Response rates remain highest for in-person surveys (64%), which typically involved students asking individuals at beaches, parks or events to fill out a survey, whereas a single mailed survey featuring an online link had the lowest response rate at 15%.

The general public in either the US or Canada was targeted for data collection more than any other group (35% of studies; Table 4), whereas 17% of studies specifically targeted residents that lived near turbines.

Incentives were used by only 26% of researchers to recruit or compensate participants (Table 5). Those who used incentives primarily used "enter to win" options (50%) or paid participants following their involvement (27%). The reasons provided most often via the author survey for not including incentives was a lack of funding (33%) or incentives not being necessary to entice individuals to participate (25%).

To assess research fatigue, we closely examined studies from those regions in which WAR was concentrated, similar to Walsh et al. [38]. Response rates and sample sizes in these regions were often greater than the overall mean response rates and sample sizes for each data collection method. For instance, on Cape Cod, Kempton et al. [55] identified that only 1 in 8 potential interview participants refused, while Firestone et al. [64] achieved a 50 percent response rate with their mail survey. In Huron County, researchers achieved response rates of 49–69% for mailed surveys [21,60,61]. In Lennox and Addington County, Ontario, a 79 percent response rate was achieved [48,49] and in-person interviews were conducted with large numbers of participants (e.g., 35 and 40) [63,65]. In Rhode Island, WAR took the form of smaller qualitative studies targeting specific groups or processes (e.g., [34,37,50,51]), though surveys' response rates did trend lower than the overall review means (e.g., 29.8% for an in-person survey [52] and 15.8% for a mailed survey with an online link [53]) Attrition rates between longitudinal surveys also varied, ranging from 27% [21] in Huron County to 37.5% in Rhode Island [32,54,66]. Finally, a close reading of studies from concentrated WAR regions found no explicit instances of researchers reporting difficulty in recruiting participants, and the author survey found that the second-most common reason offered by authors for not providing incentives (12 of 51 responses, 24%) was that individuals were willing to participate in WAR without being paid.

3.3. Theories used in WAR

Of the 114 studies reviewed, 73 (64%) lacked a theory[3] structuring their data collection that was either explicitly identified in the text (Table 6) or identified by authors when surveyed. The theories that were used varied considerably. Place-based and place-attachment theories were the most commonly relied upon, with 10 studies using either theory [12–14,32,54,66–70]. Value-belief-norm theory [52,71–74] was the next most commonly cited theory (five times). Other theories used more than once included random utility theory [75–77], consumer choice theory [78–80], ecological communication theory [29,30], and social exchange theory [60,61]—most of which were used by the same author teams respectively. Grounded theory, or theory grounded in the actual data, was used five times [25–28,81]. Additionally, many authors discussed or tested *concepts*, such as AKTESP[4] [82], or NIMBYism (e.g., [71,78,79,83]—often finding little empirical support for the latter [25,79,84] or urging the term be abandoned entirely [85]). However, Table 6 identifies only those studies that explicitly applied place-based and place-attachment theories—increasingly seen as preferable alternatives to the pejorative and problematic concept of NIMBYism [86,87].

Authors surveyed identified that the lack of an explicit theory guiding their research resulted from either the lack of an appropriate and applicable theory for their research (n = 7), relying on multiple

[3] It should be noted that referenced scholarship stated in the papers or in the survey responses that did not meet Wacker's [46] definition of a theory were reported in our results as having not used a theory.

[4] AKTESP is a framework that examines environmental problems from agreement, knowledge, technology, economic, social, or political factors.

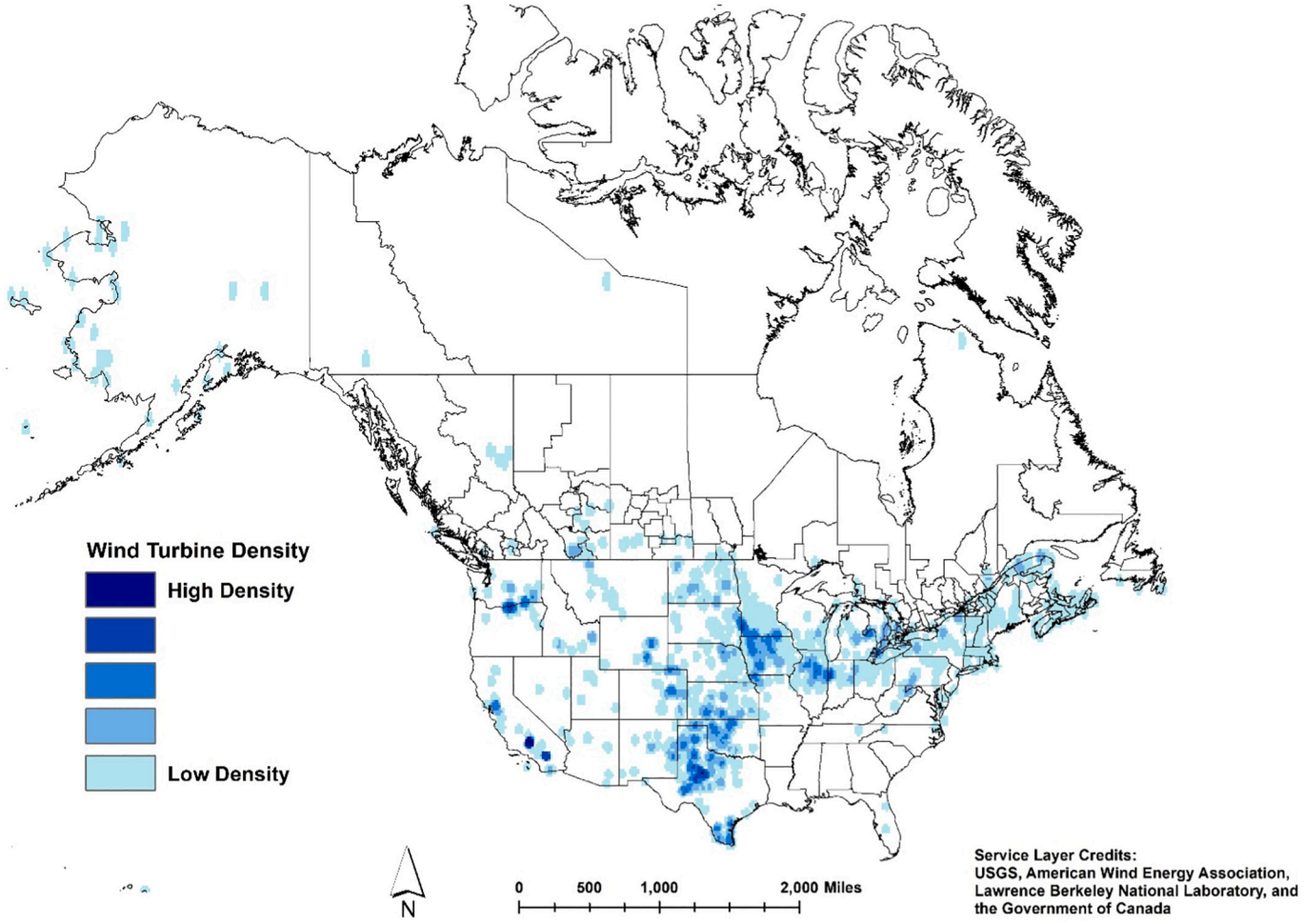

Fig. 1. Wind turbine density in Canada and the United States (Q1: 2021).

sources rather than one single theory (n = 3), or their research being exploratory (n = 2) (Table 6).

3.4. Departmental and disciplinary affiliation of WAR scholars

We identified the disciplines of the highest degree earned and home departments or institutions for all 162 co-authors listed in our systematic review. The most commonly held degrees are listed in Table 7 and predominantly stem from the social sciences, including: geography (10%); political science (6%); interdisciplinary degrees in environmental science, policy or studies (6%); economics (5%); and sociology (4%). Engineers (4%), marine scientists (4%), and planners (1%) are also involved in WAR. The most common home departments of WAR scholars tend to be interdisciplinary departments, schools or institutes that focus on a combination of agricultural, natural resource, and environmental economics (14%), geography (13%); earth, ocean and environmental sciences and studies (22%), marine affairs and policy (8%), engineering, public policy, political science, and sustainability (each 7%).

3.5. Dissemination of WAR results

Over half (58 out of 114, 51%) of the studies included in our systematic review lacked explicit description in the text of the authors' efforts to disseminate their results beyond the academic literature (Table 8). The author survey however found that an additional 33 studies (for a total of 91 out of 114, or 80%) had included dissemination of results to non-academics.[5] The methods used included sharing results via media, conferences, and community meetings (26%), sharing results with stakeholders (22%) or research participants (19%), making the results publicly available (13%), or sharing the results if participants reached out (13%).[6] Those authors surveyed that did not disseminate results identified constraints including a lack of participants' contact information and a lack of relevance to study participants or residents.

Additionally, 59% of the authors surveyed (24 of 41) identified that their university or organization provided no support or motivation to disseminate their findings beyond the academic literature, while only 12% (5 out of 41) identified existing support.

[5] The specific questions in the author survey asked, "Were the results of the selected study(s) disseminated to either the study participants or stakeholder communities?" and "Please describe how and to whom the results were disseminated."

[6] The authors recognize that this last category barely meets the definition of dissemination; however data and privacy constraints need to be considered.

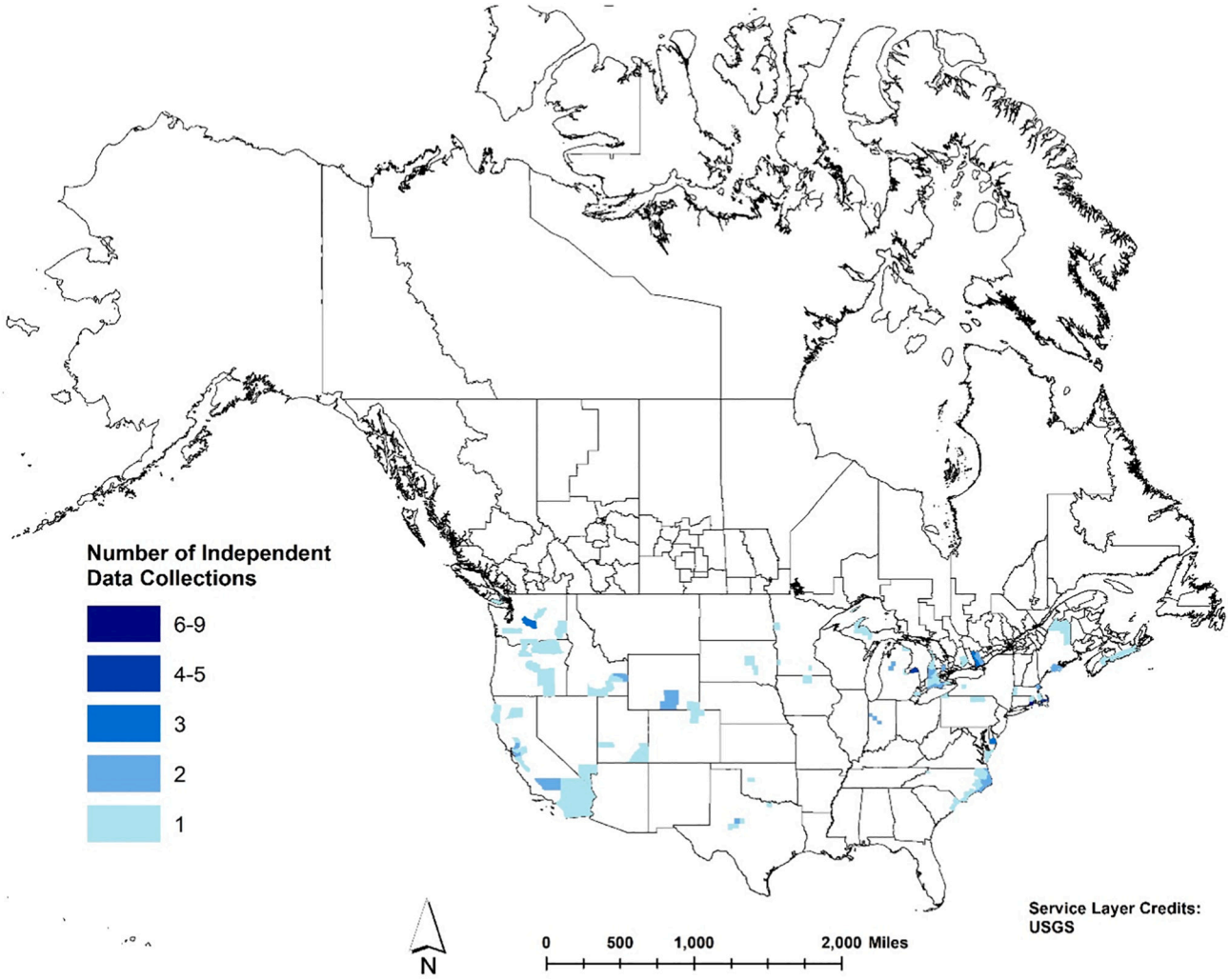

Fig. 2. WAR locations in North America. Figure depicts WAR that identified a specific county or counties as a data collection point. WAR that deployed larger, i.e., state-wide, or nation-wide, surveys are not included here. If a hypothetical proposed project was studied in a particular county, it is included here. It is important to note the widespread disparity in population densities across the US (~36 ppl/km^2) and Canada (~4 ppl/km^2) and how Canada's low population density differentiates both acceptance and WAR there from in the US [47].

Table 2
Most studied wind acceptance research communities in North America. Table lists those counties with the greatest number of independent data collection events and studies published in the academic literature (and by unique groups of scholars).

State/ province	County	No. of independent data collections	No. of studies published[a]	No. of studies published by different authors[b]
Rhode Island	Washington	9	11	6
Massachusetts	Barnstable	5	9	4
Michigan	Huron	4	4	2
Ontario	Lennox & Addington	3	5	3
Delaware	Sussex	3	3	1
Washington	Kittitas	3	3	3
TOTAL		27	35	19

[a] Some researchers used the same data collection event for multiple studies.
[b] The number of studies that were published by entirely different authors or groups of co-authors.

Table 3
Wind acceptance research data collection methods, average number of participants and response rates.

Method	No. of reports[a]	Average no. of participants[b]	Average response rate
Mailed surveys-Hard copy	40	558	42%
In-person interviews	29	30	31%
In-person surveys	13	455	64%
Content analysis	12	1244[c]	–
Online surveys	11	800	36%
Mailed surveys-Hard copy & online link	11	666	35%
Phone surveys	11	336	20%
Phone interviews	5	19	46%
Symposiums	2	27	–
Observations	2	None	–
Mailed surveys-Online link	1	196	15%
Natural experiments (census data)	1	None	–

[a] Some researchers used multiple methods and/or the same data collection for multiple studies.
[b] Only studies that reported the number of participants were used to calculate averages.
[c] Average number of sources included in each content analysis.

Table 4
Wind acceptance research respondent types.[a]

Target groups	No. of reports[b]	Percent of total
US or Canadian public[c]	63	35%
Residents near turbines	31	17%
Municipalities	21	12%
Developers	18	10%
Recreationalists/tourists	13	7%
Experts	12	7%
Organization leaders	11	6%
Opponents	5	3%
Proponents	5	3%
Total	179	100%

[a] Based on the systematic review.
[b] Some researchers used multiple target groups and/or the same data collection for multiple studies.
[c] This group represents all studies that did not specifically target residents that live near existing or planned turbines.

Table 5
Wind acceptance research incentives and reasons for not using incentives.[a]

	No. of reports[b]
Types of incentives used	
None	84
Enter to win	15
Paid after participation	8
Pre-paid	6
Voucher	1
Total[c]	114
Reason for not using incentives	
No funding	17
Participants willing to participate without incentive	13
High response rate	7
Incentive frowned upon	4
No reason given or not specified	3
No participants	2
Participants already being paid by job	2
Not allowed by the institution	2
Not applicable (e.g., content analysis)	2
Total[d]	52

[a] Based on the systematic review and survey.
[b] Some researchers used multiple rationales and/or the same data collection for multiple studies.
[c] Total is from reports in both the systematic review and the author survey.
[d] Total is from the author survey; not all authors responded to the survey or this question.

4. Discussion

Our results show that wind acceptance research is concentrated geographically in both the US and Canada, in particular on shoreline communities in Massachusetts (e.g., near Cape Wind) and Rhode Island, US (e.g., near Block Island Wind Farm); in the Thumb region of Michigan, US (e.g., near Harvest Wind and Michigan Wind) and in Ontario, Canada (e.g., near Ernestown Wind Park and Wolfe Island Wind Farm). In these regions and others, unincentivized mailed, online or phone surveys of residents were the most common form of research, most often without an underlying theory driving the work's application or results. We found little support for research fatigue, as response rates and sample sizes tended to be higher than our systematic review means in areas experiencing more WAR, though attrition rates in longitudinal studies in those regions were high. Positively, both a close reading of studies in those regions and responses to our author survey showed no evidence of researchers having difficulty recruiting participants. Finally, four-fifths of the studies in this review disseminated results to non-academic audiences; however, explicit discussion of that process was included in just over half of the authors' published articles.

Rather than focus case studies in those broad regions across the US and Canada with the highest installed capacity or resource potential, a subset of wind acceptance researchers have focused on communities experiencing relatively rapid and early development in what are comparatively less developed regions. Based on both the location of most WAR studies and the content of the studies themselves, this focus appears due to either: i) the controversy associated with such projects [18,88], ii) individual scholars or teams of scholars focusing their research on specific projects or regions near their institution (e.g., [60,61]), and/or iii) the novelty or rarity associated with particular projects, such as North America's first offshore wind farm (Block Island) [32,66], the cancellation of Cape Wind [59], and the Green Energy Act in Ontario [83,89]. The extent to which these studies in particular are representative across wind communities and the general public may be and has been questioned [9,18,59].

For example, Texas, Iowa, and Oklahoma not only have the greatest installed wind capacity in the US [90], but each installed more new capacity in 2020 than did any other state [91]. Yet our review identified that outside national surveys only three WAR studies focused specifically on sites in Texas, two in Oklahoma, and one in Iowa. Conversely, windfarms in California, a top five state in installed wind capacity [90], were the focus of eight studies. Similarly in Canada, Ontario, which has more installed wind capacity than any other province and eight of the country's largest 14 windfarms, was the focus of 19 WAR studies. In Quebec, which has approximately 70% of Ontario's installed capacity, specific windfarms were the focus of only two studies. Wind acceptance is context-dependent, yet researchers appear to be ignoring large portions of the US and Canada that are not only politically, culturally, and geographically unique from where most WAR is being conducted, but have also experienced considerably more wind development.

Less nuanced, but more representative work involved mail, phone

Table 6
Theories used in wind acceptance research.[a]

Types of theories used	No. of times each theory used[b]
None reported	73 total
Place-based and/or place-attachment theory	10 total
Value-belief-norm theory	5 total
Random utility theory; consumer choice theory	3 each (6 total)
Ecological communication theory; social exchange theory	2 each (4 total)
Agenda-setting theory; economic theory; field theory; gatekeeping theory; goal theory; neo-institutional theory; normative theory; public sphere theory; punctuated equilibrium theory; rhetorical genre theory; rural planning theory; social movements theory; social norms theory; social systems theory; theory of human influence and technology on perception of landscapes; theory of subjectivity	Once each (16 total)
Total[c,d]	114

Reason for not using theory	No. of reports[b]
No theory applicable	7
Multiple sources, no one theory	3
Exploratory	2
No reason given/not specified	3
Total[e]	15

[a] Based on the systematic review and survey.
[b] Some researchers used multiple rationales and/or the same data collection for multiple studies.
[c] Total includes reports from both the systematic review and the author survey; though the author survey results show that 49 authors reported the use of a theory, only 27 of those studies relied on a theory that fit our definition per Wacker [46]; the remaining 22 studies that were reported to rely on another form of scholarship were classified as "None".
[d] Grounded theory, defined by purposely avoiding the use of a theory, was also used five times.
[e] Total includes reports only from author survey; not every author responded to the survey or answered this question.

Table 7
Most common disciplines of the highest degree earned and current departments of wind acceptance researchers.

	No.
Discipline of highest degree earned	
Geography	16
Political science	9
Environmental science, policy or studies	9
Economics	8
Sociology	7
Agricultural economics	6
Environmental and Nat res. economics	6
Engineering (incl. Bio or Mechanical)	6
Marine affairs or studies	6
Public policy (analysis)	6
Anthropology	4
Media and communication	4
Parks and recreation	4
Human dimensions of natural resources; Energy and resources; Landscape architecture; Marine policy; Philosophy; Social or Experimental psychology	3
Economic psychology; Leisure studies; Clinical child psychology; Environmental health; Sustainable energy; Cognitive science; Behavioral decision research; Operations research; Regional or environmental planning	2
Current school/departmental/institute affiliation	
Economics[a]	22
Geography	21
Earth, ocean and environment	18
Environmental science, studies and natural resources	18
Marine affairs or policy	13
Engineering	11
Public policy	11
Political science	11
Sustainability, sustainable systems or communities	10
Public or environmental health	10
Anthropology; Recreation, parks & tourism	7
Psychology	6
Communication	4

[a] Includes agricultural, natural resource, resource & environmental economics.

Table 8
Methods of dissemination used and reasons for not disseminating wind acceptance research.

	No. of reports[a]
Types of dissemination	
None[b]	58
Shared results with community (via media/conferences/meetings)	19
Shared results with stakeholders	16
Shared results with participants	14
Made results publicly available	9
Shared results if participants reached out	9
Member checking	5
Total[c]	129
Rationale for no dissemination	
No contact info	4
No reason given/not specified	4
Not relevant	3
Controversial results	1
Did not ask participants	1
Total[d]	13

[a] Some authors reported using multiple dissemination types and rationales and/or the same data collection event for multiple studies.

[b] Fifty-nine of the 114 studies (52%) did not explicitly describe dissemination efforts in the text of the article. Results from the author survey showed that 91 out of 114 studies (80%) included some form of dissemination to the study participants or stakeholder communities.

[c] Total includes reports from both the systematic review and the author survey. It should be noted that the questions in the author survey were open-ended and thus authors may have interpreted what counts as dissemination differently.

[d] Total includes reports from the author survey only; not all authors responded to the survey nor answered this question.

and online surveys, e.g., [12,13,15,17]. These studies show increasingly positive attitudes toward wind, the strength of environmental messaging, and a relative preference for wind over both fossil-fueled power and solar by wind community residents, despite turbine sounds and noise annoyance. The majority of these types of mail, phone and online surveys used enter-to-win incentives. Despite declining response rates in general, recent research has shown that prepaid incentives significantly increase survey response rates [92], compared to no incentives or raffles, especially among farmers who tend to be oversampled in WAR [93]. Those farmers, who already receive a high number of surveys from the government, academics, and the private sector, were shown to prefer between $15 and $47 to complete a 20-min survey [94], though even $2 has been shown to significantly increase farmer response rates [93].

Rationales provided by authors for not incentivizing participants more broadly sometimes mirror the rationale provided by wind developers for not providing direct payments to those residents not holding turbine leases. Authors reported either a lack of funding or that they had enough individuals willing to participate in their studies without providing incentives—the latter serving as additional evidence for a lack of research fatigue. We have heard developers use both arguments as well, arguing that monetary incentives for wind community residents can be perceived negatively. Yet those perceptions have been linked to existing, status-quo project development processes that have been perceived to be unfair or lack procedural and distributive justice [26,95].

The response rates reported here hovered between 20% for phone surveys and 42% for mailed surveys. These rates were perhaps buoyed by the novelty and controversy associated with many of these projects, as well by wind community residents feeling pressure to mitigate the influence of their neighbors, who may not only perceive wind development differently, but may be more engaged in and more vocal about opposing local wind development either at community meetings or online. Bell et al. [19] long ago identified the outsized influence of vocal opponents, terming their effect on development as a democratic deficit. More recently, Fergen et al. [96] showed how extra-local actors are not only contributing to this deficit, but to community corrosion more broadly. The extent to which the most vocal opponents to wind development are responding to WAR surveys remains unknown however, particularly because most surveys show broad support for wind development [9,12,13].

The democratic deficit and the social gap theory from which it derives [19] is one of the most widely cited in the wind acceptance research literature (863 citations at last count), yet explicit incorporation of it or similar theories in WAR studies is also rare. Only 36% of the papers analyzed here identified such a theory guiding or constraining data collection. More common is the ex-post interpretation of survey or interview results through different theoretical lenses, or merely suggested approaches for doing so. When asked about the lack of theory in their work, authors responded that either there was no applicable theory, they rely on multiple sources rather than one theory, or that their exploratory work did not necessitate theory. Despite more than 30 years of research, and Rand and Hoen [9] arguing WAR has improved in the development of applicable theories, much of it remains exploratory in some sense. WAR remains focused on either simply measuring acceptance or determining the processes, outcomes, perceptions and impacts that result in greater support or opposition (e.g., [12,21,97]) rather than developing, uniting or testing different theoretical explanations of the underlying mechanisms that influence those perceptions and processes [9]. There are of course notable exceptions (i.e., [18,37,71,98]).

Still others have argued WAR requires a critical look at its positivist and normative theoretical underpinnings [8]. We agree, our results show that the diversity of scholars and departments engaged may be contributing to the lack of a unified or convergent theoretical approach. Teams of authors tend to work together repeatedly, using similar methods, frameworks, languages, and geographies. Some do so in

Economics and Geography departments, but far more do their work from interdisciplinary departments that lack a dominant focus on energy. Wind acceptance researchers in these departments may be forced to prioritize applied work and generating immediate results, perhaps serving smaller roles within larger physical or engineering research projects that do not prioritize advancing social science theories [99]. Even so, pursuing greater theoretical depth and reflection remains necessary within each team [11] and across WAR more generally, as does the cross pollination of ideas across disciplines and departments. Perhaps most importantly researchers should expand their work to new geographic regions with high installed capacity, particularly if we intend case studies to be more broadly comparable [9].

Finally, it remains notable that Sovacool et al. [11] identify a number of reviews of applicable theories for conducting energy social science (e.g., energy supply infrastructure [100], consumer behavior and behavioral change [101], and green consumption [102]), but do not identify a review of theories governing acceptance of renewable energy technologies. Nor do Rand and Hoen [9] explicitly call for more widespread application of theory. Our result suggests that such a review is necessary. Place-based and place-attachment theories were found to be most prevalent, yet a range of theories remain in use. Additionally, Batel [8] critically examines WAR's theoretical and ideological underpinnings and encourages researchers to go beyond surveys to include ethnographies, interviews and social-media analyses. Indeed, surveys dominated the methods reported on here. A greater range of methods combined with greater theoretical depth may also address both Rand and Hoen [9] and Sovacool et al.'s [11] call for research that is more relevant to policymakers, practitioners and communities, specifically the former authors' [9] call for a "commitment to implement research findings into developer and policymaker practice" (p. 144).

Wind acceptance researchers in the US and Canada may also benefit from looking beyond both their borders and wind as a technology for acceptance work that more commonly incorporates theory and more diverse methods and respondents. For example, work by Hymans and Uchikoshi [103] on the acceptance of geothermal siting in Japan focuses on place identity and social capital, while Carlisle et al. [104] examined the role of proximity and place attachment in the US and Fraser [105] employed policy adoption theory in South Africa, both studying support for utility scale solar. Additionally, wind acceptance researchers could draw from the increasingly transdisciplinary field of sustainability transitions, which provides a host of theoretical and conceptual frameworks to structure their investigations and test underlying mechanisms; see Kohler et al. [106] for an excellent review and Sovacool [107] for a political ecology framework that suggests more inclusive avenues for studying low-carbon transitions.

In order to meet such a commitment, disseminating results beyond academic audiences is key. Despite four out of five studies here incorporating some dissemination efforts (though less often explicitly reporting it in a scholarly article), rarely were these efforts actively and specifically targeted at practitioners and policy-makers. Instead, results tended to be shared only with residents and WAR participants and no mention was made regarding evaluating its use, relevance, or success in improving development processes or decisions. Expanding these dissemination efforts, either by partnering with Extension services or journalists, developing project websites, or disseminating results or reports via social media, as well as providing both a description and evaluation of them in WAR publications is crucial to encourage other researchers to adopt or evaluate similar practices. And while the universities and organizations that employ wind acceptance researchers share responsibility in often failing to reward dissemination or success in influencing development processes, journals such as this one could help encourage these practices by including prompts for reporting on both dissemination efforts and studies' positive impacts on wind development.

5. Conclusion

Following in the footsteps of Rand and Hoen [9], Sovacool and others [10,11], and Walsh et al. [38], this study used a systematic review of 114 articles and an author survey to examine the conduct of wind acceptance research and research fatigue by determining the location of study sites and the success of different research designs, incentives, and theories used in collecting and disseminating WAR. WAR has expanded considerably from the late 1980s, e.g., [108,109], but not uniformly across the US and Canada and not in sync with increases in installed wind capacity. While research fatigue appears unlikely to be occurring presently, WAR remains concentrated in locations distant from the highest installed capacity, and focuses on communities and projects that tend to be novel, controversial, or unique to a specific region. Nationally representative surveys exist, yet research focusing on novelty, controversy and uniqueness are less likely to be representative, reiterating the importance of Rand and Hoen's [9] recommendations. This work also found the dominant means of conducting WAR to be unincentivized mail, online or phone surveys, which often lacked an underlying theory.

Our results and analysis suggest some important next steps, including the need for i) a qualitative analysis of study site selection criteria, i.e., an investigation of the specific elements driving wind acceptance researchers to focus on specific communities or projects; ii) more theoretical analysis of WAR, specifically analysis that encourages, if not pursues itself, the integration of existing (synthesis) theories or their meaningful comparison (triangulation) [11,110]; iii) a similar, but expanded systematic analysis of WAR beyond the US and Canada (e.g., [111–115]; iv) greater integration of, comparison between, and application of lessons learned from WAR with solar acceptance research; and finally, v) a rededication as wind acceptance researchers to ensuring and communicating the clear purpose, value and financial benefit of our work to participants and wind energy stakeholders, practitioners and policy-makers [39]. That last step requires researchers to not only disseminate their findings more broadly, i.e., beyond academic outlets, but more importantly ensure their findings are actively integrated into wind energy policy, practitioner and developer decision-making processes.

Finally, WAR requires meaningful consideration of the community contexts examined, not only landowners and neighbors' relationship with wind energy development and its outcomes, but also the community's historical participation in and appetite for participating in future research and wind energy development. WAR can and should benefit all community members, in particular historically marginalized and vulnerable populations, and contribute to greater energy justice rather than simply replicate contesting business-as-usual modes of research funding, policy-making and development [8]. Doing so not only greatly reduces the risk of research fatigue but ensures wind acceptance researchers contribute positively to community welfare.

Declaration of competing interest

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

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