

Social Acceptance of Wind Energy in Urban Landscapes

Mika Westerlund

“ The restart of our economy needs to be green. It also needs to be equitable. It needs to be inclusive.”

Chrystia Freeland
Finance Minister of Canada
on COVID-19 recovery plan

Although wind energy has high potential as a sustainable energy source to fight climate change, and the post COVID-19 world may require accelerated transition to renewable energy systems, many wind energy projects nevertheless face community resistance. Research on social acceptance of wind energy has increased rapidly, but understanding still lacks regarding the different types of acceptance, whether or not the acceptance correlates with demographics, and what drives acceptance of wind farms in the urban landscape. Our analysis of 2,376 residents in Helsinki, the capital of Finland, focused on the gaps in understanding and identified three groups of people: Protagonists, Centrists, and Antagonists. While Protagonists are highly positive about wind energy projects in the city, Antagonists oppose them, and Centrists adopt a middle-of-the-road approach. Further, three factors matter for social acceptance in urban landscapes: 1) distance, as residents prefer offshore wind farms to be farther away from the city's inhabitants, 2) gender, as women are more accepting of wind energy compared with men, and outright opponents of wind energy are more likely men, and 3) participation, as residents wish to participate in decision-making processes regarding wind farms, but lack interest in having ownership of and responsibility for wind energy projects. The study discusses the implications of these findings for developers and policymakers of wind energy projects in the urban context.

Introduction

Promoting renewable energy has recently become a global priority to fight climate change (Hevia-Koch & Ladenburg, 2019; Liebe & Dobers, 2019; Sharpton et al. 2020). In particular, wind energy has been hailed as a promising clean energy technology for transition to post-fossil carbon-based societies (Caporale & De Lucia, 2015; Yuan et al., 2015; Hammami et al., 2016). News media (for example, Twidale, 2020) have reported that renewable energy has increased its share of global electricity production during the COVID-19 pandemic, thereby paving the way for a wide-scale transition away from fossil fuels to a decarbonized post-pandemic economy.

Transition to renewables such as wind energy, however, requires substantial financial investments, technical adaptation, and acceptance by the local society (Scherhauser et al., 2017; de Araujo & de Freitas, 2008; Langer et al., 2018). Hence, there is a growing scholarly interest to study wind energy from the perspective of “social acceptance” (Hall et al., 2013; Langer et al., 2016; Rand & Hoen, 2017). Low social acceptance results in delays, public protests, cost escalation, and sometimes the obstruction of wind energy projects (D'Souza & Yiridoe, 2014; Reusswig et al., 2016; Bolwig et al., 2020), while increasing the risk of failing to reach environmental policy goals (Cohen et al., 2014). Thus, energy developers and policymakers need to understand social acceptance in order to ensure successful planning,

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implementation, and operation of wind energy systems (Jobert et al., 2007; Landeta-Manzano et al., 2018).

Public opinion polls usually show high levels of support for wind energy (Aitken, 2010; Rand & Hoen, 2017). Nevertheless, various factors, including socio-demographic characteristics such as age and gender, may affect the social acceptance of adopting renewable energy systems (Johansen & Emborg, 2018). For example, older groups and women are found to have lower acceptance of wind farms (Azarova et al., 2019; Ólafsdóttir & Sæþórsdóttir, 2019). According to Caporale and De Lucia (2015), women may be more sensitive to the aesthetic impact of wind farms to landscape; thus, the perceived impacts of wind farms on landscape warrant more research from the perspective of gender. On the other hand, Hoen et al. (2019) did not find support for the gender argument, and Liebe et al. (2017) suggest that the correlation between gender and wind energy acceptance varies by region. Nonetheless, the visual impacts of wind energy systems seem to be a common factor across regions and socio-demographic groups (de Araujo & de Freitas, 2008; Firestone et al., 2018; Hallan & Gonzalez, 2020). Further, since much of the research on wind energy acceptance focuses on rural areas (Khorsand et al. 2015; Lienhoop, 2018; Gebreslassie, 2020), more understanding is still needed in urban contexts (Zaunbrecher & Ziefle, 2016).

The objectives of this study of wind farms in urban landscapes are to investigate, 1) the types of social acceptance, 2) whether acceptance correlates with gender, and 3) what drives social acceptance. The study applies explorative, quantitative research methods on a publicly available survey data set derived from an open data service in Finland. The analyzed data include 2,376 responses from Helsinki, the capital of Finland, to a survey about residents' perceptions of (hypothetical) wind farms in the city's landscape. In so doing, the study identifies different groups of people (for example, based on gender) that vary by acceptance, and discusses the key factors that matter for social acceptance of wind energy systems in urban landscapes. The results contribute to the extant literature on social acceptance of renewable energy systems (for example, Reusswig et al., 2016; Rand & Hoen, 2017; Giordano et al., 2018; Bolwig et al., 2020; Leiren et al., 2020) by providing further evidence from the urban context regarding three highly debated areas in wind energy acceptance, namely a) the distance of wind farms from the city's inhabited coastal areas, b) the role of gender in acceptance, and c) the relevance of citizen participation in wind energy

projects.

The paper is structured as follows. After this introduction, the paper reviews literature on social acceptance of wind energy and the visual impacts of wind energy systems on urban landscapes. The paper then describes the data and methods of analysis. Thereafter, it provides results from quantitative analyses, and, finally, concludes with a discussion on key findings, their contributions to theory and practice, as well as limitations and future research avenues.

Literature review

Definition and levels of social acceptance

Scholarly interest in "social acceptance" emerged in the 1980s when renewable energy developers noticed that the implementation of wind farms was facing notable opposition in communities, although the surveys conducted had suggested high levels of support (Wüstenhagen et al., 2007; Bolwig et al., 2020). Since then, it has become apparent that people can "accept" wind power, while it does not mean at the same time that they "support" installing wind farms in their city (Khorsand et al., 2015; Enevoldsen & Sovacool, 2016). Dermont et al. (2017) distinguish between "acceptability" (characteristic), "acceptance" (passive behaviour), and "support" (active behavior) for positive behaviour toward renewable energy technologies. Similarly to the negative, Friedl and Reichl (2016) label the opposing behaviour as "rejection" (passive behaviour that does not lead to taking action) and "resistance" (active behaviour, such as protesting or not using a technology). In this paper, social acceptance is defined as "the lack of noticeable opposition and active resistance, and the abundance of passive tolerance and positive attitudes, leading to support from majority for adopting low-carbon technology in a community" (Cohen et al., 2014; Khorsand et al., 2015; Wolsink, 2018).

While social acceptance can be examined at various levels, including macro (country), meso (city), or micro (individual) (Upham et al., 2015), it cannot be explained by any single factor. Rather, social acceptance combines individual and collective preferences that are rooted with economic, political, cultural, linguistic, and other social aspects (Scherhauser et al., 2017). Further, Azarova et al. (2019) argue that social acceptance of renewable energy is not only about accepting a specific energy technology, or locally installing it, but also about the acceptance of administrative, technological, and social elements that come with it. Nevertheless, most studies

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Table 1. Factors affecting acceptance of wind energy

Factor	Examples	References
Social	Social interaction; potential conflicts with others in the community; impact on the social image and attractiveness of the community; social welfare; community ties and trust toward unfamiliar actors such as energy developers; perception of peer acceptance of wind energy	Sovacool & Ratan (2012), Hall et al. (2013), Yuan et al. (2015), Walker et al. (2018), Suškevičs et al. (2019), Diogenes et al. (2020)
Environmental	Ecological change versus green benefits; adverse impacts of wind turbines on biodiversity (flora and fauna, wildlife, including felling of trees and hazards of turbine blades to birds); impacts on cliffs and other natural formations; recyclability of metals and parts used in wind turbines	Enevoldsen & Sovacool (2016), Zaunbrecher & Ziefle (2016), Rand & Hoen (2017), Roddis et al. (2018), Suškevičs et al. (2019), Bolwig et al. (2020), Caporale et al. (2020), Jørgensen et al. (2020)
Economic	Installation and maintenance costs; economic feasibility; financial situation of the community; foreign direct investments; increased employment opportunities; impacts on tourism; consumer costs vs. monetary compensation and government subsidies; negative impact on property values; energy price; impact on taxes	Khorsand et al. (2015), Spiess et al. (2015), Yuan et al. (2015), Enevoldsen & Sovacool (2016), Bhowmik et al. (2018), Roddis et al. (2018), Hoen et al. (2019), Ólafsdóttir & Sæþórsdóttir (2019), Bolwig et al. (2020), Caporale et al. (2020), Diogenes et al. (2020), Jørgensen et al. (2020), Kim et al. (2020), Leiren et al. (2020)
Technical	Operational life of the system; performance and functional efficiency; reliability, capacity and energy supply security; system constraints; need for transmission lines and pylons; changes in grid infrastructure; distance of turbines to residence; physical appearance such as the design, type of movement, and the size of turbines; number of turbines in the area; interference with TV, radio, or mobile communications	Spiess et al. (2015), Westerberg et al. (2015), Enevoldsen & Sovacool (2016), Langer et al. (2016), Zaunbrecher & Ziefle (2016), Bhowmik et al. (2018), Landeta-Manzano et al. (2018), Langer et al. (2018), Roddis et al. (2018), Hoen et al. (2019), Caporale et al. (2020), Diogenes et al. (2020), Leiren et al. (2020)
Institutional	Political commitment; favorable regulations and legal frameworks; sufficient information sharing; transparency of governmental institutions and processes; prevalence or lack of innovative culture; engagement of local actors; public involvement in decision-making; perceived distributional fairness (how well the benefits, risks and costs are distributed within the community), procedural justice (how open, fair and unbiased the decision-making and planning processes are)	Sovacool & Ratan (2012), Hall et al. (2013), Cohen et al. (2014), Walker et al. (2014), Khorsand et al. (2015), Langer et al. (2016), Scherhauer et al. (2017), Sonnberger & Ruddat (2017), Johansen & Emborg (2018), Hoen et al. (2019), Vuichard et al. (2019), Bolwig et al. (2020), Caporale et al. (2020), Diogenes et al. (2020), Jørgensen et al. (2020)
Health	Noise and acoustic pollution; infrasound; non-ionizing radiation; physiological health effects (e.g., headaches and dizziness), psychological health effects (sleep disturbances and stress from potential long-term health risks, annoyance from flickering and shadowing), safety concerns such as falling ice	Songsore & Buzzelli (2014), Khorsand et al. (2015), Langer et al. (2016), Landeta-Manzano et al. (2018), Langer et al. (2018), Ferreira et al. (2019), Hoen et al. (2019), Kim & Chung (2019), Bolwig et al. (2020), Jørgensen et al. (2020), Leiren et al. (2020)
Contextual	Place-related visual impacts in terms of aesthetics and visual appearance of the turbines; visibility of the turbines at place of residence; visual intrusion of the view; land occupation needed for the project; place identity and attachment, altered landscapes, and landscape destruction	Jobert et al. (2007), Hall et al. (2013), D'Souza & Yiridoe (2014), Khorsand et al. (2015), Enevoldsen & Sovacool (2016), Langer et al. (2016), Zaunbrecher & Ziefle (2016), Langer et al. (2017), Rand & Hoen (2017), Langer et al. (2018), Ferreira et al. (2019), Hevia-Koch & Ladenburg (2019), Hoen et al. (2019), Kim & Chung (2019), Bolwig et al. (2020), Caporale et al. (2020), Diogenes et al. (2020), Jørgensen et al. (2020), Leiren et al. (2020)

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on renewable energy investigate social acceptance broadly as either “general acceptance”, measuring general public attitudes toward a new energy technology, or as “local acceptance”, focusing on specific situations where a local community is faced with installing a renewable energy system in their habitat (Emmerich et al., 2020). Studies that combine both are valuable because, while social acceptance affects the realization of national renewable energy policy targets (Bhowmik et al., 2018), it matters especially at the local level regarding site-related decisions for residents and city planners.

Previous literature on social acceptance of renewable energy systems (for example, Wüstenhagen et al., 2007; Sovacool & Ratan, 2012; Caporale & De Lucia, 2015; Hammami et al., 2016; Landeta-Manzano et al., 2018; Rand & Hoen, 2017; Roddis et al., 2018; Bolwig et al., 2020; Devine-Wright & Wiersma, 2020) suggests that social acceptance has three dimensions: 1) “Market acceptance” concerning investment needs, opportunities, and profits for investors, project developers, energy-suppliers, utilities and grid-owners, as well as changes in electricity costs for consumers and businesses. 2) “Socio-political acceptance” in terms of opinions of the energy technology as acceptable and useful, as well as the tone of the debate in the national media, politics, and public institutions. 3) “Community acceptance” including the activity and opinions of people and businesses living, working, and operating in the environment of specific energy projects and technology installations, who must therefore bear most of the direct external impacts.

Given that COVID-19 has pushed governments across the globe to stress the role of environmental sustainability in their economic recovery and growth plans (BNN Bloomberg, 2020; Janse & Tsanova, 2020), it is now more than ever important to understand the factors that affect social acceptance or rejection of renewable energy.

Factors affecting social acceptance or rejection of wind energy systems

In general, social acceptance is affected by “perceived effects” (the risks, costs, and benefits of implementing renewable energy systems), as well as “perceived problems” (the adverse effects of relying on “traditional” energy sources). Such issues include CO₂ emissions, waning fossil fuel reserves, and the risks of adopting nuclear power (Huijts et al., 2012; Walker et al., 2014; Gaede & Rowlands, 2018). That said, general public

opinion about wind energy has been typically positive (Ferreira et al. 2019; Hoen et al., 2019), while local opposition usually tends to hinge upon the selection of a particular site for wind farms (Caporale et al., 2020). Even though this paradox is sometimes explained with the increasingly unpopular concept of NIMBY (“Not In My Backyard”), which refers to one’s own self-interests, it is likely more related to “place-protective” attitudes, associated with “place identity” and the emotions that connect people with particular places (Jami & Walsh, 2017; Kim & Chung, 2019).

In any case, more affects the acceptance of wind energy than a mere comparison of costs and benefits or one’s self-interests. Previous research has identified various factors that influence the acceptance of wind energy systems: 1) social, 2) environmental, 3) economic, 4) technical, 5) institutional, 6) health, and 7) contextual. To provide a compact reference that has resulted from this research, Table 1 lists examples of these factors along with literature references.

Visual impacts of wind farms on the urban landscape

Wüstenhagen et al. (2007) argue that the impact of wind energy systems on local landscape is central for social acceptance. Landscape is defined as “a natural resource that provides social use and non-use benefits, and that has economic (land value) and non-economic (aesthetic) value to people” (Caporale & De Lucia, 2015; Roddis et al., 2018). Indeed, Diogenes et al. (2020) and Spiess et al. (2015) note that concerns over visual impacts have surfaced as a primary reason for wind energy objections due to both economic value and aesthetic value reasons. Wind farms tend to turn a place of “romantic and unspoiled nature” into having the appearance of an “industrial space with artificial, mechanical and urban character” (Kim & Chung, 2019; Ólafsdóttir & Sæþórsdóttir, 2019). That said, after wind farm installation, communities often perceive that the wind turbines actually did not damage the scenic beauty of the area (Gebreslassie, 2020), and that turbines and their blades may even be perceived as aesthetically pleasant, creating a “postcard-like” landscape, thus having positive visual impacts (Kongprasit et al., 2017; Rand & Hoen, 2017; Firestone et al., 2018).

Urban residents seem to be more supportive of wind energy than rural residents (Yuan et al., 2015), although acceptance decreases if wind turbines are installed nearby peoples’ homes (Guo et al., 2015). That said, while a correlation between low acceptance and close proximity of wind farms to people’s homes has been

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suggested time and again, empirical evidence to prove this “proximity hypothesis” remains unconvincing (Harper et al., 2019; Hoen et al., 2019). Nonetheless, while remote off-shore installations may be more accepted than those nearby peoples’ homes, due to limited visual and auditory impacts, the trade-off people face is higher financial requirements as a result of spatial distance and lack of grid connection (Devine-Wright & Wiersma, 2020; Hall et al., 2013). Further, offshore windfarms have visual impacts on the seascape, especially from the perspective of recreational activities such as boating and yachting, as well as posing various environmental risks to birds and marine life from noise and vibration (Haggett, 2011; Guo et al., 2015; Westerberg et al., 2015; Kim et al., 2019). Thus, directly engaging local communities is essential to avoid long or failed planning processes, for both onshore and offshore wind power (Haggett, 2011; Bolwig et al., 2020; Lamy et al., 2020).

Method

Data collection

This study makes use of publicly available data from the “Wind Power Survey for Helsinki 2015”, which was collected in Helsinki, Finland. The data set was obtained from the open data service “Helsinki Region Infoshare” (<https://hri.fi/>) under the Creative Commons Attribution 4.0 (CC-BY-4.0) license. The data set’s maintainer is “Helsingin kaupunkiympäristön toimiala / Maankäytön yleissuunnittelu”.

According to Sonnberger and Ruddat (2017), representative random samples, such as survey data in the present study, make a beneficial method for analyzing social acceptance of renewable energy. When investigating social acceptance of wind energy in the Finnish context, Jung et al. (2016) pointed out that Finland is among the top European Union member states in terms of using renewable energy sources, and is solidly on track to increase the share of renewables in order to reach both national and European Union’s climate and energy targets. The Finnish government has agreed on a supplementary budget proposal for 2020 as part of its COVID-19 recovery package, in an effort to ensure “an economically, ecologically and socially sustainable emergence from the crisis”, that aims to make “Finland the world’s first carbon-neutral welfare state” (Evans & Gabbatis, 2020).

The social context for this budgetary policy making situation in Finland is that the climate change

hypothesis is largely accepted by Finnish people, while public attitudes toward both solar energy and wind energy are generally positive (Jung et al., 2016). A recent study by Suškevičs et al. (2019) shows that residents in Northern Europe, including those in Finland, have little concerns about the impacts of wind farms on their regional public image, but that instead people are concerned about visual impacts on their local landscape.

The initial data set contained anonymous responses from 2,426 respondents to an open online survey conducted in 2015. The survey focused on the social acceptance of wind energy in Helsinki, the capital and most populous city of Finland. Helsinki is in the south coast of the country, and has a population of 650,000 people, totaling 1.3 million people if including the city’s urban area (Wikipedia, 2020). The vast majority (86%) of respondents identified themselves as residents of Helsinki, while the rest did not identify their residence or were non-residents in the city (Helsingin kaupunki, 2015). Of note, Johansen (2019) found that residency influences place attachment and, therefore, people’s perceptions of landscape change due to wind farm installations.

The survey included a total of 14 questions on citizen attitudes in four areas, indicated with a letter from A through D, along with the number of questions in the results section of this study:

- A) What should Helsinki city do regarding wind energy?*
- B) What kinds of effects would wind farms have on the city’s image and landscape?*
- C) Visibility and proper distance of wind turbines from the city’s inhabited areas*
- D) Respondent’s willingness to participate in decision-making, consumption, and investments in wind energy.*

Data analysis

To understand the relationship between demographics and social acceptance of wind energy in urban landscapes, only respondents who provided information on their gender were included. The final data set included 2,376 respondents of which 903 (38%) were female and 1,473 (62%) were male. This is like the gender distribution in many other survey-based studies on social acceptance of sustainable energy; for example,

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Table 2. Wind energy acceptance in Helsinki by gender

		Female	Male	df	t-value, sig.
	The city should... (1=totally disagree, 5= totally agree)				
A01	... be an example in reducing CO2 gases	M =4.67, SD=0.93	M=4.15, SD=1.43	2364.86	10.719, p<0.001
A02	... produce wind power locally	M=4.40, SD=1.23	M=3.88, SD=1.64	2283.69	8.843, p<0.001
	Wind turbines would have a positive effect on ... (1=totally disagree, 5= totally agree)				
B01	... the city's image	M=4.44, SD=1.21	M=3.90, SD=1.61	2282.05	9.418, p<0.001
B02	... the city's landscape	M=3.73, SD=1.41	M=3.33, SD=1.66	2140.05	6.285, p<0.001
	Attitude toward having wind turbines in the city if they are.... (1=very negative, 5= very positive)				
C01	... visible from the city's shipping lanes	M=4.40, SD=1.15	M=3.90, SD=1.54	2283.15	9.001, p<0.001
C02	... visible from the city's world heritage site	M=3.97, SD=1.38	M=3.53, SD=1.66	2172.55	7.076, p<0.001
C03	... built within the city's harbour area	M=4.43, SD=1.18	M=3.82, SD=1.61	2302.08	10.628, p<0.001
C04	... built on the city's landfill areas	M=4.24, SD=1.27	M=3.73, SD=1.61	2225.40	8.615, p<0.001
C05	... built within 8-10 km from the city's shore	M=4.37, SD=1.20	M=3.90, SD=1.59	2272.48	8.285, p<0.001
C06	... built within 4-5 km from the city's shore	M=3.73, SD=1.44	M=3.44, SD=1.65	2106.69	4.731, p<0.001
C07	... built within 1-2 km from the city's shore	M=3.50, SD=1.54	M=3.14, SD=1.69	2036.22	5.214, p<0.001
	How willing are you to ... (1=totally disagree, 5= totally agree)				
D01	... influence on the location of wind turbines	M=3.86, SD=1.15	M=4.10, SD=1.14	2374.00	-4.876, p<0.001
D02	... buy locally produced wind power	M=3.98, SD=1.36	M=3.28, SD=1.68	2201.52	10.991, p<0.001
D03	... become a private investor in wind power	M=2.93, SD=1.36	M=2.93, SD=1.56	2099.43	-0.071, p=0.943

approximately a 40% female-60% male proportion in Bhowmik et al. (2018), Guo et al. (2015), and Langer et al. (2017). However, according to Helsingin kaupunginkanslia (2020), the population of Helsinki in 2015 was 53% female-47% male, thus suggesting that the sample has male dominance compared with the city's actual gender distribution. An equal split analysis of data to examine gender prevalence among early and late respondents did not suggest any selection bias ($p=0.22$).

The analysis here follows a recommendation by Bhowmik et al. (2018) to apply explorative techniques as a preferred approach to analyzing survey data in the social acceptance context. The data used for this study originally comprised responses to a number of attitudinal questions, measured on a 5-point Likert scale, where -2 equaled to "totally disagree" or "very negative" and +2 represented "totally agree" or "very positive". For the purposes of this study, the responses

were rescaled to a range of 1 through 5, to follow standard reporting style in academic research. The Likert-scale enabled this research to analyze the data using various explorative techniques, including t-tests for overall differences in means between men and women, cluster analysis for identifying several types of groups by their acceptance of wind energy, and cross-tabulation for analyzing whether these groups vary by their gender distribution.

Results

An independent samples t-test analysis showed that women were more positive than men regarding all questions except their interest to participate in decision-making and become private investors in wind energy. In respect to these two questions, women were less interested to participate than men, and there was no difference between the genders in terms of their

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investment willingness. Overall, both women and men were positive about installing wind energy farms in Helsinki, but neither of the genders was in the majority willing to become investors in such projects.

Although visibility of wind turbines from the city's inhabited areas was not deemed a major issue, both genders clearly preferred offshore turbines located farther away from the shore, suggesting that distance matters for the social acceptance of wind farms in urban contexts. Further, acceptance of having wind turbines near a city's world heritage site was clearly lower across both genders than if the turbines were installed in a more industrial area, such as the city's harbour or landfill areas (Table 2).

Next, we performed a K-means cluster analysis to identify groups of people in the sample by their type of wind energy social acceptance. K-means is a non-hierarchical clustering method in which the number of clusters has to be determined in advance (Steinley, 2006). After performing the analysis repeatedly with the number of clusters ranging from two to five, a three-cluster solution was selected because it was reasonably balanced, easy to interpret, and theoretically meaningful. Each cluster was labeled in a manner that was deemed to best describe its characteristics. The three groups from the cluster analysis were labeled as 1) "Protagonists", which represented more than half of respondents, 2) "Centrists", and 3) "Antagonists". The latter two accounted fairly equally for the remainder of

the sample's respondents. As table 3 illustrates, these three clusters varied significantly from each other.

"Protagonists" (Cluster 1) comprise people who show highly positive attitudes toward wind power. High values in all variables ($M=4.71$, $SD=0.47$) suggest that "Protagonists" think positively of having wind farms in their city, and that doing so would have a favourable effect on the city's image and landscape. They strongly promote the idea that their city should provide locally produced wind power, and lead by example in reducing carbon dioxide emissions. Further, "Protagonists" are not ignorant of the best locations for wind power, but rather accept wind turbines both offshore and onshore, including highly visible locations in and around the city, and even the world heritage site on nearby islands in front of the city's harbor area. "Protagonists" would also like to influence decision making in regard to the location of placement for wind turbines, and would like to consume locally-produced wind power even if it was more expensive than alternatives, as well invest financially in wind power at the personal level.

"Centrists" (Cluster 2) are people who, similarly to cluster 1, have a generally positive attitude toward wind power, and consider it as a great way to improve the city's image, especially if the city provides an example to others by reducing CO₂ emissions. However, "Centrists" take a middle-of-the-road approach ($M=3.57$, $SD=0.76$) by being more conservative when it comes to the effects of wind turbines on the city's landscape. They are clearly

Table 3. Clusters and their characteristics

	Protagonists (Cluster 1)	Centrists (Cluster 2)	Antagonists (Cluster 3)
	n=1342 (56.5%)	n=550 (23.1%)	n=484 (20.4%)
A01	5	5	2
A02	5	4	1
B01	5	4	1
B02	5	3	1
C01	5	4	2
C02	5	3	1
C03	5	4	2
C04	5	4	2
C05	5	4	2
C06	5	3	1
C07	4	2	1
D01	4	4	4
D02	4	3	1
D03	4	3	1
<i>Mean</i>	<i>4.71</i>	<i>3.57</i>	<i>1.57</i>
<i>SD</i>	<i>0.47</i>	<i>0.76</i>	<i>0.85</i>

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pickier than “Protagonists” in regard to the locations for wind farms and are in favour of installing wind turbines farther offshore or on the city’s landfill areas, or other less visible on-shore areas around the city. Further, “Centrists” are less prone to consume only locally-produced wind energy given that it would be more expensive than alternatives, and less willing to personally invest in wind power projects. However, similar to “Protagonists”, they are willing to participate in decision making regarding the location of wind turbine installments in and around the city.

“Antagonists” (Cluster 3) consist of people who are quite opposite to the other clusters regarding wind energy prospects (M=1.57, SD=0.85). Put briefly, “Antagonists” are against the idea that Helsinki should build local wind power plants, and that having wind farms in the city’s area would have positive effects on the city’s image or landscape, especially when it comes to wind farm locations closer to the city’s inhabited and other visible, non-industrial areas. They are rather against having wind turbines anywhere in the city, and would not consume locally-produced wind energy if cheaper alternatives are present, nor are they willing to invest in wind power projects at the personal level. “Antagonists” would however, equal to their counterparts in the other clusters, be interested to participate in decision-making regarding the location of wind turbines in the city. Of note, “Antagonists” were the smallest cluster, representing a mere one-fifth of the sample, whereas “Protagonists” represented more than half of

respondents in the sample. Figure 1 illustrates the differences in cluster profiles between the three groups.

Finally, we cross-tabulated the data to find out if the three clusters differed from each other in terms of gender distribution. We used Pearson’s Chi-Square (χ^2) to test for statistically significant differences between observed and expected frequencies in gender distribution between the groups. This test excluded the possibility that any differences would arise by chance.

Table 4 suggests that the three clusters differ in terms of their gender distribution ($\chi^2 [2, 2376] = 77.83, p < 0.001$). Bearing in mind that the gender distribution of the sample was 38% female and 62% male, the differences between the clusters become quite explicit. Both “Protagonists” (42% female, 58% male) and “Centrists” (43% female, 57% male) include more women and fewer men than expected. Overall, almost 90 percent of all females in the sample fall into “Protagonists” and “Centrists”, the two clusters that reflect positive or more positive views toward having wind energy in and around the city. Conversely, “Antagonists”, who are characterized by negative or more negative attitudes toward wind energy, include significantly more men than women (21% female, 79% male), making the cluster distinctively male-dominated compared with the other clusters. While 20% of respondents in the whole sample represent “Antagonists”, a total of 26% of all males in the sample fall into this cluster.

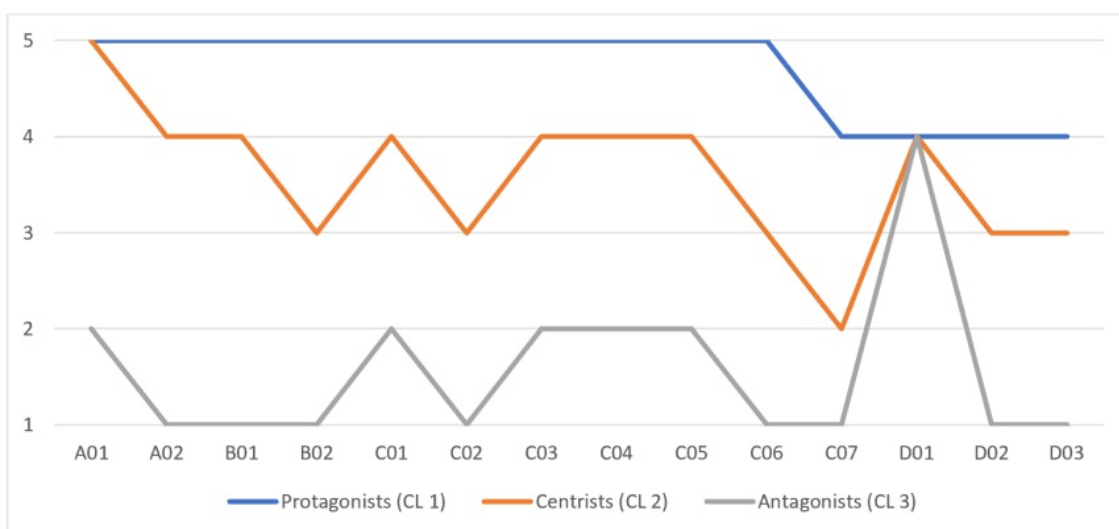


Figure 1. Illustration of cluster profiles

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Table 4. Gender distribution within clusters

Gender	N	Protagonists (CL 1)	Centrists (CL 2)	Antagonists (CL 3)	χ^2
Female	903	565/510 (62.6%, 42.1%)	238/209 (26.4%, 43.3%)	100/184 (11.1%, 20.7%)	77.83 *
Male	1,473	777/832 (52.7%, 57.9%)	312/341 (21.2%, 56.7%)	384/300 (26.1%, 79.3%)	

Note: observed/expected value, (% within gender, % within cluster), N=2376, df=2, * p<0.001

Discussion

This study has aimed to understand the different types of social acceptance, whether acceptance correlates with demographics, and what drives social acceptance of wind farms in urban landscapes. The analysis based on open sourced survey data from 2,376 residents in Helsinki, Finland, identified three groups of people by their acceptance or rejection of wind energy systems: “Protagonists”, “Centrists”, and “Antagonists”. These groups represent different types of social acceptance. “Protagonists” have highly supportive and positive attitudes toward wind energy. “Centrists” also adopting a positive but more moderate approach. “Antagonists” show explicitly negative and oppositional attitudes to wind energy.

While women were predominantly represented among “Protagonists” and “Centrists”, the opposing group of “Antagonists” was distinctively male-dominated. The three groups differed on almost every investigated factor, while all of them wanted to participate in decision-making processes related to wind energy projects in and around the city. Overall, three factors seem to matter for social acceptance of wind farms in urban landscapes: 1) distance of wind farms from inhabited coastal areas, 2) demographics in terms of gender, and 3) willingness to participate in decision-making processes related to wind energy projects.

Contributions to theory and practice

These results contribute to theory in several ways. First, the study contributes to the literature on social acceptance by showing once again that distance matters in wind energy acceptance. The farther wind farms are located away from inhabited coastal areas, the more accepting people are of them. Of note, the increased distance in this study was associated with installing offshore, rather than onshore wind turbines. Previous literature (for example, Harper et al., 2019; Hoen et al., 2019) only provided weak or controversial evidence on the role of distance in wind energy acceptance. This

study thus provides empirical support for the “proximity hypothesis”, while keeping in mind Leiren et al.’s (2020) argument that distance itself does not matter, but rather that reducing the visual impact by increasing distance and visual awareness of the wind farms does. Also, the study partially validates previous literature that suggested the proximity of wind farms to protected areas and areas with high environmental, historical, or archaeological value are less accepted (Cohen et al., 2014; Leiren et al., 2020). In the present study, location of wind farms near the city’s world heritage site was also not surprisingly less accepted than installing turbines in more industrial areas, such as nearer to the harbour.

Second, the results contribute to the debate on social acceptance by showing that gender demographics matter for wind energy acceptance. In the Finnish urban context, women come out as more supportive of wind energy than men. In this vein, the results here are in marked contrast with arguments by, for example, Azarova et al. (2019) and Ólafsdóttir and Sæþórsdóttir (2019), who found that women are less accepting of wind energy compared with men. In this research sample, the results were quite the opposite, and women were overrepresented in both clusters that support adoption of wind energy systems, as well as underrepresented in the cluster that opposes wind energy. Further, these results suggest that women are not significantly different from men in terms of having a (somewhat low) willingness to invest in wind energy. Notably, urban residents, in general, had higher investment willingness associated with their attitudes toward wind energy. Again, this finding contrasts with some previous literature. For example, Johansen and Emborg (2018) found that, overall, men are more willing to invest in sustainable energy systems, either to support sustainable energy or for economic gains. The specific motivational differences across genders were not covered by the current study.

Third, the results contribute to the literature on general social acceptance by confirming that there are different

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types of acceptance, in this case with respect to wind energy. While previous literature tends to make a dichotomous distinction between proponents and opponents of wind energy, our results support the arguments by, for example, Aitken (2010) and Khorsand et al. (2015), who suggest that there are more nuanced distinctions between the dichotomies. In this sense, our results are in line with Gross (2007), who argued that there are three kinds of people in terms of their attitude toward wind energy (positive, neutral or negative), and Langer et al. (2018), who proposed three acceptance modes (active acceptance, ambivalence, active non-acceptance). Interestingly, our results suggest that the differences between the three groups are quite distinctive in all but one factor: willingness to participate in wind energy planning processes. This finding is novel in that it suggests all groups, including “Centrists”, are quite certain about their opinions in the sense of being willing to actively influence public decision-making.

In terms of contributions to practice, in line with previous research (Bolwig et al., 2020; Giordano et al., 2018; Zaunbrecher & Ziefle, 2016), the research suggests open consultation with the community, including transparent, comprehensive, and participatory processes in renewable energy projects can contribute to social acceptance, while a lack of such processes when discussing energy and the environment can contribute to conflicts. Renewable energy developers and policy-makers should ensure that such participatory planning engages all members of community, including those who oppose wind energy. In fact, opponents of wind energy should be specifically addressed, not to mitigate their opposition by changing “wrong” attitudes into “right” attitudes, but rather because they may be asking for different types of “exchanges” than the rest of the community (Aitken, 2010; Groth & Vogt, 2014).

For example, objectors tend to emphasize aesthetics compared to supporters of wind energy (Groth & Vogt, 2014; Enevoldsen & Sovacool, 2016). Hence, in order to increase social acceptance of wind energy systems in urban landscapes, energy developers and policy makers are advised to focus on finding ways to reduce the visual impacts of wind farms, rather than providing an unlikely community with increased opportunities to invest in wind energy projects. The possibilities for innovative transformation have become a topical notion as we live now during a pandemic, and hopefully soon shift to a post-COVID-19 world, where governments across the globe are planning to boost de-carbonization of their

economies, in order to increase both human societal and environmental welfare.

Limitations and Future Research

This kind of open data research puts forward various challenges. First, the data has limitations given the fact that the survey was not designed, nor was the data collected by the author of this research paper. Wolsink (2018) emphasizes that, social acceptance being a set of processes, a researcher should examine all dimensions of social acceptance simultaneously, in order to understand the acceptance processes. In the present data set, the focus was on community acceptance and, thus, not all dimensions of social acceptance such as market and socio-political acceptance were covered. This is likely due to the specific research objectives of the City of Helsinki at the time of conducting their survey.

Second, previous research (for example, Aitken, 2010; Cohen et al., 2014; Enevoldsen & Sonacool, 2016; Harper et al., 2019) has noted that in addition to socio-demographical factors, people’s knowledge and experience of a technology also matters. Those without having had any experience with wind energy are more likely to oppose it. In contrast, this study relied on anonymous survey responses collected through an open online survey and published as open data. The data lacked information about respondents’ level of knowledge and experience about wind energy technology, such as their political views, environmental self-identity, education, income, marital status, length of residence, and so forth.

Third, the survey covered visual impacts of wind farms, but did not utilize visual exposure to the spatial location of wind farms. Visual exposure, such as showing the respondents still images of wind turbines inserted into real photographs of their city, can influence social acceptance responses (Westerberg et al., 2015; Hevia-Koch & Ladenburg, 2019; Cranmer et al., 2020).

Future research should focus on the role of “place identity” (Hallan & Gonzalez, 2020) in social acceptance of wind energy. Likewise, it should examine place-related and other “deeper” values (Hammami et al., 2016) that people have, which can affect social acceptance or rejection of wind energy in an urban community. Research that advances further should investigate the connection between place identity and perceived visual impacts in the urban landscape.

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