



# Adding insult to injury: The development of psychosocial stress in Ontario wind turbine communities



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## ABSTRACT

Though historically dismissed as not-in-my-backyard (NIMBY) attitudes, reports of psychosocial stress linked to wind energy developments have emerged in Ontario, Canada. While the debate and rhetoric intensify concerning whether wind turbines ‘actually’ cause ‘health’ effects, less sincere attention has been given to the lived experience and mental well-being of those near turbines. Drawing on theories of environmental stress, this grounded theory, mixed-method ( $n = 26$  interviews;  $n = 152$  questionnaires) study of two communities in 2011 and 2012 traces how and why some wind turbine community residents suffer substantial changes to quality of life, develop negative perceptions of ‘the other’ and in some cases, experience intra-community conflict. Policy-related forces, along with existing community relationships may help explain much of these differences between communities. We suggest a move beyond debating simply whether or not ‘annoyance’ represents a ‘health impact’ and instead focus on ways to minimize and attenuate these feelings of threat (risk) and stress at the community level.

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## 1. Introduction

The emphasis in some jurisdictions on using wind to meet carbon emission and sustainable energy targets has resulted in backlash from some host communities. In the case of Ontario, Canada, this backlash has included claims of negative health effects from local wind turbines. Ironically, the same technology is said to actually improve human health by replacing ‘dirtier’ technologies like coal (Markandya and Wilkinson, 2007) and avoiding disease outbreaks, malnutrition, and food insecurity associated with global climate change (Confalonieri et al., 2007; Jankowska et al., 2012; McMichael et al., 2006; WHO, 2002). Within the province and elsewhere, recent reports indicate that turbines are being linked to negative human health effects on those living ‘too close’ (Deignan et al., 2013; Krogh et al., 2011; McMurtry, 2011; Nissenbaum et al., 2012). In order to further investigate these potential linkages, Health Canada and the University of Waterloo are both now conducting epidemiological studies. While these projects hold promise for addressing the somatic components of health, there has been little work devoted to the psychosocial components of health and well-being (Shepherd and Billington, 2011). One

exception is a review of the noise annoyance literature by Pedersen and Halmstad (2003) who suggest the link to noise and negative psychosocial impacts is at least plausible based on comparison to air and road traffic noise studies. Because of the lack of psychosocial studies on turbines themselves, we draw on analogous theory and empirical work related to technological hazards and risk.

Despite widespread discussion of wind turbine-related health issues in the media and on the internet, the academic literature is relatively silent on the role of health risk perception and broader social determinants of health related to turbines. Instead, the current literature emphasises the dual and linked roles of turbine noise and aesthetics as motivators for concern and opposition (Devine-Wright, 2005; Eltham et al., 2008; Hill and Knott, 2010; Walker, 1995; Wolsink, 2006, 2000). Relatively less explored are community-level issues like stress-inducing intra-community social conflict (Baxter, 2006; Hill and Knott, 2010; Kasperson et al., 1988; Walker et al., 2014). Our study is rooted in humanistic geography which takes a more empathetic approach and more thoroughly traces the mechanisms for health impacts in two turbine communities immediately adjacent to each other.

The research context is Ontario – currently Canada’s leader in terms of turbine installations with approximately 2500 MW of capacity (~1600 turbines) or 34% of the country’s total (CANWEA, 2013). The province has promoted wind and other renewable energies through the Green Energy Act (GEA); an initiative that aims

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to make Ontario a “... global leader in the development of renewable energy” (Government of Ontario, 2008).

The GEA has severely limited the arguments deemed acceptable by the government to reject a renewable energy project to two main issues: i) human health and ii) environmental damage. Though not referring to Ontario's Green Energy Act specifically, some have suggested that objectors may be selective in terms of their public complaints in order to align with what is considered legitimate by policy (Bosley and Bosley, 1988; Gipe, 1995). Thus, a focus on physical health complaints (e.g., nausea, cognitive deficits, dizziness/vertigo, and cardiovascular problems) may mask equally serious mental health and/or general quality of life impacts that have already been delegitimized by officials in the public sphere (Seglins, 2012; Talaga, 2010).

## 2. Literature review

The focus of this study is on the psychosocial impacts of wind turbine development at both the individual and community level. Elliott et al. (1993, p.791) define the term as a complex mix of “distress, dysfunction, and [or] disability manifested in a wide range of psychological, social and behavioural outcomes ...” (see also Elliott et al., 2004; Luginaah et al., 2002; Wakefield and Elliott, 2000). Outcomes may include worry, anger, despair, tension, community division (Wakefield and Elliott, 2000) and conflict (Couch and Kroll-Smith, 1994; Edelstein, 1988). The above studies draw on environmental stress and coping theory (Baum et al., 1982; Lazarus and Folkman, 1984), which views stress as an outcome of the way in which environmental forces “threaten an organism's existence or well-being” (Baum et al., 1982; p. 15). Symptoms manifest from the combination of appraisal of threat and perceived lack of resources to cope with that threat (Baum et al., 1982). Thus, various types of developments pose risks (threats) to individual health and community psychosocial well-being through (perceived) exposure to harmful chemicals and a perceived lack of resources to deal with that threat. Yet, studies involving technological hazards tend to narrowly define psychosocial impacts as the combination of concern about the facility (appraisal of threat) and actions towards the facility (problem focused coping) (e.g., Elliott et al., 1997; Luginaah et al., 2002; Wakefield and Elliott, 2000). This may be a side effect of using mainly quantitative, survey-dominant methodologies. There are exceptions though; including the qualitative interview-based work of Baxter (2006) who focuses more on social conflict and its relation to the local internal dynamics at the community level (see also Barnes et al., 2002; Mason et al., 2014).

In our study of wind turbines, we move beyond the individual and take a holistic approach that considers the interplay between individual and community. We do this by combining both survey and in-depth interview based work in the same study. This approach is consistent with the work of other geographers (Meth and McClymont, 2009; Wyley et al., 2007) who use mixed-methods to fill theoretical and empirical gaps, incorporate multiple truths, and “produce [both] the generalizable and the particular” (Warshawsky, 2014, p. 161).

There is some reference to psychosocial impacts already in the wind turbine literature, particularly in relation to noise annoyance. In contradistinction to the idea that physiological determinants of stress (e.g., noise) are the only legitimate turbine health impacts, these studies tend to tightly couple annoyance and health through the WHO concept of well-being – without specifically using the term ‘psychosocial’ (e.g., Nissenbaum et al., 2012) or by using it only fleetingly (Pedersen and Halmstad, 2003). Nevertheless, Shepherd and Billington (2011, p. 393) do use this term to suggest that turbines impact health through a number of interrelated pathways

whereby, “a simple stimulus–response relationship is inadequate, and more attention needs to be paid to psychosocial factors when assessing the impact of wind turbine noise”. In their review of the health effects of turbine noise, Pedersen and Halmstad (2003) seem to agree by pointing out that annoyance itself should be investigated further; since there tends not to be a dose response relationship between noise and annoyance. Like the hazards studies, these turbine studies/reviews tend to focus on the individual; yet stress, appraisal and coping are also embedded in wider social contexts.

The definition of health impacts itself is highly politicized in the policy context of wind turbines and is thus reasonably considered a determinant of psychosocial impacts. One debate hinges on the notion of whether annoyance is considered a (legitimate) health impact (Shepherd et al., 2011). Claims against annoyance-as-health determinant may then be viewed as a tactic to delegitimize the complaints of locals convinced they are experiencing health harm from some other aspect of turbines (e.g., vibration, noise). In a pivotal document from the Ontario Medical Officer of Health, annoyance was acknowledged as an impact of turbines, but it was simultaneously decoupled from direct health impacts – which are implicitly presumed to be more legitimate (CMOH, 2010). Further, a Canadian Wind Energy Association sponsored report specifically stated that though noise from turbines in particular evokes annoyance (e.g., Pedersen and Waye, 2004) the latter “is not considered an adverse health effect or disease of any kind” (Colby et al., 2009, p. 3–13). On the contrary there is some support for the idea that environmental noise can contribute to feelings of anxiety (Stansfield et al., 2000) stress, nausea and mood changes (Babisch, 2002) but these principles are rarely applied to wind turbines. Further, there are recent studies which suggest that noise and annoyance may be indirectly linked to the more legitimized somatic health effects through their relationship to sleep (Pedersen et al., 2007; Shepherd et al., 2011). For example, based on self-report surveys Nissenbaum et al. (2012) found that lower quality sleep and poorer mental functioning can be simultaneous impacts from living close to turbines. What is important for our purposes is that the public debate surrounding this evidence is may be reasonably considered a determinant of psychosocial impacts on its own.

## 3. Methodology

Most studies about wind turbines, including studies of the psychosocial impacts from turbines, are quantitative. This has prompted a call for more qualitative and mixed methods studies (Aitken, 2010; Devine-Wright, 2005; Ellis et al., 2007). Our study is mixed methods, guided by a grounded theory framework that is flexible and allowed concepts to be developed inductively (face-to-face interviews), then interrogated further quantitatively (surveys) (Charmaz, 2006; Pedersen et al., 2007). We define a “community” pragmatically, in the sense of a collection of households in close proximity to a turbine development. Port Burwell, Ontario was chosen as the primary site because it is home to Erie Shores Wind Farm, one of the earliest large-scale wind farms in the province with 66 turbines (99 MW) (CANWEA, 2013). Clear Creek, neighbouring Port Burwell to the east is home to a total of 18 turbines (~30 MW). The move into Clear Creek was facilitated by the grounded theory design whereby residents in Port Burwell talked about those who are dissatisfied with turbines living “down the road”.

The interviews were audio recorded, transcribed, and analyzed for emergent themes with the help of NVivo qualitative data management software. The 2012 survey was conducted after the majority of interviews were complete, is based on themes in the

interviews, and consisted of a drop-off, mail-back questionnaire. More details about that process are described in a companion article (Walker et al., 2014). The resulting data from the survey was quantitatively analyzed using SPSS software. This research had ethical approval from The University of Western Ontario's ethics board.

For both the interviews and survey ( $n = 178$ ), letters were dropped off at all homes within 1 km (interviews) or 2 km (survey) of a turbine – the latter being a setback distance suggested by opposition groups at the time. We interviewed all of those over the age of 18 willing to be interviewed. Twenty-six interviews were conducted in 2011 and 2012 with residents within 1 km of a turbine. In order to explore particular issues, seven of the 26 were purposefully chosen because of either their expertise ( $n = 2$ ) or known opposition to local wind turbines ( $n = 5$ ). Thirty-eight percent of the interview sample are women. In the interest of rapport and interview flow we did not ask sociodemographic details but the majority were between the ages of 40 and 75, and most seemed to own their homes. The survey of 152 was carried out in 2012 with those within 2 km (see Table 1). The increase in distance was required to allow for larger numbers of survey responses with a final survey response rate of 33%. Self-selection is the main limitation for both the interviews and the surveys and these issues are discussed in more length in our companion paper (Walker et al., 2014).

#### 4. Survey dependent variable

While there are a number of studies that look at individual support/opposition to turbines from local and non-local residents (Baxter et al., 2013; Brauhnoltz, 2003; Eltham et al., 2008; Jones and Eiser, 2010; Krohn and Damborg, 1999) we focus on the impact of the development on the community. Thus our dependent variable is the question: "Overall, the existing wind power project has had more positive impacts than negative impacts on my community"; measured on a Likert scale; 1 = strongly agree to 5 = strongly disagree. As such, even if a person supports the local development individually, they may simultaneously feel the negative aspects on the community overcome their particular opinion.

#### 5. Findings

This section is organized according to key psychosocial themes that emerged in the interviews and were interrogated further using the survey data. At 72%, there was overall support for the wind

**Table 1**  
Sample description<sup>a</sup> (survey respondents;  $n = 152$ ).

Characteristic		Port Burwell	Clear Creek	Total
Gender	Male	50%	54%	52%
	Female	39%	43%	41%
Age	18–34	9%	13%	11%
	35–49	17%	19%	18%
	50–65	38%	39%	38%
	66+	29%	27%	28%
	Number of years in community	0–3	11%	4%
	4–6	13%	16%	14%
	7–10	17%	20%	18%
	11+	59%	60%	59%
Annual family income (after-tax)	>\$20,000	5%	4%	5%
	\$20,000–49,999	26%	20%	23%
	\$50,000–79,999	18%	27%	22%
	\$80,000–109,999	10%	11%	11%
	\$110,000+	7%	3%	5%
Housing situation	Rental property	6%	6%	6%
	Home owned	91%	93%	92%

<sup>a</sup> Results may not add up to 100% because of the option 'prefer not to say' or incomplete surveys.

turbines, with Port Burwell far more supportive (80%) compared to Clear Creek (63%). This sets the stage for community-differentiated results on a variety of concepts linked to psychosocial health.

#### 6. Impacts on daily 'quality of life'

Questions in the interviews about how residents' lives have changed since the turbines were installed often turned to quality of life issues. Initially we were hearing about minor changes as, "Mike" [all names are pseudonyms] describes (14/16; proportion is number of people whose transcript included this theme/number interviewed in that community):

**"Mike" (Port Burwell):** Well [the turbines] do make noise. I don't think, I haven't heard of anyone say it's too much and from our experience and my family and parents who live [location] ... and I mean, you don't hear it anymore. It's completely background noise at this point.

'Getting used to it' suggests that indeed the experience has not been overwhelmingly positive, but life is more or less the same when compared to before local wind turbines. Conversely, for three vocal opponents interviewed in Clear Creek, daily life has changed to the point where two of them have moved out of their homes. "Barbara" is one of these people and although she is unsure of the exact mechanism, she is convinced that the turbines are ruining her "existence":

**"Barbara" (Clear Creek):** If I stay there longer than 4 hours, then I feel as though I want to start screaming. But I don't because I understand what's happening. But it is not a pleasant feeling. ... It's not much of a life ... I call [it] an existence but not a life.

While health concerns are front and centre, these residents find it quite difficult to disentangle 'quality of life' from somatic issues whereby noise and sleep are connected. As "Barbara" says, she cannot even get to sleep near the wind turbines:

**"Barbara":** ... for 3 years. I had no difficulty sleeping, slept like a baby. But when the turbines started generating, that was in November 2008, all of that was gone.

The survey results support the notion of differences between Clear Creek and Port Burwell in terms of daily life impacts. Clear Creek residents were significantly more likely to agree with a variety of statements including "I enjoy spending time outdoors less due to the wind turbines" and "I invite guests over to my house less frequently because of the wind turbines" (see Table 2). In all cases the residents of Clear Creek are more likely to perceive a 'daily life' problem than those in Port Burwell. Further, there are medium to strong negative correlations (0.44–0.68) between the five 'daily life' questions and the 'community impact' dependent variable.

#### 7. Conflict as talk about 'the other'

One of the strongest themes relating to psychosocial effects in the interviews was manifest through negative conversations 'of the other'. This theme developed in Port Burwell where supporters would often make light of or even mock the problems facing those concerned about or opposed to wind turbines. For example, "Kelly" and "Pete" suggest that opponents have cleverly 'chosen' particular health effects that cannot be proven or disproven (3/16) while others simply have some kind of negative opinion of those opposed to wind turbine development (13/16):

**Table 2**  
Effects on 'daily life' in both communities.<sup>1</sup>

Survey question		A <sup>a</sup>					D	Mean <sup>b</sup>	p <sup>c</sup>	Corr <sup>d</sup>
		1	2	3	4	5				
I enjoy spending time outdoors less due to the wind turbines	PB	3	4	10	8	76	4.50	0.00*	-0.68**	
	CC	19	12	9	4	57	3.68			
I have thought about moving to be further from the wind turbines	PB	1	5	14	7	73	4.46	0.00*	-0.64**	
	CC	19	7	7	6	60	3.81			
I spend less time at my home during the day to limit the impact of the wind turbines	PB	0	0	16	5	79	4.63	0.00*	-0.55**	
	CC	14	4	13	9	59	3.94			
I sleep in a place other than my home to limit the impact of the wind turbines	PB	0	0	11	5	84	4.73	0.04*	-0.44**	
	CC	6	3	8	10	73	4.42			
I invite guests over to my home less frequently because of the wind turbines	PB	0	1	10	6	83	4.70	0.01*	-0.46**	
	CC	9	3	10	7	71	4.28			

<sup>a</sup> 1 = strongly agree; 2 = somewhat agree; 3 = neither agree nor disagree; 4 = somewhat disagree; 5 = strongly disagree. Values shown are percentages of each community subsample. (PB = Port Burwell; CC = Clear Creek).

<sup>b</sup> Mean score for each subsample – see note a.

<sup>c</sup> Probability – difference of community means test:  $p < 0.05$  (\*).

<sup>d</sup> Spearman ordinal correlation coefficient with dependent variable: Overall perceived community impact \*\* $p < 0.01$ .

**“Kelly” (Port Burwell):** No unless you have migraines (laughter) they can test for that, but just to say how severe your headaches are or if you're dizzy they can't test that. And it's kinda funny that they'd pick those things that you cannot prove that they're true or not true (laughter).

**“Pete” (Port Burwell):** And, I hear other people complaining, “oh the wind turbines, uh, affect our health” and I'm scratching my head saying, “unless it lands on you, chances are it's not going to hurt you ...”

Negative perceptions of the 'other side' were also part of the interviews with those from Clear Creek claiming their health problems are linked to turbines. These people felt as though they were 'attacked' not only by local residents but wider groups who seem to readily diminish the idea that turbines have negative impacts – including the provincial government.

**“Henry”:** Unfortunately when we're under this one particular political policy we've had for the last 8 years, I will mention that it's the provincial Liberals ... [they have] a policy of saying there's no problem.

In this way, Henry and other such residents were made to feel marginalized regardless of the cogence of academic evidence they put forward. Perhaps in response to what they face, opponents seem ready to cast those who are pro-turbines as having an economic stake in the matter. “Barbara”, for example, believes turbine supporters must be directly benefitting in some way:

**“Barbara”:** The people who are pro-wind are the people who are benefitting financially or in some other way and the people who are not so sure about wind and that are against it are because they're suffering the effects.

Since the survey was designed and distributed before the theme of 'negative feelings toward the other' was developed, there were no survey questions specifically dealing with this issue. The closest

questions dealt with trust in various groups within and beyond the community (Table 3). There are no significant differences for any of the trust questions between Port Burwell and Clear Creek (not shown in table), but since trust in others can have a strong effect on psychosocial well-being in terms of coping, we compared those supportive of and those opposed to their local wind development. Table 3 shows stark differences in 'trust' amongst those supportive and opposed to local wind turbines in both communities. Those supportive were significantly more trusting of local government, the wind developer, turbine support groups, and neighbours/colleagues. As expected, those opposed to their local development were significantly more trusting of opposition groups. Only through the group 'friends and/or family' was a significant difference not found – suggesting that perhaps trust through personal relationships has not been as affected by the wind turbines. Very strong correlations between trust and perceived community impact also exist but are weakest amongst the two 'closest' groups: neighbours and/or colleagues and friends and/or family.

Though few talked about open conflict or hostility in the community, opponents and supporters typically showed a certain lack of respect and disdain for each other. It is very difficult to tease out the impact of this tension from the usual community squabbles and gripes; indeed turbine conflict likely exacerbates existing divisions as cliques are common in rural communities (Cutchin, 1997). Yet, these negative sentiments directed towards the “other” seem to work against well-being to some degree; and ironically health effects of wind turbines are at the centre of the hostility. Nevertheless, Port Burwell residents in particular seemed more immune to conflict over health effects or other local turbine-related debates. In order to detect if conflict was front of mind, during the interviews with residents of Port Burwell, questions were asked about “how the community has changed since the arrival of the turbines in 2006”. In all 16 of the Port Burwell interviews, residents cited no major changes since the turbines. A passage from “Thomas” exemplifies this sentiment:

**“Thomas” (Port Burwell):** I don't know. I really couldn't answer that question because I don't know. I've never heard anybody

**Table 3**

Stakeholder trust (Survey question: I trust *this stakeholder* to provide me with accurate information about the local wind turbines).

Group		A <sup>a</sup>					D	Mean <sup>b</sup>	p <sup>c</sup>	Corr <sup>d</sup>
		1	2	3	4	5				
Local government	S <sup>e</sup>	26	34	21	12	7	2.39	0.00**	0.43**	
	O	23	13	18	10	38	3.28			
Wind developer	S	29	25	26	13	7	2.43	0.00**	0.51**	
	O	15	5	18	13	49	3.74			
Local wind turbine opposition groups	S	10	14	32	17	28	3.40	0.00**	-0.28**	
	O	30	27	24	7	12	2.46			
Local wind turbine support groups	S	19	30	28	13	10	2.63	0.00**	0.40**	
	O	20	5	27	17	32	3.37			
Neighbours and/or colleagues	S	19	34	33	9	5	2.46	0.02*	0.25*	
	O	12	27	29	10	22	3.02			
Friends and/or family	S	28	32	28	10	2	2.25	0.08	0.29*	
	O	25	23	30	10	13	2.63			

<sup>a</sup> 1 = strongly agree; 2 = somewhat agree; 3 = neither agree nor disagree; 4 = somewhat disagree; 5 = strongly disagree.

<sup>b</sup> Mean score for each subsample – see note a.

<sup>c</sup> Significance of difference of support means test:  $p < 0.05$  (\*). All means tests were shown to be significantly different except those comparing levels of trust amongst friends/or family.

<sup>d</sup> Spearman ordinal correlation coefficient with dependent variable: Overall perceived community impact: \*\* $p < 0.01$ .

<sup>e</sup> Values are percentages for Supportive ( $n = 110$ ) and Unsupportive ( $n = 35$ ) subsamples. Likert-scale question of “I support the existing wind power project in my community” was transformed into a dummy variable (1 or 2 (Strongly or Somewhat agree) = 0 (S), 4 or 5 (Somewhat or strongly disagree) = 1 (O)).

complain. Mostly I hear people saying, “Wouldn’t mind having a couple of those on my property”.

In stark contrast to those in Port Burwell, community conflict in Clear Creek was more front-of-mind for the residents we interviewed. In an interview with “Henry”, the community being “split” is the first thing he speaks about when asked how life has changed since turbine construction in 2008, while “Barbara” states that the wind turbine issue is “divisive”:

**“Henry” (Clear Creek):** Well ... its split up to a degree to a large degree the whole, all the people. Some of the ones who were indifferent, some of the ones who are very concerned ...

**“Barbara”:** So it’s very divisive and those neighbours who have [wind turbine] leases don’t speak to the people who you know signed our petition and visa-versa.

Though themes of community conflict were only evident in interviews with Clear Creek residents, the survey suggests it is actually a concern in both communities. In fact 16% of Port Burwell residents surveyed agreed there were *unacceptable* levels of conflict, while 45% agreed in Clear Creek – a difference that is statistically significant (Table 4). Despite the fact that there was a large difference in perceived levels of conflict, there were no significant differences between various oppositional activities such as signing a petition, speaking against turbines at a local meeting, and/or posting to online comment boards (not shown).

## 8. Explaining differential psychosocial impacts

While community-based differences in impacts are in themselves important, the grounded theory approach also allowed us to investigate why this may have been the case. Some of those explanations are described in a companion piece outlining the differences in the types of turbines and their spatial juxtaposition within each community (Walker et al., 2014) while the issues described below are more oriented to perceptions of the siting process and the social makeup of the communities as they relate to psychosocial impacts.

## 9. Community dynamics and the arrival of ‘newcomers’

Conversations suggested that newcomers were treated differently than long-time residents. When describing the social aspects of life in Port Burwell through interviews for example, most people said that generally neighbours were friendly and approachable (15/16). They also commonly stressed that although they do not live close to one another like would be common in an urban setting, there is still a close-knit atmosphere. “Diane” from Port Burwell

who is supportive of turbines, seemed to almost take offense when the interviewer implied neighbouring is different in rural areas:

**“Diane” (Port Burwell):** [we get along] really well ... we have a neighbour right across the street in that white house. And she is wonderful. She doesn’t miss a thing. Our other neighbours on that corner,[Names] ... they’re on standby, our neighbours down the road [Names], they’re on standby. So, we’re all, we may not be next door to one another like in a city but it doesn’t mean we’re not neighbours. And we look out for the other

In contrast, in three interviews in Clear Creek, there was much more discussion of a fractious environment that potentially impacted individual and overall community well-being. Even years prior to the construction of the turbines in Clear Creek, “Henry” explains how he has experienced the division between newcomers and the long-time residents:

**“Henry”:** Like I was just talking to you about these people who have lived there since the 1950s or something, when they grew up as kids there and they stayed there and they stayed on the farm. They’re a completely different group ...

How the division between these two “different” groups is sustained is described by “Barbara” who, is also concerned about the impacts turbines are having. Being a newcomer herself, she describes how her best attempts at integrating with long-time residents were rebuffed:

**“Barbara”:** People keep with their own groups that they’ve established since they were born there. But everybody has to be born someplace ... and I’d like to get to know the new community and however I found them very distant ... They were not welcoming newcomers with open arms... other newcomers have told me the same thing that, one of my neighbours down the road he says “well I’ve been here for 10 years and I’m still considered an outsider”.

This notion of cliques of long-time residents may go a long way to describe the majority of instances in Port Burwell where people claimed everyone got along quite nicely and in some cases, friendly relations (15/16) may have prevented wind turbine-related conflict. This is exemplified in the case of long-time residents “Carolyn” and “Frederick” a couple who have lived in the area for over 10 years. Perhaps because the closest turbine to their home was a mere 350 m away, the couple had initial problems with the lack of equity in wind turbine siting – however they do not actively oppose the local wind turbines. In what they say below, there is the suggestion that the couple had to choose between being disgruntled and continuing a historically good relationship with their neighbour who has a turbine on his land:

**“Carolyn” (Port Burwell):** ... we all need each other, we don’t need conflicts ... I mean he comes over, he [does major job], mind you he gets paid for it but there are little things they do for you, you know. [“Frederick”] has a problem with the riding lawnmower or something, [neighbour] comes over and helps him out ... So we do need each other and we don’t want to have conflict with our neighbours because of that. It won’t solve anything anyway, I mean [the turbines are] there and that’s it.

This also underscores the high psychosocial costs to taking the opposite decision that is, if this couple chose to take a public stance against the turbines.

**Table 4**  
Community<sup>1</sup> conflict.

Survey question		A <sup>a</sup>		D			Mean <sup>b</sup>	T-test p value <sup>c</sup>
		1	2	3	4	5		
The existing wind power project has created unacceptable levels of community conflict	PB	6	10	38	15	29	3.51	0.00**
	CC	21	24	29	18	9	2.71	

<sup>a</sup> 1 = strongly agree; 2 = somewhat agree; 3 = neither agree nor disagree; 4 = somewhat disagree; 5 = strongly disagree. Values shown are percentages of each community subsample. (<sup>1</sup>PB = Port Burwell; CC = Clear Creek).

<sup>b</sup> Mean score for each subsample – see note a.

<sup>c</sup> Significance of difference of community means test: \*\**p* < 0.01.

## 10. The planning process

The turbine planning and siting process itself seemed to play a role in facilitating or entrenching conflict and potential psychosocial impacts. Both the Erie Shores and ‘Clear Creek’ wind farms were sited and designed before the controversial provincial GEA legislation that removed municipal veto powers over renewable energy. Former local politician “Hilary” describes how this worked to quell concerns in Port Burwell:

**“Hilary” (Port Burwell):** ... at that time Bayham [Port Burwell area] had a lot of say, but now, right now the way it stands they have, the municipalities have no choice so I think people are just angry about that and they're digging in their heels ... if somehow you can engage them beforehand and say this is what we're planning, here's the you know, the most common concerns, here are the answers to these ... you know, this is not really a concern, or this might be a problem but this is how we're going to mitigate it. And just kind of get the anxiety level down.

The survey results serve to reinforce the idea that there are different views of the siting process in the two communities (see Table 5). Most notably, there is a significant difference in the first question dealing with ‘ability to prevent the project’ – though it should be noted both communities fell more toward the ‘agree’ than ‘disagree’ side. This suggests that the residents of both Port Burwell and Clear Creek felt as though there was not much they could do to prevent the project – but slightly more so in Clear Creek (mean: 2.74 vs 2.29). The remaining three questions dealt with how well various institutions protected individuals from human health problems. Though all differences were in the expected direction (i.e. Port Burwell more protective), there were no significant differences using community as the predictor (items 2–4). However there was when means were compared using the dependent variable perceived community impact (not shown). It is also clear that strong correlations exist between all ‘process’ questions shown and overall community impact – indicating perceived procedural justice leads to higher community support. Together, it is possible that the different planning procedures played a role changes to daily life and psychosocial stress.

## 11. Discussion and conclusion

This paper traces the ways in which psychosocial health may be influenced by wind turbines. This reinforces and expands the model of health impacts from turbines suggested by Shepherd et al. (2011) and the model of psychosocial stress (Lazarus and Folkman,

1984) that is typically used to model psychosocial impacts from technological hazards. Consistent with those models, we reinforce the idea that if the WHO (1947) and United Nations (1984) definitions of health as ‘well-being’ are to be taken seriously, there can be important social determinants of health particularly for those who speak out against turbines and ironically, those who claim they are experiencing negative health (and other) impacts from them. We expand on these frameworks to describe determinants that are much more social and policy-oriented in nature – issues that go beyond the concepts of noise, aesthetic sensitivity, and annoyance. This ties together the developing stream of research focused on annoyance and health impacts (CMOH, 2010; Pedersen and Halmstad, 2003; Pedersen et al., 2007) together with that which centres on issues of facility siting and justice (Krogh et al., 2011; Wolsink, 2007, 2006).

We conceptualize the experiences of residents in terms of two key impacts (impacts on daily life and community conflict) along with two concepts that help explain further why those impacts develop (social context and the planning/siting process). At the same time we highlight that the impacts are not evenly felt, rather they are magnified for those who oppose the turbines. Together these concepts explain how residents in one community (Port Burwell) seem to avoid or socially insulate themselves from all manner of negative impacts in an effort to sustain positive community relations. Meanwhile some residents in neighbouring Clear Creek cannot – possibly because of pre-existing community divides. By taking on the challenge of Devine-Wright (2005) and others (Aitken, 2010; Ellis et al., 2007) to move beyond survey methods alone, we describe subtleties that may have otherwise been missed with one method.

We expand the Shepherd and Billington (2011) framework for understanding health impacts from turbines by way of Lazarus and Folkman's (1984) model of psychosocial environmental stress in communities living with hazards. Both are based on modified stimulus–response models and our findings build on the determinants of “annoyance” in the former case and “appraisal of threat” in the latter. This helps trace how the nearly one in three who reported they spend less time outdoors and one in four who have thought about moving because of the turbines in Clear Creek become disturbed or feel threatened in the first place. This is consistent with hazardous facility siting literature that states that the stressor (i.e. exposure) is only one of several mediating factors that shape the experience psychosocial impacts (e.g., Elliott et al., 1993).

Though intra-community conflict has been reported in the literature on hazards (e.g., Baxter, 2006; Mason et al., 2014) it has not been a prominent feature of the literature on wind turbines or

**Table 5**  
Siting process and community<sup>1</sup> impact.

Survey question		A <sup>a</sup>		D			Mean <sup>b</sup>	p <sup>c</sup>	Corr <sup>d</sup>
		1	2	3	4	5			
There was nothing I or other community members could have done to prevent the existing wind power project if we had wanted to	PB	23	19	32	12	14	2.74	0.041*	−0.647**
	CC	40	18	24	12	7	2.29		
Local government has done an excellent job protecting individuals from protecting individuals from potential human health impacts of the wind turbines in my community	PB	9	11	45	13	23	3.29	0.123	0.558**
	CC	6	9	37	14	34	3.60		
Provincial government has done an excellent job protecting individuals from potential human health impacts of the wind turbines in my community	PB	9	10	45	10	26	3.35	0.082	0.613**
	CC	5	6	40	11	38	3.70		
Wind developer has done an excellent job protecting individuals from potential human health impacts of turbines in my community	PB	8	10	47	10	24	3.33	0.467	0.552**
	CC	11	5	41	13	31	3.48		

<sup>a</sup> 1 = strongly agree; 2 = somewhat agree; 3 = neither agree nor disagree; 4 = somewhat disagree; 5 = strongly disagree. Values shown are percentages of each community subsample (<sup>1</sup>PB = Port Burwell; CC = Clear Creek).

<sup>b</sup> Mean score for each subsample – see note a.

<sup>c</sup> Significance of difference means test:  $p < 0.05$  (\*). All means tests shown are significantly different.

<sup>d</sup> Spearman ordinal correlation coefficient with dependent variable of overall perceived community impact: \*\* $p < 0.01$ .

psychosocial health. Brannstrom et al.'s (2011) Q-sort based study of West Texas residents is an exception; where one of the five key "factors" they identify as important for understanding attitudes towards turbines is the (long-time resident) "community advocate". Conflict is implied by the fact that those who loaded highly on the community advocate factor in their factor analysis, were negatively associated with those who loaded highly on the four other factors.

In the case of the stress and coping literature, we suggest the need to add a community dimension to a framework that tends to encourage focus on the psychosocial health and processes at the level of the individual. In our study we highlight the value of paying close attention to community level processes. Supporters and non-supporters of the local wind projects may be conceptualized in terms of how a localized climate of suspicion and disdain for the other can disproportionately impact those who speak out against turbines.

The results on conflict also serve to remind of the pitfalls of relying on single methods. While the interview portion of the research from Port Burwell provided only hints about potential conflict "down the road", survey results show there was concern about "unacceptable levels" of community conflict in both areas. Not initially detecting conflict could be because the smaller interview sample size missed those interested in talking about conflict in Port Burwell combined with self-selection bias. That we captured conflict in Clear Creek interviews is due to purposefully snowball sampling for people opposed to turbines there. Residents may simply have been hesitant to come forward to speak about something negative like community division and conflict. Future research might explore ways to avoid self-selection of only the most positive residents for qualitative face-to-face interviews (Siemiatycki, 1979). This may entail a more purposeful approach to selecting participants including negative snowball sampling of those 'who think differently in the community'. The overall generalizability of the findings is difficult to ascertain since both have self-selection but we suspect the interviews (positive bias) counterbalance the surveys (negative bias).

Our finding that pre-existing social divisions may be exacerbating conflict in wind turbine communities deserves future research attention as the literature on this issue seems mixed. While Brannstrom et al. (2011) in their West Texas turbine community study found that some felt long-time residents were being neglected, Baxter's (2006) study of a hazardous waste community aligns more with the current study – the idea that newcomers to the area may be more prone to opposition and psychosocial impacts vis a vis the powerful social exclusionary roles of long-time local cliques. This type of division between long-time residents and newcomers suggested by Coleman (1957) is seen in a handful of studies about other environmental hazards like aggregate quarries (e.g., Eser and Lulof, 2003; Wakefield & Elliott). Future research into the interplay between pre-existing social divisions and how they serve to amplify or attenuate psychosocial health impacts (Kasperson et al., 1988) is a potentially valuable avenue of inquiry.

The idea that community participation leads to greater overall support for development is well-established (Jobert et al., 2007; Maruyama et al., 2007; Walker et al., 2014; Warren and McFadyen, 2010) but we add the idea that it may contribute to more positive psychosocial outcomes (Baum et al., 1982; Hadden, 1991; Wakefield and Elliott, 2000). Our study reinforces two other dimensions concerning siting: i) that a lack of personal control over siting can potentially exacerbate psychosocial stress and ii) that the absence of venues for face-to-face interaction on siting issues may reinforce negative psychosocial outcomes. Both are underscored by the fact that 42% and 58% of those in Port Burwell

and Clear Creek reported they felt powerless to stop the development. In light of such findings, it is possible that siting processes that lack meaningful engagement derail information-based coping and thus heighten uncertainty, worry, and/or anxiety. Indeed there is some evidence of anticipatory fear, whereby those communities who may be considered future sites of wind turbines (e.g., rural Ontario, Canada) are significantly more worried about the health and well-being impacts of turbines than those who already live with them (Baxter et al., 2013). The overall dissatisfaction with such aspects of the siting and planning process suggest fruitful avenues for future research.

While this is not a traditional epidemiologic health study, it does offer illustrations of the social processes that may impact mental health and social well-being in a community living with a new technology. This suggests that developers and policy actors should pay due attention to the structure of communities that are existing hosts (monitoring and mitigation) and potential hosts (siting) for wind turbines. In spite of the fact that turbines are designed in part, to combat the health impacts of air pollution and climate change, policy-makers need to be cautious. In the context of this study, turbines may be classified as a technological hazard – that when combined with the "right" social mix, can lead to potentially serious psychosocial harms.

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