

A Critical Realist, Retroductive Multiple Cross Case Analysis: Exploring Psychosocial
Factors Underlying Industrial Wind Turbine Exposure

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Few people today would deny the negative impact of non-renewable energy sources on the health of our planet. Around the globe, efforts are underway to reduce the world's reliance on fossil fuel and nuclear energy. The rapid implementation of new renewable energy technologies, like Industrial Wind Turbines (IWTs) in rural environments has raised concerns regarding the potential effects of these technologies on human health. The mechanisms by which IWTs may affect local residents' physical, emotional, and social health and well-being have yet to be determined.

The purpose of this thesis is to intentionally explore psychosocial health factors underlying the IWT phenomenon, critically examine individual and group IWT experiences and perceptions, and triangulate multiple sources of data from which to further the understanding of the IWT health phenomenon. This study utilizes a qualitative multiple cross case study design and retroductive approach to explore, through social ecological and critical realism lenses, the lived experiences of adults from three wind farm communities in south western Ontario, living within five kilometres of one or more IWTs.

A systematic scoping review of IWT health literature as well as environmental health literature was completed. IWT and health literature has increased, especially since 2013. A full text analysis of 217 articles was conducted and findings suggest that psychological and sociological (psychosocial) dimensions, including fear-perceptions, personality traits, attitudes, and community conflict, may be associated with reported adverse health effects. However, there continues to be several gaps in IWT research including; longitudinal studies, baseline studies pre-IWT installation, research regarding community response to IWT development (including noise, planning, landscape change), qualitative and field-based research. This thesis will serve to address and contribute to the latter identified gap.

Thirty-one interviews were conducted with participants representing three Ontario wind development communities. Interview transcripts underwent a narrative thematic analysis. Interview findings revealed that both IWT supporters and non-supporters have some degree of worry or distress regarding financial implications of IWT installations and believe there is a global need to reduce the reliance on fossil fuels. Majority of IWT non-supporters described IWTs as visually annoying and reported associated health effects, including poorer mental health. A minority of non-supporters indicated that IWT noise was annoying. Very few participants attributed noise annoyance to sleep disturbance. Irrespective of participants' support or non-support of IWTs, several interesting manifest (public) and latent (private) factors emerged from the interviews. Almost all participants reported being more concerned about the financial aspects of IWT development, government-decision making, and the perceived fairness in IWT siting than feeling concerned about potential health effects of IWT exposure. Additionally, a previous significant life event and a person's level of attachment to their home, land and community appeared to influence perception, the ability to adapt to environmental change, and extent to which one experienced psychological distress.

Triangulated results of thematic analysis from multiple data sources including literature, interviews and health assessment data revealed that changes to rural community and home environment (landscape) may affect person-place bonding and restorative properties of nature and home, while fear-inducing media and opposition messaging may amplify visual and noise annoyance and financial worry that may be associated with poorer self-rated health. Results from multisource data identified psychosocial factors associated with exposure potentially contribute to or be a consequence of actual or perceived environmental change. Further analysis suggests health effects may be explained by a combination of psychological (internal), socially influenced (external), and either amplifying or mediating factors. These factors informed a revision and a design of two conceptual models. The main components of these models consist of; external variables; mediating variables; and outcome variables. Individual

characteristics like values and beliefs along with community-related variables suggest the explanatory power of personality traits, life stress and coping skills, and person-place bonding as well as site-related characteristics like social networks and approach to communication and site planning. Based on these themes a revised IWT health model and what is believed to be the first IWT social ecological concept model are presented.

This work confirms previous studies that identified a need to expand policy decisions and environmental health assessments to include a holistic and ecological assessment of health impacts. In the context of wind energy and wind farm development, this multiple case study contributes to IWT literature by deepening the understanding of the dynamic interconnection between psychosocial factors and IWT development. The identification of differences between manifest and latent perspectives provides important insights into factors that may be associated with or contributed to reported health concerns. The resulting analysis elucidated that psychological processes and socially influencing factors and complex mechanisms may be indirectly associated to individual perception of wind turbines and self-rated health. Caution must be taken in interpreting the findings of this study. Given the complex mechanisms and diversity of variables of the findings, and models conclusions regarding a cause and effect relationship to IWTs must not be made.

This work highlights the need for environmental health assessments to include specific requirements that could address, alleviate, or prevent psychosocial effects from IWTs or industrialization of rural communities.

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Thank you to Professors Phil Bigelow and Steve McColl for their guidance and support. Although I struggled many times throughout the years, they continued to be patiently available to offer advice and encouragement to finish this work. I would also like to say thank you to Dr. S. Elliott, Dr. J. Garcia, Dr. T. Christidis, K. Schmalz, H. Mann, M. Gohari for their expertise, time and contributions that helped to complete this work. Thank you to the kind fellow “mature” students whom I had the pleasure to meet and learn from over the years, who graciously shared their stories of returning to school and offered words of encouragement that helped push through the difficult times.

Thank you also to Dr. Siva Sivothythaman (Ontario Research Chair in Renewable Energy Technologies and Health) and the Energy Council of Canada for supporting the initial phases of this work.

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As I became more involved in this topic and met those expressing concerns and frustrations about perceived social injustice and adverse health complaints, I appreciated the topic was not just about wind energy or a NIMBY perspective. Before this research I was concerned about the environment, both the workplace environment and environment in the ecological sense, but I did not consider myself an environmentalist. I readily admit joining the RETH team with a belief that renewable energy technologies are a positive and a necessary step in reducing greenhouse emissions associated with global warming. I have been a Registered Nurse for many years and was taught to consider both objective and subjectively presented information. I was taught to listen carefully to what patients and their families say and what they do not say in order to make a balanced assessment. As a nurse I am professionally accountable to uphold professional standards, advocate for patients and for social justice.

Events beyond my control required me to step back from this research, until I ultimately felt it important professionally and personally to complete this work and share the experiences that had graciously been entrusted to me at the beginning of this research journey. As the work progressed there have been times when opposition opinions and fear of reprisal to my work have been personally worrisome. I have witnessed backlash from opposition as research findings suggesting psychological or social factors, and not just physical factors, may be contributing to health effects. Personally, and professionally I find this backlash distressing and indicative of a stigma and disbelief that mental health is a legitimate disease or disorder. I acknowledge my bias that mental health is as legitimate as any physical symptom or disease.

Special thanks to my family, without whom none of this would be possible. For their continued love, support, patience and understanding gave me the motivation to finally check this off my “bucket list.”

Dedication

I dedicate this work to my family, who instilled a desire to learn and resilience not to quit. To my parents and grandparents, both physically here and here in spirit, who inspired me to 'reach for the stars'. To my children, Amber, Brandi, Daniel, Monica and Marina, and my sons-in-law Dave and Pete for being both my roots and my wings. To my grandchildren, Jorden, Jade, and Jansen, who offered beautiful excuses to stop writing and play.

To Cliff and Kathy for help with post-it notes, coffee and formatting wizardry and to Karen W. for her editing expertise. To my colleagues and special friends who offered both encouragement and motivation.

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1.0 Overview of IWT Phenomenon

Many people support the need for renewable energy. Renewable energy consists of mechanisms that generate electricity from solar (photovoltaic and thermal), wind, geothermal, and tidal sources. In recent years, environmental awareness about fossil fuels' effect on climate change has led to a rapid growth in research and a widespread evolution in the implementation of renewable energy sources. As these technologies became part of the predominantly rural landscape, concerns regarding potential health risks have emerged. Of all renewable energy technologies in development, concerns regarding the adverse health effects of IWTs in particular garnered significant public and political attention.

Wind turbines have been used and widely accepted for many years, and historically were used to pump water and provide electrical power to single family homes and farms. However, the need to produce, or harvest, more power from sustainable energy sources resulted in industrial scale wind turbines and the establishment of wind farms (groups or clustered IWTs). The required topography and the need for reliable wind streaming often required these IWT farms be placed in rural areas, in close proximity to residential areas or homes. While this new technology and revenue stream may be welcome to some, for others it may represent an unwelcome change. Rural areas have often been isolated from large-scale political debates and rapid technology changes. However, the emergence of more corporate agricultural operations, coupled with Internet and social media, may have begun to change the rural environment.

The literature regarding IWTs' possible health effects is conflicting. Proximity to individual homes and communities has "been associated with higher levels of complaints compared to the general population" (Arra et al., 2014, p. 2). The most commonly reported complaints of IWT exposure include annoyance, headaches, "noise, visual impact, sleep disturbance, [and] infrasound," with symptoms often described using such terms as "suffering," "victims," and "extreme distress" (Arra et al., 2014, p. 2). These reported health complaints have led to a polarized debate on the safety and efficiency of IWTs, and the possible measures by which to attribute an association between reported symptoms and IWT exposure. This research will investigate and begin to define psychosocial models for use in a holistic bio-psycho-social approach to managing IWTs' reported effects on human health.

This study assumes a respectful research position regarding the experiences of people living near IWTs. Their experience, as documented here, is their experience and their truth. It is presented as expert evidence that, however subjective, their experience cannot be invalidated because for them, it is real.

1.1 Research Purpose

Qualitative studies are an important way in which to further explore the psychological and sociological perspectives of IWTs' technology and their economic, political, health, and quality-of-life implications. Individual and public perceptions need to be studied to understand the concerns, attitudes, and experiences from all sides of the wind turbine debate. Exploration of the IWT discourse may lead to greater awareness and understanding of the interconnectedness between people and the environment, and how this techno-environmental evolution may be affecting both our

landscape and our health. The comprehensive health and environmental assessment approach taken in this study will help by identifying health and environmental concerns that could inform health management, environmental health policy and communication processes resulting in the employment of reasonable precautions, participative decision-making and holistic health considerations when introducing new technologies like IWTs to the environment.

1.2 Thesis Objectives and Contribution

The purpose of this thesis is to systematically identify psychosocial factors underlying IWT discourse, critically examine individual and group IWT experiences and perceptions, and triangulate data to expand a conceptual model by which to understand the IWT health discourse. Deeper insight into the controversies surrounding IWTs would act as the basis for further development of health strategies to help mitigate or manage the presence of reported health effects of wind turbine exposure, and to inform and potentially reframe the approaches of all parties involved in the IWT decision-making process. There is a gap in qualitative, hypothesis and theory generating research. Field research and studies applying a holistic lens to the reported clinical symptoms remains sparse in IWT literature. This work fills these important gaps in the IWT literature. In addition to contributing to the IWT research base, the findings, health model and social ecological concept models are applicable pertaining to psychosocial health. This work is also intended to stimulate discussions regarding changes to environmental health assessments and policy, to reflect and include a broader definition of health.

1.2.1 Thesis Chapter Objectives

This research builds upon a University of Waterloo renewable energy research program funded by The Council of Ontario Universities, and other existing IWT health research, by exploring the psychosocial impacts of IWTs and their potential links to psychological health and social-emotional distress. Using a critical realist lens, Chapter 2 reviews and synthesises the literature pertaining to potential psychosocial IWT factors to help gain important breadth and insight surrounding the IWT phenomenon. This work is presented in five manuscript-type chapters that are interconnected through an exploration of IWT health factors, theory and conceptual models that may help expand and explain the underpinnings of IWTs psychosocial health. The division of chapters is as follows:

1. Chapter 1 provides an introduction and background to the IWT context. The chapter also includes an introduction to the selected ontology, epistemology and research methods utilized in the study.
2. Chapter 2 presents a systematic scoping review and analysis of literature relevant to IWTs and environmental psychosocial health.
3. Chapter 3 consists of findings from an analysis of multiple data sources including: health assessments and semi-structured interviews from a multiple cross case study involving participants living in three southwestern Ontario communities. The major themes and multidimensional interconnections are presented and explored between health and psychological processes and social relationships, as well as the individual and collective ability to influence perceptions of health in the context of IWTs.
4. Chapter 4 utilizes findings of cumulative analyses from multiple data sources including: literature analysis, health assessments and participant interviews to inform and present relevant theories, develop and/or revise health and ecological models by which to critically discuss and expand on available evidence to provide a deeper understanding of the IWT phenomenon.
5. Chapter 5 summarizes key findings, recommendations and the potential impact of this work, including its use to inform future psychosocial and health research.

1.2.2 Specific Chapter Objectives

1. To systematically review literature that examines psychosocial factors related to IWTs and environmental health and stimulate a broader assessment of health and human distress beyond a traditional biological (medical) model. (Chapter 2)
2. To explore common and differing factors between and across cases from an individual and community perspective, to understand the IWT health-related phenomenon and how these factors may influence the psychosocial health of people living within 5 km of IWTs. (Chapter 3)
3. To review and reconsider existing conceptual models and to help provide and frame a psychosocial, multidimensional understanding of IWT health research. (Chapter 4)

1.3 Research Context

1.3.1 Renewable Energy Technology and Health (RETH): Interdisciplinary Research Program

This research was conducted under the leadership of Dr. Siva Sivoththaman, Ontario Research Chair in Renewable Energy Technologies and Health (RETH), a position established to meet a number of objectives. The research chair was administered, awarded and funded by the Council of Ontario Universities. The multi-disciplinary research group that made up the Ontario Research Chair program in Renewable Energy Technologies and Health (ORC-RETH) at the University of Waterloo separately and collectively researched and engaged in educational activities in the domain of renewable energy technologies (RETs).

At the time this research was initially proposed, approved and conducted, I was part of the ORC-RETH program and had been engaged in discussions regarding the development of a survey to examine possible health effects from wind turbines exposure. Through these initial team discussions with those engaged in various ORC-RETH research (i.e., health effects, sleep, health communication) and through

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observations of those reporting health effects, I realized that there was an existing knowledge gap in terms of the psychosocial aspects framing the public and individual response to wind energy and wind turbines in Ontario. The involvement with, and deepening understanding of, the issues surrounding wind turbine installation presented an opportunity to transfer knowledge gained from the research program to build a thesis topic and further expand knowledge in this area through the application of an ecological and holistic (and clinical) health lens.

The RETH Ontario-based survey was further developed and finalized after I left the RETH program and included standardized scales and an array of questions that provided a diverse set of details and information regarding health, perceptions, annoyance, quality of life, satisfaction with life, and sleep. The survey results found a relationship between proximity to wind turbines and sleep, financial worry, community capital, health and environmental worry (Christidis et al., 2014).

The RETH survey was distributed to residents of eight wind farm communities with 473 surveys were received of 4875 delivered. The RETH survey development and distribution phases are well documented in separate literature (Christidis et al., 2014; Paller et al., 2016) and noted challenges in terms of low response rate (9.70%), the average respondent age was 55 years old, identification of residents in close proximity (5 km) to wind turbines, and widespread community opposition warnings about participation in the study. 23.3% of respondents reported an income between \$40-80,000; 48.8% and had either college diploma or university degree (Paller et al., 2016). The RETH program research was among the first to identify a connection between perceptions of wind turbines and health (Christidis et al., 2014), and first to report

findings on sleep disturbance and wind turbines (Jalali et al., 2016). Additional program research included policy and planning and health communication (Deignman & Hoffman-Goetz, 2013, 2015). However, a statistical difference was noted between a comparison population and survey sample in the dimensions of marital status and education level (Paller et al., 2016). This difference introduces the potential for selection bias to my research study. Given that participants were drawn from the same RETH sample group it is important to note these demographic differences when considering data as information may not be representative of the population.

These findings separately and collectively served towards meeting the ORC-RETH program mandate of building knowledge in the field of renewable energy and specifically in the field of wind energy and health. The emerging IWT research increasingly suggested a psychological and sociological connection to reported health concerns. Wind turbine literature at the time of this study was limited, and few published studies explored the psychosocial factors related to wind turbine exposure. In recent years, there has been an increase in published literature exploring psychosocial factors related to wind turbines. This paper continues to build on the RETH knowledge base in the field of environmental health, renewable energy, and specifically in the area of wind energy and the psychosocial factors and potential effects of wind turbine exposure to (physical and mental) health.

1.3.2 Research Context, Relevance and Introduction

According to a World Health Organization (WHO, 2008) report, *Health Environment*, a broad definition of health along with an integrated and collaborative approach to research and policy development are needed to study and address the

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complex range of hazards and environmental risks. The WHO report also states that identifying and linking environmental hazards and health impacts within a social ecology approach should provide sound scientific knowledge from which to develop [environmental health] policy-relevant resources (Burger, 2012; Hartig, Johansson, & Kylin, 2003). Social ecology looks at environmental factors and complex connections between environment across various strata of influences (i.e., political, community, individual). Environmental issues affect society and often involve some dimension of income and power imbalance. Understanding how ecological issues affect society and how individuals within social structures react and interact is fundamental to both understand and address current and future environmental issues. Applying a social ecological lens to the wind turbine phenomenon provides an opportunity to understand the wind turbine issue holistically. However, it may also provide a glimpse into other ways in which to see and address environmental issues.

This research builds upon existing work done by the University of Waterloo under its Renewable Energy Technology and Health (RETH) research program, by exploring the experience, the controversy and the discourse surrounding IWT development. A discourse to some extent becomes part of an integrated “legal and political” and health construct, which is formed by reflections and perceptions of critical issues and circumstances (Cannella & Lincoln, 2007, p. 315). This work critically explores individuals’ reflections and experiences to begin to understand the complex interactions involved in the IWT discourse.

The often-intangible related aspects of health, such as social norms, perceptions and values, as described in subsequent chapters, can have a significant influence on

health and well-being. Health is a complex and dynamic process that can be categorized into three distinct and interconnected categories: attitude, behaviour and behaviour change (Nisbet & Gick, 2008). Due to the number of variables that exist within the natural and built environment, determining direct causation of environmental illness is likely impossible and warrants an approach that considers the dynamic 'nature' within which humans exist. In the context of the very public IWT discourse, the opportunity for perception bias and fear-inducing triggers may be contributing to IWT self-reported health effects.

The most commonly and consistently reported environmental complaints noted in the literature and by IWT groups include, but are not limited to, sleep disturbances headaches, and annoyance. Although each of these symptoms alone may not appear to be harmful, together they have the potential to cause distress, or worsen existing medical conditions which may lead to other serious physical or psychological health problems (Bryant, 2009; Fahey, 1995; Hartig, Johansson, & Kylin, 2003; Osterberg et al., 2007; Thoits, 2010; Toyokawa et al., 2012). If unresolved for an extended period, stress can lead to "anxiety," "insecurity," "low self-esteem," "social isolation," and "lack of control over home and work" (Toyokawa et al., 2012). However, there appears to be consistency in the literature regarding housing and nearby development, such as IWTs, having the potential to significantly affect one's overall health and quality of life (Fahey, 1995; Power & McCarty, 2006).

1.3.3 Contribution to Research and Wind Energy Knowledge

This research contributes to the knowledge base of wind energy and wind turbine exposure in a number of ways. Although there has been recent literature regarding

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psychosocial factors surrounding wind turbines, there is still sparse literature specifically focused on exploring psychosocial factors and their potential influence on health inclusive of the lived experience of those living within 5 km of wind turbines.

Additionally, whilst there have been a number of systematic literature reviews, the literature review conducted as part of this work is believed to be the first that included both wind turbine literature and peripherally related environmental health literature.

The combination of direct and indirect IWT literature was useful to further explore and begin to understand the complex interconnections and potential pathway through which one's health or perception of health is influenced by the experience of living in close proximity to wind turbines. This work is believed to be one of the first wind energy studies utilizing an ecological and holistically defined health lens and individual site-based interviews to look into the lived experience and social nuances of wind turbine exposure. The culmination of this work has resulted in an expanded wind turbine health and a social ecological model along with potential theoretical and mental health perspectives not previously introduced within the milieu of wind turbine research. A broad review of environmental health literature coupled with the identification of differences between manifest and latent reported factors may elucidate potential exacerbating and/or mediating [protective] factors between wind turbine exposure and reported health effects.

1.4 Current Understanding of IWT Psychosocial Health

Currently, health impact research related to environmental change is narrow and does not necessarily consider broad 'systems' perspectives (Devine-Wright 2005; Moffatt & Kohler, 2008; Stokols, 1996,1998). Health impact assessments often assume a traditional biomedical approach from which psychosocial elements of the environment

are generally excluded (Nisbet & Gick, 2008). The importance of the environment and its inter-connectedness with health are now widely accepted as key components of a health model and health assessment framework (Kaplan & Peterson, 1993; Stokols, 1996, 1998; Veenstra et al., 2005; Velarde et al., 2007). An expected outcome of this research is the provision of a revised IWT health model and expanded lens through which to consider psychosocial factors to reported health complaints, by exploring multiple data sources and expanding upon existing theories.

There are as many definitions of health as there appear to be ways to measure health. Evans and Stoddart (2003) have synthesized one's relationship with the environment as an "equilibrium" and suggest that a "comprehensive set of influences on health," which acknowledges "a variety of events occurring concurrently at any given time, contribute or influence health" (p. 273). These descriptions of health and WHO's definition of health have provided a starting place from which to explore IWTs' influences on health within a psychosocial and environmental frame. This thesis focuses on providing insights and connected meanings and interpretations made from participants' personal experience narratives by analyzing emerging themes, relevant survey data and contextual meanings and/or triggers within psychological and social constructs (Hesse-Biber, 2010).

1.5 Social Ecology and the IWT Complex Person-Environment Connection

This work intended to explore and expand the understanding of the reported health complaints and discord that resulted when industrial wind turbine developments and wind farms became an increasing part of our landscape. Primary research regarding the experiences and psychosocial factors remains scarce. Delving into this

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IWT discourse phenomenon required an approach that is holistic and presupposed a reality that is built and can subsequently be understood through interconnected structures, multiple dimensions, experiences, values and beliefs. To that end, the distinctive features of critical realism were identified as an appropriate theoretical underpinning by which to position this study.

Few articles regarding the impacts of IWTs reviewed for this paper referred to, or utilized, a theoretical underpinning. The use of theoretical underpinnings could dramatically improve the ability to conceptualize and analyze environmental impacts to personal health (Manzo, 2003). Several key concepts informed and framed this IWT study.

Social Ecology theory was used as an underpinning for this study. This theory is ideally suited to complex research that “will help solve contemporary environmental and relevant social problems” (Stokols, 1996, p. 3). Social Ecology theory considers the complex and dynamic relationship between the environment and people from social, political, natural, cultural and institutional perspectives (Hartig, Johansson, & Kylin, 2003; Kaplan & Peterson, 1993; Moffatt & Kohler, 2008; Stokols, 1998). There is a need for a staged qualitative research design to appropriately explore health concerns and subsequently develop reliable means with which environmental health effects can be understood, measured and managed (Elliot et al., 1994; Fahey, 1995; Osterberg et al., 2007). This qualitative study is designed to explore the concerns and nuances of socially influenced personal factors experienced by participants living near IWTs or wind farms to be better understood and managed in future wind energy developments.

1.6 Introduction to Research Methodology and Theoretical Underpinning

1.6.1 Epistemology and Ontology

This research investigates social and psychological processes by using qualitative analysis to enable consideration of connections and inter-relationships between participants and their environment. The study used deductive, inductive, and retroductive inferences to explore, identify and begin to explain, from both lived experiences (interview narratives) and a theoretical perspective (literature) (Danermark et al., 2002). The IWT context cannot be understood by reducing the narrative and rhetoric to discrete facts. One must de-construct and re-construct as much as possible to begin to understand the nuances and interconnections that may form one's reality. This social-constructivism approach starts from an ontological position that states that understanding context can only be achieved by identifying and analyzing facts alongside the complex system within which they interact. Within complex systems and situations human interactions may be *predictably unpredictable*, with no way to truly simplify and isolate dependent and independent variables surrounding some phenomena.

Therefore, a Critical Realist (CR) ontology is a suitable position from which to explore IWT-related impacts, as it was developed to account for the social processes and open systems within which we live (Bhaskar, 2008). CR is positioned on the premise that there are unobservable layers that exist and influence thought. These unobserved layers are linked to psychological processing, which work together to establish a reality that exists independent of human conscious thought. A CR ontology recognizes changes and symbolism and allows the researcher to consider social meaning in the context of an emergent phenomenon formed in a complex system, in

which actors influence personal perceptions and the social discourse. CR was developed for real-world research that acknowledges the social processes and interactions and natural systems within which people live. CR enables the researcher to explore both the observable structures and unobservable structures within one's reality and helps to position and understand both structures from the social and individual context. Natural and social realities that are conceptualized within critical realism have three distinct layers: the observable experience, the studied experience, and experiences and events that are stimulated by some mechanism or mechanisms that may have contributed to an event or experience.

CR espouses a "stratified ontology [emergence] including the real, the actual and the empirical" (Bhaskar, 1975; Wynn & Williams, 2012). Each strata has triggers that can activate and/or exacerbate a response or event unless mediated by other mechanisms that thereby negate or neutralize the triggered response or event (Wynn & Williams, 2012; Bhaskar, 1975). CR is positioned to critically assess truth, to ascertain acceptable truth derived from truth claims measured "against existing knowledge" (Wynn & Williams, 2012, p. 793).

These three layers and the distinctions between them take into account the actors' perception or reconstruction of events in the world around them, according to their reality, which may or may not be indicative of the actual event. Others may consider this individual interpretation or understanding of events to be an error or fallible. However, environmental and health issues, policy, research and advocacy involve many stakeholders, policies and complex social interactions that are influenced by individual values and beliefs. Relying on a research paradigm that is by tradition

narrowly focused, without taking into account both individual as well as collective social relationships, risks reducing the importance of the lived experience and personal narratives, and missing significant contextual meanings.

The discourse on reported health effects of IWT exposure is complex and requires exploration beyond traditional biomedical study. Critical realism (CR) offers an approach to research that enables exploration of complex issues and systems. Roy Bhaskar initially presented the CR philosophy, which was further developed by other CR researchers (Danermark et al., 2002; Mingers, 2006). CR's key elements involves identifying causal factors and/or interactions contributing to social phenomenon. CR accepts that "emotions, beliefs, and values are part of a reality and intrinsically interconnected between people and their practices, institutions, rules, roles or relationships in society and to its members" (Sayer, 1992, p. 30). Individual and public experience and perception need to be studied to understand the concerns being raised by people due to their exposure to IWTs. This work will explore experiences related to the phenomenon of IWT exposure, through health, social and psychological lenses. Deeper exploration of that experience using a CR approach may lead to greater awareness and understanding of the inter-connectedness between people and the environment, and how this techno-environmental "power" evolution may be contributing to human distress and adverse health effects.

1.6.2 Methodology: Retroduction and Retrodiction

A critical realist paradigm typically uses two "complementary processes" of retroduction and retrodiction (Elder-Vass, 2010, p. 48). Retroduction is a pragmatic approach that aims to establish a spirit of inquiry and explore the nuances and "interplay

of theory and data” (Hartig, 2011 as cited in Downward & Mearman, 2007, p. 163).

According to Danermark et al. (2002), “retroduction is achieved by studying pathological circumstances and extreme cases through comparison of different cases” (pp. 104-105). Retroduction involves an in-depth look of a contextual reality. That reality is underpinned within a theoretic construct and linked to generate relationships and circumstances that contributed to the phenomenon of study.

Retroduction consists of four primary elements: ideas, analytic frames, evidence, and images along with three analytic loops to aid representation social life (Hartig et al, 2011, p. 162). These three loops are described as follows:

- a) loop one is the “development of an analytic frame” consisting of ideas, theory, and their connections relevant to the topic being studied (Chapter 2)
- b) loop two, through a mainly inductive process, creates images or themes from evidence (Chapters 2 and 3); and
- c) loop three involves the interpretation and connections between the first two loops linked to a retrodictive process (Chapters 3 and 4)

Retroduction is a scientific approach similar to abductive reasoning used to explore, often with the intent to infer, causal mechanisms of a phenomena of study (Bhaskar, 1979). The process of breaking down events and mechanisms is important to identify foundational themes and build explanatory theory within a particular study phenomenon (Danermark et al., 2002). Analytic frames provide a cognitive lens to both construct and deconstruct a shared meaning of a particular context, event, or issue.

This study does not intend to prove or disprove specific causal mechanisms to reported health effects but rather to explore and deepen understanding of the underlying structures surrounding IWT health discourse. It combines an ecological and health lens to an explorative and interpretive critical realist paradigm focusing on retroduction (and to a lesser extent retrodiction). Retroduction involves a step-wise

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process to unravel past events to look for the cause or ultimate catalyst of a particular event. Retrodiction differs from retrodiction in that retrodiction uses the past as data to, in a sense, predict or test a theory of what may occur in future. Within the context of IWT health, the ability to unpack the predominant factors and causal mechanisms underpinning self-reported health and quality of life effects of environment change could inform public health and environmental policy change and improve clinical management of those experiencing negative health effects from environmental change. The objective of this work was not to present generalizable findings but rather to shed light and add depth of understanding of psychosocial factors that may be contributing to reported adverse health effects. This work identifies potential associated mechanisms that contribute a new perspective to the wind turbine health discussion, which can in turn help inform future research.

1.6.3 Methodology: Multiple Cross-Case Design

The key difference between case study and other qualitative approaches is that case studies can use single or multiple cases and are open to using theory or frameworks to guide research and data analysis (Glaser & Strauss 1967; Strauss & Corbin, 1990). Multiple cases are more often used as a method to gain understanding of larger-scale attributes related to a contextual issue. However, some information may be presented from single cases, depending on the case content or data and its connection to the research questions, and possibly its ability to convey meaning to the reader. Yin (2003) recommends researchers limit the scope of case studies by focusing or “binding” it to keep the research manageable. The cases in this study will be “bound” through “definition and context” of IWT health discourse (Baxter & Jack, 2008). A multiple and

cross-case design aids in deconstructing events (aligning with retroduction) and experiences to help explain how and why a specific phenomenon occurs (Baxter & Jack, 2008). Thus, I determined that a multiple case study approach was a logical method by which to explore the complex events surrounding IWTs (details presented in Chapter 3).

Case studies, particularly multi-case studies, allow for comparison of cases and rely on triangulation of data to analyze, substantiate and provide assurance that the researcher interpretation is correct (Yin, 1989). As is consistent with case study methods, data sources for triangulation primarily included health interviews and semi-structured interview narratives and observations (Yin, 1989).

In the context of the IWT cases, some people may be concerned about speaking out on either side of the debate. Some have signed confidentiality agreements with IWT companies and others may have been warned by anti-wind groups against participating in research; others fear community or neighborhood reprisal if seen to be “taking sides.” The use of previously generated theory and “analytical generalization” (Yin, 1989), as well as the removal of identifying features, helped protect participants while maintaining research integrity. The ability to analyze data from a single case to multiple cases afforded the ability to consider individual experiences and perceptions, community influence and other emergent themes within and between cases. It is not the aim of this work to deny or otherwise invalidate the experiences of people who feel their health has been negatively impacted by IWT installations in their vicinity.

2.0 Literature Review

2.1 Objectives

The main objective of this literature review is to explore relevant literature and synthesize key psychosocial concepts underpinning the public controversy over Industrial Wind Turbine (IWT) projects. An awareness and understanding of these concepts can be useful in recommending effective and constructive communication strategies and improving relationships between IWT stakeholders. The secondary objective is to lay the foundation for a theoretical framework from which to begin to explore potential links between actions and reactions to IWTs, and how these social factors may be influencing individual health (see Chapter 4).

Although the focus of this literature review is on psychosocial health factors, relevant physiological data are included to provide a comprehensive assessment of the literature. Given the broad and heterogeneous nature of the literature, articles were reviewed using a narrative and iterative approach, which allowed themes to emerge (Scammell, 2009); consistency and concept saturation was achieved.

2.2 Identification of Papers

While the number of peer-reviewed articles regarding the health effects of IWTs is growing, very few specifically address the question of psychosocial health effects. Subsequently, using a consistent combination of search terms and iterative approach, the search expanded to include peripherally related environmental health literature. Papers published between 2000 and 2019, available in English, were sought. Secondary references were additionally selected from primary selected references (n=27). Papers specific only to engineering, children or physiologic health were

excluded. Information was extracted and put into the following categories: author, geographic area, study design/type, relation to renewable energy, theme, psycho-social factor, and recommendation or conclusion.

2.3 Search Methods

The author manually and electronically searched peer-reviewed literature. Electronic databases included Web of Science, Scopus, PubMed and Pschinfo. Keywords included IWT, wind turbine, wind power, wind energy, AND/OR renewable energy, together with a combination of the following search terms: psychosocial, human health effects, human distress, environmental psychological stress, psychological distress, sociological health, environmental distress, environmental risk, human behaviour theory, social status, social conflict, social capital, place attachment, and perception bias.

2.3.1 Inclusion criteria:

- a) Articles that included psychosocial impacts of IWTs, IWT proposed development, or events involving IWTs, OR renewable energy AND a dimension of human health and well-being (i.e., headache, distress).
- b) Articles that contained some measurement, concept, theoretical model or framework related to IWTs OR environment AND a dimension of human health and well-being.
 - a. Social capital, trust, fear, anxiety, perception, environmental risk, mental stress, psychological distress.
- c) Studies and/or literature published in English and conducted in developed countries.

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- d) Relevant primary sources published before 2000 (i.e. original authors' work).

2.3.2 Exclusion criteria:

- a) IWTs AND engineering, occupational health, children, or focus on animal health,
- b) Focused on the physiological health effects of IWTs (i.e., biomarkers); and,
- c) Did not include either an IWT, renewable energy or environmental component.

2.3.3 Study Characteristics Considered:

- 1) Type of study (i.e., direct vs. literature review)
- 2) Objective
- 3) Sample and response rate appropriate to study design
- 4) Description of technique(s) used (i.e., interviews or theory)
- 5) Type of data source (i.e., interview, secondary data, survey)
- 6) Sufficiently described outcome(s) and/or outcome measures and/or data sufficient from which to draw conclusions.

2.4 Search Results

The initial electronic search resulted in 3,024 articles. Additional filters and select keywords such as: health, psychosocial, social, psychological, psychological distress, community, conflict, perception, risk, were applied (i.e., removal of non-English papers, conference abstracts, newspaper articles), resulting in 906 articles. The extraction of duplicates left 364 articles requiring abstract review. A further 27 articles were identified by cross-referencing titles from reference lists of selected articles. Inclusion and exclusion criteria and the application of a study characteristic checklist determined the eligibility of each article. A review of a random sample of selected full-text articles by an independent researcher (i.e., not myself) showed agreement of inclusion and exclusion

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criteria between 80% and 90%. Disagreements were resolved by discussion. A third research assistant reviewed the consistency and methodological rigour of this literature review, and utilized NVivo11 software to conduct an electronic thematic analysis of literature. This combined review approach helped mitigate potential bias resulting from just one researcher reviewing all articles and independently identifying predominant literature themes.

A total of 242 articles underwent full text review. Full article reviews considered study characteristics, design and methods used, year of study, type and measures of study, journal, country, and potential bias. The completed review process resulted in 217 articles for analysis (see Figure 1 below).

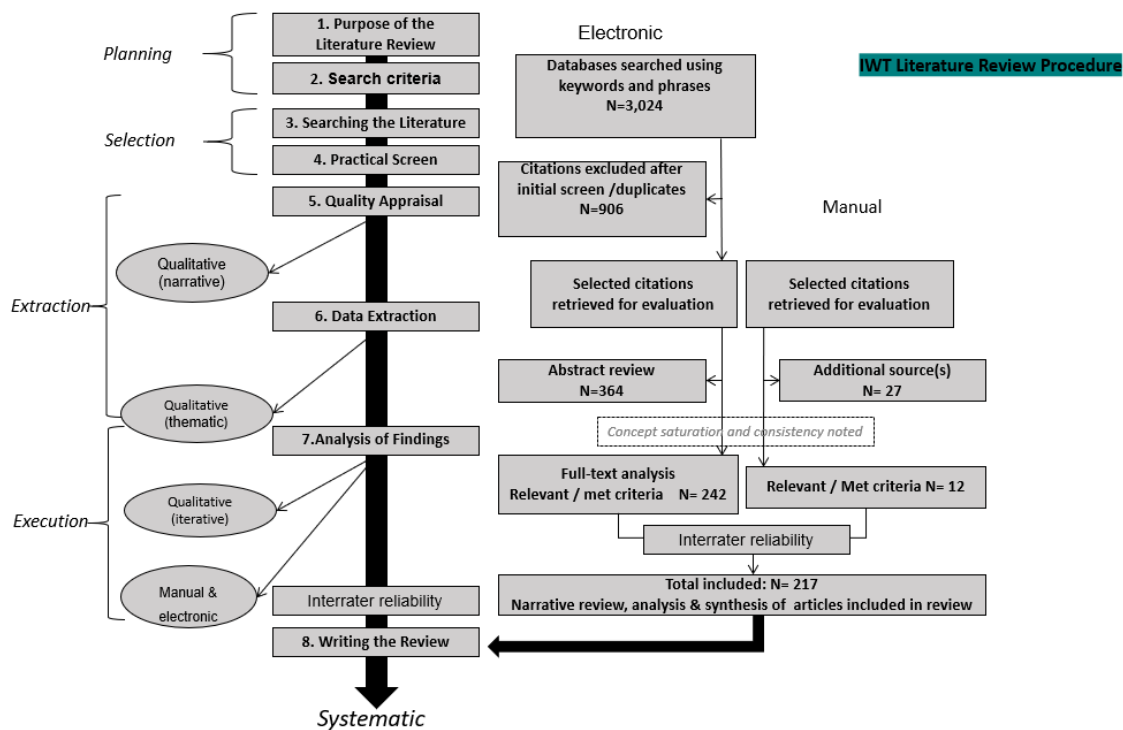


Figure 1: Literature Review Process

2.5 Literature Analysis Introduction

A review of articles using both manual and electronic methods, was conducted. The researcher followed principles consistent with a systematically rigorous yet flexible approach to identify themes and concepts. Emerging concepts were categorized and themes and sub-themes identified iteratively as the narrative review progressed. Literature excerpts were recorded in tabular form with key terms and concepts documented (table format, post-it notes). Upon completion of manual review key core themes and sub-themes were categorized. Concurrent to the manual thematic analysis an independent research assistant conducted an electronic assessment employing NVivo 11 to explore full text, conduct word frequencies and independently identify and categorize literature themes. Words and phrases within literature were identified and used to develop nodes established within NVivo.

Upon completion of the independent literature analysis, themes and sub-themes were compared between primary researcher and research assistant. Discrepancies were discussed until consensus was reached regarding the predominant themes from literature. Following identification of themes, articles were selected and included in a summary table due to their novel topic/factor and/or psychosocial variable until thematic and/or topic saturation was achieved. Articles not included in the summary table underwent full text and thematic review. Thus, the author acknowledges the select literature table (Appendix A) does not include all 217 articles reviewed and acknowledges lack of inclusion does not mitigate any specific article's relevance or significance to the topic of study.

The findings from the literature analysis were included as one of the multiple data sources used to provide important foundational knowledge to build upon. These data

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were subsequently used to triangulate data from a similarly conducted thematic analysis of participant interviews and health assessments (described in chapter 3). A triangulation and cumulative analysis of literature, interview and assessment data analysis data were subsequently used to revise an IWT health model and to develop an IWT ecological model presented in chapter 4.

2.6 Wind Turbine Literature Findings

Literature themes most commonly reported, but was not limited to: noise, visual pollution, sleep, stress, mental health, place attachment, risk, and fear. A recurring theme within the literature (Appendix A) was also a perceived inequality between predominantly rural residents living in wind turbine communities. Recent IWT literature has included some psychosocial concepts but there continues to be little research specific to wind farms and psychosocial health. However, peripherally related literature consistently cited concepts of place (home), interconnections between environment, perception and psychological health, social capital, neighbourhood characteristics, and determinants of health. The literature also consistently spoke of environmental exposure, environmental risk, risk communication, and environmental approval process, as well as specific medical (physiologic) reported adverse health effects like annoyance, noise, sleep disturbance, and headaches.

Although public opinion and social phenomena are largely explained within social science and qualitative research methodologies (Ribeiro et al., 2011), much of the IWT and renewable energy literature consists of quantitative, self-reported survey data with a small number of qualitative case studies. Most of the IWT literature is from Australia, New

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Zealand, United Kingdom and the United States, with an increasing number of Canadian studies published (2012-2018) after the Green Energy Act in Ontario was approved.

The majority of wind turbines in Ontario are located in rural communities (Christidis & Law, 2013). With many rural areas experiencing population loss and economic decline (Stolarick, Denstedt, Donald, & Spencer, 2011), initially many communities welcomed the potential to improve the local economy. However, as planning and construction progressed and opposition became visible, the literature shows that community attitudes began to change from welcoming to concerned or resistant of wind energy development.

Political discord and partisan divides have become a common topic in many countries recently. Climate change and environmental concerns are subject to partisan divisiveness around the world and more locally in Ontario. Reports of adverse health effects from wind turbine exposure began to emerge, as well as concerns over rural-based inequities. Wind energy is not new; however, large industrial wind turbines placed en masse and connected to an energy grid constituted significant environmental and technological change, and triggered skepticism of the governments' ability to protect or prevent social injustice (Elliott et al., 1993; Masuda, Poland, & Baxter, 2010).

Factors affecting wind turbine development can be grouped into the following categories: physical, political, economic, environmental, social and communicative, symbolic and ideological, landscape, community, and personal (Devine-Wright, 2005; Graham, Stephenson, & Smith, 2009). Each of the concepts or self-reported health effects is an extensive field of study in and of itself. This study is not intended to provide a detailed analysis of physical health symptoms nor a detailed assessment of each concept or theory, but rather, through a review of the literature (and interview narratives in Chapter

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3), it is intended to explore and begin to connect possible psychosocial concepts and theories (chapter 4) to provide a different perspective through which to consider and study IWT response phenomenon.

In a recent scoping review of health effects of IWTs, it was reported that the steady global cumulative installed capacity in WT energy rose from “23.9 GW in 2001 to 539.6 GW in 2017” (Global Wind Energy Council, 2018, as cited in Freiberg, Scheffer, Girbig, Murta, & Seidler, p. 2019). Freiberg utilized a systematic scoping process, a WHO definition of health and, similar to the literature review process undertaken for this dissertation, appeared to be among the first to include literature from outside the narrow IWT domain by including occupational health studies. However, their review did not extend to broader psychosocial and environmental factors (i.e., place attachment, social capital).

Most articles pertaining to health impacts considered “noise annoyance, sleep disorders, quality of life, general health, and mental health” (Freiberg et al., 2019, p. 450). One common reported factor within IWT literature is annoyance, with “three studies suggesting a prevalence of annoyance to a changed view (Freiberg et al., 2019; Pedersen & Perssen Waye, 2004). Visual features and visual annoyance appeared in the literature after 2000. Very limited studies (one or two) explored “mental health,” “quality of life” and “emotional reactions” from wind turbine exposure (Freiberg et al., 2019, p. 450). The reasons behind visual and/or noise annoyance, or the reasons for changed views of IWTs, have yet to be explored. Another gap in the literature (which this work hopes to help close) is in the qualitative study of political and health discourse.

According to Freliberg et al. (2019), an overview “examining the extent, range and nature of research activities” on the topic is missing (p. 447). Freiberg et al. (2019) also noted similarly identified literature gaps pertaining to focus towards visual aspects and annoyance with other symptoms or diseases not well explored. This study will be begin to address this identified literature gap.

2.7 Renewable Energy and Health (RETH) Literature: Emerging Psychosocial Factors

As noted, the Renewable Energy Technology and Health (RETH) survey played an important role in the genesis of this thesis, in that the survey responses found evidence that psychosocial factors influence both perception and health. Associated studies, included in this literature review, confirmed the validity of further exploration of these psychosocial factors and their impacts.

The survey involved 473 residents in eight wind farm communities in Ontario (Paller et al., 2016) and was developed following a review of more than twenty studies to identify individual factors such as attitudes towards environmental stressors and health outcomes factors like: (i.e., annoyance, lifestyle, coping and sensitivity), (Christidis et al., 2014). The survey utilized validated scales including the Satisfaction with Life Scale (SWLS), a global measure of life satisfaction; the SF-12v2 Health Survey to measure physical and mental health; the Quality Metric’s Health Outcomes Scoring Software 4.5 to provide output as a Physical Component Score (PCS) and Mental Component Score (MCS); and the Pittsburgh Sleep Quality Index (PSQI) which assesses sleep quality and disturbance over a one-month time period (Christidis et al., 2014; Paller et al., 2016). Questions also asked individuals for their view of renewable

energy technologies in Ontario. Finally, items developed by the research team and Van Den Berg (2005) were compiled to create the “Annoyance Scale” (AYS).

The RETH survey found that most survey respondents (65.9%) were poor sleepers. Almost half (43.9%) reported reduced physical health status and 16.4% self-reported they were at risk for depression. Almost one in three (30.1%) were not satisfied with their life. Participants showed consistent levels of support for reducing reliance on fossil fuels and the need to generate cleaner electricity, comparable to other studies (Walker, Baxter, & Ouellette, 2014), and agreed that communities hosting IWT developments should pay discounted electricity rates (Walker et al., 2014). The study findings were also consistent with other research indicating that most people disagreed that wind farms can cause negative health effects. The following sections will present literature key to informing and expanding understanding of psychosocial concepts underpinning IWT phenomenon.

2.8 IWT Predominant Literature Themes: setting the psychosocial stage

Scientists and health professionals have consistently purported that health in the IWT context may be best explained through a non-traditional approach. A 2010 report by Ontario’s Chief Medical Officer of Health, after a review of available evidence stated:

While some people living near wind turbines report symptoms such as dizziness, headaches, and sleep disturbance, the scientific evidence available to date does not demonstrate a direct causal link between wind turbine noise and adverse health effects. ... Community engagement at the outset of planning for wind turbines is important and may alleviate health concerns about wind farms. Concerns about fairness and equity may also influence attitudes towards wind farms and allegations about effects on health. These factors deserve greater attention in future developments.

Worldwide, the development of wind turbines has met with local opposition (Deignan, Harvey, & Hoffman-Goetz, 2013; Fast & McLeman, 2012; Walker et al.,

2014). Literature has consistently identified the following predominant opposition complaints: visual changes to landscape (turbine proximity, anticipated visibility) (Gibbons, 2015; Jobert et al., 2007; Jones et al., 2010; Pedersen et al., 2011); adverse health effects; and health risk perceptions (Deignan et al., 2013; McCunney et al., 2014). A study conducted in the UK (Gibbons, 2015) found that 23% of respondents agreed that wind farms “are or would be ugly and a blot on the landscape” (p. 177) and only 51% had actually seen a wind turbine. A Nova Scotia survey was developed to explore the issue of social acceptance by communities most affected by IWT development, and it was found “that a high level of consultation and early communication is preferred by communities and would provide a forum for increased social acceptance and reduced conflict” (Corscadden, Wile, & Yiridoe, 2012, p. 397).

Residents under 30 years of age were found to be generally more knowledgeable about the IWT technology and its environmental and social benefits (Corscadden et al., 2012). Wind turbines are less likely to be accepted by men and those with higher socio-economic status, when placed near historically significant landmarks, in locations that impede areas designated for recreation, and in communities with higher social capital (Ladenburg, 2014; van der Horst & Toke, 2010).

2.8.1 Emergence of Quality of Life and Psychosocial Factors in IWT Literature

Many studies published before 2010 did not measure, yet included, quality of life in their discussion; after 2013, quality of life began to include measures, with some studies showing no statistical association while other studies reported a statistically significant association between IWTs and deterioration in quality of life. However, a notable difference in reporting these findings was observed after 2013 in that quality of

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life and psychosocial factors were being included and discussed to some extent in most publications, regardless of statistically significant results.

Analysis of the literature also showed an interesting trend emerge after 2016. Although few articles focused on psychological or social factors, psychosocial factors began to take an increasingly predominant place in literature regarding IWT response phenomenon (Jalali et al., 2016; Michaud et al., 2016b; Paller, 2014). Nissenbaum (2012) found a relationship between IWT and mental health; however, there continued to be a gap in the literature regarding mental health and social dimensions. In fact, attention towards physical health may have caused important aspects of mental health to be overlooked (Walker et al., 2015). This study begins to address this second identified literature gap through the inclusion of psychological [mental health] and social factors through the broadly defined health lens.

An article published in 2015 by Mroczek, Banaś, Machowska-Szewczyk, & Kurpas was one of the first to explore a connection between IWT noise and depression and anxiety, and found no statistical relationship present. Mroczek et al., (2015) explored health-related quality of life (HRQoL) measures, using the Polish version of SF-36v2, including three additional questions regarding self-reported health, sociodemographic data, risky health behaviour, chronic disease and social acceptance of those living (sample size of 1,277) within 2 km of wind farms in Poland at various stages of development. Mroczek et al., (2015) are one of the few to use the term “irritation” and note that whilst irritation is not recognized as a “disease entity” by the World Health Organization, it may be a factor in disease or disorder development (p. 6067). The results of the Mroczek et al., study did not show any differences in stage of

development for “physical functioning, pain and role” (p. 6074). However, in the same article they noted a difference in “role emotional” and “non-acceptance” responses of those living near planned sites or sites under construction (p. 6074) indicating that those who were more likely to make decisions based on emotion were more likely not accept change that impacted them at an emotional level. In context of IWT, those with a more emotionally driven personality type may have stronger emotional person-place bond and thus, be less supportive to changes perceived as negatively impacting their place-based emotional bond. Furthermore, general health and mental health were rated lower in IWT construction sites than in sites in the planning phase, among those who did not accept the development. Early literature has cited increased irritability experienced when people are exposed to changes and new technology introduced into their environment (Slovic, 1987).

The potential of IWT sound to negatively impact health has been a source of controversy (Michaud et al., 2016; Pierpont, 2009; Salt & Hullar, 2010; Shepherd & Billington, 2011). The perception of sound as annoying may have a negative impact to health. The perception of sound as annoying may be amplified by IWT placement in rural areas where industrial noise (i.e., traffic) is more contrasted with sounds from nature (i.e., birds, crickets). The perception of, and reaction to, noise as an annoyance may be influenced by a number of factors including, personality traits, interference with land use, social influence and characteristics of the sound (Shepherd & Billington, 2011; van den Berg, 2005). Shepherd and Billington (2011), suggested IWT noise annoyance as a “social problem” and a “failure to predict the actual impacts of noise” resulting in a “rise of [IWT] resistance” (p. 394). They suggest the need to revisit the “stimulus-

response approach” and suggest standards and set-backs determined in isolation of individual and social considerations will not address “conceptual difficulties” that are part of the current policy and decision-making criteria (p. 397). Although their work was associated with noise annoyance the conceptual dimensions and initial IWT model paved the way for further research exploring psychosocial aspects underpinning the IWT health and resistance phenomenon. A revised and adapted model inclusive of individual and social factors identified through a review of current literature and from participant interviews is presented in chapter 4.

Studies after 2013 began to expand knowledge and explore other variables that influence health or one’s perception of health. A Canadian study (Jalali et al., 2016) was the first to use a repeated measures prospective cohort design and validated measures of sleep quality (PSQI) and insomnia (ISI) to assess self-reported sleep quality and the impact of insomnia 16 days pre and post IWT operation. The results indicated that changes in PSQI scores were associated with “negative attitude to wind turbines, turbine visibility, and being concerned about property values” and ISI scores were unchanged for those without anxiety or holding a positive and neutral opinion of IWTs (Jalali et al., 2016, p. 404). The study did not find any association between sleep quality and proximity to IWTs but did find “strong association to attitude, visual impact and worry about property values” Jalali et al., (2016) found a statistical increase in the risk of developing depression pre and post IWT noise exposure (Jalali et al., 2016). Increasingly, authors began to emphasize that subjective “non-perceptible” exposures may be stimulating cognitive arousal and triggering reports of poor health (Jalali et al., 2016; Taylor et al., 2013).

This expanded lens through which to consider health led to studies citing the WHO definition of health, with initial references to social determinants of health as well as psychological and social factors that may be connected to the IWT phenomenon. Factors such as attitude about renewable energy, support for local wind development, economic benefit, political decision-making, siting/planning process, social injustice, social/community involvement and response, as well as community opposition, can influence the perception of wind turbines and whether local development is accepted or not (Christidis et al., 2017; Devine-Wright, 2005; Graham et al., 2009; Walker & Baxter, 2017).

2.8.2 Use of Theory in IWT Literature

A case study in Saskatchewan (Richards, Noble, & Belcher, 2012) explored several significant barriers to IWT investments within a theoretical framework. Richards et al. (2012) used Tudgell's Agreement, Knowledge, Technology, Economic, Social and Political (AKTESP) model to interpret IWT study results (Tudgell, 1990). According to Richards et al., the AKTESP theory is "based on the notion that all environmental problems, and their potential solutions, can be explained by one or more of the following: agreement, knowledge, technology, economic, social, or political factors" (p. 692). Their work concluded that the key barriers were lack of confidence in IWT technology, lack of knowledge (and how it is presented), environment-based values (individual), and the political and financial structure of projects. Notably, social factors were not identified as a barrier to IWT development. However, this difference could be explained by the vast unpopulated areas available in Saskatchewan, and the limited numbers of people personally impacted by wind farms. This dissertation considers

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several theories and social constructs not previously linked with IWTs that continues to represent a continued gap in IWT literature (Chapter 4).

2.8.3 Health Canada Expansion of Epidemiologic Research

Largely in response to continued opposition concerns, Health Canada, Statistics Canada and an interdisciplinary team of health professionals conducted the first of several cross-section studies intended to provide additional detail and a “global scientific evidence base” (Michaud et al., 2013) to inform future research. Another important aspect of the research was that it is one of few studies to look at the community response to wind farms. The study was conducted in 2013 in southwestern Ontario and Prince Edward Island and involved 1,238 randomly selected participants living between 0.25 and 11.22 km from a wind farm. The study sought to use modelling to estimate exposures. The researchers also utilized WindPro software meteorology and topography to model sound, as they considered this approach to be more accurate in capturing average sound exposure levels versus discrete measurements (Michaud et al., 2013). The questionnaire included “modules on community noise, annoyance, health effects, lifestyle behaviours, and prevalent chronic illnesses and basic socio-demographics” (Michaud et al., 2016, p. 1444). Additionally, the study used psychometric scales assessing perceived stress, quality of life, and sleep disturbance (p. 1444). The study included assessment of “7-day sleep actigraphy,” “stress levels (cortisol levels in hair),” “blood pressure and heart rate,” “self-reported annoyance,” and “perceived stress, quality of life and sleep” (Michaud et al., 2013, p. 15).

The results showed that “visibility and audibility increased with increasing sound pressure levels” (Michaud et al., 2016 p. 1446). When noise levels exceeded 35 dB,

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results also showed the highest levels of annoyance for the visual aspects of wind turbines (“blinking lights,” “shadow flicker,” and “vibrations followed”). The authors emphasized in their reports that participants were “more highly annoyed by the visual aspects of wind turbines than any other feature, including noise levels” (p.1450). Their study concluded that there was “not any statistically significant increase in self-reported prevalence of illness” and self-reported sleep quality in relation to wind turbine noise, and that as noise levels increased so did perception of annoyance towards wind turbines (Michaud et al., 2016).

An increasing number of studies observe that individuals who express “worry, anxiety, concern about environmental risk, perceived modulation” have an increased likelihood of reporting adverse health symptoms they attribute to IWTs (Jalali et al., 2016, p. 216; see also Claeson et al., 2013). A 2016 survey measuring several subjective factors regarding health, quality of life and perceptions of IWTs pre and post IWT installation in a southern Ontario township concluded that the majority of respondents were not bothered by turbines, while “45.2% were visually annoyed and 19.4% were annoyed with noise” from turbines (Jalali et al., 2016). Additionally, a majority of respondents reported being worried about property values as well as increased background noise levels after wind turbine installation. Annoyance and other factors may serve as possible mechanisms for the self-reported decrease in health outcomes.

Research in this area is evolving and it is nearly impossible to account for every potential variable. Michaud et al.(2018) described the rigorous process followed to model and measure sound; however, they acknowledged that it did not capture “sound

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amplitude, tone and brief changes in sound levels” (p. 100). They also articulated the rationale for their analysis, refuted the reanalyses of external groups, and emphasized that their study should be “considered in context of the broader evidence base” and the recognition that “science is incremental” (p. 109). In short, environmental stressors and associated health measures are difficult to assess objectively and diagnose accurately (Neubauer et al., 2007; Siegrist et al., 2005).

2.8.4 Wind Turbine Planning and Construction

Governments generally make public-policy and public-health decisions based upon available scientific evidence and the best interests of the population as a whole. (Gattig & Hendrickx, 2007; Sunstein & Zeckhauser, 2011). At an individual level, a person’s value system largely determines the balance between acceptable risk, risk aversion and necessary precaution (Ball, 2002; Gattig & Hendrickx, 2007). For example, those individuals and communities benefiting financially from IWTs may be more likely to accept the risk and be potentially less annoyed by environmental changes (Ball, 2002; Bickerstaff & Walker, 2001; Linkov et al., 2009; Moffatt & Kohler, 2008; Nisbet & Gick, 2008).

Both sides of the IWT debate have challenged the evidence, often claiming “dissatisfaction over the interpretation of science ...the lack of sufficient objectivity, certainty, transparency, repeatability, and consistency in the approaches used to integrate lines of evidence in reaching conclusions about environmental risks” (Linkov et al., 2009, p. 5203). Meanwhile, according to Wolsink (2010), it’s not all about risk, it’s also about perception of unfairness and a strong sense of “place,” which can lead to an increased sense of injustice and conflict (p. 308). In short, the context for a wind power

development is reliant on a unique combination of factors; the complexity and influence of context should not be over-simplified (Fischlein et al., 2010).

After Ontario implemented its Green Energy Act (GEA) in 2019, pushback from opposition groups significantly increased. In their 2015 article, Walker et al., describe GEA as a “technocratic approach which streamlines siting [renewable energy] in the name of reaching sustainability goals” (p. 731). The planning process regulated within the GEA sought to streamline approvals by requiring two public consultations (one during the planning stage and one when a project became established). Unfortunately, changes made within GEA also meant that municipalities in Ontario lost most (if not all) IWT decision-making power. One of the most important determinants to wind farm acceptance is whether citizens are part of the decision-making process (Dimitropoulos & Kontoleon, 2009; Graham, Stephenson, & Smith, 2009; Hindmarsh & Matthews, 2008).

The streamlined GEA regulations may have been a short-sighted political strategy to achieve targeted wind energy capacity, at a cost to social capital and community cohesion, with a varying degree of environmental and financial cost (on both sides of the wind energy debate). Wind farm developments and stakeholders on all sides have perhaps been caught in a proverbial double-edged sword or vicious cycle of psychosocial factors including and contributing to a lack of power, control, transparency and mistrust and perceived risk (financial and health).

Walker et al. (2014) sought to investigate the lived experience of residents living near the Erie Shores wind farm in Port Burwell, Ontario (one of this dissertation's selected communities for its case study). Erie Shores is one of the oldest wind turbine

projects in Ontario and at the time of their study was the fifth largest wind farm with 66 turbines installed. They found that respondents supported wind turbines; however, the study was one of the first to differentiate between the different types of support people had for wind turbines, describing most supporters as pragmatic versus enthusiastic. A few respondents made strong, emotionally-laden objections to the turbines in their area (p. 734). Additionally, the authors are one of the first to use the words “vindication and outrage,” and they describe the relationship between rhetoric and resistance for those opposed to turbines, even noting specific resistance group members’ names and experiences in reference to health effects and health research now being conducted (p. 735).

Media have picked up and frequently reported on the often-negative stories (Warren & McFadyen, 2010) pertaining to health, siting, policy, and political dimensions of renewable energy, especially wind turbines. This public and antagonistic rhetoric has begun to raise questions of whether it’s the conflict or the turbines that are causing stress (Murphy & Smith, 2013). In their paper exploring the nuances of IWT rhetoric and increasing community and opposition conflict, Baxter et al. (2015) observed that the potential for public conflict and fear-arousing communication coupled with local development (proximity to IWTs) increased people’s perceptions and feelings of annoyance.

2.8.5 The Politics of Wind Turbines

Strong political discourse fuels the IWT debate at national, provincial and local government levels. Taking a mixed methods comparative case study approach to exploring the wind energy phenomenon, Walker and Baxter (2017) conducted a survey

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and interviews to explore both “planning and IWT lived experience” in three Ontario and seven Nova Scotia communities (conducted spring 2014). The results of their study reflect the impact of partisan influence and note the importance of considering political ideology in context of being able to anticipate support or opposition of future development. In response to strong opposition, politicians began to weigh in on the renewable energy debate in Ontario. In 2009, Ontario PCs called for a moratorium on wind farms, and when elected in 2018 Premier Doug Ford followed through on the party’s earlier promise and to “cancel 750 renewable contracts” (p. 673). One media reporter called out politicians on their back-peddling behavior, calling it “bone-headed and politically motivated NIMBYism” (p. 673).

Whilst Walker and Baxter (2017) describe Ontario’s political “hotbed,” the situation in Nova Scotia appears to have reached a more unified approach to renewable energy development. Study results indicate Ontario is unique in terms of a distinct political divide that shows the interconnections between “social” and “sociopolitical” discourse and their subsequent influence in preventing renewable energy progress in the province. This political debate is not simply about differing views between political parties, it is about underlying questions of economic profit or loss; social justice or injustice; and perceived risk that, when reinforced with negative or positive messaging, has the power to influence acceptance or invoke outrage. The political aspects associated with IWT planning and community developed emerged as predominant factors psychosocial IWT factors in both literature and participant interviews.

2.9 Physiological Overview

Adverse physiological symptoms are the most predominant reported health issues reported in wind turbine communities (Pedersen & Waye, 2004). These health issues include aural, visual, vestibular, cognitive/behaviour, and sleep symptoms (Minnesota Department of Health Environmental Health Division, 2009). Many reports claim there is no direct causation between adverse health effects and wind turbines; rather, health effects emerge through mediating variables such as annoyance (Government of Ontario, 2010). It has been found that noise, sleeping disorders and headaches have an extremely high correlation to annoyance and are also among the most commonly reported health complaints related to IWT exposure (Chaing et al., 2012; Government of Ontario, 2010; Pedersen & Waye, 2004; Raffaello & Maass, 2002). Much of the literature describes the relationship between IWT exposure and health effects as indirect; however, the public and the media typically describe the relationship as direct (Knopper & Ollson, 2011).

Self-reported adverse health effects consistently included; tinnitus, vertigo, headaches, sleep disturbance, anxiety, heart palpitations and generalized pain. In 2012, Dr. Pierpont self-published a book suggesting she had diagnosed this clustering of symptoms as “Wind Turbine Syndrome”. There was significant discourse following this new health diagnosis and classification. Studies to date have concluded that there is no causal relationship between IWTs and physical health. However, there may be underlying psychological and social conditions aggravating or mediating the response to IWTs.

In a review of literature related to IWT noise (WTN), the Council of Canadian Academies (2015) concluded that long-term exposure to WTN and subsequent

annoyance is the only health effect with sufficient evidence for a causal association to IWTs. The literature has found the degree to which one benefits and individual personality and attitude about wind installations influence the degree to which people experience annoyance from wind turbines and may contribute to whether adverse health effects develop (Chapman et al., 2013; Feder, et al., 2015; Pedersen et al., 2009; Taylor et al., 2013). Attitude, personality features, and personal benefit along with other psychological and socially influenced themes emerged throughout participant interviews and were consistent with factors identified in literature.

2.9.1 Wind Turbine Noise: IWT soundscaping

Home and work landscapes are filled with technology and sound. While there is legislation to govern workplace safety and exposure to hazards, there is little to mandate or regulate safety at home. Environmental sound that is perceived to be unwanted can be distracting and annoying (Chaing et al., 2012; Raffaello & Mass, 2002). Studies suggest that noise strongly and negatively impacts physical and mental health and well-being (Raffaello & Maass, 2002). Noise is cited most frequently within the literature, especially IWT literature, as a source of environmental stress and annoyance (Raffaello & Maass, 2002). Noise directly influences a person's psychological perception of their environment and can create a physiologic nervous system response (Gattig & Hendrickx, 2007; Soneryd, 2004; Toyokawa et al., 2012). Noise researchers and audiologists have hypothesized that noise-induced changes in the environment can cause gastrointestinal discomfort, insomnia, hypertension, dissatisfaction with the environment (Fahey, 1995), fear (Osterberg et al., 2007), anxiety, and stress (Raffaello & Maass, 2002; Thoits, 2010; Toyokawa et al., 2012).

The fluctuations or modulation (pulsating, swishing, resounding) effects of noise generated by a wind turbine are reportedly the highest cause of annoyance (Pedersen et al., 2008; Waye & Ohrstrom, 2002). Annoyance in this field is defined as being something beyond an experience of daily life and could itself be considered a negative health outcome (McCunney et al., 2014). There is consistent evidence to conclude that noise is strongly and negatively associated with adverse effects to physical and mental health and well-being (Michaud et al., 2016; Walker et al., 2015).

There has been significant literature and debate regarding noise and related noise annoyance from IWTs. Factors believed to contribute to noise-annoyance may be the “man-made nature of the noise itself,” which “is rarely perceived in a social vacuum” (Shepherd & Billington, 2011, p. 390; see also Maris et al., 2007). Shepherd and Billington (2011) also noted that “moderating factors including, age, noise sensitivity, attitude, social context, coping styles and mental health need to be acknowledged and accounted for when judging the appropriateness of wind turbine sites close to residences” (Shepherd & Billington, 2011, p. 390). Noise perception is an individual, subjective (psychological) and physiological response. Shepherd and Billington (2011) suggest noise may also have social dimensions that “make it difficult to predict responses to noise and develop noise standards” (p. 390). This makes it almost impossible to assess, with any degree of accuracy, the combined and cumulative effects and types of noise (Raffaello & Maass, 2002).

2.9.2 Visual Impact and Annoyance

Similar to commonly-reported IWT noise complaints, many people also report that the mere presence of wind turbines is annoying. Both auditory and visual factors,

separately and when combined, can influence how people perceive their environment (Government of Ontario, 2010; Knopper & Ollson, 2011; Raffaello & Maass, 2002; Pedersen & Wayne, 2003). The locations of IWTs, their look (size, shape and movement) and the shadow flicker from moving turbines may lead to mental stress (Firestone & Kempton, 2007; Government of Ontario, 2010). Rural residents refer to wind farms as “visual pollution” (Port Elgin Wind Turbine Town Hall participant, personal communication). The numerous, prominent and brightly-coloured anti-wind displays, billboards and signs in rural communities are an additional visual factor that may indirectly contribute to and/or trigger visual annoyance related to IWTs.

Studies have yet to study in detail the impact of IWTs to the landscape and as an annoyance factor contributing to “visual dis-amenity” and “visual distain” (Fast et al., 2016), i.e., the visual economic impact. Other explanations for reduced property values could include the fact that economically depressed areas may be attracting wind energy development (Gibbons, 2015). Public opposition messaging could also negatively influence the real estate market, causing a reduction in property values. Public opposition messaging regarding the potential health risks of wind turbine led to the introduction of a requirement that real estate agents and property owners cite wind turbines or proposed wind turbine proximity within real estate disclosure documents.

2.9.3 Annoyance

IWT reports frequently cite annoyance as a factor causing adverse health effects. According to the World Health Organization (2001), annoyance can adversely affect health. Although annoyance on its own is not a disease, the body is unable to distinguish between a real or perceived threat, and will respond similarly. The

physiological response to fear or a perceived threat is to initiate stress – flight or fight - which can lead to headaches, insomnia, pain, increased endocrine production, anxiety, and other symptoms that have been described following IWT exposure. Particular noise characteristics may lead to increased levels of annoyance (Raffaello & Maass, 2002; Osterberg et al., 2007). Residents living closer to IWTs may also see an increased anti-wind presence, which may lead to a perception bias (Ball, 2002; Soneryd, 2004) and a lower threshold for annoyance from visual and auditory stimuli (Pedersen & Waye, 2004; Pedersen, Persson & Waye, 2007).

2.9.4 Sleep Disturbance

Sleep disturbance is a commonly reported symptom of IWT exposure. Sleep deprivation can have a serious impact on health, physiologically and psychologically. A lack of sleep can diminish one's ability to cope and manage day-to-day tasks. Over time, sleep disturbance could alter health and/or one's perceptions of health and issues within their environment. Noise and medication-use are among the commonly reported causes of sleep disturbance (Kamdar et al., 2014; Raffaello & Maass, 2002).

The relationship between sleep disturbance and illness is also well established in the literature (Kamdar et al., 2014). After one night of interrupted sleep, inflammatory cytokines, catecholamines, cortisol, heart rate, and blood pressure will increase, mirroring the physiologic changes of a stress response (Epel, 2009; Kamdar et al., 2013; Raffaello & Maass, 2002; Toyokawa et al., 2012). Chronic stress significantly alters the body's regulatory system, causes shifts in hormone and insulin levels, slows recovery from acute stressors, and increases rates of depression and chronic fatigue (Epel, 2009; Jalali et al., 2016; Lane et al., 2016; Thoits, 2010; Toyokawa et al., 2012).

The RETH survey results identified a dose-response relationship between sleep and proximity to a wind turbine (Christidis et al., 2014). Whereas the Jalali et al. (2016b) prospective cohort study found there was no temporal association to IWT noise and sleep, yet a high prevalence to visual annoyance (Jalali et al., 2016). Michaud et al. (2016), in their sleep loss study analysis authors noted that sleep is evaluated by both “subjective and objective means” and “misperception of sleep quality is a common clinical phenomenon ... and that the psychological experience must be considered” (p. 97; see also McCall & Edinger, 1992). There continues to be inconsistent results establishing a causal link between IWT and sleep disturbance. However, given increased reports of worry, psychological distress along with a constellation of physical symptoms one must further consideration must be given towards other factors that may be contributing to sleep disturbance. Is turbine noise interrupting sleep or is the annoyance and psychological distress keeping people from sleep?

2.10 Psychosocial Health: Place, Home & Environmental Health

The lack of comprehensive health impact assessments as well as the multi-tiered and fragmented government construction criteria and approval process (Nisbet & Gick, 2008) add to the complexity and challenges of environmental health research. A critical evaluation of housing and built environments’ potential influence on health is needed to appropriately evaluate the need for an “acceptable risk” approach to proposed policy, technology and environmental change. Social norms and individual perceptions and values can have a powerful effect on health. In the context of the very public IWT discourse, the opportunity for perception bias and fear-inducing triggers may be contributing to self-reported health effects of IWTs (Deigman et al., 2014).

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In terms of psychological attitudes and IWTs a qualitative study (Pedersen et al., 2007) found that residents felt that turbine noise and constant blade movement made some residents feel uneasy and that IWTs were an invasion of their privacy, whilst others who did not perceive turbines as intrusive felt in control of their reactions both mentally and physically (Freiberg et al., 2019). Two later studies (Walker et al., 2014, 2015) showed a link between negative health perceptions and quality of life for residents living in communities with IWT opposition rather than in a community that supports wind installations (Freiberg et al., 2019). This link was further expanded in experimental studies that showed “if negative expectations were further triggered with a biological explanation for symptom development, symptoms and negative mood items got even worse; but if these items were triggered with information (the nocebo effect), symptoms and negative mood items could be returned to baseline” (Freiberg et al., p. 454, 2019; see also Crichton & Petrie, 2015).

A person’s reaction or predisposition to environmental changes such as smell, visual pollution, pain, or noise is difficult to predict and identify as a direct causal factor of illness or annoyance. A particular noise may be annoying to the point of stress for some, but for others it may be positive, depending on how it is perceived (Colby et al., 2009; Horner et al., 2011; Osterberg et al., 2007). Many people may seek out rural landscapes for their quiet and restorative or relaxing qualities. In those instances, a significant environmental change may create a strong contrast effect (i.e., an open landscape now filled with IWTs; natural sounds competing with IWT sounds) that in turn removes the restorative value of the home or space.

2.10.1 Emotional Attachment to Place and Home

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A report from the WHO Commission on the Determinants of Health (2008) has confirmed the growing interest in and connection between one's living situation and physical and mental health. Psychosocial factors attributed to housing, neighbourhood, and community consistently include: pride, status (Moffatt & Kohler, 2008), and security and safety (Davis et al., 2009; Hartig, Johansson, & Kylin, 2003; Petticrew et al., 2009; Veenstra et al., 2005; Velarde et al., 2007). Furthermore, many articles either directly or indirectly refer to the restorative importance of one's home in terms of reducing stress and improving overall health and well-being (Colby et al., 2009; Copes & Rideout, 2009; Hartig, Johansson, & Thoits, 2010; Horner et al., 2011; Kaplan, 2001; Kylin, 2003; Petticrew et al., 2009; Schultz et al., 2004). Study subjects frequently cited outdoor space, air quality, a sense of peace and the ability to relax at home as important components to a "healthy home environment" and one's ability to achieve and maintain optimal health (Hartig, Johansson, & Kylin, 2003; Kaplan, 2001; Kaplan & Peterson, 1993; Nisbet & Gick, 2008; Petticrew et al., 2009; Schultz et al., 2004).

Mroczek et al. (2015) support the influence of contributing psychosocial factors to health perception and health outcomes, especially to those who oppose local wind development. They report that the most common reaction to hearing of a wind farm development was initially "calmness," followed by "indifference" and then "nervousness" (p. 6074). This observation was consistent with this dissertation's interview results (Chapter 3). Respondents who believed the development would be of personal financial benefit reported higher "social functioning and mental health scores" (Mroczek et al., 2015, p. 6075; see also Feder et al., 2015). Proximity to home and stage of wind farm development had strongest association to feelings of anxiety, irritation and nervousness

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(Mroczek et al., 2015, p. 6075). These results are consistent with analysis of the literature, the interviews and RETH survey data in terms of proximity (dose response) potentiating feelings of “stress” (environmental stress), “anxiety”, “anger” (p. 6079), and “worry” (Feder et al., p. 228), especially without the presence of mediating or buffering factors (i.e., economic benefit, positive/transparent messaging, support of renewable energy).

The literature in recent years has expanded the knowledge and understanding of the complex (Guski et al., 1999) and indirect ways in which IWTs may be affecting health (according to WHO’s definition of health) and quality of life (QOL). QOL is defined by the World Health Organization as “an individual’s perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns” (WHOQOL, Group, 1994). This broad subject is an important consideration to the IWT discourse and this case study, as QOL works from a premise and evidence that “dissatisfaction with environment, psychological and/or social domains may impact physical health in individuals” (Feder et al., 2015; Guite et al., 2006). Given the important concepts and potential impact to health, the WHOQOL domains were used to formulate prompting questions for this dissertation study (see semi-structured interview questions Chapter 3 and modified WHOQOL domains in appendices).

Several studies describe annoyance as a health concern or outcome (Michaud et al., 2016; Freiberg et al., 2019) and that whilst difficult to assess, some people are more sensitive to economic inequities, noise and visual annoyance. Furthermore, these “annoyance characteristics may be mediators to health effects between reported

variables” and provide insight by showing an aggregated annoyance measure that supports a statistical association to sleep, headaches, stress and pain and noise sensitivity (Michaud et al., 2018b, 2018). These potential psychosocial variables have not been explored in depth (Freiberg et al., 2019; WHO, 2018) and are the focus of this dissertation research.

“Home is where the heart is” is a common saying, rich with ideology, symbolism and meaning. For many people, home represents shelter, safety, a significant investment, a place to raise a family, and a place where they can spend the majority of their time (Evans, Wells, & Moch, 2003; Hartig, Johansson & Kylin; 2003; Schultz et al., 2004). A home is often perceived as an extension of one’s self (Schultz et al., 2004; Manzo, 2003). The home’s quality, size, condition, and surroundings, implicitly conveyed to others, create a unique and powerful two-way message (Evans, Wells & Moch, 2003; Williams et al., 1992). There is a re-emergence of literature regarding interconnections between characteristics of housing/community and health and well-being (Davis et al., 2009; Hartig, Johansson, & Kylin, 2003; Higginbottom et al., 2006; Osterberg et al., 2007; Petticrew et al., 2009; Schultz et al., 2004; Veenstra et al., 2005; Velarde et al., 2007;). Furthermore, positive social interaction and connectedness to home and environment are crucial for restoring and maintaining optimal physical and psychological balance (Kaplan & Peterson, 1993; Manzo, 2003;).

The psychological complexities underlying people-place bonding have been well documented. However, the social factors that may contribute to people- and place-identity and attachment have received limited attention, particularly in IWT research (Rollero & De Piccoli, 2010). Place-attachment and place-identity both involve the

separate yet powerful interplay between cognitive and affective dimensions of self-identity (Scannell & Gifford, 2016). Social cohesion and perceived social support have been identified as an important influencing feature in predicting neighbourhood ties and emotional place-attachment (Bisung & Elliott, 2014; Devine-Wright, 2005; Kingsbury et al., 2019; Uzzell, Pol, & Badenas, 2002; Wen, Hawkey, Cacioppo, 2006).

2.10.2 Psychosocial Impact of Changes to Home Environment

When one's home or home environment changes it may, for some, cause distress. The term "solastalgia" has emerged in environmental literature and is defined as "the lived experience of environmental distress" (Higginbottom et al., 2006 p. 246; see also Albrecht et al., 2007; Osterberg et al., 2007). That led to the development of a five-stage model of environmental stress that is admittedly iterative, yet consistent with other similar studies. The five model stages identified are: 1) perceive environmental change (Elliot et al., 1999); 2) emotional reaction (Bohm, 2003; Gattig & Hendrickx, 2007); 3) review threat; 4) initiate coping; and 5) adapt (Osterberg et al., 2007 p. 246). These model stages collectively provide a summary that would be useful for future research in the area of environmental exposure and potential distress.

Given people's financial and personal investments in their homes, examining the influence (Schultz et al., 2003) and potential psychosocial impacts a home can have on health (Evans, Wells, & Moch, 2003; Hartig, Johansson, & Kylin, 2003; Hugh-Jones & Madill, 2009) is an important consideration. Over a prolonged period of time, unresolved housing quality, negative perceptions, conflicting values, and feelings of powerlessness (Schultz et al., 2003) can lead to learned helplessness, fear (Sunstein & Zeckhauser, 2011), or a sense of victimization (Elliot et al., 1999; Evans, Wells, & Moch, 2003, Hartig,

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Sunstein, & Zeckhauser, 2011). Many IWT victims report that adverse health symptoms resolve when away from their home. Therefore, the presence or history of individual and family psychological issues needs to be considered and further explored in the context of IWT health effects (McMurtry, 2011). A gap in research exists in general, and in the context of IWTs, as most studies do not include the interaction between housing and social neighbourhood characteristics that may exacerbate impacts on health (Elliot et al., 1999; Evans, Wells, & Moch, 2003; Hartig, Johansson, & Kylin, 2003). The findings of this paper help to fill this important gap in understanding IWT discourse.

2.10.3 Communicating Risk: Impact of public discourse to health perception

Fitzpatrick-Lewis et al. (2010) believe that risk communication can impact perception and that “effective communication is part of the risk-analysis process and

Your Health



Wind energy is environmentally-friendly, affordable, and benefits our communities. Studies also show it is a safe way to generate electricity.

Facts about wind energy and your health

- A growing number of scientific, medical, and acoustical experts have studied wind turbines and health around the world and authored [more than 25 comprehensive reviews on the potential health effects](#). The balance of scientific evidence and human experience to date clearly concludes that wind turbines are not harmful to human health. In fact, wind energy provides electricity without emitting greenhouse gases or air pollutants, and uses no freshwater to generate electricity – creating a healthier environment for people and wildlife.
- A [review of 60 research studies conducted worldwide on wind turbines and human health](#) was published in the *Frontiers in Public Health* in June 2014 and the authors concluded that the weight of evidence suggests that when sited properly, wind turbines are not related to adverse health effects in humans though they may be source of annoyance for some people.
- A recent report by the Iowa Environmental Council (IEC) found no evidence to support claims of health problems caused by wind turbines. “With the rapid expansion of wind energy, some neighbors to wind turbines have claimed the sound has affected their health. While - to some - the sound might be annoying, research studies have established no adverse health effects,” said Peter

Wind Facts

Why Wind Works

Affordable Power

Reliable Power

Social & Economic Benefits

Clean Air

Preserving Water

Respecting Wildlife

Wind Energy and Bat Conservation Review

Your Health

Figure 2: <http://canwea.ca/wind-facts/your-health/>. Example of IWT health information from wind energy proponent organization. Message provides summary statement of health effects with links to research papers, notes siting as relevant consideration and that IWT may cause annoyance for some people, emotive language not observed in messaging material.

that it is essential to inform the public in ways that do not create undue apathy, or overconfidence while not creating undue stress or alarm” (p. 2). The strategic use of evidence-based visual


images can assist with improving

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scientific literacy, memory recall and perception and risk processing (Severtson & Henriques, 2009).

Watson et al. (2013) found that media play a significant role in the ability to influence the effects of risk communication. Media can elevate the perception of risk severity, contributing to either positive or negative beliefs or behaviours. Although

electronic sources of information and social media are widely used as a source of information, newspapers continue to be a “primary source of health information for the public” (73% people over 18 read print newspaper), especially in rural communities (Deignan and Hoffman-Goetz, 2015). With rural communities primarily relying on



Wind Concerns Ontario supports responsible, environmentally sound solutions to our energy demands and environmental challenges. However, the plan supported by the Green Energy Act to locate industrial wind power plants at an accelerated schedule, with little oversight and no cost-benefit analysis, is tearing apart the very fabric of rural Ontario. Along with transformers, transmission lines, overhead distribution wires and substations these industrial wind turbines threaten people and the environment in serene, historic, rural communities, on prime agricultural land, migratory bird paths and close to sensitive wetlands, designated wildlife areas and pristine shorelines.

Wind Concerns Ontario is a province-wide advocacy organization whose mission is to protect the health, safety and quality of life of the people of Ontario from industrial wind turbines. Wind Concerns Ontario is committed to informing the people of Ontario as to the many concerns surrounding industrial wind power.

<http://www.windconcernsontario.ca/about-us/>

Figure 3 Example of IWT non-support information. Providing description and purpose of organization. Noted inclusion of emotive tone and language.

local media and word of mouth, general wind energy information from developers, supporters of wind energy (see figure 2 above) may not have the public reach and public impact from which to provide a balance opposition (non-support) messaging. Support or neutral messaging has not received as much public attention as opposition messages. Figure two and three are included to highlight the differences in tone, language use and general visual presentation of IWT messages. Figure 2 is an example of information from a source that may be considered a proponent or supportive of wind

energy, while Figure 3 is taken from an Ontario, Canada IWT opposition group or non-supportive of wind energy. The differences aligned with literature findings regarding the tone and emotive language used by opposition and media. The messaging and language used by opposition groups and its impact to some local residents emerged as a participant interview theme which will be discussed in more detail in chapter 3. Using the Canada Wind Energy Association (2012) database, Deignan and Hoffman-Goetz (2015) selected three wind farms built before 2011 to measure the emotional tone of wind-energy media articles in Ontario, Canada. Their results were alarming but not surprising. Less than 1% of published articles were positively framed, and 64.6% of articles that included a health component had a negative bias. The study also found that community newspapers had a higher percentage of negatively framed articles than provincial or national publications (Deignan & Hoffman-Goetz, 2015). The articles were primarily focused on “human health comment politics, and economy, or environment,” with community newspapers using a more negative tone and more frequently publishing health-focused articles (Deignan & Hoffman-Goetz, 2015, p. 535). As found in their previous work, the use of “fright factors” in public communication can, and often are, perceived as “threatening or fearful and can evoke high anxiety or negativity for individuals and lead to a counterproductive response” (Deignan and Hoffman-Goetz, 2015, p. 535). During the interview stage of this dissertation (Chapter 3), participants who opposed wind farm installations frequently used a negative tone and negatively triggered words (words that have a negative connotation).

Marketing literature and tactics have proved effective in targeting messages and influencing decision-making in many sectors over the years. Journalists refer to this

targeted communication, which “emphasizes” or “downplays” a topic of interest, as “framing” (Deignan & Hoffman-Goetz, 2015, p. 531; see also Entman, 1993). Journalists can frame an article with a “positive or negative tone using trigger words or phrases” (Deignan & Hoffman-Goetz, 2015, p. 531). Newspaper stories gain attention (and sell papers) when they are of timely interest, human-interest, or when they evoke strong emotions. The emotional tone of public messaging can “influence the way in which the story is interpreted” (Deignan & Hoffman-Goetz, 2015, p. 531). Frequently published stories with a strong emotional tone can alter the “discourse” and subsequently change the “frame” of the message itself (Deignan & Hoffman-Goetz, 2013, 2015; Salmon & Atkin, 2003). Media, especially non-national media sources, frequently reported the public discourse surrounding wind energy and framed it emotively using fear-arousing language from opposition messaging (Deignan & Hoffman-Goetz, 2013, 2015).

The above noted observations suggests that the frequent and negative coverage in local newspapers influenced the opinions of citizens in the community, which is consistent with research findings that perceptions can be influenced by the media. The media’s power and potential ability to alter perception, either positively or negatively, could influence a shift of public opinion and potentially public response and behaviour.

2.10.4 IWT Protective Behaviour or Activism?

When one conceives of a house and its value beyond simply an investment, a home can become an extension of both our environment and our personal identity (Hartig, Johansson, & Kylin, 2003; Schultz et al., 2004). Hartig et al. (2003) conceptualize a model whereby residences contribute to overall health through stress-reducing and restorative processes (Kaplan & Peterson, 1993). An emotional

attachment to home often contributes to high expectations of control and reliance on the home as part of a coping resource (Gattig & Hendrickx, 2007; Hartig et al., 2003; Manzo, 2003; Schultz et al., 2003).

Changes to the home environment that are beyond one's control may cause a psychosocial response (Bohm, 2003; Sunstein & Zeckhauser, 2011) and be manifested by either internalizing one's feelings or becoming engaged in opposition or "not-in-my-backyard" (NIMBY) activism, and/or engaging in behaviour that reflects a victim mentality or victim role persona (Hartig et al., 2003; Wen, Hawkey, & Cacioppo, 2006).

Wolsink (2012) and other researchers are beginning to challenge the limited and somewhat negative view of NIMBYism, stating that the conflict underlying IWT discourse cannot adequately be defined by "backyard attitudes." Wolsink (2012) suggests that the literature does not support the premise that NIMBY views cause delays in IWT progress. However, research also has suggested that IWTs' heightened profile, due to NIMBY activism, may contribute to anxiety, potentially exacerbating existing health conditions (Nisbet & Gick, 2008; Wolsink 2012). Whatever the NIMBY definition and attitude, the lobby groups' collective use of "common sense language" (Wolsink, 2012) and mass media, as well as their coordinated systems approach to advocacy, have stirred global attention and provided a rich "environment" for study.

The use of graphic images dramatizing links between wind turbines and illness, financial devastation, political wrongdoing, landscape devastation, and agriculture destruction could reasonably lead individuals to conclude that wind turbines pose severe and real risks, which require neighbourhood and individual protective behaviours. Research has shown that "fear-arousing communication can change attitudes and,

subsequently change behavior” (Milne, Sheeran, & Orbell, 2000, p. 106; see also Block & Keller, 1998). Moreover, information technology has enabled opposition to IWTs to become a Not-in-*Anyone’s-Back-Yard* kind of issue. Information technology and social media have given IWT opposition groups the illusion of size and scale; the capacity for mass communication; and a degree of anonymity that provides the safety and skill (self-efficacy) required to maximize their collective voice.

In contrast to the very public wind opposition, pro-wind messaging is positively subtle and media-silent. When one can find messages supporting wind turbines, they are often written by those who have turbines. Information from a turbine owner who is financially benefiting may be perceived and portrayed as untrustworthy, unreliable, and biased by opposition groups. As well, individuals who support local wind development are generally not identified by name. This may be due to the fear of reprisal by neighbours and families who may oppose local developments. The lack of local support for IWT developments generally leaves opposition groups free to tip the “message balance” and contribute to ongoing negative bias and fear-rousing.

The issues of IWTs’ energy efficiencies and health impacts have led to heated discussions and polarizing opinions at public forums (such as during municipal and provincial government meetings), with each side vehemently attempting to legitimize their position (Bohm, 2003; Gattig & Hendrickx, 2007; Wolsink 2010;). Traditionally, such debates assume an environmental policy and scientific perspective of known or plausible risks, often using localized assessment measures (Nisbet & Gick, 2008; Power & McCarty, 2006; Wolsink, 2010). The IWT debate, however, has been

somewhat of an exception. Social media and extensive lobbying have extended the reach of a predominantly rural population beyond the limits of geography.

The highly visible and emotionally charged communications, testimony and other lobbying tactics of anti-wind groups have potentially biased the public to become distrustful (Vaughan, 1993; Wolsink, 2012) and fearful (Bohm, 2003). For some, IWTs may be perceived as a threat, and cause an intentional or emotional reaction. Heightened IWT media attention and the use of social media by opposition groups may worsen and extend people's protective response. A better understanding of the psychosocial factors involved is essential to formulate how to effectively respond, mitigate and manage the perception of risk.

2.10.5 Socio-Economic Factors

Wind energy and wind farms in rural communities offer potential economic benefits. Potential benefits may include individual payment for landowners, local employment opportunities, and tax revenue from developers. Other more indirect benefits may include increased local spending because of new revenue streams, an additional source of local charity and recreation sponsorship from new industry, and educational or tourist activities (Gibbons, 2015).

Gibbons' (2015) quasi-experimental difference-in-difference research design differed from previous studies and used a more traditional environmental economy hedonic approach to compare property price changes in areas with wind farm developments. Gibbons categorized groups for comparison as "places where wind farms became visible in the past, or where they will become visible in the future and places close to where wind farms became operational but where the turbines are hidden

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by the terrain” (p. 178). The study found an association between property values and proximity to wind farms. Property prices were reportedly 5% to 6% lower for properties within 2 km of visible turbine developments, 2% lower when 2km to 4 km away from visible turbines and almost unchanged when 8 to 14 km away, compared to prices near wind farms that were not visible (p. 178).

Another Canadian study on the effects on property values in Ontario (Vyn & McCullough, 2014) makes an important observation that “while the results indicate a general lack of significantly [financial] negative effects. This does not preclude negative effects [willingness to pay] from occurring on individual properties” (Gibbons, 2015, p. 179; see also Vyn & McCullough, 2014). In what is believed to be the only Canadian study of this type, Vyn and McCullough (2014) applied a hedonic approach to estimate the impact of wind farms (proximity and visual disamenity) on residential and agricultural property values in Malancthon Township, Ontario (one of the community participant groups included in this dissertation’s multiple case study, Chapter 3). After accounting for property variables such as size, number of rooms, acreage, and additional features, their results showed “significant price effects of the wind turbines in Melancthon Township were not found” (Vyn and McCullough, 2014). Furthermore, they found no significant decrease or difference between “turbine density” or “turbine proximity” and property values for rural or farm properties (p. 387). Most studies regarding property values have included smaller wind farms in less “rural” areas, which may impact the degree to which environmental changes are accepted (Gibbons, 2015, p. 179; see also Sims & Dent, 2007; Sims et al., 2008).

2.11 Integrated Wind Turbine and Environmental Literature: Discussion

Global efforts are underway to reduce the reliance on fossil fuel and nuclear energy. Large-scale renewable energy technology (RET) in communities brings both environmental benefit and a complex set of political, environmental, physiological and psychosocial risks. IWTs, one of the most controversial RETs, and their potential side effects are generating significant discourse in many countries and especially in Ontario.

Issues of social and environmental justice have been discussed within the context of wind turbine development but are often simplistic, neglecting the many levels of inequality, ethical-based decision-making and social justice. Decisions need to be informed and include a fulsome understanding of nuances that bind the wind energy response phenomenon if we are to have any hope of improving tensions surrounding this topic. Many residents living in close proximity to wind farms report experiencing annoyance, headaches, anxiety and sleep disturbances. The literature strongly suggests that within the milieu of IWT discourse, psychological and social determinants of health, like housing, perception and attitudes, may be negatively influencing health and well-being. Anti-wind groups' frequent use of "loaded" language to generate publicity, using terms such as "victim," "destroy," "kill," "sick," and "decreased property value," as well as their graphic images of dead birds, graveyards, and mass protests may be perceived as inflammatory and the cause of social conflict, psychological distress, and a physiological stress response.

Interestingly, many of the reported IWT health complaints are attributable to psychosocial factors. These similarities and the presence of a strong, widespread anti-wind movement, with limited neutral or positive information, suggest that a perception bias and emotional fear-induced response may be contributing to reported IWT health

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effects. Colby et al (2009) report that fear can create a nocebo effect, which by definition is a worsening of both physical and mental health effects. The body is unable to distinguish between real or perceived stress. Many of the reported health effects of IWT exposure, such as annoyance, irritability, headaches, sleep disturbance, anxiety and pain, are consistent with symptoms of stress. The cumulative effects of stress can exacerbate existing medical conditions and/or lead to serious physical and mental illness.

Understanding and informed decision-making regarding acceptable risk requires an accurate, balanced, and comprehensive assessment of risks and transparency of information. The limited scientific research on the full complexity of health effects blamed on wind turbines, on the one hand, and the heightened, highly politicized and public controversy surrounding them on the other, have created significant political and community turmoil. The scientific literature, even such as it is, and the medical evidence point to IWTs as a source of psychological and social distress for some people. However, the lack of pre-exposure measures makes it difficult to determine causality or even association of some environmental exposures with changes in health. The literature suggests that a person's health can be affected by individual as well as social attitudes and perception.

Scientific and political players are often challenged by conflicting information (Linkov et al., 2009). Imposed changes, particularly without a consistent or transparent decision-making process, can contribute to neighbourhood concerns, conflict, and perception bias (Elliot et al., 1999; Wolsink, 2010; Walker et al., 2015). The controversy surrounding IWT development has raised questions about policy and planning. Lack of

engagement and transparent communication may have made it more difficult for individuals and interest groups to overcome ideological considerations regarding public and private land use. Bureaucratic and multi-tiered environmental processes have made it difficult for rural communities to engage in meaningful planning discussions at the local level.

Supporters of wind turbine development were able to assume a balanced perspective that contained both positive and negative views; however, consistent with the “absolute opposition” in Ontario, non-supporters of IWTs were unable to articulate anything positive about IWTs (Fast, 2015). Poor mental health and “socially mediated” factors are emerging as both a gap in literature in the context of IWT discourse but also in terms of the ways in which emotions may be mediated or exacerbated by the environment and psychosocial factors such as conflict (i.e., impact of turbines to landscape) (Fast, 2015). Authors are beginning to acknowledge the significance of environmental change and psychosocial factors, which may affect a holistic assessment of health and may lead to negative health outcomes. Visual annoyance and the loss of visual appeal as well as restorative features in one’s environment may result in “place protective actions” due to “unwanted industrial intrusion” (home, place-attachment, and landscape). Fast (2015) in an insightful recounting of IWT decision history and issues overview, acknowledge the current framework “ignores the complexity of place-bonding and identity” that needs to be explored to provide an alternative approach to turbine development (p. 6).

When considering public health protection and promotion, one size does not fit all. Public health initiatives strive to have optimal benefits for the majority; however,

there are times that “gains to some can be at the expense or loss to others” (Shain, 2011, p. 347). In the case of wind energy, reducing reliance on fossil fuel would have the beneficial effects of cleaner air and subsequently reduced instances of respiratory illness. On the other hand, some individuals’ negative experiences may result in negative changes to health. The ethics underlying public health decisions are important to consider. Shain (2011) reviews principles of ethics and principle-based decision making such as beneficence, harm prevention, fairness, social justice, precautionary principle, least impactful means test, the neighbour principle, and the polluter-pay principle within the context of IWT discourse and decision-making. Is it acceptable to expose even a few people to a potential or even unknown hazard without careful study of the risks and benefits? The principles of social justice and fairness and the balance of benefit versus burden should apply (Shain, 2011).

Fairness, or lack thereof, has been raised by a number of authors in recent years. Within a democratic society we have come to expect government to represent the interests of its constituents. Therefore, perceived inequity and unilateral decisions regarding who will benefit from green energy certainly have the potential to invoke feelings of injustice and unfair treatment (Shain, 2011). Shain purports that wind development does not fall within public health remit but within administrative bodies, resulting in the disassociation of power. This comment raises the question: did public health professionals receive adequate information and opportunity to participate in decisions surrounding wind farm installations, and contribute to the health assessment of proposed changes to the built environment?

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Since 2013 (with a notable drop in literature after 2017), literature explored the visual characteristics of turbines; however, there continues to be very few articles on the clinical (mental and physical) health aspects and IWT exposure (Freiberg et al., 2019). To date only five articles were identified that looked at health effects through a more “clinical lens.” Nissenbaum et al. (2012) considered anxiety and depression as a health effect of exposure, and several articles explored sleep from a physiological perspective using objective measures such as actigraphy and polysomnography (Jalali et al., 2016b; Lane, 2013; Michaud et al., 2016b). In the only two published studies measuring pre and post wind farm development, authors found no effective temporal difference (Jalali et al., 2016, 2016b, 2016c; Freiberg et al., 2019).

Many levels of government are involved in regulations and oversight of noise. Wind farm opposition groups have raised many complaints regarding possible adverse health effects from wind turbine noise. A number of studies have researched sound, including infra sound generated from wind turbines and wind farms. These studies differ in both design and results (Michaud et al., 2016). The majority have relied heavily on self-reported health data and modelled WT noise. Whilst literature is increasing, the “general consensus” supports an association between noise and annoyance, with inconsistent and subjective association to sleep disturbance (Bakker et al., 2012; Knopper et al., 2014, McCunney et al., 2014; Michaud et al., 2016). While methods and findings varied in the literature, there was “almost consensus” of studies exploring an association of “noise, visual impacts (Jalali et al., 2016a), shadow flicker, lights to annoyance, biophysiological variables and sleep (Jalali et al., 2016b; Lane, 2013) and stress (Freiberg et al., 2019, p. 456). Although studies vary in methodology, results

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consistently found no association between IWT noise and physical adverse health effects (Freiberg et al., 2019; Lane, 2013) or WHOQOL measures (Feder et al., 2015).

In Canada, particularly Ontario, anti-wind activists are making a concerted effort to draw attention to adverse physiological health effects reportedly experienced by individuals living in communities near IWTs (Burger, 2012; Pedersen & Waye, 2004). IWT activists have established numerous local networks, linked by social media, to create strong campaigns of resistance in many rural communities. These groups are “vigilantly resisting” IWT development and aggressively pursuing an ideology based on quasi-science, which is reinforced by divisive, emotion-inducing communication strategies. The vehemence of these lobby groups may be contributing to the environmental IWT “noise” and a perception bias.

The ability to engage in social justice and activism is part of what makes a society developed and democratic. Health professionals learn the theory and practice of social justice, advocacy and ethics as part of their undergraduate program. In fact, advocacy and social justice are part of nurses’ professional standards, to which they are held accountable. Some researchers believed it important to explore the lived experience, including the sense of injustice and lack of control experienced by some residents as a result of wind turbines (Walker et al., 2014; Murphy & Smith, 2013). These feelings of injustice, loss of control and despair, for some, may be contributing to poorer self-rated health and heightened response or reaction to IWTs as a perceived threat (to self, to family or to society at large).

Perhaps the precautionary principle should have been applied to wind installations earlier, when doubts regarding potential harm were raised. Perhaps the

concepts of neighbour and neighbourhood have evolved such that the law and health policy need to evolve as well. Information technology is an important factor in that evolution: social media have created or perhaps extended the concept of neighbor, personal boundaries and expectations of privacy. The new digital reality within which we exist may call for a need to revisit and revise the concepts of neighbor, social cohesion and social networks, relationships, personal boundaries and communication norms. Little is known of the impact and influence this virtual paradigm is contributing to perception and health within the IWT construct, and this is an opportunity for further study (especially when one considers the plethora of such literature in other domains; e.g., reported cases of cyber bullying leading to child depression and suicide). The opposition message excerpt (see above) differing tone and emotive language from that of other modes and sources of wind energy information. Public and antagonistic rhetoric may exacerbate or trigger societies' underlying commitment to collective and individual values of fair and just treatment, social justice and advocacy, upon which many of our social processes and individual belief systems have been built. Walker et al. (2014) suggest these emotions are further compounded by political mistrust, and visual and auditory triggered annoyance from IWTs. It may be plausible that both print and social media fear-inducing communication could lead to increased risk perception and changes in mental health that requires further focused attention and study.

Once triggered, some people may feel compelled to act in response to perceived injustice or misuse of power, especially towards the more vulnerable, resulting in a vehement non-supporter opposition and a supporter group who remains silent if only as a way to respect their neighbour's democratic right to express their outrage and

opinions. Again, underlying psychosocial contributing and culminating factors have shown strong potential as a predictor of support (Walker et al., 2014) or a modifying factor to acceptance of IWTs. The degree to which psychosocial factors influence one's perception of IWTs will expand what is known about the health impacts of IWT exposure, and may lead to changes in policy and health assessments in order to better to manage and mitigate health impacts and response phenomenon of future IWT developments.

2.12 Conclusion

The IWT opposition may have provided the “perfect storm” from which to explore the complex connections between the environment (physical and social) and individual health indicators. Judging by the recent increase in literature, interest in environmental, psychosocial factors is increasing. However, in terms of renewable energies and especially IWTs, the focus remains on the bio-physical effects of IWTs, with social and environmental psychologists “overlooking renewable energy as a subject of empirical research” (Devine-Wright, 2005, p. 126). Devine-Wright's IWT NIMBY research resulted in the initial identification of emerging factors believed to affect public perception. These themes were developed into the first known framework for understanding the perceptions of opponents to IWTs. That framework was later revised by Graham et al. (2009) to include environmental, “physical, contextual, political, socio-economic, social and communicative, symbolic and ideological, local, and personal” categories.

The number of peer-reviewed studies regarding IWT and health is limited, and growing slowly. Irrespective of scientific and medical evidence, many people reportedly suffering from IWT adverse health effects have accepted a diagnosis of wind turbine

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syndrome. Biologic and medical classification of symptoms may be too narrow to fully capture the complex array of symptoms described by some living near wind turbines. Social determinants of health (SDOH) and mental health are irrefutable and linked to one's overall, broadly defined health and well-being. This thesis takes a holistic health lens to explore wind turbine resistance phenomenon and the psychosocial relationship between health, the perception of IWTs, IWT development and existing theory and diagnostic concepts (Petrova, 2016), in order to expand knowledge and inform future IWT research (research objective #1).

3.0 Exploring IWT Psychosocial Health: A Multiple Cross-Case Study

3.1 IWT Phenomenon: Contextual Factors

This chapter summarizes the exploratory research undertaken as part of this thesis in an effort to close the gap identified in the review of the literature (Chapter 2); namely, that literature to date has not addressed a framework that incorporates a broad definition of health and psychosocial factors by which to explore and begin to explain IWTs' health effects. There continues to be sparse literature exploring clinical symptoms and lived experience as a primary focus of research. Additionally, there continues to be few qualitative field studies. This qualitative field explores health from a holistic and lived experience lens and begins to fill these identified IWT literature gaps. The research summarized in this chapter explores common and differing factors between and across cases from an individual and community perspective, to help understand the IWT health-related phenomenon and how these factors may influence the psychosocial health of people living within 5 km of IWTs (research objective #2).

A review of the literature often describes the relationship between IWT and health as indirect; however, the media and public opinion typically describe the relationship as direct (Knopper & Ollson, 2011). Determining cause and effects between IWTs and adverse health is complex; however, listening to the experiences of those living near IWTs may help reveal some of the associative relationships contributing to reported health complaints.

Qualitative data was garnered from semi-structured, in-depth interviews with actors from three geographic areas (communities) living within 5 km of wind turbines. Analysis included the use of inductive inference to establish a coding structure. This

structure included constant comparison (Charmaz, 2014) in an abductive approach to develop coding elements and identify patterns and relationship conditions within the data. In order to gain understanding in greater detail, questions were open-ended and focused on the experiences of the individual in their relationships with others within their household, and in their relationships within the broader community, including the virtual community.

3.1.1 IWT Background: the Ontario experience

In 2009, the Liberal government's new Green Energy Act included fast-track approval provisions designed to position Ontario as the North American leader of wind energy ("Green Energy Act," 2009). Over the course of the next few years, municipalities became sensitive to local decision-making constraints and the inability to effectively oppose provincial authority.

Some people living near wind turbines began to report feeling dizzy, having

Male participant (aged 70-74): "In one way, yeah maybe the green energy act did some good maybe it is going to do some good someday but on the other hand if you look at all the social problems that it's created for the municipalities."

headaches and sleep disturbance these symptoms were attributed to turbines. Anti-wind turbine groups became active online and in communities. These anti-wind groups began staging protests, putting up signs and presenting to local councils that the health effects from wind turbines were real and needed to be studied. Public health officials responded by indicating that scientific evidence at that time did not support a direct causal link between wind turbine noise and adverse health effects (Ontario Chief Medical Officer of Health Report, 2011).

In 2013 the Liberal government adopted a competitive bidding program for wind development assessment and decision-making, with municipal support as a weighted

criterion. The competitive bidding process, however, appeared to further minimize communities' control over wind energy approval decision-making, which increased local political outrage. Many communities saw an increase in public anti-wind messaging that predominantly spoke of negative health effects and the loss of local decision-making over land use. Municipal councils began to pass anti-wind turbine resolutions. Word of these municipal resolutions spread, and other municipalities followed suit. Anti-wind opposition groups were being heard across the province, perhaps like never before. Several municipalities went on to pass wind-turbine development policy bylaws with numerous conditions that wind energy developers had to meet before a permit would be issued. Other municipalities officially declared their communities as "unwilling wind-farm hosts." The interviews for this research took place in August 2013, during what could be considered the height of opposition messaging and activities. As a final note, the newly elected PC government repealed the Green Energy Act in 2018.

3.1.2 Putting a Holistic *Health Lens* on IWT Environment and Health Assessments

This multiple cross-case study explored the phenomenon of IWT exposure and potential psychosocial factors which may have contributed to reported health effects. It aims to expand the lens by which environmental research is conceived and conducted. Furthermore, this research seeks to add to the growing body of IWT literature and stimulate additional, contextually-rooted studies that provide further exploration in specific contexts and constructs within the IWT response phenomenon.

The IWT response phenomenon refers to, and explores, a set of beliefs, attitudes and behaviors culminating in reported health complaints experienced by some people who have been involved with, or exposed to, IWTs. Both environmental health research

and health practice currently do not consistently incorporate a holistic definition of health and quality of life factors. An ability to recognize the interconnectedness of the built environment as a determinant of health, and to identify both physical and mental health antecedents affecting health, is needed to understand the health effects of IWTs. This study aims to provide researchers, health professionals and policy officials with additional information to consider as part of comprehensive health assessments, environmental change impact assessments and future research.

3.2 Methods: Approach to Multiple Data Source Analysis

Qualitative research emphasizes flexibility (Charmaz, 2014) throughout the research process. “Yin describes five techniques for analysis: pattern matching, linking data to propositions, explanation building, time-series analysis, logic models and cross-case synthesis” (Baxter & Jack, 2008, p. 554). The use of tools, including constant comparison, independent researchers, and literature and data triangulation, provided methodological rigour and coding validation.

Qualitative research requires a high degree of transparency on the part of the researcher. The reviewed information, decisions and decision criteria need to be credible in order to generate trust in the results and assertions made (Charmaz, 2014). Analytic strategies such as verbatim transcripts, coding reviews, journaling, stating the researcher’s position, and the utilization of independent researchers at key research stages added an important aspect of rigour, integrity, and credibility to this research (Bowen, 2006).

The transcripts underwent a “line-by-line” manual analysis using an inductive lens to create codes to represent keywords, concepts and/or feelings expressed by

participants (using participants' own language as much as possible). This manual review included a back-and-forth review of emerging themes. Concurrently, an independent research assistant used NVivo qualitative software to identify themes and establish "tree-nodes". Both manual and electronic processes included inductive inference to determine emerging themes, ideas, concepts, specific behaviours or actions, as well as the highlighting of specific phrases or sentences that articulated key categories. As analysis proceeded, overlapping concepts were noted and recurrent themes were grouped and named using language as close as possible to that of the participant.

A thematic analysis (deCasterle et al., 2011) enabled refinement of coding and analysis of data from each of the three communities studied. Further analysis of qualitative data using a "between-method triangulation" (Denzin, Ed.2010 p. 140) method added validity to the findings, avoided preconceived bias, and minimized an "over-reliance on qualitative software" (deCasterle et al., 2011, p. 3). This robust process assisted in identifying and illustrating "how social movement framing" may bring forward the "less visible and contradictory constructions of political action" (Naples, 2003, p. 91). To ensure the nuances of language, non-verbal cues and the interconnection between individual and social dynamics were captured by the two researchers and coded both manually and using NVivo software. The findings were compared and consensus was reached. The key phases of qualitative interview data analysis method and specific process followed throughout this study are outlined below:

Preparation of the coding process: manual and electronic categorization from literature followed by an electronic process to "deliberately develop a useful and

empirically based framework for actual coding” (deCasterle et al., 2011, p. 4).

Stage 1 – Initial review of interview data

Stage 2 – Development of narrative report for key storylines and concept framing

Stage 3 – Linking of concepts to concrete experience/examples (iterative, adaptive, refining concepts and coding categories)

Stage 4 – “Forward-backward movement between within-case and between-case analysis” (deCasterle et al., 2011, p. 8). Identification of common themes and links to research questions and conceptual framework.

Stage 5 – Review of interview data, validation of categories, finalization of coding

Stage 6 – Analysis, description and deeper understanding of concepts

Stage 7 – Extraction and integration of meaning to data and interviews

Stage 8 – Description and discussion; a retelling of stories by reconstructing categories both within and between cases (building blocks) to answer, prove or disprove questions and/or events “to understand a particular in the all-together” (deCasterle et al., 2011, p. 9).

3.2.1 Methodology: Analysis of Literature and Narrative

The analysis of literature (Chapter 2) and narrative text (health assessments, interviews) did not follow a linear process. As much as possible, terminology for both core and sub themes was consistent with language and terms used by participants. Additionally, as primary researcher I used the inductive process of thematic analysis and comparison to link similar concepts within the thematic hierarchy.

The next step of data analysis utilized a deductive process, referring back to the original research objective (Chapter 1) to further refine and begin to connect both the

narrative and literature data to the context of wind turbines and psychosocial health. Further validation of concepts and triangulation of data were conducted. Additionally, the utilization and scaffolding of previous related wind turbine survey data and basic health information enabled a richer understanding of the self-reported health and the experience of those exposed to wind turbines. The combination of concept identification, specific experiential patterns, relevant health theory and behaviour models began to emerge. The use of retroduction enabled the consideration of context and specific connections or moderators that exist in the context of those exposed to wind turbines (Danermark et al., 2002).

3.2.2 Researcher Assumptions

Critics of such qualitative research design often cite potential researcher bias (data collection and analysis) and an inability to generalize results as limitations. This researcher attempted to approach this study without preconceived notions, while also acknowledging it is impossible for any human to remove all bias. Additionally, the researcher acknowledges a certain personal affinity towards those reporting adverse health effects, and an appreciation that a person's report of suffering is real, regardless of whether its cause can be determined to be "real" or perceived.

The research employed several strategies to maintain rigour and minimize bias, including: independent reviewers at critical methodological junctures, independent sample selection, triangulation of literature and interviews, negative instance analysis, thematic validation (Bowen, 2006), independent interview transcription and independent manual, electronic and statistical analysis without prior discussion of literature findings or access to interview transcripts. Through the semi-structured interviews, each study

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participant contributed to the content and quality of data. The sampling was not random, as participants were selected based on their completion of previous surveys, consent to be contacted, proximity to IWTs and geography.

As with any qualitative research, the researcher position must be considered. The potential for researcher bias exists, as I have met each participant in his or her home and was privy to personal information. I also acknowledge a personal connection as a former resident of one of the regions of study and daughter of a former local journalist/editor/columnist who is vocal in his support of renewable energy but opposed to IWTs. My training as a Registered Nurse, ensured the maintenance of core standards of practice pertaining to assessment, communication, ethics, confidentiality, and the conducting of research. Health professionals are taught to be observers of subjective and objective perceptions of health and well-being and conduct health interviews and assessments. This experience and my professional status may have helped foster trust and, in turn, enabled richer conversations and a better understanding of context. The nursing profession especially is built on an understanding that one must consider the whole person (holistic care).

My position is one that respects that a person's values and beliefs are deeply rooted and provide an important and complex lens through which he or she perceives the world. Many factors influence these values and beliefs, including family structures, cultural dimensions, social influences and experiences. Seen or unseen, reality is very much an individual experience, and this truth must be applied to our understanding of individuals' perceptions and behaviours within a social construct. That being said, the maintenance of therapeutic boundaries during interactions is also a deeply entrenched

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component of professional practice, which enabled the needed objectivity to mitigate any bias. Furthermore, my collaboration with a graduate student during the process of data entry and categorization also helped mitigate the potential for bias.

3.2.3 Ethical Consideration

This research study received ethics approval from the University of Waterloo under the Renewable Energy Technology and Health (RETH) research program. Study participants gave explicit written, informed consent (see Appendix F). Standards of nursing practice were followed throughout the research process. Research and health information were secured in a locked office and accessible only to authorized members of the research team. All research members were advised on privacy legislation and signed a confidentiality policy. Additionally, verbal consent was obtained to both proceed with data collection and explicitly to consent to audio recording the interview.

3.2.4 Non-disclosure and participant protection measures

IWT developers' non-disclosure or confidentiality agreements, signed by some residents, may have reduced the number of participants willing to participate, as well as the extent of participants' willingness to fully disclose information about their experiences. This may potentially impact the research and study findings. Many participants expressed fear of breaching non-disclosure agreements and/or being identified by neighbours. The "word of mouth" that is common in small communities was a serious concern raised by some participants. To mitigate non-disclosure concerns and protect privacy and anonymity, results were aggregated and identifying features removed prior to publication. Participants were given an identifier; all information was kept secured.

3.3 Methods: Multiple Cross-Case Study

A multiple case study approach allowed the researcher to look both within and across a specific IWT context (locale) to understand the similarities and differences that may influence psychosocial health. The multiple data sources and integrated design allowed the researcher “to identify and explore into central mechanisms from the interviewee’s point of view” (Hartig, 2011 p. 174). Once analysis was complete the literature was re-examined, and data sources triangulated to finalize models, graphic representations and theories through which to begin to explain psychosocial factors surrounding IWT health effects. The combination of analytical approaches and pattern matching is an emerging approach within social sciences to aid in-depth analysis (Seawright & Gerring, 2008) and can help the researcher unpack the layers of complex meanings. This multipronged and phased approach allowed the researcher to explore and answer complex questions and corroborate findings within a single study (Hartig, 2011). A cross case analysis resulted in contextually rooted information that can sensitize and inform interpretation against available and new data whilst maintaining integrity of the participant’s narrative.

3.3.1 Defining and Binding the Case

Participants were selected from previous RETH research (Christidis et al., 2014) who had agreed to be contacted for future research. Each participant had experience with an IWT development in their community and lived near IWTs. Members of the RETH research team contacted individuals by phone to ascertain potential interest in this phase of the RETH study and confirm distance from the closest IWT. Individuals who agreed were sent a package of information including a consent letter, a cortisol

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collection kit and a sleep diary template. Cortisol and sleep diary data were not completed by more than half participants and were therefore excluded from data analysis. Of those participants who agreed to be contacted, 31 volunteered and were included in this third phase of the RETH study. Finally, a member of the RETH team contacted each participant to schedule field interviews. Interviews took place between August 13-26, 2013.

Selection criteria for participation included: living within 5 km of an IWT; adult over the age of 18; no gender criteria (gender mix of male/female was preferred); an ability to provide informed consent; and a mix of reported health symptoms. We endeavored to obtain 10 participant interviews within each of three exposed communities (Table 3) to provide sufficient information to achieve saturation within and between individuals, and each of the communities (Charmaz, 2014, p. 214).

Interview questions were developed to serve as prompts to explore participants' experiences with IWTs. Participant recruitment procedures and consent protocols were established as part of the RETH research program. Explicit written consent was sought and confirmed at the start of each interview. After consent was obtained, a health assessment was conducted first (unrecorded), followed by an interview. In instances when the participant asked health-specific questions or sought to direct the interview outside the research scope, the participant was advised to seek advice from their health practitioner and questioning was redirected back to the topic of study. Any unforeseen or revealed health concerns requiring urgent or immediate attention were managed in accordance with professional nursing standards and the utilization of emergency services.

3.3.2 Participant Interviews and Narrative

The RETH program included a multidisciplinary research team and used a broad definition of health (WHO, 2008) that contributed to the assessment tools used as part of the RETH research and used in this study. The semi-structured interview questions were developed by myself. After completing the health assessment, participants were asked if they would like to proceed to the interview phase, if they would like a short break, or if they would like to decline further conversation. Once participants agreed to continue the interview progressed. The in-depth interview provided an opportunity to include lines of questioning that could explore a deeper and holistic level, the personal and social experiences, and attached meanings raised during the health assessment.

Qualitative research “seeks to understand how people make meaning of their social world” (Hesse-Biber, 2010, p. 258). This study assumed a perspective that those living with IWTs are the experts and “that it is this view of reality that is being sought to interpret” (Hesse-Biber, 2010, p. 258). Within a critical realist paradigm, issues pertaining to “power, control and social injustice” were explored (Hesse-Biber, 2010, p. 258). The interview questions and interview process sought to explore health in the context of a physical, personal, interpersonal and societal (Denzin, Lincoln, 2000. p. 647) environment. The semi-structured methodology provided the ability to be intuitive and flexible (Rubin, 1995, p. 145), which allowed the interview to follow a more natural and comfortable pace. The main questions provided prompts that guided the conversation towards in-depth information regarding the respondent’s feelings and perceptions about their environment and its potential influence on their overall health.

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According to Broom, Hand, and Tovey (2009), “an understanding of the range of interpersonal dynamics that can shape qualitative interview contexts is crucial if researchers are to produce high-quality analysis” (p. 51). With such a high degree of mistrust of researchers and professionals studying this topic, efforts were taken to build rapport and emphasize professionalism (Broom et al., 2009).

People having negative beliefs about wind turbines are more likely to report health symptoms than those with positive beliefs (Pedersen & Peerson, 2004). A careful assessment of triggers and the positioning of reported complaints in the context of other health assessments are important to accurately determine etiology. Literature suggests reported complaints are often interconnected; therefore, determining the existence of a dose response, pre-existing health [including mental health] condition and other psychosocial antecedents would provide the ability to identify whether relationships between IWTs and reported health complaints exist.

According to the World Health Organization (WHO, 2008) report, *Health Environment*, a complex range of hazards and risks requires a coherent and integrated approach to environmental policy development and implementation. The WHO Health and Environment Linkages Initiative (HELI) suggests the use of a framework for determining interactions between environmental conditions and health impacts. The questions used in this study drew from the HELI framework categories to inform the development of question categories for the interview guide. The key categories adapted from the HELI are:

- **Environmental Hazards:** Examining health and environment linkages by determining hazards to health caused by the environment, which can be helpful in identifying policy responses such as monitoring and mitigating strategies.

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- **Health Impacts:** Focused on reducing harm to a group of people, which can influence policy in terms of communications, prevention and protective interventions.
- **Human Setting and Economic Sectors:** Understanding from a grassroots perspective the settings in which people live and how to modify policy to improve assessment, regulation, management, investment and sustainability.
- **Ecosystem:** Understanding the impact of environmental stress at a local and/or community level can help support and inform strategies to protect (eco) systems.
- **Vulnerable Populations:** Exposure to health risk can be unevenly distributed and some groups may be at more risk than others. An appreciation of these vulnerable populations can allow for targeted policy actions, which will be most effective (e.g., potential of rural “vulnerability”).

The thesis supervisor reviewed the interview process at various stages: after initial interviews, following an unusual interview occurrence, at the conclusion of interviews, and finally at the initial stage of interview analysis. The interviews occurred in July and August of 2013. A research assistant joined the interview process after the first set of interviews, which supported a process of post-interview reflection. Interviews were later transcribed by an independent member of the RETH team.

3.3.3 Health Assessment

Conducting a health assessment and health history is a basic nursing skill. As part of the larger RETH health study, obtaining baseline assessment data and measures was deemed important to the work. A health assessment template was developed (see appendix E) to document pertinent basic health information of participants prior to completion of the semi-structured interview. The health assessment

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and history included blood pressure, pulse, respiration rate, current medications, previous surgical procedures and significant (physical / mental) health issues.

The health assessment and health history were not audio recorded. All documentation was completed and stored in accordance with professional and research requirements of confidentiality. Assessment details were entered into an excel data base and subsequently imported to NVivo11 for narrative and text analysis. Health history data were considered as part of the case study narrative information for the purpose of analysis.

3.3.4 Modelling and Pictorials

Every participant's narrative included nuances of language and descriptors that conveyed symbolism as they described their experiences living near IWTs. As the review and data triangulation progressed, models began to take shape and were useful to conceptualize and understand the interconnected pathways within an environmental and ecological context. Diagrams, tables and a concept map were created to represent a number of conducted analyses and to help identify thematic categories. The use of visual models to convey data from the interviews was an important component of analysis and evaluation and have been included within the chapters as applicable or in appendices for additional reference.

3.3.5 Community Profiles

Community 1 - Grey, Bruce and Huron Counties encompass rural communities covering a large geographic region of south western Ontario, with several wind farms dispersed within each county. Some IWT farms are in close proximity to a nuclear power station. Whilst traveling to field interviews, researchers noted opposition signage

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on almost every road within these counties. Participants indicated a continued and strong presence of opposition messaging through signage, media and frequent town

Table 1: Table Summarizing Sample Geographic Community Sample

Wind Turbine	Wind Energy Description <small>Adapted from Locations: https://howlingpixel.com/en/Huron_Wind</small>	Selection Rationale	Number of Participants
Grey/Bruce/Huron <i>Enbridge Ontario Wind Farm located in Bruce County near Lake Huron consists of 110 Vestas V82 wind turbines for a total capacity of 181.5MW. The project includes a substation to increase power generated to 230kV for transmission.</i>		The location was the first commercial wind turbine farm built in Ontario	5 (2 Participants agreed to be interviewed and cancelled) Several people contacted refused to participate.
		The Ripley community has a positive outlook for wind turbines	
		Has a mix of positive and negative reported perceptions of IWT development	
		Has a mix of positive and negative reported perceptions of IWT development	
Melanchthon <i>The Wind Farm is a <u>199.5 megawatt (MW)</u> wind farm in Amaranth and <u>Melanchthon</u> Township, near Shelburne, Ontario. The centre, Canada's largest wind energy installation, is owned and operated by TransAlta. Construction and began operation with 67.5 MW Phase I in 2006. Construction of the 132 MW Phase II in 2007 with full operation in November 2008.</i>		The Melanchthon wind turbine farm is among the largest in Ontario	9
		The Melanchthon/Shelburne communities have a conflicted outlook for wind turbines with many residents thinking negatively	
Elgin / Essex <i>The Comber Wind Farm is a 165.6 megawatt consisting of 72 2.3 MW Siemens SWT 2.3 wind turbines with <u>101 meter</u> diameter rotors. Construction was completed in January 2012.</i> <i>Kingsbridge Wind Power large wind farm located between Goderich and Kincardine consists of 22 1.8 MW Vestas V80 wind turbines with a capacity of 39.6 MW. Each tower is over 78 meters tall.</i> <i>Port Burwell Wind Farm (formerly known as the Erie Shores Wind Farm) stretches approximately 8 kilometres (5.0 mi) to the west of the town, and 16 kilometres (9.9 mi) to the southeast and opened on April 13, 2006. The farm includes 66 GE 1.5 MW Wind Turbines (model 1.5 SLE) a 80 meter tubular tower metre with a blade diameter of 77 metres.</i>		The Port Erie wind farms are among the largest in Ontario	17
		The Port Erie community has a neutral to positive outlook on wind turbines	

halls or community protests. RETH members identified challenges in obtaining participants from these communities. Community 2 - Melanchthon Township was an early adopter of wind energy construction, which occurred between 2004 and 2007. Initially the wind farm development was well received; however, town hall

meetings in 2005 began to hear concerns regarding setbacks and property devaluation (Vyn & McCullough, 2014).

Community 3 – Elgin/Essex is the site of three wind farms, which collectively operate 160 of the largest turbines. Port Burwell was noted to have had significant opposition presence initially (from 2005 to 2009) within the community and surrounding

communities of Vienna and Honeywood. However, participants observed that this opposition presence had all but stopped and was seemingly replaced with controversy surrounding ship tourist attraction that reportedly cost town a million dollars.

3.3.6 Completion of Interviews

Researchers conducted semi-structured interviews to gather information and lived experience from the actors' perspectives. According to Charmaz (2014), semi-structured interviews "focus the topic while providing the interactive space and time to allow the research participant's views and insights to emerge" (p. 85). To enable topical context, interviews occurred in person and in English at the participant's home. Field interviews allowed the researcher a brief opportunity to "live their experience" and see and hear IWTs. An interview guide (see Appendix F) was developed and questions and probes were used when needed; however, each interview was afforded the ability to narrow, expand and to some extent direct the discussion to respect and explore the actor's experience and perspective.

All interviews were digitally recorded. Recordings were transcribed by a University of Waterloo student and RETH team member. Due to technical issues, one interview was not recorded and interview notes were used in data analysis. A total of 31 interviews were completed, resulting in more than 31 hours of taped interviews, 381 pages of transcribed notes and 164,330 words. All interviews were conducted from August 13 to August 26, 2013. Thirty-one health assessments were also completed. Information saturation was obtained at the conclusion of the 17th interview. Interviews continued past the point of saturation to include participants from each identified geographic region and ensure appropriate sample size from which to draw associations

from the data. The information from participants was rich in context, detail and their experiences. The quality and quantity of data and saturation of information provided confidence to proceed with initial coding and analysis. Initial coding between the researcher and independent research assistant confirmed achievement of saturation and the ability to compare within and between data from the cases, and from there identify connections.

An inductive approach to thematic analysis, coding and interpretation of information allowed the data to take shape in a natural or more organic manner that stayed true to the participant voice. While it is impossible to determine cause and effect to reported health concerns, participant narratives as well as available literature consistently identified and described factors that, when woven together, may explain the IWT phenomenon, at least from a psychosocial perspective.

3.3.7 Retroductive Approach to Narrative Analysis

Once core categories and themes were established, researchers used retroduction to more deeply explore pathways and event connections underlying the varied participant responses. Exploring what was consistent and what was different in the experiences may help understand and ultimately improve issues for those reporting adverse effects from IWT exposure. Retroduction provided a strategy for critically examining assumptions against the emergent themes, in the surrounding context of outcomes, structures and processes and outcomes within IWT phenomenon (Danermark et al., 2002). Given the multiple roles and multidimensional social structures to which people are exposed, it is difficult to attribute causal factors and influences to specific situations or phenomena (Elder-Vass, 2010, p. 203). Previous

experience and current social constructs play a “key role in forming normative structures and in extreme cases situations may be taken to shape individual behavior and everything we understand” (Elder-Vass, 2010, p. 203). Language, experience, discourse and knowledge all contribute to forming beliefs and perceptions and ultimately behaviors of both individuals and actors within social structures (Elder-Vass, 2010, p. 203).

Each data set (assessment, interview, and literature) was imported to NVivo and coding “nodes” were applied to frequently mentioned words or phrases or unique concepts and perspectives. Throughout the forward-backward analysis process, nodes were further developed to themes and sub-themes. The deductive process also led the researcher to re-assess the interview transcript for examples of participant “voice” that addressed the research questions or best conveyed their experience with IWTs. This review process maintained a backwards-forwards within and between group (and data set) approach (abductive) to assess language and content and explore patterns and processes that could begin to explain the IWT response phenomenon. Furthermore, this continuous critical review of the data created yet another opportunity to maintain rigour to the research process. The multiple data set table below (Table 2) captures the frequency of concepts. Frequencies ten or greater were highlighted using red colour font.

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Table 2 Multiple Data Set Comparison Table

Codes	Number of sources that mention the codes		
	Literature	Interviews	Health assessment survey
1 Physical health - General	0	5	0
11 Physical symptoms – General	1	0	0
111 Noise and hearing matters	18	16	23
113 Mental health and sleep matters	12	14	22
114 Existing conditions – bleeding	0	1	0
114 Cardiovascular matters	0	3	15
114 Fibromyalgia	0	1	0
114 Other physical matters	3	2	14
114 Pain	0	1	23
114 Photosensitive epilepsy	4	0	0
211 Significant life events	1	10	14
212 Depression	1	0	0
212 Multiple health impacts and stress	15	13	0
212 Psycho(social) Factors	29	0	1
212 Stress - Anxiety – Depression - General	2	0	0
212 Stress and mental health	6	0	21
213 Trust and neighbourhood	2	2	0
214 Attitudes towards IWT	1	0	1
214 General feeling	1	20	3
214 Let-it-be attitude	0	13	0
214 Varied awareness and knowledge	7	15	1
215 Counting frustration	0	1	0
215 Electric shock	0	1	0
215 Feel for killing	0	1	0
215 General health risk perceptions	1	23	0
215 Impact on privacy	0	2	0
215 Killing birds	3	6	0
215 Lack of time	0	1	0
215 Sensitive to electromagnetics	2	5	0
215 Water quality	0	1	0
216 Fairness	1	0	0
216 NIMBY	4	0	0
216 SES	2	0	0
221 Ecological psychology	2	0	0
221 Living around people and animals	0	2	0
221 Living place and place attachment	39	12	0
221 Noise-visualization-landscape combination	9	3	0
221 Place identity and attachment	1	0	0
231 Broader health and adaptation	6	1	0
232 Animal fear	0	3	0
232 Impede traffic	0	5	0
232 WT falling	0	3	0
243 Barrier to information	0	3	0
243 Provision of official information	9	11	0
311 Limited walking space	0	1	0
311 Social capital	36	6	0
311 Neighbour relationships	1	4	0

Upon completion of analysis, six primary codes, ten core themes and 34 sub-themes were established. The six primary codes or categories created a multi-level framing of IWT psychosocial factors influencing a broad definition of health. The six categories are: 1) physical health, 2) psychological health, 3) social, 4) economics, 5) environment and 6) political. Sub-themes (n=31) identified include specific physical symptoms such as tinnitus and headache, psychological factors such as stress, mental health and attitudes about IWTs, social factors such as social ties and feelings of distrust, and so on (see Coding table, Appendix B).

3.4 Findings

3.4.1 Overview

Interview themes showed that those who reported having a neutral to positive experience with IWTs consistently shared the following potential key modifying variables or buffering factors: residing in communities that had experienced less IWT fear-arousing messaging (attitude and perception); residing in communities that were perceived to have received more transparent communication (trust); experiencing a significant life event (adaptive coping skills); not being socially linked to an environmental or IWT group (positive social network); living close to IWTs that are spread out geographically, shorter in height, and/or with a more rounded blade design (less threatening & visual impact to landscape); and being financially stable (benefiting directly, less impact of potential property value loss). Interestingly, a high number of respondents believe there is an obligation to generate clean energy. Non-supporters of clean energy are almost twice as likely as supporters to believe IWTs are a health risk.

A surprising observation of this research was the strong opposition to wind energy in communities with a nuclear power facility. Those interviewed expressed confidence in the local facility and government to regulate and safely manage nuclear-related health factors. Furthermore, several participants noted the economic benefits the nuclear plant had brought to the area in terms of jobs and local business development. Those interviewed commented that trusted neighbours or family members worked “at the plant” and told them nuclear power was safe.

Participants who indicated that IWTs are visually dominant have a higher perception of IWT health issues. Furthermore, participants who perceived IWT noises as annoying were more likely to look at IWT as a threat to their health. Few reported

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IWT noise caused sleep problems. Several manifest factors and connections between mental health, depressive symptoms and renewable energy support were noted. Those who reported visual and auditory annoyance were more likely to believe IWT had negatively affected their health (especially mental health) and quality of life.

Another predominant theme that emerged was a clear difference in support of IWT development based on the number of years that they had lived in their current residence. The longer someone had lived in the rural community and/or their home the less likely they were to support IWT development in their community. Aspects of financial satisfaction emerged as a latent and most predominant interview theme, as it was strongly associated with support or non-support of renewable energy and nearby IWT development. The more a participant perceived renewable energy as a personal source of income, the greater the level of support. The descriptive table summarizes participant key themes.

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Table 3 Interview Summary Table (List of abbreviations: CAD, Coronary artery disease, CVA, Cerebral Vascular Accident, MI, Myocardial Infarction)

Participant	Gender and age range	Duration at Property and Community	Wind Turbine Opinion	Pre-existing conditions	Self-reported Symptoms	Previous Significant Life Event	Psychosocial factors and Participant Narrative
1	Male 70-75	23 years Rural-local	Global support Non-support (local)	Vertigo, Oto/vestibular	Dizziness. Occasional anger.		Financial concerns Neighbors Powerlessness / activism <i>"We can make a statement nowadays and uh find support"</i> <i>"Wind turbines may effect personal health and families' health"</i>
2	Female 55-60	16 years Moved from city	Global support Non-support (local)	Nil	Arthritis. Dizziness, Vertigo.		News paper <i>"major ruckus about nothing ...I cannot see them, so not a major problem for me ... nuclear power wastes issues to a lesser degree than the wind turbine".</i>
3	Male 45-50	19 years Local	Non-support	Cerebral Vascular Accident. Myocardial Infarction Cancer, sleep disturbance	Coronary Artery Disease Headaches, decreased concentration, fatigue Tinnitus, vertigo, sleepiness Distressed and annoyed.	Cancer, chronic disease, marital	Strong sense of place Mistrust Internet, seminars <i>"They didn't provide was the health concerns, tried to steer so clear of that in those meetings ... cause is Wind Turbines without a doubt wind"</i>
4	Female 65-70	65 years Local (generation home)	Non-support	Arthritis (osteo)	Pain Headache and tinnitus. Nausea, increased weight, hormone illness		Strong sense of place Information at meetings Mistrust (government, developer) <i>"This Chinese company is supposed to buy all these guys out and they walk out with their pockets full ... hate the wind".</i>
5	Female 55-60	30 years From rural area	Support	Spinal disease, Asthma, kidney disease	Difficulty balancing. Nausea. Difficulty concentrating. Situational distress. Anger. Fatigue. Sleepiness.	Death of spouse, significant illness	News articles, doctors
6	Female 45-50	6-7 years From urban	Non-support	Minor illness	Neck pain, headaches, spinal injury	Serious accident	Newspaper, radio <i>"We don't want another quarry no we don't want another this, we don't want that"</i>
7	Female 45-50	7 years From urban	Support	Episodic illness	Dizziness, difficulty concentrating, memory loss, palpitation. Night terrors		Financial – reduced property values, no reduction on electricity bill Newspapers <i>"To receive some of the energy at a discounted rate"</i>

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Participant	Gender and age range	Duration at Property and Community	Wind Turbine Opinion	Pre-existing conditions	Self-reported Symptoms	Previous Significant Life Event	Psychosocial factors and Participant Narrative
8	Female 60-65	14 years Rural/urban status unknown	Global support Non-support (local)	Sleep disturbance.	Heart problems. Tinnitus, Nausea, palpitations, sleep disturbance, reduced concentration	Mother's death Family pet buried at property "will not leave here"	Website, company staff <i>"When windy storms are facing the house .. I feel the intensity"</i> <i>"I don't work, difficulty concentrating ...industry is going to come in and affect the area as much as we've been affected"</i>
9	Female 55-60	5 years Rural/urban status unknown	Non-support	Osteoarthritis, spinal disease	Trouble breathing. Fatigue. asthma, gait disturbance Reduced concentration and memory Increased frustration and Anger		Financial – property values, no reduction on electricity bill Private sector that makes money Strong sense of place Information source: web-based articles
10	Male	22 years From urban <i>Built home</i>	Non-support	Hypertension. Minor episodic illness	Pain Tinnitus. Anxiety.	Child's death	Financial – property values, no reduction on electricity bill Foreign involvement Information source: word of mouth, neighbours Mistrust (secretive process)
11	Female 55-60	22 years From urban <i>Built home</i>	Non-support	Coronary Artery Disease Anxiety	CAD Difficulty concentrating. Sleep disturbance, Fatigue. Anxiety and distress.	Child's death	Financial – property values Information source: word of mouth, neighbours Powerlessness <i>"The company dictates ... you're in a movie with a bad script that you can't get out of and that it's already been decided"</i>
12	Male 65-70	24 years from urban	Neutral	Coronary Artery Disease	Dizziness, memory loss, Frustration and distress.	Death of spouse	Strong sense of place Information source: community members <i>"More important thing to worry about that Wind Turbines"</i>
13	Female 45-50	14 years Rural / urban status unknown	Non-supporter	Cancer, episodic illness	Sleep disturbance, fatigue, dizziness. Depression, anxiety, frustration	Family death Marital issues	Information source: neighbours, council meetings Personal stress
14	Male 70-75	13 years From urban	Global support Non-support (local)	Diabetes. Myocardial infarction diaphoresis/ nausea	Chronic disease(s)		Financial – property values, no reduction on electricity bill <i>"farmer politics ... do almost anything to oppose them ... I got rid of all modern gadgets".</i>
15	Male 75-80	64 years Rural-local (generational home)	Non-support.	Coronary Artery Disease	Reduced memory, increased frustration Anger	Parental loss (past)	Information source: public meetings Health concerns. Property concerns. Loss of control. <i>"They were selling a good story"</i>
16	Female 45-50	13 years Urban	Non-supporter	Asthma, anxiety Migraines. Nausea.	Asthma. Nausea. Dizziness, tinnitus, Buzz/drone noise		Information source: community members <i>"I was looking forward to moving last years but I don't know"</i>

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Participant	Gender and age range	Duration at Property and Community	Wind Turbine Opinion	Pre-existing conditions	Self-reported Symptoms	Previous Significant Life Event	Psychosocial factors and Participant Narrative
					combination, anxiety, frustration, increased anger, reduced memory Palpitations at night.		<i>how to get out of here.... WTs affect my health"</i>
17	Female 65-70	7 years Urban	Support	Significant episodic illness	Motion sickness. Headache, joint pain. Dizziness, gait changes Anxiety, Anger. Fatigue Loss of concentration and memory		Financial – exporting energy out of country Strong sense of place Community and work members
18	Female 65-70	Urban / rural status unknown	Unknown	Infectious disease, hormonal disease, episodic illness	Episodic illness, motion sickness. Sleep disturbance, anger (family conflict)		
19	Female 60-65	12 years Rural urban status unknown	Support	Spinal injury, serious episodic illness	Tinnitus occasionally, dizziness, Coronary Artery Disease, occasional fatigue and sleepiness	Significant injury	Strong sense of place Information source: newspapers Political issues <i>"Needed science first"</i>
20	Male 70-75	29 years <i>Built home</i>	Non-support	Arthritis Caregiver fatigue Stress, anxiety	Sleep disturbance, Coronary Artery Disease, Anxiety Tinnitus and dizziness. Reduced memory	Traumatic injury	Information source: community people, TV documentaries, farmers Angry – environmental change Strong sense of place
21	Female 45-50	Rural urban status unknown	Non-support	Depression.	Sleep disturbance. Dizziness, reduced memory and concentration. Frustration. Anxiety. Worry, stress	Significant loss (job, family death)	Strong sense of place Landscape <i>"Rural people have a different way"</i>
22	Female 50-55	9 years Rural-local	Non-supporter	Episodic illnesses	Migraine, tinnitus, joint pain, reduced memory, stress, fatigue, gait changes, sleepiness		Information source: newspaper Quality of life changes from chronic illness
23	Female 60-65	62 years Rural / local (generational home)	Initially neutral Non-supporter	Heart disease, Coronary Artery Disease Tinnitus. Arthritis. Anxiety	Pain, tinnitus, reduced memory, reduced hearing, vertigo Tinnitus, Depression and anxiety. Coronary Artery Disease		Financial –no reduction on electricity bill Strong sense of place Municipal councilor, newspaper Community / neighbour conflict <i>"Company that makes profits ... No one asked neighbours"</i>
24	Female 75-80	From urban	Neutral	Pain	Pain	Significant marital issues	Financial – property values, no reduction on electricity bill Information source: newspaper, bulletin

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Participant	Gender and age range	Duration at Property and Community	Wind Turbine Opinion	Pre-existing conditions	Self-reported Symptoms	Previous Significant Life Event	Psychosocial factors and Participant Narrative
25	Male 60-65	2 years From urban	Non-supporter	Traumatic injury (past)	Minor episodic illness	Trauma (past)	Financial – property values Information source: News bulletins
26	Male 55-60	Duration at residence and urban / rural status unknown	Neutral	Minor episodic illness	Minor episodic illness		<i>“Haven’t really given it a lot of thought”</i>
27	Male 50-55	12 years From urban	Non-supporter	Anger and frustration. Reduced concentration and memory	Minor episodic illness gait changes, tinnitus, reduced concentration, sleep disturbance Mood disorder. Frustration and anger	Parental traumatic death.	Financial – property values, no reduction on electricity bill Information source: Newspaper articles, TV shows, bulletins, community groups. “They did not provide enough information” Landscape change Political issues (conflict) Strong sense of place <i>“I see WTs and yet my energy bill is higher... that is frustrating”</i>
28	Female 55-60	32 years Rural	Non-supporter	Frequent minor episodic illness. Chronic illness Tinnitus. Mental health	Coronary Artery Disease, pain, Tinnitus. Increased weight. Reduced concentration Stress. Frustration. Fatigue. Grief	Parental loss	Financial – property values, no reduction on electricity bill, sell electricity to another country Rural Community people Landscape change Strong sense of place <i>“we are a small community and a lot of people know one another”.</i>
29	Male 70-75	50 years From urban	Neutral initially now supporter	Cerebral Vascular Accident, cancer Coronary Artery Disease,	Sleep disturbances Tinnitus, Coronary Artery Disease	Cancer, Cerebral Vascular Accident	Information source: newspaper, magazines, some science journals Some feelings of powerlessness Objects to IWTs in water
30	Male 40-45	9 years Rural – local	Initially supporter Now neutral	Non reported	Non reported		Information source: newspaper articles Financial: ‘A money-making type scheme’ Government/political issue <i>Neutral ... “as long as nothing life threatening to family”</i>
31	Female 35-40	Duration at residence unknown Rural – local	Non-supporter	Depression. Anxiety	Obsessive Compulsive/ depression Anxiety, anger Irritability, distress frustration		Vision of family harmed (tortured, hurt) Financial – property values, no reduction on electricity bill Visual distress

3.4.2 Description of IWT Non-Supporters

The majority of interviewed participants (21 out of 31 interviewed) identified themselves as non-supporters of IWTs. The non-supporters consisted of eight men and 13 women. Five non-supporters supported IWTs in principle but did not support local development (NIMBY opposition). One of these five participants noted they were currently experiencing a significant life event and felt “trapped and unable to move from the area.” All of the non-supporters had lived in their communities for more than fifteen years. Six had lived in the same home or rural area all their life, four had moved to current location from a neighboring rural area where they had lived more than 20 years.

The common themes within the non-supporter group included feelings of psychological distress, a reliance on local sources of information, strong person-place attachment, and pre-existing health conditions (especially within the mental health domain). The non-supporters typically expressed these feelings in the context of a perceived threat and loss of control and reported that their feelings worsened when they saw or heard IWTs. The economic aspects of wind turbines and wind farms were the most commonly reported source of worry or anxiety.

Some of the non-supporters had initially attended public meetings or followed opposition websites but stopped because they felt IWTs were consuming their lives and reading about all the possible negative implications of wind energy and turbines made them feel worse. Participants frequently stated their support of wind energy in general but expressed a level of concern ranging from mildly worried to “extremely anxious about having a wind turbine close to their home and family.” Important to understanding the IWT phenomenon is identifying the mechanisms that create a gap between an

individual who opposes local development but supports wind energy in principle (Bell et al., 2005; Graham et al., 2009). At the community level, this *social gap* is reflected by a majority of support for wind energy but a relatively low rate of progress in wind energy development. Participants' feelings of anxiety were compounded by their expressed reluctance to contribute to community conflict, as well as the fear of ridicule from those who support renewable energy, or retribution from neighbours opposing the IWT development. Participants were often left feeling helpless and unsure of what they could do and often said they were simply left "feeling that nothing they would do would make a difference anyway."

Among non-supporters who reported adverse health effects from wind turbine exposure, all also reported being able to both hear and see wind turbines from their home. Additionally, those who reported adverse health effects, or were worried or anxious of developing adverse health effects, stated that seeing WTs while driving or when at home made them feel more anxious. Non-supporters often described associated feelings of anger, an "increased heart rate" or "palpitations," and "feeling nauseous at the sight of them." Some described turbines as "menacing" or "monsters," "looking down on them and always watching."

Paradoxically, non-supporters also shared that their feelings of frustration or anxiety became "even worse when the turbines weren't moving because then all the stress is for nothing. They're not even doing anything; what a waste." If the turbines were spinning it meant they were working to produce energy, which for non-supporters allowed them some solace that at least the turbines were possibly "doing something useful."

3.4.3 Description of Supporters

The five supporters (four women, one man) commented on the need for renewable energy and viewed IWTs as a sign of progress in terms of both energy and for the rural community. All but one of the supporters had moved from urban

environments to the rural area

within past 20 years. Each of the

five supporters received local

sources of information about

IWTs; however, each also

indicated having researched

scientific journals and reliable

internet sources for further

*Female Participant: I hear about it on the news and I think at one time this was new there was something going around but I just never really got involved with it I was too busy with life you know too busy at the time to, until it actually affected me but then again like I said it was too late, they were coming down the road with the lines, cutting the trees, doing their thing, clearing it out like **it wasn't going to be stopped** and there were people a lot worse off than us... although **I was upset I could empathize with them** and I thought wow we're not that bad off, could be worse."*

*Participant: I think almost like **I get helpless** like you **almost grieved a little bit.***

information about wind energy and IWTs. Everyone in the supporter group talked about financial aspects of IWTs. Supporters and non-supporters alike believed that IWTs should be used to alleviate increasing energy costs and have some tangible economic benefit to the community. Participants who supported both renewable energy and local development and who were also retirees consistently did not express annoyance or worry about IWTs, but rather saw them as a neutral or positive step forward towards environmental stewardship. There were also those who were neutral or supporters who expressed feelings of helplessness and grief at the way in which the planning process unfolded and at the landscape changes (see quote above). In contrast, those who perceived wind turbines as ugly or an invasion to the natural beauty surrounding their home were still employed and commuting to work, or were full-time homemakers.

Three supporters reported some health changes but did not feel these were attributable to IWTs. One of the supporters, a long-standing rural citizen, reported experiencing a recent significant life event and stated wind turbines are “not what I’m

going to spend time worrying about.”

*Male participant (aged 65-69): “We started to walk down town for the fall fair and I just took her hand and said this **isn’t our town anymore** and we just turned around and went back. **My wife died a few years ago and I’m not going to worry about wind turbines.**”*

Supporters who had experienced and reportedly recovered from a significant event expressed staying aware but felt

there were more important things to worry and were “not going to worry about wind” (see quote above).

3.4.4 Analysis and Discussion of Findings

There was an observed difference between supporters and non-supporters in terms of the frequency and degree of reported health concerns. Non-supporters consistently reported believing their health declined as a result of wind turbines. Also consistent with literature was the reports of feeling more annoyed by the landscape and visual effects of wind turbines (large, metal and white) than most other features (even noise). The combination of the visual and noise effects for many appeared to increase levels of negative emotion and annoyance (see quote below). Several participants

*Male participant: “they are pretty ugly looking, and it **ruins landscape** ... They’re white, they didn’t camouflage them they didn’t paint them to the environment like maybe some browns and greens and stuff kind of make them look like a tree for instance so you’re seeing a nice trees as you’re driving down the road and all of a sudden this **big white thing** is sticking in the middle ... you see this red flash like beep beep beep so it’s all over for miles and miles and to me that’s **not uh visually correct**. I understand it’s for safety so a plane don’t run into them but I don’t really know why they have to have a light on.”*

suggested that blending IWTs into the landscape could minimize the stark contrast between the industrial turbine features and the rural amenities.

Either explicitly or inferred, more than half participants described feelings of personal annoyance and/or general concern and responsibility to maintain the integrity of the landscape. Another commonly mentioned topic amongst participants was a recognition that whilst they support green energy and environmental protection in principle, they have concerns about IWTs being “close to their home” because “no one knows if it will make you sick.” Not all participants perceived wind farms as negative or worrisome. Some people viewed IWTs through the lens of “progress” and found the “repetitive sound” and “turning blades” from turbines as “relaxing, almost like meditating.” As one participant

commented, “Europe has been doing it for many decades.” As interview

*Female participant: I think the wind turbines are a **great thing**, um it's **renewable energy** and uh it doesn't bother me aesthetically looking at the landscape, they have it all over Europe. **Europe has been doing it for many, many decades.***

themes began to emerge that may help understand why some people, perceived IWTs as relaxing and a “great thing” and sign of progress towards “renewable energy” and environmental stewardship. While others were distressed by the sight, sound, and loss of rural “singularity” afraid of being pulled away from what’s natural to us.”

Audible sound and infrasound have been well documented in IWT literature. It may be that noise is causing health efforts or it could be that noise is a trigger to complex socially influenced psychological stress response. Whilst noise was factor in perception and support of IWT, the visual impact and landscape changes and loss of restorative features of rural living had a stronger impact to quality of life of those interviewed. However, the threat of financial loss and inequity of payment schemes

emerged as the strongest annoyance and distressing feature of wind turbine installations for those interviewed. For those who had very strong feelings of emotional attachment to their home and land felt unable to escape from IWTs with increasing anger at the sight and sound of turbines. Interviews revealed a stronger connection between psychosocial measures, physical symptoms and self-rated health. Somewhat contrary to environmental risk literature was the way in which interviewees sought to inform themselves about IWTs. All interviewed sought information from local community members and news sources. Supporters typically also sought information from scientific sources, steered away from opposition messaging and subsequently stopped seeking information when perceived there to be no risk. Supporters often thought IWTs were a beautiful addition to the landscape and a sign of progress. Supporters often commented that wind energy has been in Europe for many years seemingly without significant impacts to health. Those with a neutral position did not see IWTs as a threat enough to become informed. Non-supporters typically felt a degree of risk and sought information primarily through local and opposition sources. Focused research regarding the mental and social aspects of health have yet to be fully explored and this work may help fill this literature gap.

3.5 Psychological Health: Complex Interconnected Processes

3.5.1 An Overview of Identified Psychological Factors

Given IWTs' potential impact on psychological health, it's important to explore the relationships and subsequent pathways that lead one person to perceive and react to a threat, while others do not. Physiological responses are predicated and mediated by psychological processes. There are different schools of thought regarding the etiology of disease, and until recently IWT research has held to the paradigm of isolating

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biological and causal dose-response physiological health effects and social influences. Yet cumulative and chronic stress and/or chronic annoyance can potentially result in a mental health illness or disorder. Social-cognitive linkages have been identified as modifiers to biological systems (Von Dras & Blumenthal, 2000). Physiologic distress may in fact be the result of, or be worsened by, an inverse effect of well-meaning social support (Mama, 2016; Thoits, 2011; Uchino 2006).

All participants were asked to recall when and how they first heard about a proposed wind farm development in their community. No participants could recall definitively when they learned IWTs were proposed locally; however, all participants recalled learning of IWT installations via opposition, community member, or media communication. Furthermore, the majority of participants recalled that they felt “renewable energy was a good idea and sounded harmless,” but as the opposition and media coverage of opposition concerns grew, they “started to worry.”

Previous psychosocial exposures, such as a stressful life event (Shain, 2011) and resulting coping mechanisms (resilience), may exacerbate or mediate the experience of future exposures to perceived events and psychosocial processes. Life transitions (events) can be perceived as positive opportunities for personal growth, or as negative experiences that have the potential to cause psychological distress and future [stress-related] health symptoms (Praharso, Tear, & Cruwys, 2017). Participants who had recovered emotionally from a significant life event (such as survival of cancer, the loss of a child or spouse, or living with a critical or chronic injury or illness) consistently expressed a predominantly supportive or neutral perception of IWTs. When probed, participants generally made statements along the line of “this is not what I’m going to

spend time worrying about.” Those who had experienced a significant life event and had a neutral/positive perspective also had strong positive family support and social ties. Participants in this support category tended to see both positive and negative characteristics of IWTs. There was a reliance on local sources of information, however local information was typically augmented with scientific journals. They were more likely to consider acceptance of IWTs as a responsibility as a global citizen. Participants in this category tended to seek information until reassured there was no threat or risk to themselves or their family. Once no perceived risk was identified they felt no need to “waste time worrying about IWTs.”

In contrast, participants who had *not experienced* or *had not recovered* from a significant life experience and did not report having positive [supportive] family or social ties expressed feelings such as IWTs being “probably one of the worst things that’s ever happened *to me.*” Furthermore, those without previously developed coping mechanisms were more likely to ruminate about the potential risks of turbines and seek validation of symptoms through social media. There also appeared to be a temporal feature of life events and

*Female Participant: Worse than that. It’s just **this is probably one of the worst things that’s ever happened to me** (crying) and I’ve had my animals die, and the trauma and you know, I just, this has really **changed my life**, I can’t believe ... **done this (crying) to me.**”*

IWTs. For example, two participants reported loss of a close family member within past 12-24 months. They shared feelings of grief and felt that adding IWT worry was more than they could manage. They felt they were not able to move from their home and subsequently felt trapped and caught in a cycle of despair. Another participant experiencing marriage and significant health life stressors (within 24 months) felt anger

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and blamed wind turbines stating, “I’m feeling very aggressive when the buzzing sound and the ringing sound gets too loud in my ears, I have no tolerance for little things”.

Another associated characteristic among those with negative perceptions is the reported feeling that IWTs had become a symbol of their worry or anxiety. They reported heightened symptoms, including physical reactions, upon seeing or hearing wind turbines (including signage). For some, these heightened feelings reportedly “made it difficult for them to relax or sleep.” Without moderating factors or interventions stress-related symptoms may develop. Individuals experiencing increased distress and anxiety appear more likely to spend extraordinary time searching information, connecting with other ‘victims’, and more likely to engage in opposition [activist] group activities with these actions appearing to serve as protective measures. Considering the stress related fight-or-flight response in context of IWT response one might consider extraordinary information and social media engagement or physical activist protest as akin to a protective fight-response.

3.5.2 Amenity: Person-Place Bonding and Adaptation to Change

The restorative component of rural life and landscape and the impact of wind turbines have been underestimated. The communities that were part of the study have rich and unique cultures. Many of the families and farms have deep roots within each community. Many of those interviewed have family history going back generations, and some participants having lived on their property their entire life. Among those interviewed who moved to the area more recently, all expressed being drawn to the “quiet countryside” and “escaping the noise of the city.” Interestingly, non-supporters fell primarily into a *rural newcomers* category who had lived in the rural community less

than 10 years or *locals* who lived in community 20 years or less. The motivation for support or non-support of IWTs had key differences and similarities. Newcomers sought the restorative and quiet features of rural living and had previously visited or had existing ties to the area. Local non-supporters lived in their multigenerational home or



Female Participant: Uh I guess because they're large on the landscape larger than silos and um they're uniform ...all white and they look exactly the same they have a sort of an uncanny feeling of something creeping across.

property, built their home and reported concerns of community and neighbour conflict. All non-supporters

shared a strong emotional attachment to either the community, their home or both. Non-supporters perceived IWT's as an intrusion and invasion to their home and landscape. The turbines were often described as "ugly, looming, white monsters" that gave a "sort of uncanny felling of something creeping across" and that stood in contrast from the natural and peaceful landscape that used to exist. Participants felt the presence of turbines would detract from tourism as others seeking the peaceful countryside would find these structures repulsive. The amenity factors of visual appearance and annoyance of seeing turbines were often noted ahead of IWT noise annoyance factors. The highly visible and emotionally charged community conflict, emotive tone of wind energy (IWT) messaging and lobbying tactics by anti-wind groups may have amplified the visual annoyance, perception of risk and political distrust (Bohm, 2003; Vaughan, 1993; Wolsink, 2012).

3.5.3 Information Source: Fear-arousing Communication

Social media have begun to challenge assumptions and previously established means of information sharing. The anonymity afforded through social media can

positively encourage free thought and the sharing of opinions, but the following question also arises: has such anonymity significantly altered the social behavioural norms of 'safe' differences in opinions? During the health assessment part of the interview (non-recorded), some participants who participated in opposition activities described reporting of health complaints due to IWTs important for solidarity and group belonging. However, other participants expressed feeling reluctant to report concerns regarding potential health effects for fear of being ridiculed. For individuals who perceive themselves to be powerless, marginalized and without voice, the fear of being isolated from a source of power and compassion may be very difficult to overcome.

The analysis of interview narratives suggests an association between early and sustained exposures to fear-arousing communication and what could be described as an excessive negative reaction or response to IWTs. For example, wind turbines were taller, more visible and had a sharper blade design among those who reported greater exposure to fear-arousing communication. In contrast, participants did not note hearing or seeking information from wind development or pro-wind sources. Information consistently came from word-of-mouth, local news, local events and opposition bulletins. Literature regarding the use of emotive language in local messaging was discussed previously in chapter two. Non-supporters were noted to use similar *emotive* and *frightful* language to language used by media and opposition to describe turbines and adverse health effects. As well, some individuals with a pre-existing condition of anxiety or depression who were exposed to early and/or sustained fear-arousing communication seemed more likely to self-report adverse health effects from IWT exposure. Participants who were less positive or who were experiencing adverse health

effects expressed a diminished sense of self, emotional fatigue and limited previous significant life stress resilience.

A psychosocial explanation of health suggests that multilevel socio-structural processes (such as communication from opposition groups) may lead to individual psychological processes and changes, including behavioural and physical health changes. In some cases, these psychological influences lead to health changes via psychobiological processes (stress response) or through indirect cumulative behaviour change (reduced restorative activities).

3.6 Social Influenced Factors

Potentially, social networks either reinforce positive protective systems or negative emotional supports (social identity), influencing a psychosocial process (Bisung & Elliott, 2014) and health outcome. Therefore, the consideration of relationships and social identity is an increasingly important lens by which to explore a holistic perspective of health (Praharso et al., 2017; Tajifel & Turner, 1979). To maintain in-group membership and a perceived source of support, individuals may continue to act in accordance with group norms. “Social identity may influence the degree to which a person perceives a stressor [or anticipated stressor] as threatening” (Praharso et al., 2017, p. 266), which in turn may lead to a real or perceived source of distress (threat) and a real or perceived fear of losing social support, all of which contributes to an altered sense of well-being. Several non-supporters expressed feeling there was something “wrong with them” and feeling rejected and “judged by people” who didn’t believe them. There is considerable literature surrounding the mechanisms and impacts of stress. Relevant to this work is acceptance that the body [mentally and

physiologically] does not differentiate between real and perceived stress. One experiences stress as they perceive it (negative, positive).

Study participants who indicated they witnessed increased local coverage and opposition activist activities were more likely to communicate perceptions of victimization and financial worry. Feelings of psychological distress, worry or anxiety

*Female Participant (55-59): when you try to tell someone who's not understanding what you're experiencing they just sort of think there might be something wrong with you or your weird or whatever **you feel incorrectly judged by people who aren't experiencing the same things***

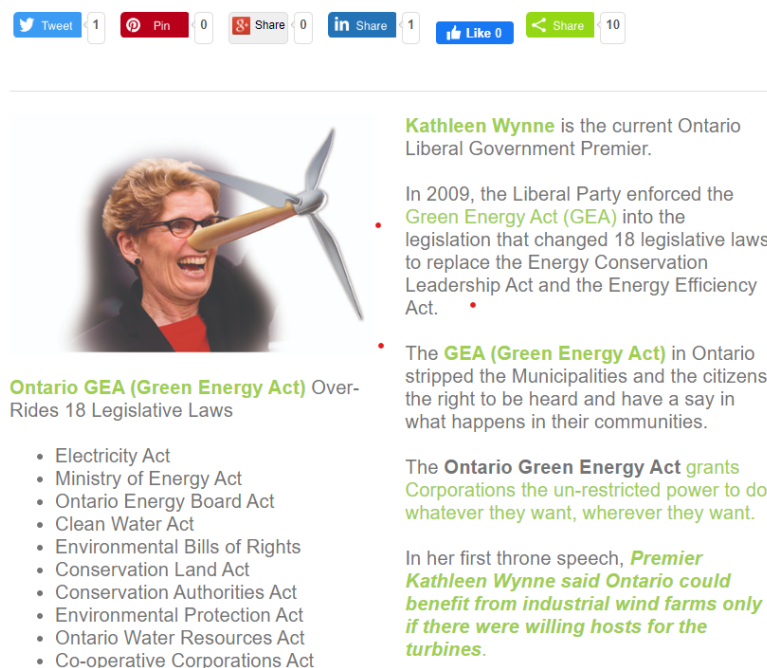
appeared to be amplified in participants with self-reported pre-existing mental health conditions (diagnosed or sub-clinical). Some

sought help from family, social groups or medical professionals, but a greater number stated they *suffered in silence*. Many 'silent sufferers' expressed feelings of isolation and withdrawal, with feelings of anxiety worsening over time.

As stated by one female participant (see above quote), initial attempts to get medical help or support from family and friends were met with disbelief or ridicule, which led several participants to stop seeking help. Interestingly, some of those who were ridiculed became aligned or active with opposition groups. Affiliation with opposition appeared to validate and reinforce the perception of risk and causation of reported health changes. Opposition affiliation also appeared to give some feeling of power and control back to their lives. Participants who were not actively involved in opposition activities described themselves more as bystanders, unable to do anything to change decisions about wind turbine development in their community.

3.6.1 Trust and Social Justice

Approximately one-third of participants saw IWT corporations as untrustworthy and felt the motivation of both developers and government was financial and not mindful of the communities in which they were investing. Additionally, all levels of government were consistently seen to be in opposition of community members (constituents) and working in secret with developers. This perception seemed to further heighten the discord and distrust of information provided by “officials” and shifted information



Ontario GEA (Green Energy Act) Over-Rides 18 Legislative Laws

- Electricity Act
- Ministry of Energy Act
- Ontario Energy Board Act
- Clean Water Act
- Environmental Bills of Rights
- Conservation Land Act
- Conservation Authorities Act
- Environmental Protection Act
- Ontario Water Resources Act
- Co-operative Corporations Act

Kathleen Wynne is the current Ontario Liberal Government Premier.

In 2009, the Liberal Party enforced the **Green Energy Act (GEA)** into the legislation that changed 18 legislative laws to replace the Energy Conservation Leadership Act and the Energy Efficiency Act.

- The **GEA (Green Energy Act)** in Ontario stripped the Municipalities and the citizens the right to be heard and have a say in what happens in their communities.

The **Ontario Green Energy Act grants Corporations the un-restricted power to do whatever they want, wherever they want.**

In her first throne speech, **Premier Kathleen Wynne said Ontario could benefit from industrial wind farms only if there were willing hosts for the turbines.**

Figure 4 Opposition party example of emotive language and image. In context of IWT messages may have contributed to political rhetoric and amplified feelings of political distrust and social injustice.
<https://howgreenisthis.org/ontario-green-energy-act/>

non-Canadian companies. During interviews, participants directly or indirectly indicated that wind turbines were taking money from local people and lining the pockets of foreign investors. Furthermore, participants commented on inefficiencies regarding production and storage of the renewable energy produce by IWTs, which threw doubt on market viability. Also noted were perceived high costs to manufacture and maintain IWTs.

credibility to lobby groups who were seen by the non-supporter group to be protecting the rural citizens. Participants frequently expressed sentiments such as “not being able to trust those city slickers” and “suits” “who come in and try to sell us a bill of goods.” Several participants

expressed added concern when local developers were

Trust and fear consistently emerged as sub-themes underlying the IWT discourse at both individual and social structural levels. Trust, or the lack of it, mediated responses regarding credibility, reliability and belief in information and data. A retired journalist who extensively reported on IWTs in all communities in this case study stated, “the first turbine in [North Bruce] was built about 12 years ago. It was a local initiative, started by one person ... I remember I was there that day. Then a couple more were built a few years later. But now former Liberal government of Ontario’s Green Energy Act [did] an aggressive push to get renewable energy development [and] more wind turbine developers showed up, offered landowners deals that sounded good but later proved to be problematic. Very quickly local communities felt like they had utterly lost control. Signs started going up on lawns and fences, Stop the Turbines, or words to that effect. So if there was any place in Ontario where renewable energy could have, and arguably already had, got off to a good start [it was here] but big wind ruined everything” (personal communication). Opposition groups messaging regarding IWTs increased as did the use of emotive images and language (see figure 4). Loss of control over their land and community was a recurring interview theme. Loss of control appeared to be a catalyst to feelings of injustice, distrust and community conflict. These perceived negative social factors appeared to escalate and be sustained in communities with a stronger opposition presence. The literature along with the interview narratives portray a cascading set of communication and actions that amplified and resulted in a public wind turbine discourse. Health effects of IWTs were a common topic in IWT literature and media, however interviews revealed participants were distressed over financial matters.

3.6.2 IWT Financial Security Factors

Since health concerns had dominated the media and opposition messaging, we had expected they would dominate our interviews with participants. Surprisingly, worry about the financial aspects of IWTs dominated almost all interviews. Participants (as per quote above) consistently shared feelings of worry at having “been working on it [home] for 20 years and now your property is worth half” or “this is my retirement” and concerns about “leaving something behind for

my kids”. These feelings of distress were amplified for people who resided in multigenerational homes and shared feelings of pressure to “not be the one to lose the family farm.”

*Female (aged 55-59): “This is our **retirement home we have been working on it for 20 years** and for people to say well now your property is **worth half of what it was** cause nobody wants to live near a turbine and we’re going to have one right like right there...*

The degree of financial angst ranged from mildly concerned to psychologically distressed. Several participants felt the financial distress was affecting their health. Some described feelings of worry, anxiety, anger, powerlessness and sleep disturbance due to concerns about financial insecurity caused by IWTs. Individuals most frequently spoke about increasing electricity costs, IWT inefficiency, foreign-owned wind energy company/developer, the exporting of energy outside Canada, diminished inheritance and reduced property values. Consistent with the quote above many participants shared that their home is their primary investment and “no one wants to live near a turbine” and a decrease in value would compromise their retirement financial security. “The more you read the more you think that’s going to be us” ... as expressed in the quote above the more participants relied on opposition group information the greater their sense of

injustice and financial concern. Many also worried a decrease in property value would affect the inheritance and amenity features of their property for surviving children.

Almost half of those interviewed were living in a multigenerational home, had built their home or had lived in the same community all or most of their lives, and therefore had an amplified person-place attachment. These individuals felt a strong sense of duty and responsibility to protect both the financial value and amenity features of their home and community for future generations. Some recognized and supported the need for renewable energy sources; however, the need to protect their financial security and home environment outweighed the impacts of global climate change. Most people communicated that

compensation was needed at a community level (reduced electricity costs) and/or at an individual level when IWTs are

*Female participant (60-65 age): "humans feel like they have to be rewarded for things. If there was a **discount surrounding communities** for their use of the energy I think it would probably alleviate a lot of the complaining. They're **not receiving anything** and they feel like the wind turbines are taking away from them. If you give them something you know it might quiet a lot of people down."*

in close proximity to their home. Non-supporters shared a need to assign blame. They asserted that IWTs were unjust, politically motivated and made by "city officials" who "don't understand rural." The combination of financial worry, person-place attachment and injustice appeared to culminate in significant psychological distress and anxiety.

Many participants made reference to "winners" and "losers," describing those who chose to have an IWT on their property as winners and those who refused but are 'forced' to look at and endure IWTs everyday as losers. There were several interviewed who felt that providing some compensation would help resolve the sense of financial imbalance and community conflict and narrow the divide between perceived IWT

winners and the IWT neighbours and community who feel victimized or losers of IWT installations.

3.7 Conclusion

Uncertainty over real or perceived threats, particularly threats that are deemed to be outside one's control or ability to cope with, may lead to feelings of anxiety, and depending on mitigation or mediating (intrinsic or extrinsic) factors, may contribute to a cascade of self-protection behaviours, especially where a *stress-inducing* trigger may be frequently potentiated or reinforced (i.e., auditory, visual stimulus). IWTs may, for some, become a conditioned-stimuli triggering a stress response, resulting in cascading emotional and physiological symptoms.

Participants frequently shared the importance of establishing trust with developers and decision-makers, transparent communication and local control over the planning and siting of a wind farm developments. This work has served to highlight the importance of holistic and informed decision-making and the importance of the human and human-environment connection. Increased understanding of wind turbine responses and other behaviours could provide important direction to future development processes, as well as health mitigation and management programs for those experiencing adverse health effects.

This IWT response phenomenon requires further study. Perceived stress, anxiety, the presence or absence of a significant life event and perceived social connections and support emerged as themes throughout the interviews with study participants. A daunting knowledge base also exists regarding the effects of acute and cumulative stress. Stress, real or perceived, has been shown to alter physiology

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(immune indicators). This work noted that people who had experienced a significant life event reported fewer or no health effects and an improved ability to cope with changes to their environment. The potential impact of psychosocial factors to promote, maintain, or exacerbate one's overall health may be a clustering of factors that are part of the IWT phenomenon. Conceptualizing these factors within a social ecological model and as having a bidirectional connection between multiple social strata may provide a deeper understanding of how health may be influenced by factors at both the societal and individual levels.

Chapter 4 will present theories and an expanded conceptual and clinical lens through which to assess and study self-reported health symptoms. The themes and associations noted are intended to inform further research, health policy and health management strategies and are not intended to be a clinical diagnosis, which is outside the scope of this work as well as outside professional standards.

4.0 Developing a Theoretical and Conceptual Understanding

The following sections will introduce theoretical constructs and concept models intended to stimulate thought and further study of the wide-ranging responses and experiences of those living near wind farms and concludes with potential practical applications and implications to policy, practice and research.

4.1 Introducing a Conceptual and Theoretic Underpinning

Theory and conceptual models are important ways in which to convey influencing factors and underpinning to a specific phenomenon. IWT research to date has been dominated by physiologic (physical) health with little literature exploring the social and psychological dimensions of health. The use of a systems and ecological perspective has yet to be included in IWT research. An ecological lens (Bronfenbrenner, 1994) provides a framework to explore issues across many levels and between people, social structures and the environment. An IWT ecological conceptual model is presented to illustrate predominant IWT social-environmental influences affecting individual perception and, in some instances, adverse health outcomes.

4.1.1 Defining Health and Psychosocial Health

The World Health Organization (WHO) states that health is “not merely the absence of disease, but is the state of complete physical, mental and social well-being” (WHO, Quality of Life, (2008)). Quality of life (QOL) is defined by WHO as “an individual's perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards and concerns” (WHOQOL Group, 1994). IWT literature has been dominated by physiologic research with little attention to mental health and social well-being. More recent IWT

literature has begun to shift focus towards the psychosocial aspects affecting or influencing the health of those exposed to IWTs.

Psychosocial health was defined by Elliot (1993) as “distress, dysfunction and [or] disability manifested in a wide range of psychological, social and behavioural outcomes.” Elliot’s subsequent works have expanded the definition to include negative-based emotions (as cited in Wakefield & Elliot, 2000, p. 791; see also Walker et al., 2014). The definitions of health and psychosocial have important implications for IWT health researchers. By definition, psychosocial factors have the ability to mediate and/or modify one’s health or perception of health and quality of life. As detailed in Chapter 3, predominant psychosocial influences that emerged during interviews with people living close to IWTs include perceived financial loss, a previous significant life event, the influence of emotive opposition language and person-place bonding. In addition to the aforementioned themes consideration must return to a social ecological framework and tenants of social capital to help further understand nuances of the IWT phenomenon.

4.2 Social Capital and the IWT Phenomenon

Social capital literature is built upon the work on sociologist James Samuel Coleman and dates back to the 1920s. Putnam’s more recent work found that social capital is largely based on the concepts of human bonding and social structures or bridges, by which society is built. Social capital has increasingly become a subject of mainstream scholarly work in economic and political works (Putnam, 1993).

Social capital takes into account principles that underpin bonding and bridging, such as social norms, values and trust (Mohan & Mohan, 2002). Within the IWT response phenomenon, one may hypothesize the human-social-psychological complex

and interconnected dimensions and relationships have resulted in unexpected and perhaps extreme protective behaviours at both individual and community levels (Steptoe & Feldman 2001). Social capital is the extent to which people collectively act as a resource to meet their needs and interests (Coleman, 1988; Poder, 2011). While originally social capital was developed to provide a tool for understanding the differences between individual and social action (i.e., socially influenced vs. self-interest) its application has begun to expand to other research agendas.

Social capital is defined by contextually relevant “functions” and “values,” and not by any single factor (Coleman, 1988). Coleman (1994) further describes social capital as the *bonding* and *bridging* between social networks, norms, and trust that enable or lead to mutual benefit. Bonding and bridging can be reinforced to either build a strong sense of belonging or antagonism to outsiders. Social capital and the emergence of local networks may act as mediators essential to the formation of reciprocal relationships and levels of cooperation needed for economic development. Literature shows an association between social ties and health (Thoits, 2011; Uchino, 2006), and indicates that social support acts as mediator to stress (Thoits, 2011). Social integration with a group can provide information, emotional support, validation and reinforcement through feedback (Thoits, 2011).

According to Poder (2011), “Many authors agree that the mechanisms which lead to the formation of social capital are connected to the transmission of information, establishing trust and the development of standard collaboration” (p. 351). Significant to the IWT conflict is how social capital manifests itself when relationships are not positively reinforced. Poder (2011) states that, “if there is a deviation from what

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everyone expects from the other, we may engage in a vicious circle of deflection, disorder, mistrust, isolation, exploitation and stagnation” (p. 354).

Examining the IWT context there is a noted cascading pattern of deflection, mistrust and conflict. Interestingly, in a recent opposition post the term cognitive dissonance (see excerpt from website below) is used to describe a one Ontario medical officer of health’s response letter to a resident. The cognitive dissonance appears to

Huron County MOH suffers from cognitive dissonance when it comes to wind turbines

Posted on 10/18/2019

Below is a letter sent to a citizen in Huron County, from Dr. Maarten Bokhout, acting Medical Officer of Health from the Huron County Health Unit.

Everyone knows wind turbines are pummelling rural population’s health, but the only recourse offered anymore is through the courts... not an option for most unless you have a safe place elsewhere to live, bottomless pockets of cash, and decades left in life to fight.



Figure 5 Opposition website post regarding MOH response letter to resident. Use of emotive language and medical principle of 'do no harm' infers potential professional wrong-doing. Retrieved from <http://ontario-wind-resistance.org/>

(clean energy). As identified in both literature and interviews, many people recognize the need to reduce impact of climate change and increase reliance on clean energy. For some the dissonance arises when they oppose local installations. The degree of cognitive dissonance and resultant distress and response behaviours may be depend on individual values, beliefs, identity, and established patterns of behavior (i.e., coping).

infer that by not agreeing or supporting the evidence they must be experiencing personal conflict or dissonance. The use of the phrase cognitive dissonance both highlights and supports the juxtaposition and emotional pathways underlying support and non-support of IWTs

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For example, some people may isolate themselves from the public discord, others may form virtual bonds and networks via social media (i.e., opposition groups). Other aspects linking socially influenced attitudes and behaviours are how real or proximal one perceives a threat or encroachment to themselves or someone [something] of value. The proximity of IWTs to places of meaning has been shown to have an influence on attitude development, perception of risk, and social acceptance of these projects (Devine-Wright, 2005; Evans, Parks, & Theobald, 2011; Hindmarsh, 2010). In terms of psychosocial factors, ecology doctrine posits that the closer an influencing factor is to an individual the more influence the factor may have to alter perception.

The IWT influencing factors identified in this research have been developed into a revised conceptual model. Additionally, relevant psychological, social and health theories that may begin to explain IWT psychosocial reaction phenomenon are outlined in the following sections. The literature is lacking a contextually sensitive psychosocial perspective with which to understand the experience of those living near IWTs. The proposed models and theories are intended to provide a contextually-rooted foundation from which to expand upon the psychological and social connections surrounding IWTs. In the context of reported health effects of IWTs, psychosocial factors may be the mediating or exacerbating layer between one's perception of health risk and the development of adverse effects. Select participant quotes are thread through the remaining sections to highlight factors, psychological or social concepts presented.

As an outcome of this dissertation research a four-level social ecological model has been developed built upon original Bronfenbrenner's social ecology model (1994) and Stokols' (1996) later work to help portray and understand social IWT factors that

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may be influencing individual perception and health. The model is intended to portray the complex interplay between individual, interpersonal, community and societal levels that may either moderate (buffer) or amplify the perception of risk posed by IWTs. The first, personal level considers aspects of biological, personal history and personality features building either resilience or vulnerability to victimization. Health promotion strategies that foster positive attitudes and behaviours like credible, transparent information and plain-language education are recommended for this level. The second, interpersonal category looks at relationship experience that may protect or increase risk. Relationships in this category typically include family, spouse and close friends and peer group members. Promotion and mitigation strategies at this level may include formation and constructive use of social structures and networks and programs designed to promote collaborative decision-making and conflict resolution. The community level includes consideration of social capital elements and an emphasis towards community settings and relationships. Places whereby people have emotional attachment or may be part of the social identity (i.e., rural features, landmarks, church, school, and shoreline) are important to take into account during IWT planning phases. Promotion strategies applicable to this level may include formal recognition of value and emotional attachment to community, landscape and home throughout the IWT project phases. Additionally, economic and community benefits to host communities would be recommended strategies at this ecological level. The fourth level is the societal or public policy level. This fourth level consists of broad social factors (i.e., rural v urban, global climate change) and cultural norms as well as general health, economic and political processes and policies. Strategies that may be effective at the societal level include

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health policy, regulatory processes promoting community involvement and benefit schemes, and environmental health assessments inclusive of psychosocial health features. These societal aspects play a role in fostering social justice, preventing inequity and either escalating or de-escalating discord. Individual attitude, perception and health is influenced by these environmental factors within each level. Health has often focused on individual health factors, diagnosis and treatment. IWT health studies should not be distracted by looking at individual-level and limited factors but should look at health determinants at all levels being mindful of bio-psychosocial interrelationships. The constellation of IWT features and social influencing factors across the ecological levels suggests that a multilevel approach to IWT development is necessary to address and mitigate discord and negative health effects.

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Industrial Wind Turbine Psychosocial Health: Social Ecological Model

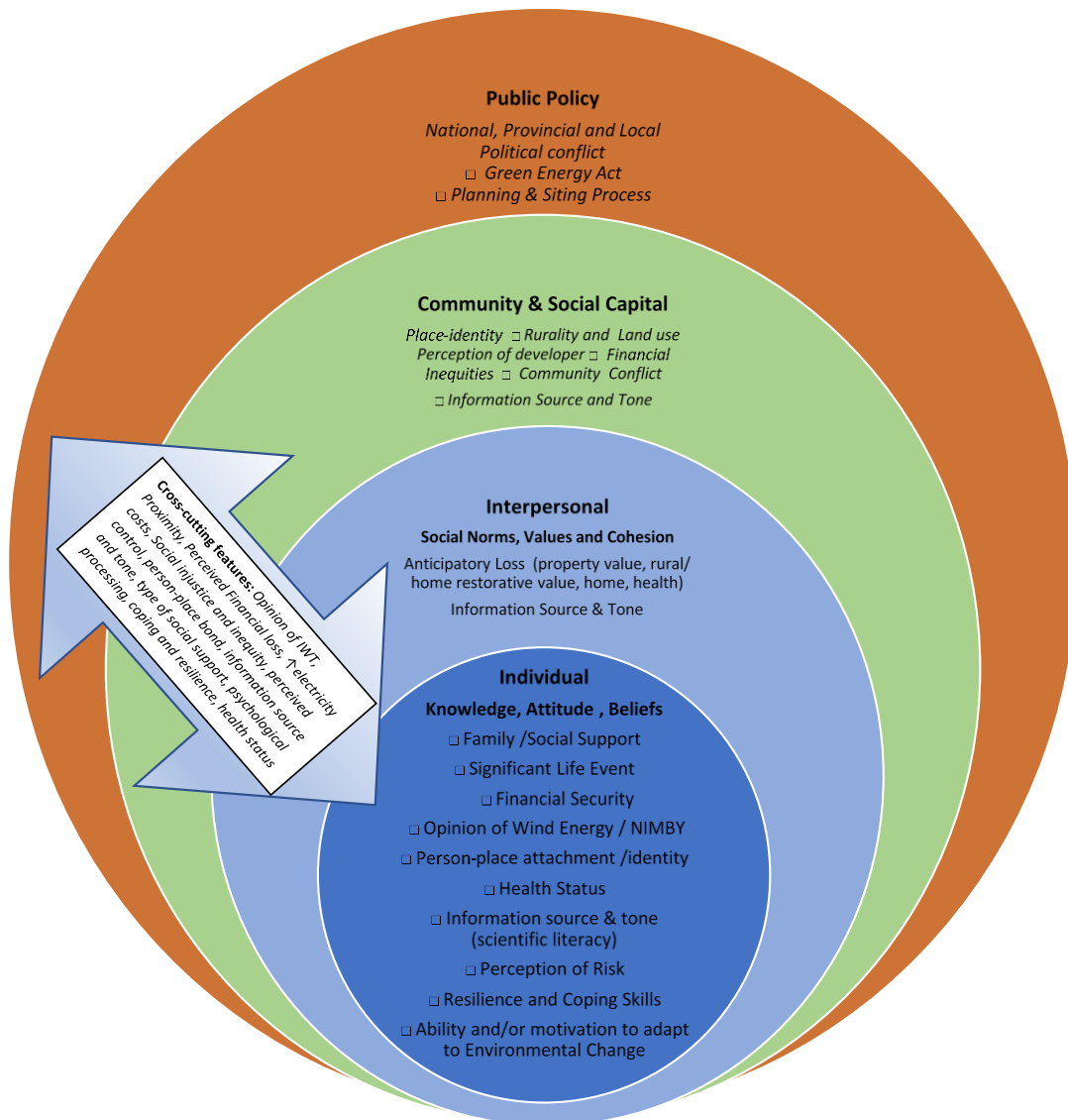


Figure 6: IWT Social Ecological Model - Multifaceted view of interconnecting factors within and between the social environment that interact and influence individual health and behaviour

4.2.1 Social Capital and Environmental Activism

Constructive advocacy can create conflict and discord. Historically, environmental advocates relied on traditional methods to establish a shared NIMBY voice and strong following. The IWT NIMBY culture has established itself as a powerful oppositional collective. In fact, its use of social capital and social media communication

methods may have influenced individual health, environmental activism as well as public policy.

Activism is layered with principles of social capital, which is gaining increasing importance within the literature. The concept of social capital is multifaceted. Bonding and bridging are two dimensions described as essential elements of social capital (Putnam, 1993). Bonding refers to homogenous ties and/or networks between and within family members and/or community members in which common or shared experiences support a collective need. Putnam believed that the sharing of common attributes and beliefs insulated and protected the group from outside forces, perceived to be untrustworthy, that could influence group norms. Group trust and social norms may provide a traditional source of strength and, in some situations where groups may promote distrust and fear, the bonding could have negative consequences.

Communicating messages and the rallying of others through bonding and bridging requires access to people and the ability to share information, ideas, risk and conflict in ways that may either deter or incite activists to emerge. The effect is dependent on a number of variables including the extent of social influence and the degree of self-awareness and self-efficacy. Bonding and bridging are not mutually exclusive but are most constructive when the interdependencies of each are complementary and build overall social capacity.

*Male participant: "I watched the **news** on a very regular basis and found I would **get very irritated and stressed** out with it and just decided that **I needed to kind of again remain blissfully ignorant** sometimes to **maintain a level of mental health.**"*

In the past, environmental action may have included print media, petition letters and local public protests to inform and connect people to a common cause.

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Communication technology has since advanced to create a virtual infrastructure and virtual neighbourhood. This virtual network connects people who otherwise would not have been connected in the past. The Internet provides immediate access to information, and social media provides a forum by which people can share information individually and in groups. Information can be private or can be viewed by others. Users of social media can divulge their identity or use a pseudonym. One could argue anonymity has both positive and negative aspects. Anonymity may provide a degree of safety that could help liberate feelings and ideas; however, it may also provide freedom from accountability. In the context of health communication, risk perception and IWT discourse, information is power,

both in terms of what is communicated and how it is

*Female (aged 55-59): The more we read like there are a lot of **anti like Ontario wind resistance and a lot of websites** out there and **the more you read the more you think that's going to be us** that's going to be us and truthfully we talk about wind turbines probably every day."*

communicated. This power may be used positively or negatively by those who control the flow of information. In the social structures of these opposition groups, bonding and bridging are imbalanced rather than complementary, which contribute to negative consequences for some group members.

4.3 Introducing a Theoretical Perspective to Identified Themes

4.3.1 Health Belief Model

The Health Belief Model (HBM) is often used to help understand perception and behaviour changes related to perceived threat and risk (Rosenstock, 1974). The HBM is built on four tenants: (1) perceived susceptibility, (2) perceived benefits of action to mitigate risk, (3) perceived costs or barriers, (4) perceived severity and consequences

of condition (Mehta &

Kapoor, 2018). The

HBM purports that how

we interpret and

subsequently respond

(act) to environmental

cues is informed by our

beliefs and values.

IWT opposition

and media

communications

include emotive and

HEALTH

The global wind power developer lobby and others associated with the industry promote the idea that there are no “direct” health effects as a result of the noise and vibration (infrasound, sound pressure, low frequency noise) produced by large-scale wind turbines.

*In truth, there is **plenty of evidence to support a causal link via indirect pathways**. The simplest explanation (but not the whole explanation) is that the noise and vibration keep people awake at night, they do not get restful sleep and in fact are made anxious through the night, and the resultant sleep deprivation in turn causes health problems. This is documented and accepted.*

In fact, both the Health Canada study and the report from the Council of Canadian Academies, confirm health impacts from wind turbine noise and infrasound. “Annoyance” –a medical term denoting distress– has been identified; annoyance IS an adverse health effect.

Retrieved from <http://www.windconcernsontario.ca/health/>

Figure 7 Opposition health information indicating support of causal indirect link between IWT and health effects. Retrieved from <https://howgreenisthis.org/ontario-green-energy-act/>

fear-arousing language about the risks of IWTs to economy and health. IWT political and community discord has referenced a lack of decision-making and control and lack of health studies to protect against potential harmful effects of IWTs, and have reported on the potential structural risks posed by IWTs. Some opposition messages purport a belief that (see figure 7) through direct or indirect mechanisms IWTs cause health problems. Caution must be taken in interpreting findings of this study. Findings of this

work suggest indirect pathways may be affecting the health of some people. However, findings also show that potential indirect mechanisms include psychosocial factors are multifaceted and require further study.

Within the HBM, wind energy phenomena may have provided an example of how health risk communication can play a potentially harmful role in amplifying the perception and belief that IWTs are a financial and health risk. Without psychological or social factors to mitigate IWT cues to actions (i.e., noise, visual amenity, emotive messaging), the perceived threat could lead to protective behaviour change and stress-related illness (Mehta & Kapoor, 2018).

4.3.2 Complex Emotional Response to IWT Installations: Emotion Theory

Emotions are complex and consist of interconnected cognitive, affective and behavioural components, and are believed to be influenced by phenomenological experience. Different emotional stimuli can trigger indistinguishable physiological responses. For example, fear can cause both a perceived and an actual feeling of tachycardia (accelerated heart rate) and may motivate behaviours to avoid actions. Similarly, feelings of love may also result in tachycardia and may motivate behaviours that continue actions.

Emotions are informed in part by our values and by how we perceive and evaluate our experiences at a cognitive level (Döring, 2007; Tappolet, 2000; 2016). Emotions may inform a perception or belief based on both what is seen and what is heard as well non-perceptual varieties of emotions influenced by a narrative (Scarantino & de Sousa, 2018). According to emotion theorists, the constructs of emotion-cognition

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enable a person to see or hear something as threat; yet cognitively evaluate and “believe” the same object to be safe.

Within IWT discourse, the consideration of emotions as perceptions, derived from real or perceived experience and with closely tied autonomic and cognitive reaction, may provide insight into what some may consider to be an irrational, emotional or recalcitrant response to IWTs. This, in turn, may help explain why some issues motivate, or conversely mediate, action. A challenge of emotion theory is that many emotions do not lead to action. In the early 1980s, multidisciplinary scholars expanded on initial work of Jean Sartre (1939) and supposed emotions as social roles (Averill, 1980; Lutz, 1988). Behavioural-based literature frequently cites concepts such as self-efficacy as a significant mediating factor to behaviour motivation.

Within emotion theory and literature, self-deception (Fingarette, 1969; Mele, 1987; van Leeuwen, 2007) and a belief, without supporting evidence, of risk appears as a common feature and may be relevant to the IWT discourse. Self-deception refers to establishing beliefs contrary to available evidence, but which may be consistent to a belief that is being sought (i.e., by the social group). The desire to conform to social influences is not a new concept, and colloquial terms such as “peer pressure” and “group think” are used and generally accepted. However, a consideration of the impact of social groups and social roles in terms of influencing emotions, and in the context of environmental action, has yet to occur. Further research on the exploration of the social and psychological construct of emotion formation is required.

4.3.3 Conservation of Resources Theory

During the interviews, participants consistently and often passionately shared a range of opinions regarding economic decisions and personal financial concerns due to

IWTs, resulting in significant levels of mistrust and anxiety. The Conservation of Resources (COR) Theory (Hobfoll, 1989, Hobfoll et al.,1996) may provide a unique lens through which to consider some people's responses to IWTs. COR is underpinned by three dimensions, which address a belief that stress occurs when resources are threatened, lost, or the investment of resources does not have subsequent gain. Few studies have explored the associations between individual health and economic distress. However, some research has shown that economic factors and social capital play a significant role in self-reported health (Ahnquist, 2012; Rose, 2000).

IWTs have led to a perception that property values will be reduced and the ability to sell properties will be more difficult. Landowners are encumbered with IWT agreements that, among other things, may make refinancing properties more difficult. Participants were concerned about a reduced inheritance and an additional burden of property management issues upon their death. Real estate (resale) and refinancing difficulties as well as the distress caused by estate planning worry have received little public or research attention. Coupled with opinions of increasing electricity costs and economic challenges (especially in rural areas), it is plausible to connect the COR construct to reported financial distress. Perceived threat and loss may be further reinforced with multiple stimuli, compounding the perceived stress. Reinforced stimuli can lead to classical conditioned response and evoke a new associated learned response—in this context, to the sight and/or sound of IWTs.

4.3.4 Protection Motivation Theory

Within emotion theory, self-deception (Fingarette,1969; Mele, 1987; van Leeuwen, 2007) and a belief with or without supporting evidence of risk appears as a common feature and may be relevant to the IWT discourse. The key input filters include

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several modes of receiving environmental sources of information (persuasion and observation) and intrapersonal sources (previous experience). Several mediating processes are involved in forming *intention* (threat perception) and *behaviour* (adaptive or maladaptive) appraisal. Persuasion tactics and fear-appeals can positively or negatively influence the mediating processes of vulnerability and risk severity, and the ability to

Ontario Wind Resistance

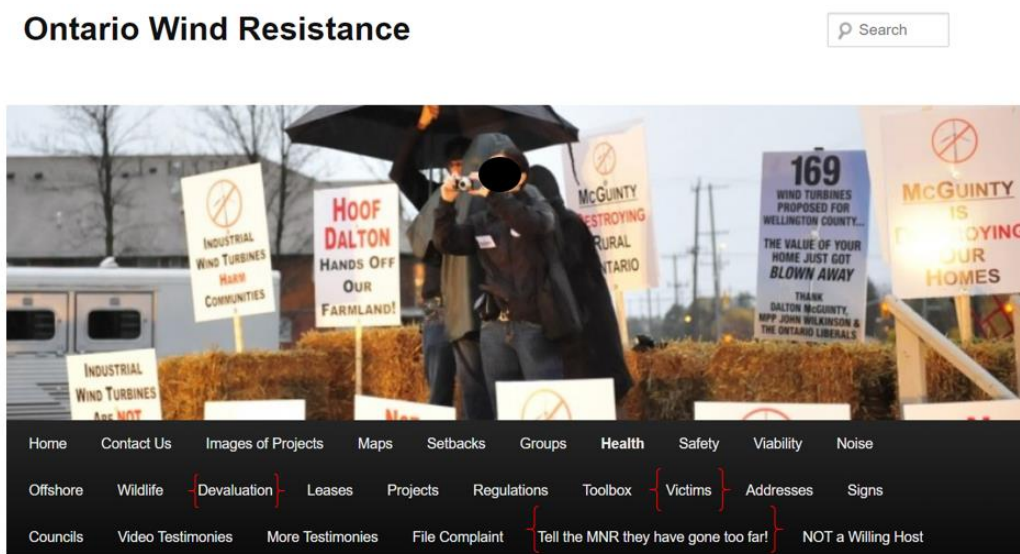


Figure 8 Opposition website image. Use of emotive language. Signs convey concerns regarding political / social injustice, destruction of rural communities, risk to farmland, and reduction of property values. Website link titles include emotive words. Retrieved from <http://ontario-wind-resistance.org/health/>

change the outcomes in either a positive or negative manner.

Anti-smoking campaigns are

an example of a positive fear/threat

appeal. Graphic images of cancerous lungs, heart damage and fetal damage, along with messages of how smoking can increase your risk of disease and death, have contributed to changes in smoking initiation and cessation rates. Of course, some people see and hear these warnings and continue to smoke. Without debating the influence of addiction, one could surmise that smokers have considered the potential risk and severity and have chosen to either accept the risk or perceive smoking to be worth it.

Initially developed for the sector of health promotion and disease prevention, PMT describes how individuals are motivated to react to a perceived threat. PMT's key elements include: the appraisal of a threat; and the appraisal of one's ability (response

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and self-efficacy) to cope with or manage the threat. Rogers expanded his original work in 1983 to include the cognitive dimension of adaptive and maladaptive responses to a threat. In subsequent research, Tanner (2013) purports that the appraisal and coping mechanisms provide a significant opportunity to better understand behaviour, especially behaviour connected to public communication, perceptions of threat and human responses to information and threat.

PMT literature also notes the concepts of trust and certainty, which have a causal relationship to future response actions. Studies reported that timely and accurate information had the potential to overcome uncertainty and mitigate or prevent a maladaptive response (Shain, 2011). The concept of *uncertainty* may contribute to the action of bonding and bridging individuals together to share the experience, or to find a collective way to cope with the threat through a source of support and trusted information. Within the context of IWT discourse, study participants frequently inferred or explicitly stated mistrust of IWT

developers and government, as well as a degree of uncertainty regarding economic impacts (i.e., property values) and the safety of

*Male participant (aged 55-60): "It's **all about business**, the man who's in charge **has come in from the states** so they come and do all this stuff and they leave and **we're the people who live here along with the mess and they move on to the next project.**"*

IWTs (see quote above). People living in rural communities, especially long-term residents, are more likely to know and trust other community members. Outsiders and outside influences are often met with uncertainty and skepticism. The combined effects of new developments and developers along with a perceived lack of transparent

information may have led to increased feelings of uncertainty and perceived risk that may have triggered self-preservation and protection mechanisms.

4.3.4 Identity Process Theory: Being one with the environment

Identity Process Theory (Breakwell, 1986) is “the process involving the assimilation of new information from the environmental (social and physical) and the accommodation and adjustment to this information within the existing identity structure. If a threat to identity is encountered, as a means of dealing with the threat, behavioural and cognitive processes are adjusted to maintain one’s sense of distinctiveness, self-esteem, self-efficacy, and continuity” (Kyle et al., 2013). The preservation of self-identity adds another important dimension to the complexity of psychosocial factors influencing IWT discourse and reported health effects. In chapters 2 and 3, aspects of person-place bonding and emotional connection to ones’ environment are discussed. Information is processed by several complex cognitive mechanisms. Information may be received without conscious awareness of how the message is being *filtered* and *perceived*. In context of IWT, information is being conveyed verbally, in text and through visual changes to their environment [turbines, turbine infrastructure]. Those with strong emotional attachments to place often perceived their home and community as an integral part of the personal identity. Participants used phrases like, “I’m a country person” and shared stories of how their home was almost a part of them and their family. Those with strong attachments whereby the environment became intertwined within their personal identity resulted in unwanted changes to their environment more likely to be perceived as a risk or threat.

4.3.5 Gate Control Theory: When the mind can hurt the body

Self-reported pain is a common complaint of those reporting adverse health effects from IWT exposure. Complaints of pain range from chest pain, abdominal pain, headaches, to muscle and joint pain. Pain is a subjective clinical feature. The use of pain assessment scales has helped clinicians quantify pain, yet individuals perceive and tolerate pain in different ways. Pain is a complex topic and a plethora of studies have explored pain from physiological and psychological perspectives. In many cases, pain is accompanied by other health disturbances, such as loss of appetite, interrupted sleep patterns and decreased mobility. Pain may lead to behaviours that could be considered maladaptive with perceptions of increased pain levels, feelings of helplessness, and lower self-efficacy (Campbell et al., 2003; Covic et al., 2003).

According to Gate Control Theory, there are three dimensions of pain: “sensory-physiologic,” “motivational-affective,” and “cognitive-evaluative.” Each dimension is connected with and influenced by one’s environment (Campbell et al., 2003; Katz & Melzack, 1992). Research strongly indicates that psychological, social, and environmental factors may affect some types of pain conditions or disorders (Campbell et al., 2003). In the context of IWT-related health concerns, Gate Control Theory may provide a lens through which to explore and begin to explain why some experience adverse health effects, including some types of pain.

4.3.6 Diathesis-stress model and Stressful life events

Diathesis-stress model is a belief that psychopathology is formed through combined individual and biological vulnerabilities along with environmental stressors or triggers (Gibb & Alloy, 2006; Lazarus, 1993). Significant or stressful life events emerged

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as a predominant psychosocial influence during interviews with people living close to IWTs. Stressful life events may be a key role in prolonged or situational anxiety, depression and has also been linked with post-traumatic stress disorder.

Holmes and Rahe (1967) developed the Social Readjustment Rating Scale (SRRS) to identify stressful life events within a 12-month period. Each of the events on the scale were weighted depending on how traumatic the event may be perceived. The higher the score, the greater likelihood the individual would have to experience feelings of stress. The SRRS does not consider personal or specific cognitive factors nor does it consider day-to-day factors that may be considered irritating or frustrating versus a source of significant stress. Daily frustrations, or rather the culmination of daily irritations, may be a stronger link and predictor of stress-related illness and needs to be taken into account along with stressful life events.

Participants' temporal experience and recovery from stressful events was a recurring interview theme. The factor most evident was not necessarily if someone had experienced a stressful event but rather when and the extent to which they had adapted or recovered from the event. Almost all participants felt some degree of financial distress related to IWTs. However, those that had adapted [recovered] from previous stressful event (i.e., illness, death of someone close or retirement) reported they felt able to keep IWT impacts from consuming their life. Whereas, those who had not recovered felt overwhelmed with distress and unable to cope.

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The Holmes-Rahe Life Stress Inventory The Social Readjustment Rating Scale

INSTRUCTIONS: Mark down the point value of each of these life events that has happened to you during the previous year. Total these associated points.

LIFE EVENT	MEAN VALUE
1. Death of spouse	100
2. Divorce	73
3. Marital Separation from mate	65
4. Detention in jail or other institution	63
5. Death of a close family member	63
6. Major personal injury or illness	53
7. Marriage	50
8. Being fired at work	47
9. Marital reconciliation with mate	45
10. Retirement from work	45
11. Major change in the health or behavior of a family member	44
12. Pregnancy	40
13. Sexual Difficulties	39
14. Gaining a new family member (i.e. ... birth, adoption, older adult moving in, etc.)	39
15. Major business readjustment	39
16. Major change in financial state (i.e. ... a lot worse or better off than usual)	38
17. Death of a close friend	37
18. Changing to a different line of work	36
19. Major change in the number of arguments w/spouse (i.e. ... either a lot more or a lot less than usual regarding child rearing, personal habits, etc.)	35
20. Taking on a mortgage (for home, business, etc. ...)	31
21. Foreclosure on a mortgage or loan	30
22. Major change in responsibilities at work (i.e. promotion, demotion, etc.)	29
23. Son or daughter leaving home (marriage, attending college, joined mil.)	29
24. In-law troubles	29
25. Outstanding personal achievement	28
26. Spouse beginning or ceasing work outside the home	26
27. Beginning or ceasing formal schooling	26
28. Major change in living condition (new home, remodeling, deterioration of neighborhood or home etc.)	25
29. Revision of personal habits (dress manners, associations, quitting smoking)	24
30. Troubles with the boss	23
31. Major changes in working hours or conditions	20
32. Changes in residence	20
33. Changing to a new school	20
34. Major change in usual type and/or amount of recreation	19
35. Major change in church activity (i.e. ... a lot more or less than usual)	19
36. Major change in social activities (clubs, movies, visiting, etc.)	18
37. Taking on a loan (car, tv, freezer, etc.)	17
38. Major change in sleeping habits (a lot more or a lot less than usual)	16
39. Major change in number of family get-togethers ("")	15
40. Major change in eating habits (a lot more or less food intake, or very different meal hours or surroundings)	15
41. Vacation	13
42. Major holidays	12
43. Minor violations of the law (traffic tickets, jaywalking, disturbing the peace, etc.)	11

Now, add up all the points you have to find your score

TOTAL

150pts or less means a relatively low amount of life change and a low susceptibility to stress-induced health breakdown.
150 to 300 pts implies about a 50% chance of a major health breakdown in the next 2 years.
300pts or more raises the odds to about 80%, according to the Holmes-Rahe statistical prediction model.

KEY PARTICIPANT DATA

14 non-supporters reported previous experience with 1 or more significant life event. 1 participant who supported global but not local installations reported experiencing a recent life event to which they were *recovering* and felt "trapped". 1 supporter reported recent life event to which they had *recovered* and were "*not going to spend time worrying about wind turbines.*" 30 participants reported financial concerns.

Adapted from: American Institute of Stress <https://www.stress.org/holmes-rahe-stress-inventory-pdf>

Figure 9 Adapted Holmes-Rahe Life Stress Inventory. Modified to include arrows indicating current and historic stressors reported by participants. Most frequent reported source of stress indicted by red arrow, next frequent, yellow arrow followed by blue arrow.

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Stress has the potential to impact both mental and physical health (Businelle et al., 2013). One stressful life event may be enough to cause significant and lasting trauma or serve as a protective buffer to subsequent stressors (Businelle et al., 2013). Whereas, cumulative effects of daily stressors were also associated with increased risk of mental illness or poorer mental health (Businelle et al., 2013). This potential association of significant life event and/or daily stressors (Bisung & Elliott, 2017; Kingsbury et al., 2019) and “other variables impact mental health” (Businelle et al., 2013, p. 10) has yet to be explored in the context of IWT health effects and is an area that would benefit from specific research.

When environmental demands outweigh individual coping resources, psychological distress and stress-related illness can occur (Bisung & Elliott, 2017). Significant life events experienced by participants appeared to be affected by both the timing and the individual’s recovery from the life event. This temporally sensitized feature appeared to determine whether significant life events was a moderator or amplifier of the environmental stressor. Participants who reportedly adjusted to the significant event felt the experience taught them the importance of living each day to the fullest and were neutral about the presence of IWTs. Whereas, those who had not adjusted reported feeling frustrated, distressed, anxious and more fearful of change. Furthermore, those who had not adjusted to the significant life event appeared to be reactive to ongoing environmental triggers, which created a recurring and reinforcing feedback loop. The most frequently mentioned environmental triggers the sight and sound of wind turbines, higher electricity bills, and negative verbal ‘wind turbine talk’ from family, community members, local newspapers and opposition reports. These

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negative environmental triggers, if paired with an ongoing significant life event or pre-existing social-cognitive diathesis, may lead to health reactions and clinical outcomes.

Diathesis-stress model combines two important aspects of social and individual psychological vulnerabilities within both an environmental and ecological lens.

A recurring theme throughout the interviews was that a positive or negative social environment (family,

community) had the potential to

influence psychological

processes, which in turn

contributed to an individual's

perception of risk and

subsequent ability to adapt or

feel unsafe and victimized. The

psychosocial causality and

*Male participant (age 50-54): "No just television mostly. And articles in the [local] newspaper ... Mostly **anti-turbine groups** and followed court proceedings ... There was a group that was trying to stop a farm being put in... **individuals saying that it effected them was making them sick**, I thought that was kind of silly ... I was thinking to myself maybe they're just making it up but now that **it has been here for a year I know why they were they were sick**, it was making them sick because of the noise and the vibration. **Just looking at them makes me mad** ... government should take better care of humanity by helping the poor... my **electricity bill didn't go down** either and every time I get my bill I'm thinking well I got all this stuff up here, the solar, the windmills, and if they would have built one nuclear plant they would have saved this problem."*

consequences of wind turbine exposure will be difficult to prove. One participant (as quoted above) described a process by which he had heard of IWTs via local media and opposition group information and, like many others, initially believed reported adverse health effects "to be kind of silly" but after "they had been here for a year I know why they were sick ... now just looking at them makes me mad". Do wind turbines directly affect health or is there an element of diathesis involved for some experiencing negative health outcomes? The exploration of specific recurring themes within models such as the diathesis-stress model could help elucidate the often-extreme differences in response to IWT exposure.

4.4 Mediators or Amplifiers: Opposing forces or temporal continuum

4.4.1 Person-Place Attachment: Home, Community and Landscape Bonding

Place attachment is a “complex phenomenon that involves the interplay of affect and emotions, knowledge and beliefs, and behaviours and action in reference to place” (Gattino et al., 2013 p. 813; see also Scannell & Gifford, 2016). People living in smaller rural areas typically have a higher person-place bonding than people living in urban settings (Gattino et al., 2013; Prezzo, Amici, Roberti, & Tedeschi, 2001; Shepherd et al., 2013). Many years of study have concluded that these bonds are formed through cognitive, affective and conative pathways (Jun & Absher, 2014; Manzo, 2005; Scannell & Gifford 2010, 2016). The depth of place attachments and community and individual bonds may manifest themselves with behavioural and territorial responses (Scannell & Gifford 2010, 2016). Social psychologists purport that within a spatial construct, cognitive concepts are key to studying and understanding “sentiment” and “action within spatial contexts” (Jun & Absher, 2014 p. 1019), and form the core standard of behaviour at the individual level. The stronger the person-place bond or attachment, the stronger, more central its influence on self-worth and the more likely it becomes an antecedent to emotional ties and subsequent behavioural responses (Jun & Absher, 2014).

Jun & Absher (2014) note that although interest and “conceptual logic” are growing to consider place identity and emotional attachment to landscape, there continues to be an “absence of theory” underpinning this construct. Within the study of person-place relationship and bonding, the concept of one’s connection to the environment has yet to be explored in the context of IWT development. Aspects of attachment to community and place have individual and social dimensions. Long and Perkins (2007) reported that “being attached to one’s community as a place may make

feelings of social isolation ... all the more stark and disappointing” and that residential belonging was a “predictor of a sense of community” (p. 577) or place identification.

Informal and collective social “neighbouring” may provide a sense of control and belonging as well as the strengthening of social bonds. Consistent with the principles of social capital, an individual’s emotional connection with other people and places is an important feature of well-being (Scannell & Gifford, 2016). The degree to which a person-place attachment causes or is a “consequence” of psychological well-being remains unknown (Scannell & Gifford, 2016 p. 360).

Place attachment may be connected with environmental behaviour. Additionally, rural residents with a stronger sense of belonging and higher feelings of person-place attachment report feeling more positive and satisfied with life (Scannell & Gifford, 2016). Some studies have shown that those who have lost their homes may be at greater risk of developing mental health disorders such as post-traumatic stress and psychological distress (Scannell & Gifford, 2016). The participant quote below includes many IWT topics addressed on both sides of the discourse, missing from the text narrative is the distressing manner with which this was shared during the interview.

*Male participant (aged 70-74): “They knew the Green Energy Act was sort of slipped on the people before they knew what was really involved in it. The wind companies knew, but was **never conveyed to the public**. This is where I got upset because I have always felt that **anything that was going to affect my livelihood or my life. I should have an opportunity to object to it without being ridiculed**. My biggest objection was the fact that **our rights were taken** away from us. Well if I’ve got a 100 acre farm that’s my yard! That’s my home!*

*That is **an intrusion** because every time **I look out my bedroom window or whatever, there sits that damn thing**. To me, people say oh they’re so beautiful. **Beauty is in the eye of the beholder**.*

Attachment to both place and persons includes a degree of symbolism and proximity which could consist of building or “purchasing a home, frequenting a specific geographic area, and feeling a sense of safety” (Scannell & Gifford, 2016 p. 361). In context of IWTs, extreme person-place attachment may have contributed to an extreme perceived sense of insecurity, loss, and grief. IWT literature has consistently noted proximity and amenity as well as control as contributing factors surrounding IWT annoyance. A secure attachment to places and people has been shown to improve satisfaction, a sense of control and an association with either a positive or negative affect (Scannell & Gifford, 2016).

Understanding the reasons for a vehement reaction and discord in response to changes to rural landscapes continues to elusive. However, literature suggests that situations that threaten the security found through person-place attachment, through perceived loss of control, change or language cues (i.e., IWT messages, IWT noise), may have an effect on psychological health. Without protective psychosocial buffers, an altered sense of belonging and place may have negative health effects and spark environmental activism behaviour.

4.4.2 Information Processing and Language

Psycholinguistic studies have found that language influences both thought and perception. Akin to suggesting that people see what they choose to see, perceptions are formed by what is reinforced. A cognitive process occurs during which a person reorganizes linguistic patterns to form thoughts, develop perceptions and search out answers or evidence to support a belief or perception. This process of processing and filtering information is thought to influence both perception and experience. The result

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could be a perception of safety or a perception of threat and risk. In any given situation, two individuals may have opposite perceptions, which in turn shape opposing personal beliefs and, ultimately, different personal realities.

Within IWT discourse, emotive messaging was frequently used in print material, media and social media information. The decision to support or not support IWT installations involves a variety of factors. These factors have been categorized as, 1) contextual, 2) environmental, 3) social and communicative, 4) symbolic and ideologic, 5) community, 6) socio-economic, 7) personal, 8) physical, and, 9) political and institutional (Devine-Wright, 2005; Graham, Stephenson, & Smith, 2009). Each of the nine factors have elements associated with psychosocial factors; however, social and communicative as well as symbolic factors are most pertinent to linguistic influence of IWT messaging. However, IWT messaging used a predominately negative emotive tone to describe IWT exposure environmental and health risks. Examples of emotive language includes news media (print and TV) frequently used fear-arousing language to describe health effects, opposition signs stating wind turbines will make you sick were widely distributed and visible. Opposition websites included images symbolizing death and destruction alongside graphic reports of wind turbines causing illness, reducing property values and killing birds. Amplifying the impact of emotive messaging was the lack of neutral or positive messaging from a trusted source. The use of language and fear-arousing messaging may have negatively reinforced IWT perception of risk and amplified the psychosocial health effects of living near wind farms.

4.4.3 Exploring Self-rated Health and Psychological Distress: distress or anxiety?

Anxiety is a human emotional state. As a construct, anxiety is complex and linked with concepts such as stress, trust and certainty. Anxiety consists of processes interacting between physiological, environmental, psychological and sociological systems. A number of factors, such as life events and familial influences, can affect these systems. The Diagnostic and Statistical Manual of Mental Disorders (DSM), now in its fifth edition, distinguishes that fear is an “emotional response to a real or perceived imminent threat, whereas anxiety is

the anticipation of future threat” (DSM-V p. 189). Anxiety manifests itself as a vigilance in protecting or preparing for threat or avoidance

*Male participant: “I get very very irritated when they’re off ... **I get irritated when I get my electricity bill and it’s higher than it was before they were put up...** I find that stressful. **Irritating.** Driving ... I find myself counting how many of them are on versus off. And getting irritated and distracted from my driving. That’s **irritating.** Which is stressful. Right?”*

behaviours (DSM-V). Commonly reported clinical symptoms of anxiety may include all or some of the following: headaches, palpitations, nausea, sleep disturbances (fatigue), hyper arousal, reduced ability to concentrate, avoidance behaviours and generalized complaints of pain. Symptoms can be mild but could also become severe or debilitating or as shared by one participant increased feelings of “irritation”, “distraction” and “stress”. A diagnosis of any classification of anxiety requires a specialized assessment by a qualified practitioner.

An early article on health and the environment suggested that “psychosocial stimuli can influence health by impeding recovery and aggravating disability, whatever the etiology of disease ... a psycho-socially induced emotional overlay may be rooted in intense anxiety versus disease, or in utilization of disease as a means of avoiding responsibility or providing a release from social pressure” (Kagan & Lennart, 1974. p.

229). Higher levels of anxiety and distress have been linked to low self-esteem and may be able to mediate between individuals' social ties/role relationships and their mental health (Taylor & Stanton 2007; Thoits 2011). Studies have reported that social ties contribute positively to physical health (Uchino 2006) and psychological wellness (Norris & Kaniasty, 1996; Taylor & Stanton, 2007).

Social support may be a major link between social and health domains and may be a way to minimize or de-escalate a potential threat (Thoits, 2011). Group members provide important attentive behaviours by validating a sense of self-worth and acceptance to a group or support network (Thoits, 2011) and often become very important to each other. Another dimension to a secondary group's influence, which has not fit as well into evidence-based categories, is the group's ability to model and

reinforce either positive or potential maladaptive behaviours. More than one participant expressed a mind of

*Female participant (60-64): I suppose it could make you sick. I don't know. I have a thought I think **your mind is very powerful**, I think your mind can do a lot to a point to build on things that could not be making you ill but you **think they are making you ill.**"*

matter belief and that the "mind can do a lot ... to build on things that could not be making you ill but you think they are making you ill." Other participants shared that their feelings and symptoms worsened (see chapter 3 participant quotes) when exposed to increased opposition and media information or when they experienced increased life stress.

Non-supporters interviewed for this thesis reported feeling some degree of difficulty adapting to the change in their community or home environment. They expressed amplified feelings of worry about the financial implications of IWTs, and many were unsure of their ability to cope. Some felt anxious "all the time" or "when they

saw or heard wind turbine.” Those who reported increased anxiety also reported symptoms of sleep disturbance, headaches and irritability.

Anxiety and the effects of distress have largely been overlooked in the IWT phenomenon and research. A full understanding of the IWT phenomenon requires further research that is inclusive of a broad definition of health, which considers mental health, anxiety and distress as factors in, or causes of, diseases and disorders.

4.4.4 Coping and Adjusting to Change: resistance or resilient

Adjustment disorder (AD), according to the DSM-V (2013), is described as “clinically significant emotional or behavioural response to identifiable stressor, either singular, continuous or multiple stressors ... characterized by marked distress in excess of what would be expected from exposure to stressor (p.266).” Onset is within three months of exposure to the stressor.

The condition can resolve in less than six months (after removal of stressor) or it can persist beyond six months if

*Male participant: Driving ... I find myself counting how many of them are on versus off. And getting irritated and distracted from my driving. That's **irritating**. Which is stressful. Right?"*

symptoms progress to a persistent form that results in “significant impairment in social or occupational functioning” (DSM-V, 2013 p. 266). Assessing symptoms of adjustment issues can be challenging. AD symptoms can sometimes be attributed to a specific event, but there are often variations and challenges in determining, with required diagnostic certainty, a triggering event. Perceived environmental changes could be considered as stressors contributing to feelings of anxiety, insecurity and fear (Wakefield & Elliot, 2000; Pampalon et al., 2007, Steptoe & Feldman, 2001). Stress perception and response are frequently noted as a strong predictor of adjustment or

maladjustment outcomes. Given the DSM V change linking adjustment disorder with trauma and stressors, an association between stress and environmental change must be given serious consideration and further study.

A gap in the literature persists regarding the relationship between daily stress and significant stressful events and raise questions like: do previous stressful events make individuals more vulnerable to developing AD or other mental health disorders, or do they help some individuals become better able to cope and adjust to new stressful situations? Future research in this area, in the context of IWTs and environmental change, may help identify ways in which to predict individual responses and enable applicable management and support.

4.5 Connecting the Theoretical and Conceptual Dots

A report from the WHO Commission on the Determinants of Health (2008) has confirmed the increasing interest in, and connection between, one's living situation and physical and mental health. Although few randomized controlled studies or recent health outcome evaluation work have been conducted in this area, literature suggests that housing and neighbourhood perceptions affect health (Hartig, Johansson, & Kylin, 2003; Petticrew et al., 2009).

The most commonly reported environmental complaints noted in the IWT literature and by IWT groups include but are not limited to annoyance, headaches, anxiety, and sleep disturbances. Although each of these symptoms alone may not appear to be harmful, together they have the potential to cause distress, or worsen existing medical conditions that in turn may lead to other serious physical or psychological health problems (Bryant, 2009; Fahey, 1995; Hartig, Johansson & Kylin, 2003; Osterberg et al., 2007;

Thoits, 2010; Toyokawa et al., 2012). Stressful situations, if unresolved for an extended period of time, can lead to anxiety, insecurity, low self-esteem, and social isolation (Toyokawa et al., 2012).

People often share narratives with the very good intent of trying to protect others from harm. Powerful champions have emerged from IWT opposition groups. During the semi-structured interviews of people living in close proximity to IWTs that was part of the work of this thesis (Chapter 3), participants empathized with the powerful stories shared by others and were often visibly distressed by their suffering. Additionally, participants shared concerns that they, their family or their neighbours may suffer similar fates from IWT exposure.

IWT opposition groups have emerged with a strong and determined voice and may have contributed to a polarized and deeply entrenched conflict, which in turn may have enabled individual and social identities to respond and react in unhealthy ways. Drawing from social, health and psychological research may help to explain this reaction and response phenomena surrounding wind turbines.

Social media communication channels and virtual networks have provided an effective forum for many IWT opposition groups, and the anonymity afforded through social media has enabled many people to share powerful personal stories of their suffering due to IWT exposure, with many stories recounted with vivid and distressing detail. These vivid and distressing experiences have given power to voice, resulting in increased media and political attention. IWT opposition groups are perceived to present biased information and to encourage members to create dissonance. So as not to paint all IWT activist groups with the same brush, some groups seek to open a balanced,

informed and constructive dialogue based on information. Further consideration must be given to the motivations of the social network's approach for communications (i.e., anonymity) and whether the network truly represents the voice of the collective.

The tenants of social capital contend that positive social networks, bonding and bridging can lead to significant societal benefits, trusts and strengths; with that in mind, the opposite can also be true. Some IWT opposition groups have built a network of people who may be distrustful of government. The use of distrustful and fear-arousing messaging does not readily allow for mediation processes but instead may amplify fear and foster outrage. People may feel increasingly threatened via socially influencing factors. For some, these amplified emotions and perceived threats challenge their ability to adapt and cope. The language and visual images used by IWT opposition groups may create an environment that leads to a triggered response in some individuals. This response may be further exacerbated by continued vivid group narratives and ongoing IWT visual and auditory triggers.

Grassroots networks have historically been effective in establishing a shared identity and belonging amongst members. Individuals and groups may seek to continuously reinforce themselves and maintain a unified stance. Groups may continue for long periods of time, or may dissolve once the main purpose is achieved. Further research in the area of group forming, normalization and dissolution would help explain social and psychological processes and motivational influences of environmental activist movements.

The perceived loss of power and control, coupled with social isolation, are well established as influencing and predicting psychological distress (Ross & Mirowsky,

2009). Fear appeals, when used carefully, can be effective in evoking positive behaviour change. However, fear can stimulate a range of emotions and motivate a protection instinct as well as cascading cognitive processes that, depending on our individual experiences and ability to accurately appraise a perceived threat, can lead either to effective coping actions (adjustment) or the development of distress and prolonged anxiety (maladjustment). Further exploration of PMT and other emotion-based theories is warranted, as these may be tools to help understand and more effectively promote trust, improve procedures for environmental change, mitigate threat- or fear-induced messaging, and manage environmental response behaviours.

Theories along with the principles within social capital (networks, social cohesion) may help explain, in part, why and how IWT opposition groups leveraged sufficient power to draw attention to and perhaps shift the green energy political agenda as well as attract media and social media attention. Individuals who "perceive themselves to be members of the social category [i.e. IWT opposition], share some emotional involvement in this common definition and achieve some degree of social consensus about a valuation of their group and of their membership in it" (Tajfel & Turner 1986, p. 15). Foddy and Hogg (1999) reported that self-categorization "is thus responsible for self-definition as a group member and is seen to be the basis for normative behaviour, conformity, differential intergroup behaviour, ethnocentrism, in group bias and stereotyping" (pp. 312-313). Within the construct of IWT those that had positive IWT support were more likely to support or be neutral of wind energy development. In contrast, those that belonged to, or relied on, opposition messaging was more likely to be worried or anxious about wind development. Those same

participants felt their worry was validated by other members of the opposition 'group' with non-supporting and health complaints becoming a normative behavior reinforced through the various complex mechanisms presented in this paper. Continued messaging and in-group validation may have continuously reinforced and strengthened the opposition network ties and cohesion.

Perceived differences between people who are in or out of groups may in some situations highlight attitudes, behavioural norms and values and expectations of group membership. These expectations of behaviours and beliefs may knowingly or unknowingly result in individuals being *assimilated* to belong or continue to belong to the group. In the context of wind turbine concerns, belonging and bonding with an environmental activist group may be the only source of social support and justification available to some individuals experiencing (self-reported) health adverse effects from wind turbine exposure. Therefore, continued membership and validation of symptoms and concern may have become an essential part of their individual and social system.

Lived experience and cognitive processes and individual attributes influence individual and social relationships, which in turn contribute to ones' overall perception of the environment. According to Brewer (2001) there are two key threats to social identity: distinctiveness and inclusiveness. Distinctiveness originates from a fear of domination or loss. Inclusiveness originates from a fear that one's belonging and alignment with the "in" group may be challenged and the membership questioned or marginalized. Brewer (2001) states that social categorization puts a spotlight on group similarities and differences. Brewer goes on to argue that continued group attachment is a self-reflecting phenomenon and an important component of social categorization and the

establishment of trust with group members. However, Brewer's work purports that discrimination or the perception of discrimination may occur "not because 'out' groups are hated, but because positive effects such as admiration, sympathy, and trust are reserved for the 'in' group and withheld from out groups" (p. 23). Social theorists purport that people possess many roles and identities and these roles may change as situations change. These identities, when threatened, can lead to distress and behavior change.

Emotions, emotional-place attachment, loss of resources (economic security), self-rated health and the need to protect oneself from perceived risk are relevant to the wind turbine phenomena. Each theory, model and predominant theme introduced above helps to explain the complex psychosocial factors surrounding the wind turbine phenomenon. These complex and interconnected concepts may be serving as either moderating or amplifying factors (or both) and influencing individual perception of risk, the ability to adapt to environmental change and individual self-rated health.

4.5.1 Developing Psychosocial Health Conceptual Models

Shepherd et al. (2011) presented one of the first conceptual models of how IWT noise could affect health. Their cross-sectional study of the quality of life of those living within 5 km of wind farms used questionnaires to help ascertain the degree to which noise and amenity impacted health-related quality of life. The study suggested that the "landscape—soundscape violation" (combined landscape change along with IWT noise) in semirural areas and could "exacerbate annoyance reactions" for some and could invoke "stronger emotional reactions" (p. 334). Shepherd et al. (2011) suggested that the combination of noise along with changes IWT posed to landscape may have played a role in amplifying the feelings of annoyance for some people. Annoyance from

turbines may have an associated relationship between annoyances and sleep disturbance that could affect HRQOL (Oiamo et al., 2015; Shepherd et al., 2011). The main scope of the work of Shepherd et al. (2011) was noise annoyance and its potential relationship to HRQOL; however, their modelling of primary and secondary health effects, the interconnection between psychological processes and responses, maladaptation, and acute and chronic stress-related disease helped lay important groundwork for subsequent research including new conceptual models developed as part of this dissertation research (such as the IWT Social Ecological Model, Figure 6). This thesis expands on their initial model with the inclusion of holistic and psychosocial health factors identified through both literature and participant interviews.

This revised conceptual model (Figure 10) illustrates how psychosocial factors singularly or in combination could be triggering a cascading pathway leading to changes in health and HRQOL. The model also indicates the mediating or amplifying social-cognitive role in environmental risk perception. The social influences on individual cognitive processes are made up of complex and interconnected mechanisms.

This chapter has unpacked some of the predominant psychosocial factors and expanded upon possible theoretic and conceptual models that can be applied to IWT research. Add to that the literature review (Chapter 2) and narrative analysis of the experience of people living close to IWTs (Chapter 3), and this thesis is able to present an IWT psychosocial ecological framework of health-influencing factors and a revised conceptual health model.

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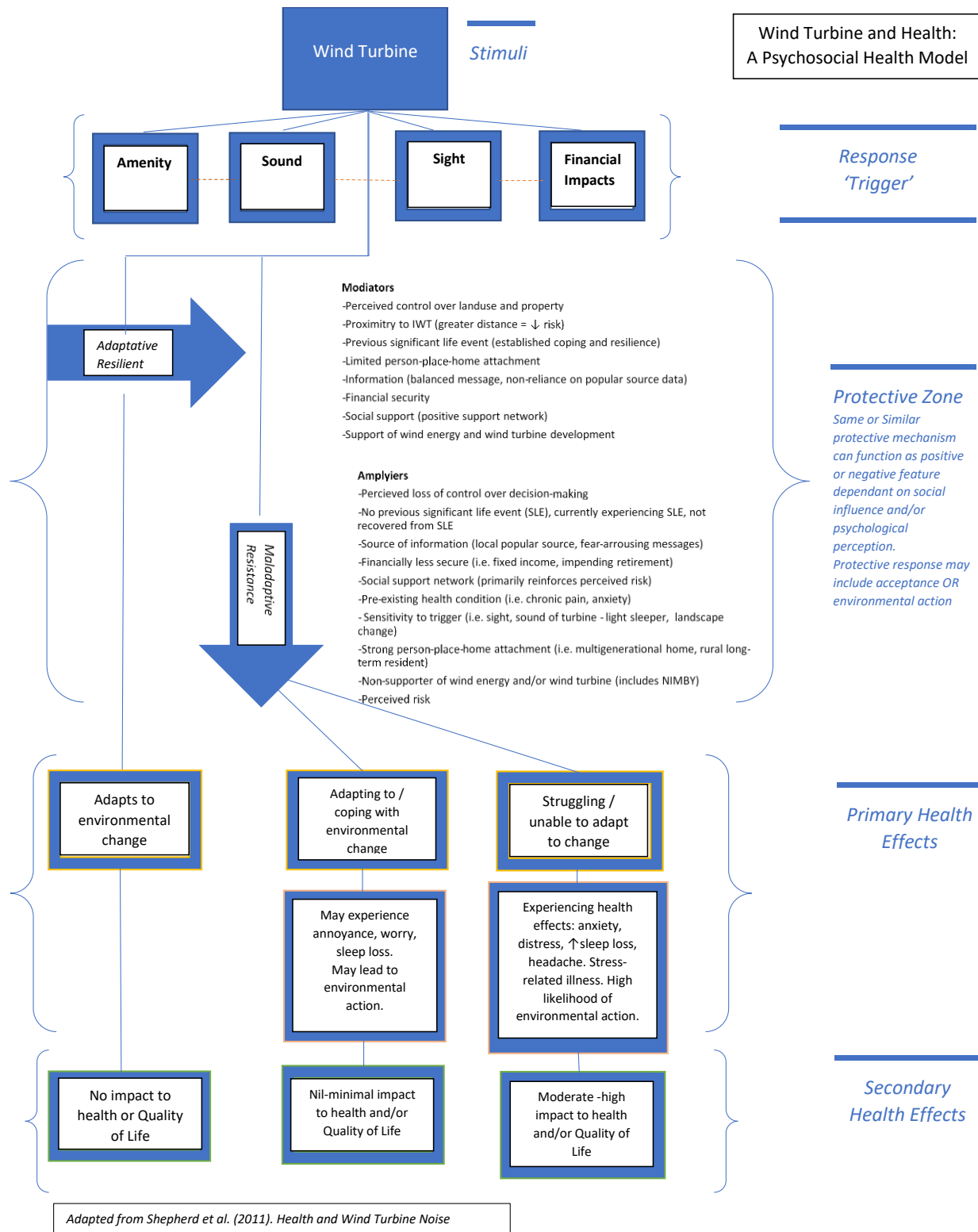


Figure 10: Wind Turbine Health Concept Model - Association within and between amenity features (land use, planning, political features, sound and visual impacts and financial impact as predominant stress-inducing factors. Environmental action could include active (i.e. information seeking, engaging organized lobbying) and/or passive resistance (i.e. non-support belief, rumination, worry).

5.0 Integrated Thesis Discussion

This thesis has used a critical realist multiple cross-case analysis to investigate the psychosocial aspects of reported IWT health concerns. A comprehensive literature review and an analysis of the lived experience of individuals and communities exposed to IWTs informs and provides important insights into the various nuances, antecedents, and meanings that have been and are attached to IWTs. It is hoped that people on both sides of this discourse will be able to improve communication, symptom identification and response management through further knowledge and understanding. The potential impact of this work is to provide an expanded lens for environmental health assessment and policy as well as improved supports for those suffering with self-reported adverse health effects.

This thesis begins to unpack the potential role of psychosocial health and related research that distinguishes between the interconnected social layers, which may influence the health of some individuals living near IWTs (research objective 2). The consideration of individual and social factors, along with interpersonal relationships and health pathways or processes could not be fully understood through the use of a single research approach.

Psychosocial determinants of health within the construct of social epidemiology recognizes further exploration of “causal pathways” and “mediating mechanisms” that influence social determinants of health will become more important as increasingly “complex combinations of social, psychological, and biological processes that contribute to ill health and subsequently inform health policy need to be clarified” (Martikainen, Bartley, & Lahelma, 2002, p. 1091).

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An ecological perspective consists of a complex web of systems that includes relationships, community, home, school, and activities that influence people and have the potential over time to either promote or prevent successful adaptation to changes within the environment. The diagnosis of wind turbine syndrome may be too narrow to fully capture the complex array of symptoms reported by those living near wind turbines. The literature is clear on the need to step out of the traditional medical model used to study illness and equally unclear about how this work should be conducted. The multiple and cross-case approach employed for this dissertation provided an opportunity to critically explore information from each individual case whilst making observations and identifying patterns across cases and across rural south western Ontario communities.

Case study and site-based research affords an excellent opportunity to place the researcher into the field of study. The brief opportunity to experience wind turbines through the lens of those interviewed, coupled with the multiple sources of data, provided additional context and richness to their stories. This research highlighted the multiple layers of interconnected relationships that were part of the participants' experiences with wind turbines. Their perceptions and strata were useful throughout the IWT multiple data source analysis to both explore and identify psychosocial (active or possibly inactive/unknown) mediating and mediating factors associated with IWT exposure. The psychological and social structures and advances of organized social media have expanded the boundaries previously associated with a not-in-my-backyard environmental opposition response, and resulted in a public controversial environmental movement. The wind turbine response phenomenon is more than wind turbines and more than NIMBYism. Industrialization (could include large scale farms, manufacturing,

waste sites) of rural and semi-rural communities is changing the landscape and may be affecting the restorative and safety features or home-scape features of rural living (or vacationing). One participant described many of the key themes discussed throughout this study, sharing instances of sleep disturbance and “being woken up ... like I’m running a marathon” and “feeling

frightened”. She shared that she supported alternative energy but that the “decision to put them close to homes wasn’t very smart” and didn’t feel that made her a nimby. She talked about how “other people may be pro turbines who are receiving a payment” and to say something different made you “an outsider”. There were also shared feelings of injustice about the process and about the fact that “nobody [making the decisions (government and neighbours] said anything to use ... no one called us, no one wrote to us”.

*Female (aged 55-59): “On a windy night to be woken from my sleep you know hurting with my **heart racing and my muscles aching and my joints like I’m running a marathon** ... woken up like that and then I can’t go to sleep you have to relax right so I have to wait for that to stop and it doesn’t stop right away till that wind and those turbines slow down. **That’s frightening to me.**”*

*I support alternative energy but I think maybe the decisions to put them so close to the homes here wasn’t very smart, that’s my personal opinion but you know if your government is calling you names, labeling you **nimbies** ...*

*other people who may be pro turbines who are **receiving a payment** such as my neighbours and if you say something contrary **you’re an outsider** because the farmers here are pro turbines, they’re on their property, they’re you know they’re paid hey great for them right they’re getting an income, additional income, great for them but nobody said anything to us ... **no one called us, no one wrote to us.**”*

The reaction one may have to environmental changes that affect smell, vision, and/or hearing are impossible to predict, let alone identify as a direct causal factor of negative health effects or annoyance (Colby et al., 2009; Horner et al., 2011; Osterberg et al., 2007). People may also seek out a rural setting for its landscape, for its quiet and restorative or relaxing qualities. In those instances, a significant environmental change

may create a strong contrast effect. This may be especially true for those living in rural areas, in close proximity to IWT installations. On the other hand, individuals and communities benefiting from IWTs may be more likely to accept the risk and be less annoyed by environmental changes (Ball, 2002; Bickerstaff & Walker, 2001; Linkov et al., 2009; Moffatt & Kohler, 2008; Nisbet & Gick, 2008). However, according to Wolsink (2010), it is not all about risk: perceived unfairness and threat among those with a strong sense of “place” can also lead to an increased sense of injustice and conflict.

Technology is evolving quickly and change is a constant feature in our work and homescape. Environmental change for some challenge the capacity to adapt or cope and may cause emotional distress. Over a prolonged period of time, unresolved housing quality, negative perceptions, conflicting values and powerlessness (Schultz et al., 2004) can lead to learned helplessness, fear (Sunstein & Zeckhauser, 2011), or a sense of victimization (Elliot et al., 1999, Evans, Wells, & Moch, 2003, Hartig, Sunstein & Zeckhauser, 2011). Determining IWT exposure is causally linked either by direct or indirect means may be impossible. Participants in this study experienced symptoms that suggest IWTs are adversely affecting some people given that many experiencing symptoms attributed to IWTs report symptoms resolve when away from their home and away from IWTs (i.e., absence from direct or indirect stimuli).

Many participants interviewed supported renewable energy in principle but opposed local energy projects. Participants, IWT-specific literature, and environmental literature consistently cite psychosocial factors of proximity (personal impact), perception, NIMBYism, community benefit, decision-making power, and developer values as associated and integral to understanding the connections between community resistance

and individual health (Cass, Walker, & Devine-Wright, 2010; Devine-Wright, 2005).

Psychosocial factors such as trust, beliefs, and social cohesion only partly explain this local or proximity influence. Social capital is defined by various contextually relevant and values-based functions and not by any single factor (Coleman, 1988). Coleman (1994) further describes social capital as the *bonding* and *bridging* between social networks, norms, and trust that enable or lead to mutual benefit. Bonding and bridging can be reinforced to either build a strong sense of belonging or antagonism to outsiders.

Increased anti-wind resistance messaging in communities may lead to a perception bias (Ball, 2002; Parks & Theobald, 2011; Soneryd, 2004) and a lower threshold for annoyance stemming from visual and auditory stimuli (Pedersen, Persson, & Waye, 2007; Pedersen & Waye, 2004). Positive social interaction and connectedness to home and environment are crucial for restoring and maintaining optimal physical and psychological balance (Kaplan & Peterson, 1993; Manzo, 2003). Changes to the home environment that are beyond the homeowner's control may cause a psychosocial response (Sunstein & Zeckhauser, 2011) and be manifested by either internalizing the response, becoming engaged in community activism, and/or taking a "victim" position (Hartig et al., 2003), which is consistent with emotive language used in participant interviews and in IWT opposition messaging.

There continues to be a gap in IWT research that looks at the restorative importance of one's home to reducing stress and improving overall health and quality of life in context of IWTs (Colby et al., 2009; Copes & Rideout, 2010; Hartig, Johansson, & Kylin, 2003; Horner et al., 2011; Kaplan, 2001; Petticrew et al., 2009; Schultz et al., 2004; Thoits, 2010). Additionally, the presence or history of individual and family psychological

issues needs to be considered and further explored in the context of IWT health effects (McMurtry, 2011). There is an urgent need for multi-disciplinary psychosocial environmental health research, the utilization of validated health assessment tools, and transparent policy approval and communication processes regarding environmental decision-making and health impact assessments (Elliot et al., 1999; Moffatt & Kohler, 2008; Stokols, 1996, 1998).

5.1 Exploring the IWT Phenomenon: findings and lessons learned

The persistence and content of IWT messages by anti-wind lobby groups may

*Participant: "I'm impartial ... I'm happy that they are having an alternative energy source but uh as far as all of the details I'm not really aware of the bonus or the hindrance ... **If I get too much information, I'll probably sway one way or the other and I got too much to think about other than something like that. I'll let you guys worry about that ... I heard already that there's things about it ... nothing life threatening to my family or myself so I'm not really that much into it yet.**"*

have negatively impacted factors of social capital and the health of those living near wind turbines. The frequent use of emotive words and warnings of decreasing property value along with vivid images may

be perceived as threatening (examples provided throughout chapter 3 and 4 images and participant quotes). When messages are perceived as a threat they have the potential to cause psychological distress and a physiological stress response. As illustrated in participant quotes throughout this thesis, those interviewed consistently expressed IWT ideology using language similar to that found in messaging from opposition and print media. Additionally, as the quote above indicates participants felt too much information could "sway them one way or another" and some have "too much to think about other than [IWTs] and unless it is "threatening to my family or myself I'm

not really into it". The concepts of the types and sources of information and the perceived risk and resiliency to process and cope continued to emerge from both supporter and non-supporter participant narrative. In today's digital age, utilization and reliance on social media as a source of information public discord has a potentially large public reach. This reach can have both a positive or negative effect.

Environmental groups on either side of discourse may consciously or unconsciously make strategic choices that are akin to marketing maneuvers in their efforts to strive for political attention. Unfortunately, these actions may have caused harm to some individuals who live near IWTs. Social media have enabled environmental groups to spread their message and increase their power of voice exponentially. Such increased power needs to be balanced with greater responsibility and accountability to both the message and the members of their group. Environmental and justice movements are intrinsic to democratic society; however, it is important that the democratic process also include opportunity for dialogue between all stakeholders to develop a common perspective and, ideally, collective agreement in order to avoid unnecessary conflict and harmful messaging within and outside of disenfranchised social groups. Green energy may be motivated by environmental considerations, economic factors, political agendas, and opposition groups arguing for and against renewable energy development. There appears to be little evidence of neutral ground in terms of opposition or support for wind power development. The current conflict dynamic may further lock each side into a position from which it is hard to move — a situation that in turn contributes to even more of a closed system of information and knowledge transfer and exchange (interpretation), within group connections (reinforcing

behaviours), and during decision-making (micro-macro level). This may create a problem in comprehension for many who cannot accurately interpret and apply research that would previously have been available to a limited scientific audience. An emerging responsibility of researchers and public health officials is to recognize this widening gap and take measures when necessary to translate science into common language to improve transparency, accuracy, and the public's trust in the results (Fitzpatrick-Lewis, Yost, Gilska, & Krishnaratne, 2010).

This discourse may not just be about non-support or support of wind energy and industrial wind turbines. This era of rapid technological advancement and access to information may present new challenge to policy-makers to keep pace with the type and manner in which environmental changes are made. The IWT phenomenon has highlighted a gap in knowledge regarding the extent and type of industrial-type exposures within a community and within a home environment. Without understanding the extent and scope of home and community exposures, appropriate monitoring, management, and prevention measures of environmental health cannot be established. The IWT health concerns need to be further studied and addressed.

New technologies and infrastructure projects are rapidly emerging in rural areas. The digital-age has enabled social access and networks previously difficult to maintain in isolated and rural communities. While noting the economic benefits industrial projects and business may bring to rural communities, these projects may also bring (for some) environmental health risk. Health risks may include risks of noxious odor, noise (audible and inaudible) exposure, and psychosocial risks (landscape, amenity and property

value). This is not simply an IWT issue; IWT is reflective of a broader issue regarding home and community environmental exposure prevention and management.

5.2 Research Objectives and Potential Impacts: Reviewed

This study adds to the growing body of evidence suggesting psychological and social mechanisms may have a significant role in self-reported adverse effects of IWT exposure. This thesis suggests the potential impact of psychosocial factors to promote, maintain, or exacerbate one's overall health may be a clustering of factors that are part of the IWT phenomenon. The thesis highlights the complexity underpinning the IWT phenomenon and presents findings through which health and environmental policy changes may be informed. Conceptualizing these factors within a social ecological model as having a bidirectional connection between multiple social strata within which individuals live has provided a deeper understanding of how health may be influenced by the experience of, or exposure to, IWTs.

Although this research explored IWT experience, the underlying complex interconnected aspects of place-home-cyber bonding, opposition and media communication, social and place identity, significant life event, and environmental adaptation may be transferable to a variety of environmental domains (i.e., waste, noxious odor, infrastructure change) and open new research avenues.

This thesis was dynamic and evolved throughout its development. Initially little was known or published on wind turbines or wind farms. As opposition and public rhetoric increased and the political climate changed, more questions arose regarding the underlying concepts and factors behind the divided IWT response phenomenon. There were more questions than answers, and a sense of urgency grew to provide

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scientific proof to policy makers, health professionals, and the public regarding the health and environmental safety of wind energy. Resistance exacerbated political, social, and individual discord, which ultimately added a layer of complexity as well as an opportunity for research on this ever-evolving subject. Exploration of the IWT discourse may lead to greater awareness and understanding of the interconnectedness between people, and the environment, and how this techno-environmental evolution may be affecting both our landscape and our health.

IWTs are not the first, and nor will they be the last of environmental changes facing rural communities. While the literature on psychosocial connections to environmental distress is growing, the application of an additional theoretical perspective may provide greater conceptual clarity regarding the predominant IWT-related psychological and social aspects that influence health outcomes.

Urban spread has led to rural communities experiencing increased population growth, with the resultant development of infrastructure and business. There is little evidence or availability of change management supports that may help mitigate the negative environmental stressors faced by communities experiencing significant growth and development. This research may highlight the health implications of the absence of such support, and communicate the importance of applying a psychosocial lens when managing environmental change and improving healthcare practices (i.e., stress screening, coping skills training). It is also hoped that this work will be used by decision-makers in public health and health policy, as well as health practitioners to develop evidence-informed tools by which to assess and manage those experiencing adverse health effects from IWT exposure.

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This research illustrates the interconnections between individuals, their social and built environment, and health. This socio-ecological and holistic approach to health has led to greater insight and understanding of the multilayered, psychosocial factors surrounding the wind turbine phenomena. Walker et al. (2014), highlighted the need for further research in line with the work of Devine-Wright (2011) in terms of perception, place identity, and other psychosocial factors, noting that “to better understand the connection ... the effects of linked phenomena (e.g., conflict, setbacks, [risk perception]) need to be considered” (p. 30). Social-person-place bonding was a predominant theme within this study. The digital age has given rise to social media and virtual communities as well as immediacy and anonymity in communication. Further research is needed to understand the nuances and impact of the digital age within the context of environmental change and environmental advocacy. Additionally, future research should explore the extent to which life events, economic insecurity, and place-based attachment affect the mental health of those living in proximity to IWTs. The mental health implications of annoyance, psychological distress, and stress-related illness associated with IWTs is both a public health issue and an area of future research.

This study met identified objectives through the following ways a) the completion of a systematic literature review examining psychosocial factors related to IWTs and environmental health (chapter 2) b) explore the IWT local health response phenomenon common and differing factors between and across cases from an individual and community perspective (chapter 3), and c) to review, reframe and potentially revise conceptual models and provide deeper understanding to IWT health research (chapter 4). Triangulated results of thematic analysis from multiple data sources including

literature, interview, and health assessment data revealed that changes to rural community and home environment (landscape) may affect person-place bonding, restorative properties of nature and home. Fear-inducing media and opposition messaging may amplify visual and noise annoyance and financial worry that may be associated with poorer self-rated health. Results from multisource data identified psychosocial factors associated with home-based environmental exposure which may be potentially contributing to or a consequence of actual or perceived environmental change.

5.3 Study Strengths and Limitations

The risk of ecological fallacy is inherent when considering group and individual level data (Schwartz, 1994). Cross-level analysis and concept comparison of factors mitigate the risk of ecological fallacy. Using cross-level analysis and concept comparison within a social ecological structure allows layered chains of association to emerge from data (Schwartz, 1994).

In qualitative research, the concept of saturation indicates that additional (new) data does not add any further context to the topic of study (Glaser & Strauss, 1967). The frequencies can be less important than in quantitative research because one occurrence of data is all that may be required to include it as part of the analysis. Ritchie et al. (2003) outlined several factors that can affect the sample size of qualitative research, including population heterogeneity, selection criteria, nesting samples within a study, resources, and budget available. Literature notes that the quality of data and skill of interviewer may be more relevant the sample size in terms of the value and ability to make observations from data (Guest et al., 2006; Morse, 2000). The size of sample will

be dependent on research method and research questions. Various authors provide guidelines as to an acceptable sample size. For example, Creswell (1998) recommends 20 to 30 for grounded theory and 2 to 25 for phenomenology and Charmaz (2006) suggests 25 is an acceptable number so long as data saturation is reached. The sample size of this study was $n=31$ which falls within an acceptable participant size according to guidelines available. Furthermore, the analysis of interview data achieved content saturation and enabled the researcher to make meaning from data, thus meeting the principle required of qualitative work.

Unforeseen circumstances led to a time lapse between interviews and the completion of this dissertation. Some literature addressing psychosocial health had been published during this time period. However, a review of recent literature shows that the study of psychosocial health effects related to IWTs is still scarce. While information consistency and saturation were obtained in both the literature review and interview data, the information within this study must be interpreted carefully and is not intended to be diagnostic.

A sample bias may also exist as a result of geographic differences. As noted previously, participants were selected from previous respondents of the RETH project and may not be representative of all those exposed to wind turbines or to the population at large (i.e., gender, age, cultural). Additionally, while participants expressed understanding of anonymity and provided detailed and descriptive insight, participants may have signed nondisclosure agreements with wind turbine developers and may not have been completely forthcoming when they described their experience. As a former member of one of the rural communities included in the research, I again note a

possible limitation and bias. This potential bias was mitigated by engaging independent research assistants and through years of professional experience in the maintenance and management of professional boundaries as a registered nurse. A second researcher enabled me, as the primary interviewer, to engage more fully with participants. The second researcher made important observations and jotted notes that supported accuracy in recall, especially important given the time lapse to publication.

5.4 Conclusion

The rapid implementation of new renewable energy technologies like Industrial Wind Turbines (IWTs) in rural environments has raised concerns regarding the potential effects of these technologies on human health. Triangulated results of thematic analysis from multiple data sources including literature, interviews, and health assessment data revealed that changes to rural community and home environment (landscape) may affect person-place bonding and restorative properties of nature and home, while fear-inducing media and opposition messaging may amplify visual and noise annoyance and financial worry that may be associated with poorer self-rated health.

Results from multisource data identified psychosocial factors associated with exposure that potentially contribute to or become a consequence of actual or perceived environmental change. Further analysis suggests health effects may be explained by a combination of psychological (internal), socially influenced (external), and either amplifying or mediating factors. These factors led to the revision of IWT health model and the development of new IWT social ecological model. The main components of these models include; external variables (e.g. individual and exposure-related variables) mediating variables (e.g. social network membership and involvement, general health

status measures); and outcome variables (e.g. concern, effects, actions) (Elliott et al., 1993). Individual characteristics like values and beliefs along with community-related variables suggest the explanatory power of personality traits, life stress and coping skills, and person-place bonding as well as site-related characteristics like social networks and approach to communication and site planning.

This study utilized a qualitative multiple cross case study design and retroductive approach to explore, through social ecological and critical realism lenses, the lived experiences of adults from three wind farm communities in south western Ontario, living within five kilometres of one or more IWTs. Thirty-one interviews were conducted with participants representing three Ontario wind development communities. Interview transcripts underwent a narrative thematic analysis. Interview findings revealed that both IWT supporters and non-supporters have some degree of worry or distress regarding financial implications of IWT installations and believe there is a global need to reduce reliance on fossil fuels. IWT non-supporters described IWTs as visually annoying and reported associated health effects, including poorer mental health. A minority of non-supporters indicated that IWT noise was annoying. Very few participants attributed noise annoyance to sleep disturbance. Irrespective of participants' support or non-support of IWTs, several interesting manifest (public) and latent (private) factors emerged from the interviews. Almost all participants reported being more concerned about the financial aspects of IWT development, government-decision making, and the perceived fairness in IWT siting than feeling concerned about potential health effects of IWT exposure. Additionally, a previous significant life event and a person's level of attachment to their home, land, and community appeared to influence perception, the

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ability to adapt to environmental change, and extent to which one experienced psychological distress.

A systematic literature analysis that included 217 articles suggests that psychological and sociological (psychosocial) dimensions, including fear-perceptions, personality traits, attitudes, and community conflict, may be associated with reported adverse health effects. This work confirms previous studies that identified a need to expand policy decisions and environmental health assessments to include a holistic and ecological assessment of health impacts. However, there continues to be several gaps in IWT research including, longitudinal studies, baseline studies pre-IWT installation, research regarding community response to IWT development (including noise, planning, landscape change), psychosocial health, and primary qualitative and field-based research. This thesis contributes to the latter identified gap.

This thesis explored psychosocial health factors underlying the IWT phenomenon, critically examined individual and group IWT experiences and perceptions, and triangulated multiple sources of data from which to establish a deeper understanding of the IWT health phenomenon. The identification of differences between manifest and latent perspectives provides important insights into factors that may be associated with or contributes to reported health concerns. The resulting analysis elucidated that psychological processes and socially influencing factors and complex mechanisms may be indirectly associated to individual perception of wind turbines and self-rated health. Given the complex mechanisms and diversity of variables of the study caution must be taken in interpreting the findings of this study.

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This work highlights the need for environmental health assessments to include specific requirements that could address, alleviate, or prevent psychosocial effects from IWTs or industrialization of rural communities. Interview findings revealed that both IWT supporters and non-supporters have some degree of worry or distress regarding financial implications of IWT installations and believe there is a global need to reduce reliance on fossil fuels. The majority of IWT non-supporters described IWTs as visually annoying and reported associated health effects, including poorer mental health.

The approach taken in this study illuminated health and environmental concerns that could inform health management, environmental health policy, and communication processes that could inform the employment of reasonable precautions, participative decision-making, and holistic health considerations when introducing new technologies like IWTs to the environment. The research also highlighted the importance of the medical and health professional community to have current evidence-based information and tools to assist them in the assessment, diagnosis, and management of environmental health conditions. The underlying issues and potential impact are not limited to IWTs. It is also hoped that this work will stimulate further discussions regarding changes to environmental health assessments and policy that reflect and include a broader definition of health. It is fitting that the last words be from study participants, who graciously shared their experiences and their truths in the hope that their voices would be heard and make a difference.

Participant: "I do have a voice and I want it to be heard and I wanted to participate along with other people around here and hopefully you know have a more positive effect on our lives ... whatever the outcome is I mean I don't think someone's going to listen to me and take these turbines down or move them, but that's what I would like, I would like them to move them because I can't be the only one being affected by them."

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Appendix A: Summarized Table of Literature (Select)

Table 4 Summarized Table of Literature (table may contain select direct excerpts, descriptors and paraphrased summaries of specific IWT literature)

Legend: □ Article not directly (specific) to Wind Turbines □ Predominantly economical
 □ Predominantly psychological factors □ Predominantly social
 □ Predominantly policy and/or planning

Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
Abbott (2010)	Globally	Review	Indirect	Participation in groups considered key to social capital.	Social Capital Social groups	Participation may help local and national government promote self-efficacy and health promotion and reduce social isolation.
Adler (1994)	Globally	Review	Indirect	Onset of disease affected by individual and social factors.	Health behaviours Social environment	Environmental stress involves interactions among systems. Interaction of psychosocial variables and health behaviours associated with advances in technology require further research.
Ahnquist, Wamala & Lindstrom (2012)	Europe	Research study, secondary data	Indirect	Health outcomes affected by Independent and interconnected factors of lack of economic capital and social capital	Social capital Social interaction Economic	Economic capital and low social capital associated with poor health status.
Alonzo (1985)	Globally	Review	Indirect	Model and related intervention strategies yet to be developed representative of complex relationships between individual, social, physical environments	Social interaction	Not effective or as effective to intervene in individual situations without also influencing macro level factors such as economic, political, and cultural as each may contribute to producing or supporting unhealthy conditions.
Ambrose, Rand & Krogh (2012)	United States	Research study	Direct	Wind turbine infrasound and low-frequency noise	Annoyance	WT noise distinguishable from ambient background noise. <i>Noise levels capable of exceeding human detection thresholds.</i>

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
Anton & Lawrence (2014)	Australia	Research study	Indirect	Relationships between place-identity and dependence to residence and living in a threatened place and subsets of place attachment	Place identity Place attachment	Socio-demographic predictors (<i>length of residence, education, and owning one's home</i>) to place identity and to both home and local area.
Ashrafi, Davoudpour & Khodakarami (2015)	Globally	Review	Direct	WT Complex technological systems risk assessment approaches	Natural environment Social Political economic	Proposed WT model assessing risk and reliability as well as interacting components with organizational factors within environmental constructs of social, political, economic.
Barnett, Burningham, Walker & Cass (2012)	United Kingdom	Research study	Direct	Interdependencies between principles and practice of engagement and nature of imagined publics	Public engagement	The perceived necessity of engagement on public responsiveness and engagement mechanisms a function of certain factors of imagined publics.
Basner, Babisch, Davis, Brink, Clark, Janssen & Stansfeld (2014)	Globally	Review	Indirect	Auditory and non-auditory effects of noise on health	Noise Annoyance	Noise exposure leads to annoyance, disturbs sleep and causes daytime sleepiness and may impact cardiovascular and cognitive function.
Baxter & Greenlaw (2005)	Canada	Research study	Indirect	Community risk perception difference explanations. Cultural theory of risk, specifically <i>place-contingent ways of life and worldviews</i>	Cultural, community-placed risk perception	Risk perception socially constructed. More community-specific risk communication may not ease concern. Root concern must be addressed directly.
Baxter, Morzaria & Hirsch (2013)	Canada	Research study	Direct	WT perception, health, economic benefits and community conflicts	Risk-benefit perception Social conflict	Key predictors reported: health risk perception, community benefits and general improvements

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
Beery & Wolf-Watz (2014)	Europe	Research study, secondary data	Indirect	Place-based application of environmental-nature behavior relationship	Place identify and connection	Human values and perceptions often neglected when considering environmental connectedness as rooted in material/objective perspective.
Bevc, Marshall & Picou (2007)	United States	Research study	Indirect	A methodological design that enables researchers to assess what factors cause mental and physical health problems for individuals living in contaminated areas.	Perception Risk	Socio-demographic, perceived exposure, objective exposure, are significant predictors of physical health and psychological well-being.
Bisung & Elliott (2014)	Globally	Review	Indirect	Social capital's role in water-health nexus in low- and middle-income countries.	Social capital Health literacy	<i>Social capital improves knowledge, attitudes and practices. Collective action helps move towards improving access [to water, sanitation and hygiene].</i>
Boardman, Downey, Jackson, Merrill, Onge & Williams (2008)	United States	Research study, secondary data	Indirect	Gender, occupational status, and family status play role to moderate industrial activity impact on psychological well-being of nearby residents.	Social and personal identity / roles health literacy risk perception	The closer the Industrial activity the greater the potential negative impact associated with mental health. Social roles, gender, occupation and family status are important to understanding potential health risks.
Bronzaft (2011)	United States	Review	Direct	Potential adverse effects to children's well-being from WT noise.	Child and family well-being Noise risk	Further research needed on the health impacts of WTs. Warnings about WT noise hazards should be considered within health policy.
Bullers (2005)	United States	Research study	Indirect	Physical and psychological effects of people living nearby to	Perceived control	Residents have higher levels of psychological distress than control group. Perceived control did not mediate health effects.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				industrial hog farms.		
Calogiuri & Chroni (2014)	Globally	Review	Indirect	Relationship between natural environment and promotion of physical activities and active living	Information Health literacy Social campaigns and media	Policy and infrastructural interventions. Social campaigns could use media to highlight how nature can be useful to reduce stress.
Carneiro, Rocha & Rocha (2013)	South America	Research study, secondary data	Direct	Possible societal risk associated with wind power generation systems	Safety	Safety principles of wind turbines implementations must be observed.
Carpiano & Hystad (2011)	Canada	Research study, secondary data	Indirect	Measurement of social capital and aspects of sense of belonging (community)	Social capital Social network Place identity Sense of Belonging	Sense of community belonging and network social capital associated positively. Differences noted between urban and rural settings.
Brauer & Mikkelsen (2010)	Europe	Research study	Indirect	Perception variability of employees in workplace involves psychosocial and environmental factors at individual and workplace level.	Perception Sense of belonging	Contextual factors may be important. Future research should include multilevel analyses.
Christidis & Law (2012)	Canada	Review	Direct	The current planning process used in Ontario for wind energy and the connection between negative perceptions of the wind energy planning process, complaints and	Perception Trust Public engagement	The “top-down” approach is one of the factors leading to negative opinions and annoyance. Collaborative planning approaches to Renewable Energy Approvals process recommended.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				annoyance.		
Christidis et al. (2017)	Ontario, Canada	Research Interview based Case Study	Direct	Inequalities exist between social and political structures	Community ownership model Concern regarding decision and policy process Economic Local control	Case study with provincial and local politicians, community members exploring stakeholder experience with IWTs (especially in context of opposition). Differing perceptions between local politicians and community members may be barrier.
Coleby, Miller & Aspinall (2009)	United Kingdom	Research study	Direct	Public participation and wind power opinion connection to WT site planning and design	Public engagement Public opinion Trust	Increase public input and participation in local land use was wanted by local respondents.
Compton & Beeton (2012)	Australia	Research study, secondary data	Indirect	Land management practice can be affected by social capital and either inhibit or empower individuals and groups.	Social capital Control Public engagement	A reinvigorated interest is called for to 'tailor programs' to community need.
Corscadden, Wile & Yiridoe (2012)	Canada	Review	Direct	Community consultation and essential components of consultation guidelines.	Public engagement Social influence Health literacy	Early communication provides opportunity for increased social acceptance and reduced conflict. With employment as key drivers for enhanced social acceptance.
Crichton & Petrie (2015)	New Zealand	Research study	Direct	Provision of a nocebo explanation for symptoms would ameliorate symptoms during further exposure.	Perception risk/health *nocebo	Nocebo response has potential to reduce symptomatic experiences in people reporting WT infrasound symptoms.
Cross (2015)	United States	Research study	Indirect	Attachments to places and people are formed over time and through		Place attachment is formed through seven processes that interact at individual, group, and cultural levels over time.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				interactions with others		
Deignan, Harvey & Hoffman-Goetz (2013)	Canada	Research study	Direct	Ontario newspapers coverage of effects of WT published communication using fright factors.	Risk perception Language Health literacy Fear	Reporting using <i>fright factors</i> in Ontario newspaper articles about WT and health may produce fear and anxiety for readers.
Deignan, Harvey & Hoffman-Goetz (2015)	Canada	Research	Direct	Emotive public messages may influence how be interpret and act on information received.	Information framing (interpretation) Risk perception Reinforced (frequent) messaging Fear-inducing Anxiety-inducing	The frequency and emotional messages (tone) of IWT discourse in media, especially community media may be 'sensitizing' readers and contributing to a negative attitude about IWTs. Repeated emotive messaging about health effects of IWTs may influence and heighten perception of risk and action in response to perception of risk.
Devine-Wright & Howes (2010)	United Kingdom	Research study	Direct	There may be symbolic meanings associated with a proposed locations of wind energy projects	Trust Symbolism Place attachment Social influence and group involvement	relation between place attachment and negative attitudes to the wind farm may be moderated by trust. Place attachment may challenge NIMBY assumptions that offshore wind farms will be less controversial.
Devine-Wright (2005)	Globally	Review	Direct	assessment of wind energy public perceptions, opposition and NIMBYism	Perception Social influence	Future research needs to be less fragmented, theory and be more grounded in social science.
Devine-Wright (2011)	Europe	Research study	Direct	Symbolism, place-attachment and place-related meanings to help explain public responses	Place attachment Symbolism Social influence	Place attachment and symbolism emerging as significant positive predictor of WT project acceptance.
Ding, Sallis, Conway, Saelens, Frank, Cain	United States	Research study	Indirect	The interactive built environment - psychosocial	Interaction with environment	Built environment may have stronger influence on adults not psychologically predisposed to be active.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
& Slymen (2012)				effects on physical activity.		
Dobbie & Brown (2014)	Globally	Review	Indirect	A framework for understanding risk perception under the perspective of water practitioner	Perception Health literacy	Risk could be a component, a process, or a technology, and be public or health, profitability, or professional reputation.
Dohrenwend (2000)	Globally	Review	Indirect	The role of adversity and stress in psychopathology	Personality Adversity and coping experience	Uncontrollable changes varies with gender, ethnic/racial and SES status, and SES. Types of psychopathology potential varies with types of adversity and types of personal predispositions and experiences with adversity and stress.
Dominicis, Fornara, Cancellieri, Twigger-Ross & Bonaiuto (2015)	Europe	Research study	Indirect	Place attachment moderates risk perception and prevention behaviours to cope with environmental risks.	Place attachment Perception Personality and coping experience	"Place attachment diminishes environmental risk coping intentions and actions when associated with high risk perception".
Droseltis & Vignoles (2010)	Globally	Research study	Indirect	Social and motivational processes underlying identification with place.	Place identification and attachment Symbolic	Three dimensions of place identification (<i>attachment/self-extension, environmental fit, and place-self congruity</i>). Dimensions predicted by different combinations of needs and motives and links to places (e.g., self-esteem, belonging, meaning, control, aesthetic pleasure, social/symbolic links to places (e.g., genealogy, economics, loss).
Elgar, Davis, Wohl, Trites, Zelenski & Martin (2011)	Globally	Research study, secondary data	Indirect	Links between social capital and self-rated health	Perception Social capital Trust	Benefits of social capital greater in women, older adults and more trusting individuals.
Evans, Parks & Theobald (2011)	United Kingdom	Review	Direct	The implications of commercial urban wind	Social opinion Public engagement	Community responses were complex and varied and not adequately be explained by 'nimby'. Private sector

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				projects for local communities		provides new insights into public engagement in terms of social acceptance of Renewable Energy.
Fassio, Rollero & De Piccoli (2012)	Europe	Research study	Indirect	Predictive role of population density on quality of life, socio-demographic and diseases.	Rural / urban community influence	"Population density strongly influences psychological, relational and environmental quality of life".
Fast (2013)	Globally	Review	Direct	Social acceptance of renewable energy	Social acceptance	Geographical concepts place, landscape.
Fast (2015)	Canada	Research study	Direct	Wind energy planning and politics.	Planning Public discourse	Gap in WT studies include: discourses of absolute opposition, impatient support and idealistic support.
Feldman & Steptoe (2004)	United Kingdom	Research study	Indirect	Pathways through which low neighbourhood (SES) and associated subjective neighbourhood characteristics may be associated with self-reported physical functioning.	Perception Social influence Social and psychological experience	Neighbourhood SES and associated perceptions of contribute to shaping social and psychological experiences.
Fiorillo & Sabatini (2011)	Europe	Research study	Indirect	The role of social interactions in self-reported health	Social interaction Social network	The potential role of unobservable variables suggests the existence of <i>endogeneity</i> problems that need more investigation.
Frasquilho, Matos, Salonna, Guerreiro, Storti, Gaspar & Caldas-de-Almeida (2016)	Globally	Review	Indirect	Recent evidence shows a possible association between economic factors and mental health effects.	Economic Influence to health (psychological)	Periods of economic recession (<i>financial strain</i>) may be associated with increased prevalence of poorer mental health.
Frohlich & Abel (2014)	Globally	Review	Indirect	Mechanisms raising health	Inequity (fairness)	Capital interaction theory and action discussed in

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				inequities at local level	Health literacy	terms of interactions to reduce social inequities in health-related practices.
Gallant & Fox (2011)	Canada	Research study, secondary data	Direct	Costs and benefits related to renewable energy policy	Cost – benefit	Showing the average Ontario residential user's annual bill will exceed \$2,800 by 2015 and \$4,100 by 2030, compared with the current \$1,700.
Gattig & Hendrickx (2007)	Globally	Review	Indirect	Environmental risk shows temporal discounting less pronounced than other domains.	Economic Risk perception Health literacy	Targeting public's long-term preferences and consideration of standard economic decision theory may help increase success of developments.
Gattino, De Piccoli, Fassio, & Rollero (2013)	Europe	Research study	Indirect	There may be predictive affective link to place of residence and perception community on health and quality of life.	Place attachment Urban/rural	"Quality of life affected by sense of community but not place attachment. Living in a small town enhances the environmental, psychological, and relational quality of life."
Gifford & Nilsson (2014)	Globally	Review	Indirect	Personal and social influences on pro-environmental behaviour	Personality experience adversity and coping Control Threat	"Factors reviewed include childhood experience, knowledge and education, personality, sense of control, political and world views, goals, felt responsibility, cognitive biases, place attachment, age, gender and chosen activities. The social factors include religion, urban–rural differences, norms, social class, proximity to problematic environmental sites and ethnic variations."
Gifford (2014)	Globally	Review	Indirect	Interactions between individuals and built and natural environment	Interaction with environment	Human existence occurs and interacts in one environment or another with important consequences to people and natural and built environment.
Gosling & Williams (2010)	Australia	Research study	Indirect	Relationship between pro-environmental behaviour and emotional	Place attachment Connection with nature Pro-	Emotional connection with nature leads to an increased sense of self and environmental value and pro-environment behaviour.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				attachment to place and nature.	environmental behaviour	
Graham, Stephenson & Smith (2009)	New Zealand	Research study	Direct	Public perceptions of wind energy development	Perception Social influence	Found no apparent relationship between negative perception WT proposal and proximity of submitters.
Greenberg, Schneider, Lowrie & Dey (2008)	United States	Review	Indirect	Experience of community in reversing downward spiral. Theory underpinning pariah land uses.	Community use Social influence	Reversing impacts of <i>urban decay</i> should be locally initiated effects and multifaceted to address local concerns.
Guite, Clark & Ackrill (2006)	United Kingdom	Research study	Indirect	Interconnections between built environment and physical and social factors and well-being.	Social influence Environmental influence to psychological health	Promoting mental well-being on residential areas requires interventions on both design and social factors. Important factors noted: neighbour noise, sense of overcrowding, escape industrialization.
Harding, Harding & Wilkins (2008)	Globally	Review	Direct	Seizure provoking effect of flicker applied to wind turbine features.	Visual annoyance	Flash frequency should be kept to a maximum of three per second.
Hartig, Johansson & Kylin (2003)	Globally	Review	Indirect	Residence as integral to the arrangements that people make to manage change in themselves and their environments.	Restorative value of nature and home *social ecological model	Social ecological model can aid in evaluating stress interventions related to residence. Some people working from home has the unanticipated effect of diminishing the residence as a place for restoration.
Havas & Colling (2011)	Globally	Review	Direct	Wind turbines impacts on adverse health symptoms	Noise perception	Wind turbines generate electromagnetic waves and ground current, can adversely affect those who are sensitive to both sound and electromagnetic waves.
Heagle, Naterer & Pope (2011)	Canada, United States and United Kingdom	Review	Direct	The social barriers, policies, and incentive programs for WTs.	Public engagement Social acceptance and influence	Government, industry, community cooperation and incentive programs can increase social acceptance and WT project implementation.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
Hindmarsh (2010)	Australia	Research study	Direct	Wind farms and community engagement	Public engagement Social involvement and influence Trust	Current engagement activities are inadequate. A collaborative approach would enable social and technical boundaries needed to identify the most socially, economically and technically amenable sites of renewable energy.
Honjo (2004)	Japan	Review	Indirect	Distribution, advantages and disadvantages reflect distribution of health and disease.	*social epidemiology	A social epidemiological view should be considered to promote population health.
Horner, Jeffery & Krogh (2011)	North America, Australia	Review	Direct	Public concerns about possible adverse health effects of WTs.	Health literacy Social influence Risk perception	Research is needed to develop WT siting and health guidelines.
Howell (2012)	United States	Review	Direct	Perspectives of Beck's 'risk society' and the associated concept of 'reflexive modernization'.	Social perception Risk *risk society	Exploring controversy of WT installation. Should be re-isolated in relation to energy and infrastructure projects.
Jackson (1992)	Globally	Review	Direct	Prospects of contributions to world energy supply from renewables in the 21st century.	Economic Planning process	Some institutional obstacles need to be managed using economic and institutional policies.
Jalali et al. (2016)	Ontario, Canada	Research Prospective cohort design	Direct	Negative attitude towards IWTs, could hear and see IWTs from their properties may lead to poorer self-reported sleep quality.	Economic (reduced property value) Visibility of IWT (landscape) Anxiety (ruminating) Stress Attitude of IWT	First to use repeated noise measures (prospective). Psychological factors may contribute to health complaints. Self-reported sleep disturbance may be linked to attitude and concerns about IWTs and indirectly 'triggered' by auditory and visual cues.

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Jalali et al., (2016)	Ontario, Canada	Research Prospective cohort	Direct	Mental health values decreased in those with negative IWT attitude after installation.	Noise Personal factors -worry -anxiety - environmental risk Annoyance Visual aspects Quality of life Noise Property values	First noise and health longitudinal study. Majority noticed but did not experience annoyance from IWTs. Attitude to IWTs affected feelings of apprehension and annoyance and influenced reported changes in mental health and "life satisfaction". Social and psychological mechanisms may be increasing likelihood of feeling worried about IWTs.
Jeffery & Krogh (2014)	Globally	Review	Direct	Annoyance caused from from audible WTs linked to health effects	Noise annoyance	Close proximity to WTs negatively affects physical, mental and social well-being. Inaudible noise and infrasound possibly linked to health effects.
Jepson, Brannstrom & Persons (2012)	United States	Research study	Direct	Environmental ity and environment skepticism at wind energy development	Scientific literacy Trust	Skepticism is not overturned even if supportive to local economy.
Jolivet & Heiskanen (2010)	Europe	Review	Direct	Actor- network theory to explore participation processes and controversy of wind power	Planning process Public engagement	New approach that considers the interaction between and in combination of technology, characteristics of site, participation process and social dynamics of wind power.
Kagan & Levi (1974)	Globally	Review	Indirect	Six sub-systems and a model of psychosocial factors and disease	* psycho social model	"Evaluation of health actions efficiency, safety and cost should be mandatory. Important of establishing scientific principles protect individuals from danger, and the community from unnecessary expenses, avoid false sense of security and provide rational support for innovative measures based on perceived cost and effect."
Kelley & Covi (2013)	Globally	Review	Indirect	The "transdisciplinary" nature of environmental	Hazardscape Environmental land use and	The concept of hazardscape may be helpful consideration in discipline of environmental health.

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				health seems to make it well suited to evaluate hazardscapes from geographical, physical, chemical, biological, sociological and psychological perspectives.	health assessment *multi/inter discipline research and assessment	
Kim, Baum, Ganz, Subramanian & Kawachi (2011)	Globally	Research study, secondary data	Indirect	Contextual effects of social capital on health	Social capital Trust	Public health improvements may be large when social capital increased “(especially country-level trust on self-rated health)”.
Kitchen, Williams & Chowhan (2012)	Canada	Research study, secondary data	Indirect	Association between sense of community belonging and health different across urban-to- rural continuum	Sense of belonging	Significant association between sense of belonging and health, particularly mental health.
Kitchen, Williams & Simone (2012)	Canada	Research study, secondary data	Indirect	Measuring Social Capital using the Social Capital Measurement Tool	Social capital Perception Personality and coping	Strong association between social capital, health (especially mental health) and life stress.
Knopper & Ollson (2011)	Globally	Review	Direct	Audible and inaudible noise relationship and effects to self-reported health	Environmental change Annoyance	Wind turbines may be a source of annoyance to some people. “May be the change in environment that is associated with reported health effects and not turbine-specific variable.”
Krogh (2011)	Canada	Review	Direct	Loss of social justice reported by individuals living near IWTs.	Social justice Control Fairness Trust	Loss of justice and power caused by a number of factors like lack of fair process and loss of rights.
Kudryavtsev, Stedman & Krasny	Globally	Review	Indirect	The sense of place in environmental	Place Sense of belonging	Sense of place may be influenced through direct place experiences and

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(2012)				education from an environmental psychology perspective	Health literacy	instruction/education.
Kyle, Jun & Absher (2013)	United States	Research study, secondary data	Indirect	An attitudinal construct used by environmental psychologists to describe people's bonding to the physical landscape.	Sense of belonging Place attachment	Of three components: cognitive, affective, and conative elements. Place identify (cognitive) is antecedent of other affective and conative dimensions.
Lane, J., Bigelow, P., & Majowicz, S. (2016)	Ontario, Canada	Research	Direct	Small sample study revealed no relationship between sleep	Noise Opposition Stress Sleep Change in environment Visual impact to landscape Attitude	No statistically significant relationship between sleep and IWTs were made (used several sleep scales). Recommendation for future studies to use combined actigraphy and sleep diaries.
Lehtonen (2004)	Europe	Review	Indirect	Preliminary ideas on frameworks to analyzing environmental social connections	*social – environmental framework	A single framework for studying environmental–social interface is not feasible nor desirable. The paper emphasizes the need to situate the analysis in its context.
Lewicka (2010)	Europe	Research study	Indirect	Relationship between scale of place and strength of attachment.	Place attachment Sense of belonging Personality	Attachments differences between smaller and larger scales of place requires more study and attention from environmental psychologists.
Lewicka (2011)	Europe	Research study	Indirect	Measures of relationships with place and identity	Place identity Social capital Group participation	A number “measures differentiated five types: values, measures of social and cultural capital, self- and group-continuity measures, and general life satisfaction.”
Lewicka (2011)	Globally	Review	Indirect	Despite mobility and globalization place attachments continues to be strong	Place Personality	The Person component of <i>place attachment</i> has attracted “disproportionately more attention than the place and process components.” Individual differences may have been a barrier to the development of place

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
						attachment theory.
Long & Perkins (2007)	United States	Research study	Indirect	The impact of the social alone on community-oriented constructs like Sense of Community constrains understanding	Sense of belonging Control Place attachment	“Sense of Community is related to social capital (neighbouring, citizen participation, collective efficacy, informal social control), communitarianism, place attachment, community confidence, and community satisfaction.”
Lorenc, Clayton, Neary, Whitehead, Petticrew, Thomson, Cummins, Sowden & Renton (2012)	Globally	Review	Indirect	The links between crime and fear of crime, the social and built environment, and health and wellbeing.		Crime and fear of crime may have substantial impacts on wellbeing and be mediated through indirect mechanisms and environmental factors.
Loring & Duffy (2011)	United States	Review	Indirect	Validity and ethics of place-based approaches to communicating standards managing environmental risks	Place-based Risk	Management of environmental health requires awareness of local context and sensitivity to social, cultural, and economic drivers. “A two-tiered approach that blends state-based and place-based environmental risk management recommended.”
Lyons, Huebner & Hills (2016)	United States	Research study	Indirect	Coping behaviours may play a mediating role between environmental and intrapersonal variables as predictors global life satisfaction	Environmental stress Coping and life satisfaction	Personality, environmental stressors and coping behaviours associated with the development of life satisfaction among early adolescents.
Maehra, Watts, Hanratty & Talmia (2015)	United Kingdom	Research study	Direct	Visual impact and emotional responses to WT on the landscape	Visual impact Emotional response	“The psychophysiological response to turbines was stronger than the response to churches, but did not differ from that of other industrial constructions. Turbines were rated less aversive and more

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						calming compared with other constructions. Supporters and non-supporters did not differ significantly from each other.”
Mama, Li, Basen-Engquist, Lee, Thompson, Wetter et al. (2016)	United States	Research study	Indirect	Psychosocial mediators between the social environment and mental health	Social connection to mental health	The social environment and mental health mediated by psychosocial factors of social status and social support and may influence mental health.
McCubbin & Sovacool (2013)	United States	Review	Direct	Tangible cost of natural gas compared to benefits of wind energy	Economic	Overall costs of electricity generated by natural gas higher than wind energy when human health and environmental factors are quantified.
McIntosh, Lyon, Carlson, Everette & Loera (2008)	Globally	Review	Indirect	Implications of meso-system measurement for ecological research and models of care.		It takes a coordinated and strategic effort to develop the most useful taxonomy of meso-system concepts to create a set of measures applicable to diverse populations across contexts.
McMurtry & Krogh (2014)	Canada	Review	Direct	WT health effects diagnostic criteria f	Confusing symptoms	Revised proposed case definition to inform physicians and a model to establish diagnosis.
Mechanic (1995)	Globally	Review	Indirect	The disability process and the types of considerations relevant to promoting function and maintaining patients' quality of life.	Role (sick) development	Broader practice orientations and the types of interventions that can be helpful in encouraging and reinforcing.
Meldelson, Catano & Kelloway (2000)	Canada	Research study	Indirect	Health affected by workplace building	Victim (sick role) Legitimacy of symptoms	Need to recognize SBS legitimacy and symptoms. Potential victims should be kept informed and provided opportunities to discuss concerns.
Mohan & Mohan (2002)	Globally	Review	Indirect	Social capital contributes to analysis and geographic concept understanding	Social capital	“Social capital privileged over material inequalities (between people and places) may be both analytically weak and practically disabling.”

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Molnarova, S klenicka, Stiborek, Svobodova, Salek & Brabec (2012)	Europe	Research study	Direct	Visual impact affects of WT	Visual impact	The physical attributes of the landscape may be influenced the visual impact more than other factors.
Moore, Bockenholt, Daniel, Frohlich, Kestens & Richard (2011)	Canada	Research study, secondary data	Indirect	Association of social capital with likelihood of having core ties, neighbourhood ties, and high self-rated health	Social capital and health	Conventional measures of social capital may not capture network mechanisms.
Morgan (2010)	Globally	Research study	Indirect	A model of the process where place attachment emerges from childhood experience.	Personal experience and place-attachment development	A process by which place attachment develops, parallel with developmental process of attachment theory.
Morris (2009)	Globally	Review	Indirect	Connections between behaviour analysis and ecological psychology	*theory	The alliance and integration of ecological psychology and behaviour analysis.
Nisbet, Zelenski & Murphy (2009)	Canada	Research study	Indirect	Individual connections with nature (affective, cognitive, experiential)	Personal experience Connection to nature	Nature Relatedness (NR) correlated with environmental scales. Explores potential of NR as method for "investigating relationships and underlying environmental concern behaviours."
Nisbet, Zelenski & Murphy (2011)	Canada	Research study	Indirect	Individual (NR) are associated with differences in well-being.	Connection to nature	The benefits of strong connection NR predicted well-being better than other environmental measures may contribute to psychological health.
Norris & Kaniasty (1996)	United States	Research study	Indirect	Post-disaster received support counteracts deterioration in expectations of support after major life events.	Perceived support Legitimacy of symptoms Social support	Received support matters in times of stress. Stress precipitated by catastrophic disasters is long lasting. Community support may be key to conquer the spiral effect of losses, maintenance of perceptions and indirectly better mental health.

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Obst & White (2007)	Globally	Research study	Indirect	Influence of choice on individuals' social identification and psychological sense of community with group	Social role Sense of community	Choice positively associated with levels of social identification and psychological sense of community.
Pampalon, Hamela, De Koninck & Disantb (2007)	Canada	Research study	Indirect	Neighbourhood Perception of problems and social cohesion	Social cohesion Perception Place	Social cohesion varies significantly by neighborhood. Perceptions of place a significant predictor of individual health.
Parks & Theobald (2013)	United Kingdom	Research study	Direct	Perceptions of public engagement with information of renewable energy development.	Public engagement Health literacy Information	Specific nature of proposals shaped local residents' information needs, concerns and challenged how public should be engaged with information.
Pavlova, Körner & Silbereisen (2015)	Europe	Research study, secondary data	Indirect	Perceived social support, community functioning and civic participation across the life span	Place Group involvement	Civic participation positively associated with place attachment and organizational efficacy. "Social cohesion had no significant effects."
Pedersen & Larsman (2008)	Europe	Research study	Direct	Visual and noise factors impact people living close to WT's.	Visual and noise annoyance Place Restoration	Negative visual attitude enhanced potential of noise annoyance and may have prevented psychophysiological restoration. Aesthetic considerations of noise important in context of WT's.
Pedersen & Waye (2007)	Europe	Research study	Direct	Association between noise and perception and annoyance.	Noise annoyance	Importance of considering uniqueness of setting when planning new wind developments.
Pedersen (2015)	Europe	Research study	Indirect	Prevalence of annoyance with a combination of potential environmental stressors	Annoyance Stress and sensitivity Residential satisfaction	QOL lowered by annoyance via the mediating construct residential satisfaction. Stress negatively affected quality of life yet not directly correlated to annoyance.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				common in urban areas.		
Perry (2011)	United States	Research study, secondary data	Indirect	Formal diagnosis of a mental illness may create a paradox with both helpful social processes and detrimental ones.	Personal experience and coping Social processes	Individuals with more severe and visible symptoms of mental illness often have larger functional networks and may be more vulnerable to stranger rejection and discrimination.
Nielsen-Pincus, Hall, Force & Wulforth (2010)	United States	Research study	Indirect	Socio-demographic effects on place bonding.	Place attachment	Socio-demographic changes in second-home may lead to less emotional, connection to place. "While socio-demographic changes from permanent in-migration may have less effect on place-bonding".
Poder (2011)	Globally	Review	Indirect	Social capital in economics and social science context.	Social capital	Social capital literature still conceptual with empirical problems.
Pralle (2011)	United States	Review	Direct	The nature and limits of the trade-off frames being used and their probability of success.		The trade-off frames used in climate change both help and may hinder identifying issues in energy policy reform.
Ramkissoon, Smith & Weiler (2013)	Australia	Research study	Indirect	Place attachment as a factor in relationships with place satisfaction and pro-environmental behavioural intentions.	Place attachment	"The four-dimensional second-order factors of place attachment include: (a) positive and significant effects of place attachment, (b) a significant and positive influence of place attachment on place satisfaction, (c) a significant and positive effect of place satisfaction (d) a negative and significant influence of place satisfaction on high effort pro-environmental behavioural intentions."
Randall, Kitchen & Williams (2007)	Canada	Research study, secondary data	Indirect	Relationship between residential mobility and perceived		Self-reported QOL showed no relationship between residential mobility and well-being.

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Article	Geographic Focus	Type of Research	Relation to Renewable Energy	Theme	Psychosocial Factor	Conclusion and Recommendation
				well-being across different socio-economic status		
Raymond, Brown & Robinson (2011)	Australia	Research study	Indirect	Influence of place attachment, values norms about environmental action	Place attachment	Place attachment has significant effects as noted in Values-Benefits-Norms theory.
Raymond, Brown & Weber (2010)	Australia	Research study	Indirect	Development integrated approach measurement of place attachment.	Place attachment Interaction with nature Family and friend bonding	“A five-dimensional model of place attachment comprising of place identity, dependence, nature bonding, family bonding, and friend bonding is a valid and reliable measure of rural landholder attachments to their natural resource.”
Richards, Noble & Belcher (2012)	Canada	Research study	Direct	Barriers to renewable energy		A multidimensional approach including technological, social, political, or economic consideration is needed to address barriers to renewable energy progress.
Rollero, Gattino & De Piccoli (2013)	Europe	Research study	Indirect	Determinants of quality of life and gender differences	Perception Sense of belonging Community	“Gender is moderator between predictors of QoL (i.e. socio-demographic characteristics, perceived health, income, social support and sense of community).”
Roskrige, Grimes, McCann & Poot (2011)	New Zealand	Research study, secondary data	Indirect	The impact of social infrastructure expenditure on social capital formation.	Social capital Social influence	The links between social capital, geography, and public social infrastructure investment are more subtle than literature implies..
Rostila (2011)	Globally	Review	Indirect	A resource-based definition of social capital that bridges the individual and the collective.	Social capital	The individual and collective form specific mechanisms that link social capital and health. Specify circumstances identified by which may be attributed to negative health /social capital.
Rowlands (2007)	Canada	Review	Direct	The role of idea “multiple		Changes in the policy and politics needed for significant

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				streams approach” in policy development		shifts in Ontario’s efforts to promote use of renewable electricity.
Ruijsbroek, Droomers, Hardyns, Groenewegen & Stronks (2016)	Europe	Research study, secondary data	Indirect	Social cohesion, safety and disorder factors affect health	Social cohesion Fear Threat	Deteriorating social cohesion and unsafe feelings were negatively associated with general health. Safety appeared to be a factor for health.
Samuel, Commodore-Mensah & Himmelfarb (2014)	Globally	Review	Indirect	Social capital and behavioral theory	Social capital	“Community social capital–related concepts associated with both <i>health-promoting and disease-promoting</i> behaviours yet often have no relationships and interactions among the concepts.”
Scannell & Gifford (2010)	Globally	Review	Indirect	Three-dimensional, person-process-place organizing framework of defining place attachment	Place attachment	“Place attachment construct can be used in theoretical explorations and practical domains.”
Scannell & Gifford (2010)	Canada	Research study	Indirect	Connections between natural and civic place attachment and pro-environmental behaviour	Place attachment	“Natural, but not civic place attachment, predicted pro-environmental behaviour when controlling for the town, length of residence, gender, education and age. Research should consider civic and natural dimensions independently.”
Schmidt & Klokke (2014)	Globally	Review	Direct	WT turbine noise exposure and suspected health-related effects	Noise annoyance	Wind turbines noise increases risk of annoyance and disturbed sleep. “No existing statistically-significant evidence of association between wind turbine noise exposure and tinnitus, hearing loss, vertigo or headache.”
Schultz & Stewart (2008)	Globally	Review	Indirect	Conceptualization, prediction of occupational disability relevant medico-legal context of psychological	Person-system interaction	The models of disability will continue convergence towards integrated bio-psychosocial. Emphasis on person–system interaction, importance of psychosocial factors, particularly cognitions involved in self-perception, coping,

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				injury		adaptation, and resilience.
Severtson & Henriques (2009)	Globally	Research study	Indirect	Features that leverage visual perception capabilities promote meaningful comprehension	Visual annoyance Perception Health literacy	Images facilitate comprehension of environmental health risk information may be independent of accurate knowledge.
Shepherd & Billington (2011)	Globally	Review	Direct	Noise standards to safeguard community health and well-being.	Social influence	“Location of wind turbine installations grouped into broader categories, the credibility of procedures and players, research to inform standards, critique of current approaches / noise standards, and broader social factors.”
Silver & Grek-Martin (2015)	Canada	Research study	Indirect	The sense of place in disaster recovery process	Sense of place Restorative value	Positive outcomes from shared experiences including strong feelings of social cohesion. “Disorientation” and “reorientation” recovery experience.
Song (201)	United States	Research study, secondary data	Indirect	Social capital as network resources plays diverse roles in the social production of health	Social capital Psychological distress Social status/role Group participation	Social capital is inversely associated with psychological distress, and part is indirect through subjective social status. Social capital acts as a distress intervening mechanism to link seven social factors (age, gender, race-ethnicity, education, occupational prestige, annual family income, and voluntary participation).
Songsore & Buzzelli (2014)	Canada	Research study	Direct	The role of health risk perceptions and other associated concerns of wind energy development	Perception Fairness Risk	The most radical forms of resistance to wind energy development on health grounds are driven by perceived injustices. The Green Energy Act is fueling these perceptions nuanced ways by acting as a major confounder to health risk concerns.

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Sovacool (2009)	United States	Research study	Direct	The socio-technical impediments to renewable electricity	Social benefit	Newer and cleaner technologies that may offer social and environmental benefits but are not consistent with the dominant paradigm of the electricity industry and face comparative rejection.
Stain, Kelly, Carr, Lewin, Fitzgerald & Fragar (2011)	Australia	Research study	Indirect	The factors associated with drought impact in rural and remote Australian communities.	Environmental change	Psychological responses to chronic adversity of drought show important interactions between environmental change, ecological factors and mental health. Further research with drought affected communities is the role of hopefulness in protecting against psychological distress.
Stain, Kelly, Lewin, Higginbotham, Beard & Hourihan (2008)	Australia	Research study	Indirect	The associations between mental health and measures of community support, social support networks, sense of place, adversity, and perceived problems in populations.	Social and community influence (psychological health)	The importance of addressing subgroup differences, the mediating role of social factors and community characteristics in mental health.
Stephoe & Feldman (2001)	United Kingdom	Research study	Indirect	The impact of the residential neighbourhood on health and well-being	Neighbourhood conflict stress response	High levels of neighbourhood problems could stimulate chronic activation of neuroendocrine, immune and autonomic pathways may increase disease risk.
Sutherland & Holstead (2014)	United Kingdom	Research study	Direct	The role of renewable energy production in farm business decision-making		Farm renewable energy production could lead to increased environmental awareness among farmers (more economically and environmentally sustainable agricultural practices). Opportunities at risk by large-scale energy companies better able to negotiate growing requirements of IWTs.

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Takahashi & Selfa (2014)	United States	Research study, secondary data	Indirect	Place and community attachment, community satisfaction, and environmental attitudes have all been independently linked to environmental behaviours	Environmental belief Place attachment	Environmental attitudes and place attachment are the strongest predictors of self-reported pro-environmental behaviours. Community satisfaction with services and leadership is not a significant predictor.
Tartaglia (2006)	Europe	Research study	Indirect	Multifactor structure for the Italian Sense of Community Scale (ISCS) that has already been validated as a unitary index of Sense of Community.	Sense of community	Knowledge of different components and predictors of SOC could lead to useful ways in which to improve coexistence and quality of life in local communities.
Thoits (2011)	Globally	Review	Indirect	The mechanisms through which social relationships and social support improve physical and psychological well-being	Social network and psychological health Role Belonging Perceived support	Seven possible mechanisms linking social ties and support to physical and mental health are (1) social influence/social comparison, (2) social control, (3) role-based purpose and meaning (mattering), (4) self-esteem, (5) sense of control, (6) belonging and companionship, and (7) perceived support availability.
Thoits (2010)	Globally	Review	Indirect	Stress and Health	Personality and coping Personality and experience	Coping and support interventions should be more widely used. Programs and policies at macro and meso levels of intervention should include a focus towards structural conditions.
Tigges (2006)	North America, Australia	Review	Indirect	Contemporary place-bound communities and their challenges and the process of ongoing	Urban / rural	Rural and urban communities are facing challenges of internal and external forces.

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				relationships that generate community.		
Toyokawa, Uddin, Koenen & Galea (2012)	Globally	Review	Indirect	Social environment plays a considerable role in determining major psychiatric disorders.	Social link to psychological health	Epigenetic changes introduced by social environment then manifest as psychological consequences. Social environmental exposures, mediated through epigenetic processes and affect mental health.
Van Der Horst (2007)	Globally	Review	Direct	The relevance of location and the politics of voiced opinions in renewable energy siting controversies	Social influence Fear Place	Proximity has strong influence on public attitudes to proposed IWT projects. Extent of influence may vary according to local perceived 'value' of land, fear of being considered NIMBY, and ethics associated with renewables may 'colour' responses.
Von Dras & Blumenthal (2000)	Globally	Review	Indirect	Psychosocial and social-cognitive constructs, lifestyle, and contextual elements influence rates of morbidity and mortality and these factors may advance the aging clock.		The social psychologists are asked to research and become more vocal about influences on human experience across the life span.
Wahlström, Michélsen, Schulman & Backheden (2013)	Europe	Research study	Indirect	Satisfaction with support after disasters and the relation to psychological symptoms	Social support Formal support Sick / victim role	Social and formalized support should be differentiated to improve preventive intervention efforts after disasters. The dissatisfaction with social support and may increase risk of psychological symptoms.
Wakefield, Elliott & Cole (2007)	Canada	Research study	Indirect	The relationships among environmental health, social capital and collective actions	Environment and place benefit	Explored concept of social capital as unitary construct that produces place-specific benefits.

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Wakefield, Elliott, Cole & Eyles (2001)	Canada	Research study	Indirect	Social capital is a primary contributor to the decision to take certain kinds of action, while attachment to place plays a lesser role.	Group involvement Social influence Trust Policy process	Calls for more research and policy development in context of the role of social trust and informal involvement in community and civic action-taking.
Walker, Baxter & Ouellette (2015)	Canada	Research study	Direct	The lived experience and mental well-being of those living near turbines	Personality and experience Social influence	Turbines may be classified as hazard when combined with the “right” social mix, and may lead to potentially serious psychosocial harm.
Walker, C., Stephenson, L., & Baxter, J.(2018)	Canada Ontario & Nova Scotia	Research Comparative case study	Direct	Political rhetoric, benefit of IWT development and transparent decision making may impact support for IWT installations.	Political Decision process (transparency) Loss of control Local impact Policy Public / political rhetoric Landscape	Explore political nuances between ‘political forces and wind energy community support. Noted differences between Ontario and Nova Scotia may be attributed to perceived imbalance of local benefits, opposition and perceived lack of transparent decision-making.
Walker, Devine-Wright, Hunter, High & Evans (2010)	United Kingdom	Review	Direct	Interpersonal and social trust is implicated in community renewable energy programmes and projects	Trust	Trust may be functional for development of community RE and may be enhanced by adoption of community approach.
Watson, Riffe, Smithson-Stanley & Ogilvie (2013)	United States	Research study, secondary data	Indirect	Potential racial and economic disparities in objective and perceived environmental health risks	Perception Risk Social media influence	Perceived risk and confidence to cope with local environmental problems shaped primarily by media use (local news v national news) whereas newspaper reading increased individuals’ environmental self-efficacy.
Webber, Huxley & Harris (2011)	United Kingdom	Research study	Indirect	The effect of social capital on the course of depression and subjective	Social capital Place attachment	Social capital had no independent effect on course of depression. An interaction of social capital and attachment style significantly

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				quality of life		related to changes in quality of life alongside multiple covariates.
Werg, Grothmann & Schmidt (2013)	Globally	Review	Indirect	Assessments of social vulnerability and building social capacity by integrating psychological and governance factors.	Social influence and vulnerability Social capital	Psychological indicators seen as complementary not equal to traditional indicators of vulnerability assessment.
Wester-Herber (2004)	Globally	Review	Indirect	Concerns about health and safety in relation to the risk of proposed project can alter the aesthetic appearance of the landscape.	Place identity place attachment Social influence	The local attachment to a specific geographical place, needs to be part of considerations concerning industrial risks. The local population has to be considered to mediate or reduce conflicts.
Wills-Herrera, Orozco, Forero-Pineda, Pardo & Andonova (2011)	South America	Research study	Indirect	The relationship between perceptions of insecurity, social capital and subjective well-being	Perception Insecurity (threat)	The relationship between insecurity and SWB (and demographics) moderated by level of social capital in the region.
Zivin & Neidell (2013)	Globally	Review	Indirect	Contributions economists have made to understanding of the relationship between the environment and individual well-being		Pollution has wide range of effects on individual well-being, even at levels below current regulatory standards. Human capital and environmental conditions are important considerations of economic growth.

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Appendix B: Data Coding Table

Table 5 Interview Theme Coding Table

Data Coding: Summary Table		
Coding	Theme	Sub-theme
Physical health	Physical symptoms	Tinnitus Headache Sleep disturbance Existing condition Proximity to IWT
Psychological health	Perception	*Significant life event Stress/ anxiety / depression Trust Attitude about IWT Risk / threat Outrage? fairness
	Symbolic	Place identity and attachment Constant reminder
	Safety and security	Adaptation (Coping) Fear Values
	Information	Information (language) Information sources Scientific literacy
Social	Social capital Safety and security	Social ties Distrust Social groups (activists) Social norms Representation of IWTs Future responsibility
Economical	Property value Electrical costs	Inefficient /wasteful Income potential Financial security Community benefit Community control & decision
Environment	Environmental belief	Energy policy opinion - general Energy policy opinion – local Landscape changes Environmental damage IWT design
Political	Planning process	Local community benefit and Public consultation Perception of developer

Appendix C: Research Methodology

Table 6 Research Analysis Procedural Table

Dissertation Analysis Procedure

Key Phases of Data Analysis	Alignment to Data (procedure)	Measures to Ensure Qualitative Rigour
Preparation of the coding process: manual and electronic categorization of interview data and literature	<ul style="list-style-type: none"> Review survey material Consolidating study data and literature into analysis software Develop study database 	<ul style="list-style-type: none"> Developing database structure that integrates various data and measures Utilizing NVIVO 11 software to develop themes, nodes/categories, and memo's tracking key researcher discussion/decisions and emerging ideas / notations Include second researcher
Stage 1: initial review of interview data & initial review of literature	<ul style="list-style-type: none"> Semi- Open coding interview data Independent electronic initial review and thematic analysis Independent manual initial review and thematic analysis Cross-checking and initial comparison and agreement of themes and coding Electronic review of literature Manual review of literature Cross-checking and initial comparison and researcher agreement of themes and coding Explore conceptual relationships 	<ul style="list-style-type: none"> Each team member conducted initial review of interview data and identified emerging themes Reliability of results confirmed through consistency of findings Themes and sub-themes compared and agreed between independent researcher analysis To ensure reliability of literature selected for analysis a 3rd independent researcher randomly selected 30 selected and 30 deleted articles and evaluated against inclusion criteria.
Stage 2: narrative report developed to key storylines and concept framing	<ul style="list-style-type: none"> Literature review - concept frame Draft framework: themes and subthemes 	<ul style="list-style-type: none"> Investigator triangulation Data triangulation
Stage 3: linking concepts to examples (iterative, refining concepts and coding categories)	<ul style="list-style-type: none"> Conduct statistical analysis Conduct open and closed text query 	<ul style="list-style-type: none"> Cross checking Triangulation of data and methods <p>Retroductive Inference (5 strategies)</p> <ol style="list-style-type: none"> Counter factual thinking Constitutive factors (which concepts exist) Begin to differentiate between factor and accidental circumstance

Stage 4: "forward-backward movement between within-case and between case analysis. Identification of common themes and links to research question and conceptual framework	<ul style="list-style-type: none"> Statistical analysis: regression analysis, cross-case 	<p>Retroductive Inference (strategies)</p> <ol style="list-style-type: none"> Extreme case analysis Cross-case variable testing
Stage 5: review interview data and validate categories, finalize coding	<ul style="list-style-type: none"> Iterative review of converging evidence 	<p>Methodological Rigour (Merriam, 2009)</p> <ol style="list-style-type: none"> Member checks Information saturation ("thick description") Peer review
Stage 6: analysis, description and deeper understanding of concepts	<p>Data Analysis Plan (understanding of data v analysis of data)</p> <ol style="list-style-type: none"> Descriptive statistics Exploratory and Inferential Regression analysis 'concept-driven' qualitative comparative analysis (Raglin, 1999) to describe key primary and secondary psychosocial variables that may result in positive or negative perception of IWT's <ul style="list-style-type: none"> Develop chapter 4 – concept / framework 	<p>Methodological Rigour (Merriam, 2009)</p> <ol style="list-style-type: none"> Converging evidence and triangulation of Data Consideration of "plausible options" <p>Multiple Analysis (Reichart & Gollob) "Systematically distinct assumption frameworks"</p>
Stage 7: extraction and integration of meaning to data and interviews	<ul style="list-style-type: none"> Consider Qualitative pathway analysis (dependent on identified key variables and emerging predicted response) 	<ul style="list-style-type: none"> Triangulation: researcher / peer / methods Supervisor Thick description / data saturation Plausible options and addressing researcher bias / position
Stage 8: description and discussion of stories and initial reconstructing categories (retrodition), to explore and begin to link concepts.	<p>Develop/finalize chapter 3 – analysis, discussion and linked narrative quotes.</p> <p>Finalize chapter 4 – theory /concept Conclusion</p>	

Appendix D: Reflexivity Note

There is an emerging trend in qualitative research to include a reflective note, often referred to as reflexivity. Interestingly, reflecting or reflective practice is a foundational component of nursing education and practice. As I began to reflect on my PhD journey I realized that in fact I have been applying reflective practice throughout the academic and research process. I will attempt to expand the reflection made within the body of this paper in this reflective summary.

I initially began PhD studies while working as a health executive. Prior to that my clinical practice involved community hospitals, academic teaching centers in my early clinical specialty involved emergency and critical care. My foundational nursing education was built upon two theoretical paradigms 1) Sr. Calista Roy's theory of adaptation; 2) Jean Watson's theory of human becoming. As I reflect, I've come to realize these two theories not only socialized me to the nursing profession and practice but have influenced my approach to leadership and now to research. Roy's theory of adaptation simply put, considers the individual as having distinct systems to which they will adapt to changes in their environment. Environmental influences can be internal (physiological) or from external stimuli. Within this theory the nurse learns to assess individuals' ability to adapt and maintain homeostasis or assess signs of mental adoption and inability to cope to change. Following an assessment using this theory nurses will reconsider the individual through a holistic lens (i.e., systems thinking) and establish a plan of care including interventions that will support and promote healthy adaptation. In retrospect I see the parallels of Roy's model to that of critical realism, retrodution and retrodiction approach used in my research.

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The second theoretical paradigm within my nursing education, Watson's theory of human becoming is built on several altruistic assumptions that caring is demonstrated interpersonally and involves one's family. Other assumptions to this theory include the belief that effective health promotion involves people feeling satisfaction of certain human needs and that one must accept people as they are at a point in time and as who they may become. Within this model and using scientific problem-solving approaches nurses cultivate sensitivity, build trusting relationships that enable and promote health and health teaching. As I reflect now at the end of this research I realized that again I had unknowingly incorporated the assumptions of Watson's theory within my research approach. Years of experience and practice along with both Roy's and Watson's theoretical underpinning allowed me to consider the individual in a holistic way and recognizing their family and social structures influence who they are and who they may become at a particular point in time. Additionally, I care not only about the research to which I was exploring but about what's happening to those experiencing adverse health effects they are attributing to wind turbine exposure. I believe the sincerity and professionalism by which I approached this work allowed me to build a rapport with those I interviewed, which in turn enabled what I hoped to be an honest sharing of participants' feelings about their health and their experience.

These interviews were not without challenges. Building rapport and approaching individuals with sincerity and openness, especially in their homes, opens one up to experiencing their own range of emotional responses. Added to this potential emotional investment is that I in fact lived and worked and had/have family in several of the communities studied. As a professional I am skilled and experienced maintaining

boundaries and acknowledging and preventing personal bias from entering decision-making. That said, several times throughout the research process the public opposition and criticism towards those engaging in research did give me significant cause for concern both personally and professionally. Whilst there were some members representing opposition groups who were interested and open to research and respectful in their communication. Unfortunately, there were others who posted targeted inflammatory messages and personal attacks on social media. Recent articles have been published about this confrontational response and the effect it had on those engaging in research. Upon reflection I recognize that I had/have concerns about publishing this work. These concerns contributed to my delay in progressing and completing my PhD.

In terms of conducting the research, the team experienced challenges in selecting a sample of consenting participants from the first and second phases of the RETH research. Unfortunately, many people declined further participation. Some cited ongoing concerns regarding their signed nondisclosure agreement while others either directly or inferred being warned away by opposition. Thus, the community boundaries through which participants were included was extended to include similar geographic region (i.e., Huron, Grey and Bruce counties). We began the selection process with the goal of 10 to 15 participants from each regional community however due to the challenges 32 participants had agreed and rescheduled for interviews. Two participants later cancelled, and one participant's spouse asked to be included at the time of interview resulting in a total of 31 interviewed. The intended sample size was between 35 and 40 however, given the challenges identifying participants and maintaining the

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overall integrity of researching three communities a decision was made to proceed with the confirmed participants.

I was warmly welcomed by most who had agreed to participate in the interview process. However, some participants were confrontational at first asking questions like “was I in anyone’s pocket”. I responded openly answering all questions and referring back to the study information and consent material. Participants were also made aware that they were welcome to reach out to supervising professors and by reinforcing the fact that their participation is voluntary and can be withdrawn at any time.

Initially, I felt comfortable to conduct field interviews alone. However, during one of the first interviews I experienced an unsafe situation in the home of one participant and after reporting this incident to my supervisor it was agreed that a graduate student would accompany me to the remaining interviews. A second incident occurred towards the end of the interview process when one of the participants disclosed significant health concerns and potential risks to her safety. As a health professional I have a duty to uphold my standards of practice regardless of role and needed to set aside the interview in this situation to focus on ensuring the individual’s immediate health and safety needs were addressed. Both situations were documented and reported to my supervisor according to University policy.

The addition of a graduate student to the interview work was very positive. The graduate student was not a health professional but had some familiarity with the research program and was very quick to become familiar with the research questions and interview process. I continued to take the lead in facilitating the interview while the assistant helped with equipment set up / packing and taking jot notes that were useful in

our reflections at the end of each day. A second researcher present and managing equipment and note taking allowed me an ability to be even more engaged in the interview process and enabled further depth to observations of both verbal and nonverbal cues. As I reflect, and especially given the time lapse the verbatim transcript along with the detailed notes provided excellent memory triggers and details needed to confidently analyze and report observations.

A number of years have passed since the interview phase and admittedly there have been a number of times when I questioned my ability and willingness to complete the PhD program. However, my lifelong goal of completing a PhD and my professional and ethical commitment fueled the motivation needed to persevere and tell the story of those who trusted me to share their experience.

Although it seems the public rhetoric and fear arousing communication has dwindled my concerns remain regarding the personal and potentially professional consequences of publishing this work, particularly because of the observed mental health contributory factors. Unfortunately, there continues to be significant stigma surrounding mental health with many continuing to believe mental health is not as *real* as a physical illness like diabetes or cancer. The opposition have been very vocal in their position that wind turbine exposure causes adverse health effects. Mental health and mental illness can be serious and sometimes debilitating. Mental illness can be linked to headaches, heart palpitations, pain, sleep disturbance and a number of other physical symptoms. Many of these physical symptoms have been reported and well documented in the literature and were described by several of the people interviewed. It is outside the scope of this research and scope of practice to diagnose. However, there

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are psychological and social mitigating and mediating factors that require further study involving clinicians or researchers whose scope would include appropriate exploration of mental health IWT associations. Over the years I have seen many people struggle with physical and mental health symptoms that go undiagnosed for many months and sometimes years. Many times, these people express feelings of frustration and anger at not being believed or being told what they feel is 'not real and is 'just in their head'.

While this work is not intended to validate by empirical means any causality to a specific clinical diagnosis the literature and the interview observations suggest factors involving mental health (illness) need to be further examined.

Appendix E: Renewable Energy Technology Health: Health Assessment Approved Forms

PARTICIPANT INFORMATION (may be filled in before entering participants home)

Participant's Study ID: _____

Address: _____

The nursing student and research assistant introduce themselves to the participants and explain purposes and process of the health assessment. SEE SCRIPT BELOW:

Hello my name is _____ and I am a nursing student and this is my colleague _____ who is a research assistant with the University of Waterloo. May we speak with (PARTICIPANT'S NAME)? As we discussed on the phone we will be conducting a short health assessment with you. This assessment will involve discussing your health history, completing a survey, as well as taking your blood pressure, heart rate, height and weight and collecting a small hair sample. This information is important for the Ontario Research Chair program in Renewable Energy Technologies and Health (ORC-RETH) at the University of Waterloo in understanding what the day-to-day life is like for people living near renewable energy technologies. We would like to know how well you sleep at night, how you feel throughout the day, and whether your body shows signs of stress. This information will be kept confidential and you may stop participating in study at anytime. The health assessment will be done to assess health and how it relates to renewable energy technologies and is not to replace visits to medical professionals. If you have specific health concerns, please seek treatment by visiting your doctor, nearest health clinic or the hospital Emergency Room. We will also be checking the Global positioning system (GPS) coordinates of your home to calculate the distance between your home and the nearest RET. Thank you again for your participation.

BEFORE BEGINNING ASSESSMENT CHECK GPS coordinates: _____

Administer the interview-based QUESTIONNAIRE. *Ask the participant the survey questions as written and record their answers on the survey.*

Background information on collecting a Health History

This information is to assist the nursing students in collecting data from the participant by explaining the areas of inquiry and providing example questions. Please refer to if needed.

Ask the participant to describe their chief complaint(s), the sign(s) and symptom(s) and if and when they have accessed health services. Obtain as many details as possible about the complaint(s). For instance, if the chief complaint is pain, ask whether the pain is sharp or dull, aching, burning, or shooting.

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Find out what the person was doing when his symptom began and how often the symptom occurs. Ask when the person first felt the symptom and how long it lasted. Then ask about its location. To help identify symptom ask him/her to point to the affected area.

Ask about aggravating and relieving factors. Aggravating and relieving factors can provide insight into the cause of the complaint. Ask the person if the symptoms seems to get worse at certain times – for instance, with a change in the season or temperature. Find out what measures, if any, bring relief. Does the symptom improve with rest? With medication or being indoors or outdoors? With heat or cold application?

Explore associated symptoms

Find out if the person has other symptoms that could be associated with the complaint(s). These symptoms could provide clues to the underlying cause(s). If the person has several complaints, ask him which one concerns him most. Explore all complaints and symptoms.

Obtaining a history of the present illness

The history of the present illness usually provides additional information about the chief complaint. What's more, it may help identify the underlying cause by placing the symptom in the context of recent events.

Exploring previous treatment

Find out if the person has ever been evaluated or treated for his symptom. If so, determine the type and outcome of treatment.

Suppose for example, the person reports he's been sleeping poorly. To elicit information, ask such questions such as (PQRST Scale):

P - provoking and precipitating factors, relieving factors	Q - quality of pain (eg. burning, stabbing, gnawing)	R - radiation	S - severity	T – timing
<i>Ask:</i>	<i>Ask:</i>	<i>Ask:</i>	<i>Ask:</i>	<i>Ask:</i>
What makes your pain worse?	What does your pain feel like?	Does the pain move anywhere?	On a scale of 0 to 10 with 0 being no pain and 10 being the worst pain you can imagine, how much does it hurt right now?	When did your pain start?
What makes your pain better?	What words would you use to describe your pain?		How much does it hurt at its worst?	How often does it occur?
What previous treatment have you tried to relieve your pain?			How much does it hurt at its best?	Has its intensity changed?
Were they effective?				How long does it last?

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The table below is also useful for collecting information on signs and symptoms.

Characteristic	Explanation	Sample Questions
1. Location <ul style="list-style-type: none"> • Localization • Generalization • Radiation 	<p>The specific anatomical area that is affected</p> <p>Occurs in one specific area of the body</p> <p>Occurs over larger area of the body, or over whole body</p> <p>Moves to or from another area</p>	<p>“Describe where your pain is.” (symptom)</p> <p>“Where is your rash?” (sign)</p> <p>“Is your pain in one spot?” (symptom)</p> <p>“Is the rash only on your left elbow?” (sign)</p> <p>“Is the rash only on your chest and back, or does it cover other areas, too?” (sign)</p> <p>“Does the tingling move from your back down your legs?” (symptom)</p> <p>“Is the redness moving along your arm?” (sign)</p>
2. Quality	<p>The nature or feature of a symptom or sign</p> <p>Refers to colour, consistency (thick, thin, hard, soft), and type (crushing, throbbing, aching, burning, cutting, stabbing) of a symptom or sign</p>	<p>“Describe what the sputum looks like.” (sign)</p> <p>“What colour is the rash?” (sign)</p> <p>“Is it itchy?” (symptom)</p> <p>“Has the mole changed colour?” (sign)</p>
3. Timing <ul style="list-style-type: none"> • Onset (slow or fast) • Duration • Constancy • Time of day/month/year 	<p>When the symptom or sign began and the speed of onset</p> <p>The length of time the symptom or sign occurs</p> <p>Whether the symptom or sign is constant or intermittent</p>	<p>“When did you first notice the pain?” (symptom)</p> <p>“How long does the pain usually last?” (symptom)</p> <p>“Is the rash itchy always or only sometimes?” (symptom)</p> <p>“Does the rash appear all through the year, or mainly in the winter?” (sign)</p>
4. Intensity/ severity	Quantity of a symptom or sign	<p>“On a scale of 0 to 10 (0 = no pain, 10 = worst pain), how would you rate your pain?” (symptom)</p> <p>“How many towels did you use to soak up the blood?” (sign)</p>
5. Aggravating	Activities or exposures that worsen the	“What makes the pain worse?” (symptom)

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factors	symptom or sign	“What makes the rash worse?” (sign)
6. Alleviating factors	Activities or exposures that reduce the symptom or sign	“What lessens the pain?” (symptom) “What reduces the rash?” (sign)
7. Associated symptoms or signs	Other symptoms that may be related	“Are you experiencing any other symptoms like nausea or dizziness?”
8. Environmental factors	Anything in the client's surroundings that may be related to the symptom or sign	“What is going on in your life, at home, or at work that might be causing this?” “Are any renovations going on at home or at work?” “Did you travel anywhere recently?” “Have you made any major changes in your life that might be affecting how you are feeling?” “Is anyone else sick at home?”
9. Significance to client	The impact of the symptom or sign on the client's lifestyle and well-being	“How does this affect your lifestyle? Your work?”
10. Client perspective	What the client thinks is happening	“What do you think is causing your pain?” (symptom) “What do you think caused your rash?” (sign)

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HEALTH ASSESSMENT DOCUMENTATION SHEET

Collect and record information on the participant's symptoms.

Do you have any current health concerns? If so what is your biggest concern?

Concern: _____

Symptoms (What symptoms do you experience?): _____

If any of the symptoms mentioned are in the list below then collect the symptom characteristic information on the next page.

Otological and vestibular

- (a) Tinnitus (ringing of the ear)
- (b) Dizziness
- (c) Difficulties with balance
- (d) Ear ache
- (e) Nausea

Cognitive

- (a) Difficulty in concentrating
- (b) Problems with recall or difficulties with remembering significant information

Cardiovascular

- (a) Hypertension
- (b) Palpitations
- (c) Enlarged heart (cardiomegaly)

Psychological

- (a) Mood disorder, that is, depression, anxiety
- (b) Frustration
- (c) Feelings of distress
- (d) Anger

Regulatory disorders

- (a) Difficulty in diabetes control
- (b) Onset of thyroid disorders or difficulty controlling hypo- or hyperthyroidism

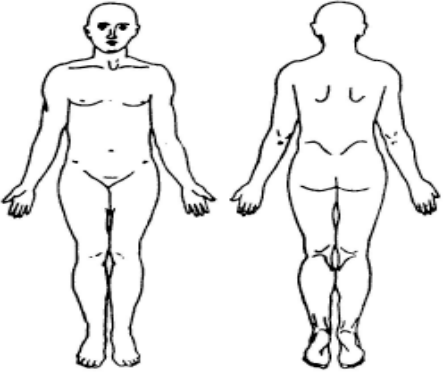
Systemic

- (a) Fatigue
- (b) Sleepiness

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Location and Quality: indicate on McGill Pain Questionnaire The descriptors fall into four major groups: sensory 1-10, affective 11-15, evaluative 16, and miscellaneous 17-20. The rank value for each descriptor is based on its position in the word set, choose no more than one word per group. The sum of the rank values is the pain rating index (PRI). The present pain intensity (PPI) is based on a scale of 0 to 5.

PRI: S _____ A _____ E _____ M _____ PRI(T) _____ PPI _____
 (1-10) (11-15) (16) (17-20) (1-20)

1 FLICKERING QUIVERING PULSING THROBBING BEATING POUNING	11 TIRING EXHAUSTING	BRIEF _____ RHYTHMIC _____ CONTINUOUS _____ MOMENTARY _____ PERIODIC _____ STEADY _____ TRANSIENT _____ INTERMITTENT _____ CONSTANT _____
2 JUMPING FLASHING SHOOTING	12 SICKENING SUFFOCATING	
3 PRICKING BORING DRILLING STABBING LANCINATING	13 FEARFUL FRIGHTFUL TERRIFYING	
4 SHARP CUTTING LACERATING	14 PUNISHING GRUELLING CRUEL VICIOUS KILLING	
5 PINCHING PRESSING GNAWING CRAMPING CRUSHING	15 WRETCHED BLINDING	E = EXTERNAL I = INTERNAL
6 TUGGING PULLING WRENCHING	16 ANNOYING TROUBLESOME MISERABLE INTENSE UNBEARABLE	
7 HOT BURNING SCALDING SEARING	17 SPREADING RADIATING PENETRATING PIERCING	COMMENTS:
8 TINGLING ITCHY SMARTING STINGING	18 TIGHT NUMB DRAWING SQUEEZING TEARING	
9 DULL SORE HURTING ACHING HEAVY	19 COOL COLD FREEZING	
10 TENDER TAUT RASPING SPLITTING	20 NAGGING NAUSEATING AGONIZING DREADFUL TORTURING	
	PPI	
	0 NO PAIN	
	1 MILD	
	2 DISCOMFORTING	
	3 DISTRESSING	
	4 HORRIBLE	
	5 EXCRUCIATING	

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Associated symptoms (Do you experience any other symptoms?): _____

Environmental factors (What in your surrounds may be causing or affecting the symptom, may be something in your home, did you travel, do you feel stress from work, or major life changes that may be related?) : _____

Significance (How does this affect your lifestyle or work?):

Clients perspective (What do you think is causing the symptom?):

Have you talk to your care provider about this? If so when and where? Yes No

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Have you ever been diagnosed with an illness? If so what was it and when were you diagnosed?

Yes No

Diagnosis: _____ Date: _____

Diagnosis: _____ Date: _____

Diagnosis: _____ Date: _____

Diagnosis: _____ Date: _____

Diagnosis: _____ Date: _____

Additional Notes: _____

Have you received any treatments for this illness (i.e. surgeries, medications, etc.), if so what was it and when did it happen? Yes No

Procedure: _____ Date: _____

Procedure: _____ Date: _____

Procedure: _____ Date: _____

Procedure: _____ Date: _____

Procedure: _____ Date: _____

Procedure: _____ Date:

Additional Notes: _____

Do you have any other health concerns? Yes No

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Current Medication Name / Dose/ Start date	Reason for use	Experienced side effects

Ask permission to tape measuring tape to a wall in the house and tape to wall with numbers increasing upward. Ask participant to stand without shoes, with their back straight against the tape. Measure height and record below. Ask the participant to stand on scale without shoes and record weight.

Gender: _____

Age: _____

Height: _____ cm or feet/inches

Weight: _____ lbs or Kg

Take a few minutes to review your findings and clarify responses. During this time ask to take the participant's blood pressure and heart rate. Remember to sanitize hands before touching participant and to clean equipment before and after use. Ensure the participant has been inactive for 5 minutes before measuring pulse and blood pressure.

Obtain the participant's blood pressure from **left arm** with a blood pressure cuff and stethoscope while the participant is sitting.

Blood pressure _____/_____ mmHg

Obtain the participants heart rate from the **right wrist (radial)** while the participant is sitting.

Heart rate _____ (bpm)

Hair Sample Instructions

SCRIPT: We are now collecting a small hair sample from your head. Your hair sample will be used to measure a hormone related to stress called cortisol. Your hair acts as a record of cortisol in your body and the sample will show if you have dealt with stress in the last few months.

Since some conditions may cause inaccurate results in measuring stress, we need to note whether you have any of the following conditions. If you do we might not use your hair sample in the study results. Please answer the following questions.

Have you ever been diagnosed with Cushing's disease? Yes No

Have you ever been diagnosed with an adreno-corticoid dysfunction (kidney problems)? Yes No

Have you ever been diagnosed with a sleep disorder? Yes No

Have you ever been diagnosed with hypertension, diabetes, or cardiac arrhythmia (irregular heartbeat)? Yes No

Do you have intolerance to MSG which may lead to chest pain or cardiac arrhythmia? Yes No

When did you last dye, bleach, straighten, or get permanent waves in your hair, if ever? Record the date

here: _____

(DD/MM/YYYY and how they manipulated their hair i.e., dyed, etc.)

INSTRUCTIONS for hair sample:

Always use disposable gloves when collecting a hair sample. Use new gloves for each participant. Ensure that scissors are cleaned with an alcohol swab before and after each use.

Step 1: Select hair at the midline on the backside (vertex posterior) of the head. Collect 30-50 strands of hair.



Step 2: While firmly holding the strands of hair, cut as close to the scalp as possible. Request a second sample and proceed if the person agrees.

Step 3: Place the scalp end of the hair on the marked spot on the designated paper. Place the piece of plastic about 4 mm from the scalp end and press down firmly while taping the hair sample on top of the plastic.

Step 4: If a second sample is also collected, place it besides the first sample on the same paper and secure in spot similarly.

Step 4: Place sample(s) in the pre-labelled envelope and store at room temperature.

TRAIN participant on how to use saliva collection kit and how to fill out the symptom log. Schedule a date and time to come back in about four days to retrieve the saliva samples.

Next visit: DATE : _____ at _____
(DD/MM/YYYY) (__ :__ AM or PM).

November ____, 2012

Dear Resident,

I would like to thank you for your participation in the Quality of Life and Renewable Energy Technologies Study. As a reminder, the purpose of this study is to identify if renewable energy technologies are related to quality of life and this portion of the study aims to better understand what the day-to-day life is like for people living near renewable energy technologies. Enclosed is remuneration of \$75 for your participation in this study.

The data collected from the survey will determine which measures need to be collected in the physiological assessment due to which areas of health seem to be more affected by renewable energy technologies. The research conducted will contribute to a better understanding of the public's concerns about renewable energy technologies.

Please remember that any data pertaining to you as an individual participant will be kept confidential. In the case where individual data is presented, your information will not be identifiable. Your information will be stored safely and securely at the University of Waterloo at the School of Public Health and Health Systems.

Once all the data are collected and analyzed for this project, this information will be shared with the research community through seminars, conferences, presentations, and journal articles. Any publications or reports that result from this study will be presented as group data. This information will also be shared with your local media and will be mailed to you, anticipated to be sent by December 2014.

If you have any questions about the study at any time, please contact Tanya Christidis (Project Manager) at **519-888-4567 ext. 31342** or (tchristi@uwaterloo.ca). This study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

Regards,

University of Waterloo Renewable Energy Technologies and Health Research Group

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Appendix F: Interview Guide - Semi-Structured Questions and Categories

Question Category	Question / Prompt
Introduction	1. How long have you lived in the area? Before/after IWTs? 2. Do you recall when and how you initially heard about IWTs? a) What were your initial feelings and reactions, have they changed overtime? b) How do you hear about IWTs? What do you know about IWTs and the health effects? Are you worried about IWTs, are others you know concerned about health effects of IWTs? 3. How do you feel about IWTs (general, local)?
Demographics (contextual) *identity *isolated *social supports	4. How many IWTs, how far, what type, when was the first /last? (permission to take pictures of house/property/IWTs) 5. Tell me about yourself? (marriage, children, education, work) 6. Who lives in the house? 7. Where did you live before you moved here? What drew you to the area?
Psychological *perception, risk, mood	8. From when you first heard about IWTs to today, can you tell me about how IWTs have affected you?
Sociological *family dynamics *SES *changes in routine *social support	9. How would you describe your relationship(s)? (spouse, children, neighbours, community), have these been affected by IWTs? 10. Has your health interfered with your usual home or social activities? a) Are you involved in social groups, changes since IWTs?
Physiological Health *definition of health *physical (sleep, headache) *mental (anxiety, stress)	11. What does being healthy mean to / for you? a) What things do you do to keep healthy? b) Are there things that worry you about your health? 12. How would you rate your overall health?
HEALTH SURVEY B/P, HR, Sample collection Collect journal	***** QUESTION BREAK ***** 13. Do you have health concerns or conditions? (detail) - Primary complaint(s) - Subjective information Medical history (i.e., current medications, diagnoses) Family history (The amount of detail and question line will depend on participant presentation, responses, situation, and condition).
Conclusion *remuneration	14. Is there anything else you would like to mention?

Appendix G: Expanded WHO - HELI Framework (exploratory categories)

Expanded HELI framework: Exploring Details

Physical

1. Pain and discomfort: questions pertaining to this domain will explore the prevalence of IWT symptoms. One's control over, and fear of, pain influences on one's ability to cope and effects on overall health and quality of life.
 - a. Headache:
 - b. Hearing and visual disturbance(s): noise and annoyance, shadow flicker
 - c. General physical health status (hypertension, physiological symptoms of stress, exacerbation/development of chronic disease(s))
2. Fatigue: impacts ADL's and interpersonal relationships
3. Sleep: sleep and rest are frequently reported within WT research
4. Dependence on medication/treatments: a person's reliance on intervention to maintain health and well-being may affect one's perception of their overall health status and quality of life

Psychological

1. Memory and concentration
2. Perceptions
 - a. Perception of environment and health (contentment, balance and general enjoyment of life)
 - b. Intensity – a more intense state may be related to the degree to which a specific behaviour is perceived
 - c. Capacity – relates to corresponding changes in QoL measures and ability to manages changes within one's environment
 - d. Frequency – time frame and corresponding changes (threshold) for adapting and coping with changes
 - e. Scientific literacy – critical appraisal of a circumstance or behaviour
3. Self-esteem: includes self-efficacy and control of their environment
4. Negative feelings: the degree to which a person experiences negative emotions influences their ability to function and cope with stress and changes within their environment
 - a. Annoyance: recurring theme of 'clinical' annoyance related to WT's as an environmental trigger of stress and negative emotions
 - b. Social Capital: community support/engagement: victimization, social cohesion and isolation as contributors to perception and QOL
 - c. Family support/engagement: determinant of health
 - a. Working capacity: employment and socioeconomic status
 - b. Lost work time due to illness
 - c. Type and time of day at work

Sociological

1. Personal relationships: the extent of support from family and potential impact the environment to one's family has the possibility to be both positive and negative implications to one's overall health and perception of QOL
2. Social support
 - a. Community involvement and engagement: the extent to which individual's perceive the level of support and approval of their social network may impact their ability to depend on others and feelings of security
 - b. Availability and perceived quality of health and social care
 - c. Opportunities for acquiring new information: connectedness to outside sources of information from which one basis decisions
 - d. Participation in and opportunities for recreation and leisure: feelings of social and family cohesion, energy and managing stress

Environmental

1. Physical safety and security
2. Home Environment: the ability to provide a comfortable 'safe' home and immediate neighbourhood
 - a. Neighbourhood and/or 'state' that is perceived to be free from threat and resources adequate and available to protect sense of safety and security
3. Financial resources: SES as a determinant of health and QOL
4. Physical environment (noise/traffic/technology): impact of visual changes to landscape, disturbances in perceptions/feelings of 'peace' from urbanization, increased traffic, wind turbines, solar panels or flight patterns and frequency