

**The Social Acceptance of School-based Solar
Photovoltaic Projects: An Ontario, Canada Case Study**

by

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Author 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.

Claire Beckstead

Abstract

The installation of solar photovoltaic (solar PV) technology on elementary and secondary schools has been undertaken around the world in an attempt to tie together positive environmental action, innovative environmental education, and potential economic gains. In Ontario, the advent of the Renewable Energy Standard Offer Program and the increased focus on environmental education by the Ontario Ministry of Education has resulted in preliminary interest from some Ontario school boards in installing solar PV technology on schools. However, simply installing the technology on school roof-tops does not guarantee that the potential benefits of a school-based solar PV project will be realized. Drawing from the literatures describing the social acceptance of innovation and technology, the social acceptance of renewable energy innovation and technology, and the social acceptance of educational innovation and technology in schools, this thesis attempts to identify non-technical factors that may impede school-based solar PV project development, and ultimately, attempts to identify factors that help maximize potential benefits. The research was conducted in two distinct phases, with the results from Phase 1 informing the focus and design of Phase 2. Phase 1 consisted of nine key-informant interviews with individuals directly involved in school-based solar PV projects in Canada and the United States, and Phase 2 consisted of a case study in the Halton District School Board (HDSB) and the Halton Catholic District School Board (HCDSB) (Ontario, Canada). Both quantitative and qualitative data were collected in Phase 2 through 30 stakeholder interviews and 50 stakeholder surveys. Respondents in the HDSB and HCDSB generally have a positive perception of solar PV technology, but are concerned to some extent about the cost and economic viability of implementing this kind of project. Five funding models for school-based solar PV projects were evaluated by respondents to determine the effect of project funding models on overall project social acceptance. The results show that the project funding model does affect social acceptance, with 78.1% of respondents reporting that at least one of the five models would cause their support for the project to either increase or decrease. Respondents indicated a strong preference for the government/utility model, while the corporate funding model was shown to be the most controversial. This thesis recommends that a

broad-based, inclusive, stakeholder-oriented approach to project development could improve trust and communication between project stakeholders, and thus improve the social acceptance for any of the five funding models. Additionally, with any funding model, teacher and administrative support and social acceptance is particularly important to help maximize the educational component of the project.

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Dedication

For Mom and Dad – for teaching me to be curious, adventurous, and brave.

and

For Agustín – who knows about love, honesty, deodorant, and fixing computers.

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1 Introduction

Electricity is essential in the day-to-day lives of all Canadians. However, electricity production has significant environmental impacts. For example, electricity production by coal is a significant contributor to greenhouse and smog-causing gases in Canada. Both nuclear and fossil fuel power plants consume a significant amount of water resources, and produce toxic and hazardous waste. All centralized generating facilities require a significant amount of land for the location of the facilities. Public environmental awareness is growing, as evidenced by opinion polls in 2007 indicating that the environment has overtaken both health care and education as Canadians' number one issue of concern (Laghi, 2007). Coal powered generation is a particularly 'dirty' way to generate electricity, and in response to the demand from Ontarians for cleaner electricity sources, the provincial government has committed to phasing out coal entirely by 2014. However, demand for electricity in Ontario continues to grow (fuelled by both population growth and a growing economy); therefore, the Ontario government must find a way to reduce the environmental impact of the electricity industry, while at the same time meeting electricity demand. Additionally, the existing nuclear facilities in Ontario are up for retirement or refurbishment, so there will be additional strain on the electricity system if alternate generating capacity is not found.

As part of a broader strategy to address the challenges of electricity production and consumption, the government of Ontario has identified that "renewable energy is a key component of the Ontario government's plan as it builds a cleaner sustainable energy future for Ontario" (Ontario Ministry of Energy, 2007a). In 2004, the Ontario Ministry of Energy set a target for the province to produce five per cent of its electricity from renewable sources by 2007 and ten per cent by 2010. According to their website, the government is currently on track to achieve these targets (Ontario Ministry of Energy, 2007b). The Ontario government has established a variety of policies designed to encourage renewable energy generation. For the purposes of this thesis, the most salient policy initiative is the Renewable Energy Standard Offer Program (ReSOP).

The ReSOP was announced in March of 2006, and applications to participate have been accepted since November 2006. This program is intended to specifically stimulate the growth of small-to-medium size renewable energy projects. According to the final rules available from the Ontario Power Authority (OPA), in order to qualify for this program, project capacity must be 10 MW or less, and generate electricity from a qualifying renewable source (Ontario Power Authority, 2006). The eligible renewable technologies are as follows: wind, solar photovoltaic (solar PV), solar thermal electric, renewable biomass, biogas, biofuel, landfill gas and waterpower (Ontario Power Authority, 2006). Under this policy, owners of qualifying projects will sign a 20-year contract with the OPA which will guarantee that the owner will be able to sell the electricity generated at a fixed rate. The current contract rate is 11 cents per kilowatt-hour for all renewable technologies except for solar PV, which will be paid 42 cents per kilowatt-hour. The price paid will be partially indexed for inflation every year, again with the exception of solar PV technology which will receive 42 cents per kilowatt-hour for the entire term of the contract. Solar PV technology is also exempt from the ‘on-peak’ production bonus which is available to other non-intermittent renewable energy technologies. Policies similar to the ReSOP (i.e., feed-in tariffs) have been used to stimulate the growth of the renewable energy sector in Europe, and Ontario is the first jurisdiction in North America to implement this type of policy (Toke, 2007). As of May 12, 2008, the ReSOP program has been temporarily suspended pending a review of the program rules. The revisions are expected to be completed by the end of summer 2008, and are intended to make the program more efficient, equitable and accessible to all proponents (Ontario Power Authority, 2008).

The ReSOP is designed to stimulate the growth of small-scale renewable energy projects. The main benefits of this kind of project are that there are no greenhouse or smog precursor gases emitted. As well, the generating facilities are smaller and can be located closer to where the electricity will be consumed. In contrast, with large-scale, centralized power plants, most of the end users are located far from where the electricity is produced, and require that the electricity be transported long distance to reach them. The

transmission infrastructure is expensive to maintain, and inevitably, there is electricity lost in transmission.

One application of small-scale renewable energy that is growing in popularity in Canada (and around the world) is the installation of solar PV technology on elementary and secondary schools. “Solar Schools”, as these installations are often called, are designed to generate electricity from a renewable source, but are also intended to be used in conjunction with school curriculum as a hands-on educational tool. There are many potential benefits to installing renewable energy technologies on schools. For one, data from the technology can be incorporated into the curriculum, or can be used as a focus for school projects. Solar PV technology can also be connected directly to the electricity grid, and thus could be a source of renewable electricity, thus helping to achieve provincial renewable energy targets. Further, production of electricity from solar PV technology has been shown to correspond reasonably well with peak electricity demand in Ontario, and therefore could be useful in reducing the province’s dependence on coal-powered generation during times of peak demand (Rowlands, 2005). As well, locating solar PV technology on schools is an excellent way to raise energy awareness in a community. Schools are community gathering places, and locating a renewable energy project in such a centralized location can improve the profile of renewable energy and conservation in general.

Some jurisdictions in the United States and Australia have been relatively aggressive about installing solar PV technology on schools, and both countries have organizations (both private and public) dedicated to the development of new Solar Schools (e.g., The Foundation for Environmental Education in the United States, and solarschools.net in Australia). However, in Canada, solar PV development (in general, let alone on elementary and secondary schools) has lagged in comparison to our major trading partners. According to the latest statistics available from the International Energy Agency, in 2005, Canada’s gross electricity generation from solar photovoltaic technology was 17 GWh as compared to 1282 GWh in Germany (International Energy Agency, 2008a; International Energy Agency, 2008b). However, the announcement of

the ReSOP in Ontario caused a huge jump in demand for solar PV systems, and the Canadian Solar Industries Association (CanSIA) estimates that due to this policy, sales of grid connected solar PV systems “soared in Canada by over 400% in the first half of 2006” (Canadian Solar Industries Association, 2006).

The ReSOP is a step forwards for the development of the solar industry in Canada. This policy has helped to reduce some of the financial barriers that limited solar PV projects in the past. Public interest in renewable energy generation is high, and there is significant growth in the number of installed solar PV projects.

Concurrent with, and largely independent of, the development of the ReSOP, in March 2007, the Ontario Ministry of Education Curriculum Council appointed a working group to evaluate elementary and secondary curricula in Ontario. The first topic selected for review was environmental education. The working group’s recommendations address educational policy, leadership and accountability, curriculum, and teaching and resources (Ontario Ministry of Education Working Group on Environmental Education, 2007). The working group calls for a more systematic, integrated approach to environmental education in Ontario, and argues that environmental education should be the new “basic” for education in the 21st century (Ontario Ministry of Education Working Group on Environmental Education, 2007, p. 17). The Ontario government has indicated that it plans to implement all of the recommendations put forward by the working group (Ontario Ministry of Education, 2007). Resources are currently being developed to assist teachers in incorporating environmental education into existing curricula, and some are already available on the Ministry of Education’s website (Ontario Ministry of Education Curriculum Council, 2008). It appears that environmental education will have an increased profile in the Ontario education system in the coming years.

Within this provincial policy context, there has been interest from several school boards in Ontario in installing solar PV projects on elementary and secondary schools. The ReSOP helps to reduce the financial barrier for solar PV projects, and the growing focus on environmental education at the Ontario Ministry of Education has provided the impetus for schools to explore creative ways to deliver environmentally-focused

curriculum. The enthusiasm for Solar School projects in Ontario is high, both inside and outside the school system. However, there is relatively little local experience or ‘know-how’ as to the best way to plan and develop Solar School projects, and little knowledge as to the barriers and challenges associated with project development. Indeed, even amongst countries with more advanced Solar School programs and organizations, there is little evaluation or criticism of how to best plan, develop and implement Solar School projects, particularly to maximize the potential benefits of the projects. Therefore, drawing heavily on existing renewable energy innovation and technology literature, this thesis is designed to explore these areas, and ultimately, to help to fill this gap in understanding.

1.1 Thesis Rationale

School-based solar PV projects represent a unique opportunity to bring together positive environmental action, innovative environmental education, and potential economic gains. Specifically, some of the potential benefits inherent to school-based solar PV projects are: the production of electricity from a renewable source, thereby reducing the emission of greenhouse and smog-causing gases; the use of the technology as an innovative, hands-on learning tool; and the potential to reduce the cost of electricity for schools, as the electricity produced can be used to offset electricity demand. However, simply installing the technology on school roof-tops does not guarantee that these potential benefits will be realized. Therefore, it is important to identify factors that may impede project development, and ultimately, to identify factors that help maximize the potential benefits of the projects.

Fundamentally, if technology is not used or implemented, the potential benefit inherent to the technology cannot be realized. This is not to imply that technological solutions should be applied to every problem; however, in many cases, technological solutions already exist, even if they are not always implemented. This implies that when technical barriers have been overcome, other, non-technical barriers may still impede the development of a project (and by extension, impede the potential benefits of the project from being realized).

Social acceptance is a concept in the technology literature that has been used to describe some of the non-technical barriers to the adoption and implementation of specific technologies. Chapter 2 will elaborate on how this term has been used in a variety of literatures; however, the term as it is used in the context of the thesis will now be defined.

At the broadest level, social acceptance can be understood as the existence of positive public attitudes and opinions towards a specific technology. However, as the wind energy technology literature demonstrates, positive attitudes and opinions towards a technology do not always translate into positive attitudes and opinions for specific projects. As Maarten Wolsink (2007b, p. 1191) argues: “attitudes towards wind power are fundamentally different from attitudes towards wind farms.” Therefore, to gain an understanding of the social acceptance of a specific project, the term itself must include more than a simple measure of public opinion. Drawing from the technology and innovation literature, social acceptance is most often defined as an individual’s willingness to adopt a particular technology. This literature is often based on Rogers’ Theory of the Diffusion of Innovation (2003), and argues that individuals decide to adopt (or not to adopt) a particular technology by evaluating characteristics of the technology itself. A technology achieves broad social acceptance by being adopted by the majority of individuals in society.

The energy technology literature adds to the definition of social acceptance by defining it at a community scale. There has been a growing body of literature that identifies that social acceptance can be a significant barrier to the development of any renewable energy projects, including solar PV projects (Wustenhagen et al., 2007). Specific siting decisions have generated local community resistance and controversy in some cases (i.e., lack of social acceptance at the community scale). Many researchers have detailed cases in which local resistance to a project caused significant delays or the complete cancellation of a project. This literature is particularly plentiful within discussions of wind energy technology; however, several authors have noted that themes that are apparent in the wind energy literature may also be applied to other renewable energy

technologies, such as solar PV, as well (Mallett, 2007; Wolsink, 2007b; Wustenhagen et al., 2007).

As described above, social acceptance can be defined on a societal, community, and individual scale. All levels of social acceptance may not apply to all technology projects; however, resistance to a particular technology or project can occur at any level.

A significant research project focusing on the social acceptance of renewable energy technology is currently being undertaken by a research consortium in Europe. In February 2006, nine European institutions and universities formed a consortium to develop a new multi-stakeholder tool to measure, promote and influence social acceptance of renewable energy technology. The project was titled: Cultural influences on Renewable Energy Acceptance and Tools for the development of communication strategies to promote *[sic]* ACCEPTANCE among key actor groups, or CREATE ACCEPTANCE (Create Acceptance, 2007a). The objective of this project was to

improve the social acceptance of renewable energy and rational use of energy technologies. It aims at improving this social acceptance through the development of a tool that not only can measure societal acceptance, but can also be used to promote and improve societal acceptance by creating communication, participation and bridging mechanisms for key stakeholders (Create Acceptance, 2007a, p. 1).

The existence of this broad-based European research consortium gives weight to the argument that the social acceptance of renewable energy technology is a key consideration for the planning, development and implementation stages of a renewable energy project. The CREATE ACCEPTANCE researchers argue that neglecting the various stakeholders in the planning stages of a renewable energy project, and not taking into account the divergent points of view could lead to severe resistance to the project during the implementation phase (Create Acceptance, 2007a).

Implicit in the creation of this tool is the recognition that early stakeholder involvement is key to both evaluating and creating social acceptance of renewable energy projects.

Several case studies from around Europe were used by the CREATE ACCEPTANCE research consortium to evaluate both unique and common barriers associated with particular renewable energy technologies in order to help create the tool. Table 1 presents some critical issues and success factors cited for solar energy technology, as identified in these recent case studies. The researchers point out that the issues and factors identified may not be exhaustive, but simply represent the range of issues that may exist for solar energy technology.

Key problems and uncertainties	Factors likely to promote success
<ul style="list-style-type: none"> • Costs • Difficulty of developing economies of scale • Small-scale applications require significant user involvement • Mistrust in technology as a reliable energy source • Small-scale PV: gaps in grid connection rules and procedures • Insufficient competences in installation firms 	<ul style="list-style-type: none"> • Possibility to link decision making to other (construction) decisions and specify or mandate simple technologies • Demonstration investments at public institutions • Potential to enhance local/personal energy independence • Prosperous and fresh image

Table 1 - Critical Issues and Success Factors for the Social Acceptance of Solar PV Technology
Source: (Create Acceptance, 2007b)

In addition to identifying technology-specific issues and barriers, the CREATE ACCEPTANCE researchers also identified factors that are likely present in projects with high levels of social acceptance. They are likely to:

1. be locally embedded;
2. provide local benefits;
3. establish continuity with existing physical, social and cognitive structures;
4. apply good communication and participation procedures;
5. have the capacity to leverage the social support they have gained to overcome difficulties in financing, policy instability or lacking market power (Create Acceptance, 2007b).

The research being completed by the CREATE ACCEPTANCE research consortium will contribute significantly to the literature on the social acceptance of renewable energy technology, and underscores the importance of local participation and involvement in the planning and implementation of renewable energy projects. The final tool developed by this research consortium was made available to the public in March 2008. Therefore, it

was not available when planning this thesis project. However, the work done by the CREATE ACCEPTANCE research consortium was valuable in forming the conceptual framework of this thesis, and the emphasis on early stakeholder involvement was particularly useful and influential.

The examination of the social acceptance of a school-based solar PV project is a unique case that has yet to be examined in the literature. The existing literature examines the social acceptance of solar PV technology at the individual scale, characterizing social acceptance as the decision to adopt (or not adopt) solar PV technology on individual homes (Kaplan, 1999/8; Keirstead, 2007). Siting a solar PV project on a school may have unique implications for social acceptance due to the fact that schools are the educational centre of many communities. In this case, a lack of social acceptance at the community scale may become apparent. There may be issues related to the educational goals of the project, the funding sources for the projects, as well as the wider community's trust and confidence in the specific actors who are implementing the project. For example, in some cases, the installation of a solar PV project may direct funds away from other school-based projects, such as sports teams or library expansions. Moreover, corporate involvement in schools may be a sensitive subject for some people (Richards, Wartella, Morton, & Thompson, 1998). Indeed, projects undertaken in schools can be particularly sensitive and emotionally charged because children are involved. Finally, from an educational perspective, the social acceptance of stakeholders from 'within' the school, such as teachers and administrators, may be important because they are responsible for the delivery of the educational programs.

School-based solar PV projects can be positive projects that have environmental, educational and economic benefits. However, there is relatively little experience in Ontario, let alone in Canada, as to how best to implement this kind of project in order to maximize the potential benefits of the project. This thesis will aim to fill that gap.

1.2 Thesis Questions

This thesis will answer the following primary research questions:

What factors may impede the development of a school-based solar PV project in the Halton District School Board and the Halton Catholic District School Board? What factors help to maximize the potential benefits of such a project?

The sub-questions addressed in this thesis include:

How do perceptions of solar PV technology affect the social acceptance of a project? Do different funding models affect the social acceptance of a project? How does social acceptance vary among different project stakeholders? What factors emerge as most significant for stakeholders?

1.3 Overview of the Research Design

This thesis was designed as exploratory research. Robert A. Stebbins defines social science exploration as:

a broad-ranging, purposive, systematic, prearranged, undertaking designed to maximize the discovery of generalizations leading to description and understanding of an area of social or psychological life (Stebbins, 2001, p. 3).

An exploratory design was selected because the study of social acceptance of renewable energy innovation is a relatively new field, and the literature that exists has been most often applied to wind energy technology. Literature on the social acceptance of solar PV technology exists, but the concept of social acceptance has not been specifically applied to the case of a school-based solar PV project. Therefore, literatures pertaining to technology and innovation, renewable energy technology and innovation, and educational technology and innovation were used as a heuristic to guide this thesis project, with the key concepts being applied to this new case. A flexible research design was thus necessary in order to study and describe this new case sufficiently.

As Stebbins describes, “to explore effectively a given phenomenon, they [researchers] must approach it with two special orientations: *flexibility* in looking for data and *open-mindedness* about where to find them (Stebbins, 2001, p. 6, emphasis in original). Both

qualitative and quantitative data can be collected during exploration, and as Stebbins (2001, 6) again describes, “some researchers even conduct quantitative surveys as a subsequent part of their investigation, asking respondents fixed-response questions predicated on the qualitative data gathered previously”. This two-stage data collection approach is the approach taken in this thesis.

Data for the thesis were collected in two distinct research phases. The data collected in Phase 1 consisted of qualitative data collected in open-ended, semi-structured interviews conducted with individuals in Canada and the United States involved with existing school-based solar PV projects. These data then informed the design of Phase 2, which was a specific case study conducted in the Halton District School Board and the Halton Catholic School Board in Ontario, Canada. The data in Phase 2 were collected through quantitative surveys, complemented by qualitative survey questions and in-person interviews. An in-depth description of the research design, including the detailed methods used in both Phase 1 and Phase 2, can be found in Chapter 3.

1.4 Research Contributions

The contribution of this research will be twofold. The practical application will be to determine the factors that will likely affect the development of a school-based solar PV project in the geographical area of the Halton District School Board (HDSB) and the Halton Catholic District School Board (HCDSB) (Ontario, Canada). This information could inform the development of a project plan, which could allow the school districts to move forward with the solar PV project in a way that could be most likely to attract the highest level of social acceptance and support.

Academically, this project will contribute empirical evidence to the bodies of literature describing the social acceptance of renewable energy innovation. In particular, this research will add to the literature on solar energy innovation, which is lacking in the assessment of social acceptance, particularly as applied to school-based projects.

1.5 Target Audience

This study will be of interest to communities, community groups and particularly school districts that are planning or are in the process of developing community or school-based solar PV projects. This research may also interest policy makers at the local and provincial levels as the results from this research may have implications for future renewable energy policy and programs. This research also may interest private sector companies considering the pursuit of similar community energy projects. Finally, this research will be of interest to academics doing work in the field of the social acceptance of renewable energy technology.

This introduction has sought to provide the background and rationale for this thesis, as well as a brief overview of the research design and expected contributions. Chapter 2 provides an overview of the relevant academic literature, and will also discuss existing research gaps to help situate this thesis in the academic literature. Chapter 3 then lays out the research methodology, and explains how the methodological instruments were developed and used. Chapter 4 provides the results of Phase 1 of the thesis research, and explains the development of the case study approach. Chapter 5 presents the results from Phase 2 of the research, and Chapter 6 contains the analysis and discussion of these same results. Finally, Chapter 7 concludes the study by offering a summary of the results and their analysis, and discusses potential policy implications. Suggestions for future work are also presented.

2 Social Acceptance, Solar Photovoltaic Technology and Schools

The installation of solar PV technology on elementary and secondary schools is a unique case because it brings together environmentally-positive technology, local, small-scale energy production, and youth and community education. However, the potential benefits of this kind of project may not be realized if the project is developed in a way that is unacceptable to individual project stakeholders or to the wider community. A school-based solar PV project may share similar challenges and barriers with other renewable energy projects (both large and small-scale), and also may share similarities with other technologies implemented in schools for educational purposes. The purpose of this chapter is to outline the existing research and literature that pertains to the themes mentioned above, and to explore how they relate to the thesis questions outlined in Section 1.2. There is relatively little literature that specifically examines school-based solar PV projects; therefore, this literature review will attempt to tie together different literatures that cast light on the challenges that may exist with school-based solar PV projects. Figure 1 illustrates the literatures used for this thesis research.

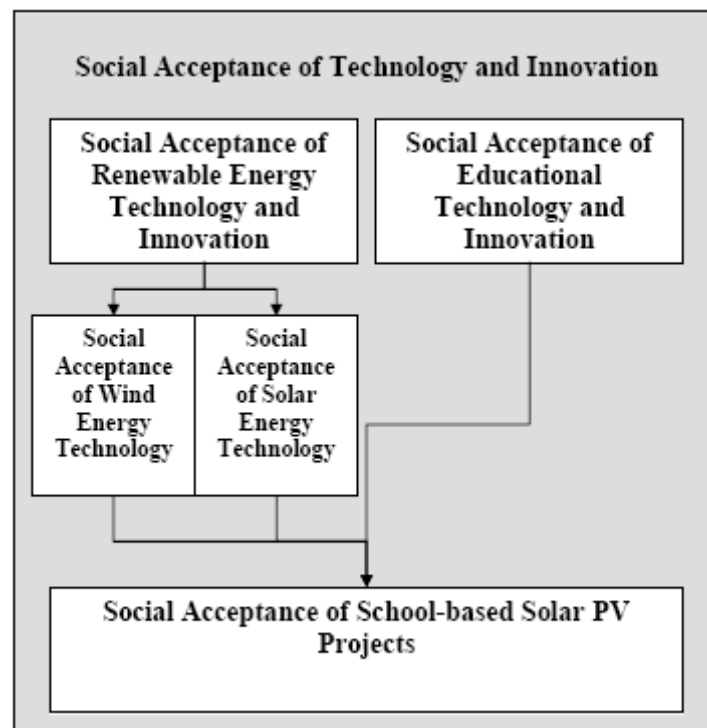


Figure 1 – Outline of the Literature Review

As mentioned in Section 1.1, lack of social acceptance has been identified as a significant barrier to the development of renewable energy projects. Section 2.1 will outline previous research on the social acceptance of technology and innovation to set the theoretical and conceptual context for this thesis research. Section 2.2 will then outline the literature regarding the social acceptance of renewable energy technology, focusing primarily on wind energy and solar energy technology. Recognizing the fact that the research questions focus attention upon schools, which raise particular issues, Section 2.3 will outline the literature that examines the social acceptance of educational technology, and will discuss the unique conditions that may affect social acceptance when projects are located on schools. Section 2.4 will outline the key conclusions from the literature review, and will describe the hypothesis of this thesis regarding the social acceptance of school-based solar PV projects. Finally, Section 2.5 will describe the conceptual framework for this thesis research and will outline the research gaps that exist in the literature.

2.1 Social Acceptance of Technology and Innovation

Social acceptance has been identified in the technology and innovation literature as a key component to the successful diffusion (or spread) of technology and innovation into society. There is a recognition that social acceptance is an important factor to consider when developing and marketing an innovation. Much of the discussion surrounding the social acceptance of innovations has been based on the recognition that a lack of social acceptance can be a significant barrier to the successful diffusion (i.e., broad-based uptake) of a new product or innovation. Broadly speaking, the innovation and technology literature has two main research foci in regards to the social acceptance of innovation and technology. First, the literature focuses on studying characteristics of specific innovations or technology that aid or impede adoption, and secondly, the literature focuses on identifying specific characteristics of the technology adopters themselves, often to facilitate marketing efforts. The literature generally focuses on the individual scale of social acceptance, and defines it as the willingness of individuals to adopt and use a particular technology.

This definition of social acceptance stems from Rogers' Diffusion of Innovation Theory (2003), and this theory has formed the theoretical underpinning for much of the literature examining the diffusion of technology and innovation in society. Rogers elaborates what factors can affect the speed and success of the diffusion of an innovation. In particular, Rogers' theory identifies that potential adopters' perceptions of new innovations are made by the evaluation of the innovation's relative advantage, compatibility, complexity, divisibility and communicability (Rogers, 2003, p. 221). In other words, potential adopters try to determine if:

- the innovation is better than the idea it supersedes;
- the innovation is compatible with existing values and experiences;
- the innovation is easy to understand and use;
- the innovation can be tried and tested;
- the results from using the innovation can be observed by others (Rogers, 2003, p. 221-258).

In other words, potential adopters evaluate characteristics of the technology itself. According to Rogers' theory, if the innovation is judged positively by potential adopters (using the criteria above), the innovation will diffuse through society in a relatively predictable way. However, Rogers also identified that all individuals in society will not adopt new technologies at the same time. Rogers has identified five innovation-adopter categories: innovators, early adopters, early majority, late majority, and laggards. Figure 2 is a theoretical representation of the diffusion of innovations; the shape of the S-curve for a particular innovation is innovation-specific, and describes only the diffusion of a successful innovation (Rogers, 2003, p. 275).

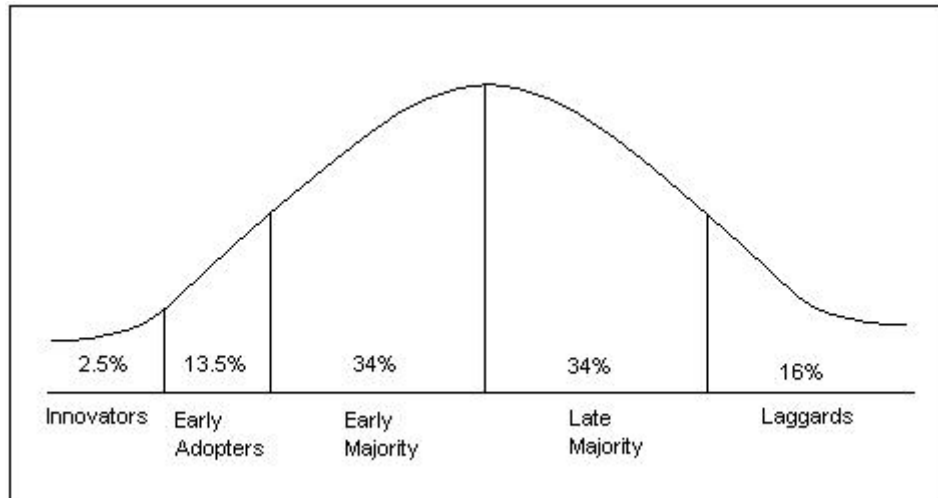


Figure 2 - Adopter Categorization on the Basis of Innovativeness

Source: adapted from Rogers, 2003, p. 281.

An innovation becomes more ‘socially accepted’ as more individuals adopt the technology, and in particular, when individuals in the early majority and late majority begin to adopt the technology. Moore (1999) expanded on Rogers’ diffusion curve by adding the concept of the ‘chasm’, which he inserts between the early adopters and the early majority categories (Moore, 1999). The concept of the chasm illustrates that some innovations have difficulty moving past the ‘early adopters’ stage on the diffusion curve, and therefore never reach majority acceptance in society. Understanding barriers to adoption (theoretically represented by the chasm) is motivated by a desire to move the innovation along the diffusion curve towards majority adoption.

People in each of the five adopter categorizations may share certain qualities, and much of the innovation literature focuses on identifying characteristics common to each group, often to facilitate marketing strategies (e.g., A. Faiers & Neame, 2006; Martinez, Polo, & Flavián, 1998). The rationale behind this research is that if targeted, effective marketing strategies are developed, then the innovation can be marketed to the people most likely to adopt the innovation in a way that would most likely appeal specifically to them.

Rogers’ Diffusion of Innovation Theory (2003) laid the theoretical base for much of the research pertaining to the social acceptance of technology and innovation. However, research pertaining to the social acceptance of energy technologies has a broader focus

than just individual, market-based social acceptance. This is because the decision to adopt particular energy technologies has more than just individual implications. For example, entire communities may be affected by the implementation of wind energy projects. The following section will expand on the definition of social acceptance provided by Rogers and the innovation and technology literature, and will describe how the term has been used in the context of renewable energy technology.

2.2 Social Acceptance of Renewable Energy Technology and Innovation

Renewable energy literature borrows heavily from the technology and innovation literature for its definition of social acceptance. This connection is obvious, as renewable energy is both an innovation and a technology; however, the literature on the social acceptance of renewable energy innovation examines social acceptance on an individual scale, a community scale and a societal scale. The distinctions among the three scales of social acceptance will be described in the paragraphs below.

Wüstenhagen et al. (2007) refer to the “triangle of social acceptance of renewable energy innovation”, which represents three distinct levels or scales of social acceptance. See Figure 3 for an elaboration.



Figure 3 - The Triangle of Social Acceptance of Renewable Energy Innovation

Source: Wustenhagen et al., 2007, p. 2684

Socio-political acceptance is the broadest level of social acceptance, and includes social acceptance of renewable energy technology and related government policies by the public, key stakeholders, and policy makers themselves. This level of social acceptance is not dependent on geography, and does not refer to the acceptance of specific renewable energy projects. At this scale, public opinion surveys are often used to gauge acceptance. In fact, when renewable energy projects were first implemented in the 1980s, no special consideration was given to social acceptance of projects at the community and individual scales because policy makers and developers assumed that high levels of social acceptance at the societal level for renewable energy technology generally would translate into acceptance and approval for individual projects. Indeed, renewable energy technology, particularly wind, has enjoyed relatively high levels of public support for the technology in Europe and the United States (Wolsink, 2007a). However, when individual projects began to encounter resistance at the community and individual level, researchers and policy makers began to examine social acceptance in more depth.

Community acceptance refers to the social acceptance of a specific renewable energy installation located in a specific geographic area. Not-in-my-backyard (NIMBY) is a term used to describe instances in which individuals and communities support the use and implementation of a particular technology in theory, but oppose its implementation in the local community. NIMBYism is generally applied to proposed projects and facilities that are in principle considered as beneficial by the majority of the population, but are in practice often strongly opposed by residents (van der Horst, 2007). The literature examining community acceptance often points out that *how* a project is implemented, *who* it is implemented by, and *how the effects are distributed* (both positive and negative) across the affected community can significantly affect the community scale of social acceptance of individual projects. The literature identifies that public and stakeholder participation in the development of a technology-based project can serve to improve the social acceptance of the project (Ornetzeder & Rohracher, 2006).

Finally, market acceptance is the third level of social acceptance suggested by Wüstenhagen et al. (2007). This level of social acceptance focuses on individual acceptance of particular renewable energy technologies through consumption and investment behaviour. This level of social acceptance draws most heavily on the technology and innovation literature, and often makes use of Rogers' Diffusion of Innovation Theory to explain why individuals may or may not decide to adopt a particular renewable energy technology.

The three points of the triangle are described as the three, sometimes interdependent, dimensions of social acceptance of renewable energy technology (Wüstenhagen et al., 2007). The following paragraphs will describe in further detail the existing literature on the social acceptance of renewable energy technology as it has been discussed at these three scales. The following discussion of the social acceptance of renewable energy technology draws heavily on the wind energy literature, as it is the literature that is most developed on this topic. However, several authors have noted that themes that are apparent in the wind energy literature may also be applied to the understanding of the

social acceptance of other renewable energy technologies, such as solar PV, as well (e.g., Wolsink, 2007b).

The study of the social acceptance of renewable energy technology first began to appear in the late 1980s, particularly in the wind energy technology literature. Socio-political considerations began being noted as a potential reason for the lack of renewable energy development, particularly in the wind energy industry (Carlman, 1988). Early research focused on identifying particular technological and physical attributes of wind installations that provoked negative reactions, as well as documenting particular cohorts of people that had particularly positive or negative perceptions of wind energy technology (Thayer & Freeman, 1987). The conclusions from this early research indicated that there were technical issues, as well as policy issues, that contributed to the lack of social acceptance of early wind energy installations (Bosley & Bosley, 1988). There was also a suggestion that a lack of communication and understanding between wind power developers and local communities may have contributed to the lack of social acceptance for local wind developments (Bosley & Bosley, 1992).

This early wind energy research suggested that the 'Not-In-My-Backyard' (NIMBY) could explain local resistance to renewable energy development. This concept has been used to discuss and understand opposition to facilities that may pose some (real or perceived) risk to the community in which they are located (Cowan, 2003; Hampton, 1996; Hsu, 2006). Many researchers have detailed cases in which local resistance to a project caused significant delays or the complete cancellation of renewable energy projects (e.g., Haggett & Toke, 2006; Kahn, 2000; Kaldellis, 2005). NIMBY attitudes towards renewable energy projects have been explored most extensively in the literature with regards to wind power developments (Agterbosch, Glasbergen, & Vermeulen, 2007; Groothuis, Groothuis, & Whitehead, 2008). However, NIMBY attitudes towards other renewable energy technologies have also been documented by other authors (Sauter & Watson, 2007).

Some authors argue that NIMBYism is too simplistic an explanation and does not accurately illustrate the opposition towards renewable energy (Bell, Gray, & Hagggett, 2005; Wolsink, 2007b). Maartan Wolsink, for example, argues that the term NIMBY denotes a selfish opposition to renewable energy developments, and that opponents to renewable energy developments have a range of motivations for opposing the projects (Wolsink, 2007b). The use of the term NIMBY can potentially mask important differences between opponents to renewable energy developments (van der Horst, 2007). Kempton et al identified three reasons why NIMBY as a term should not be used to describe opposition to renewable energy development. “First, it is generally used as a pejorative implying selfishness as an underlying cause; second, it appears to incorrectly describe much local opposition to wind projects; and third, the actual causes of opposition are obscured, not explained, by the label” (Kempton, Firestone, Lilley, Rouleau, & Whitaker, 2005, p. 124). In terms of social acceptance, it is important to move beyond labels of NIMBYism to discover the root causes of the lack of social acceptance for individual renewable energy projects.

It has been suggested that the institutional environment in which projects are developed may have a significant effect on the social acceptance of renewable energy projects. Institutional factors create the framework in which renewable energy schemes are planned and implemented. This includes the economic and policy conditions, as well as the established framework for stakeholder and public participation. There has been significant research into how institutional factors have influenced the social acceptance of renewable energy developments (Agterbosch et al., 2007; Breukers & Wolsink, 2007; Upreti & van der Horst, 2004). Different renewable energy policy schemes have been found to have disparate levels of success in encouraging growth in the renewable energy sector. Different countries have strikingly different rates of wind energy installations, which cannot be explained by a difference in the wind resource alone (Toke et al, 2008). For example, advanced renewable tariffs (or feed-in tariffs) in Germany have been credited with much of the boom in wind energy development in that country. Under this scheme, local ownership of wind projects is encouraged, and therefore local communities are able to directly benefit from wind energy developments. In contrast, in Britain, many

wind energy developments have met with significant local opposition, perhaps due to the fact that a policy of 'green electricity certificates' was used which favours large scale developers (Toke, 2005).

National renewable energy policy and economic conditions set the 'rules' that developers must work within to develop renewable energy projects. It has been extensively discussed in the literature how these national policies affect social acceptance for individual renewable energy projects. Breukers and Wolsink (2007) compared wind developments in three different countries: the Netherlands, England, and Germany. Their conclusions indicate that lack of social acceptance is problematic to some extent in all three countries, but is exacerbated when there is local discontent with the decision-making process and management of the facility. Local involvement, both financially and in decision-making, appears to enhance support for wind schemes locally (Breukers & Wolsink, 2007). Similarly, Jobert et al. (2007) looked at French and German case studies and found that the developer's behaviour during the implementation of the wind project is critical. Local integration, such as knowledge of local context, contacts with authorities and media, and an ability to create a network of local actors aids in fostering social acceptance of the development (Jobert, Laborgne, & Mimler, 2007).

The literature suggests that the different national policies have been more or less successful in providing a forum for local participation in the planning and implementation process of individual renewable energy developments, which in turn helps to lead to actual project development. The literature indicates that the more that the local community is involved with the planning and implementation of the project, the greater the social acceptance of the project.

Why does increased community involvement and participation result in greater social acceptance at the community scale? The theme of community involvement as expanded in the literature answers this question by examining the concepts of education, trust, equity, and risk communication.

The early wind energy literature identified that some resistance to wind energy technology can be attributed to a lack of knowledge about the technology and the true risks and benefits associated with the technology (Bosley & Bosley, 1992). Indeed, the perception of risk is an important factor in determining social behaviour associated with innovations and technology. Education programs have been suggested as a possible solution to this resistance (Kaldellis, 2005). Wind energy technology has become more familiar in the public discourse, but this same lack of knowledge has been identified with other, newer energy technologies (Schulte, Hart, & vanderVorst, 2004; Upreti & van der Horst, 2004). It has been recognized that simply ‘educating’ people about the risks and benefits of a specific technology are not sufficient to create social acceptance (Upreti & van der Horst, 2004).

Many authors have argued that a locally-based, participatory process for the planning and implementation of renewable energy projects can encourage a collaborative learning process, and increase the local acceptance of energy projects (Gross, 2007; G. Rogers, 1998; Upreti & van der Horst, 2004; Wolsink, 2007a). However, these authors stress that the participatory process must be seen to be fair and equitable by the community to be effective in increasing social acceptance. For example, Catherine Gross argues that “outcomes that are perceived to be unfair can result in protests, damaged relationships and divided communities particularly when decisions are made which benefit some sections of the community at the perceived expense of others” (Gross, 2007, p. 2727). What segments of the population are asked to bear the cost, and what segments receive the benefits of a particular project have a significant bearing on the level of social acceptance.

The specific stakeholders and the structure of community and stakeholder participation can influence the social acceptance of the project as well. Specifically, the level of trust that the community has for the various actors can play a significant role. As Huijits et al. (2007) describe, when people are confronted with new unfamiliar technology, due to a lack of information, it is often difficult to weigh the costs and benefits of the new technology due to a lack of information. Therefore, people must often rely on experts to

provide the necessary information, which in the case of renewable energy developments may include project developers, policy makers, and local government. However, the level to which people trust these experts will influence the credence given to the information received. If the actors involved in implementing a renewable energy facility are perceived to be untrustworthy, or are seen to benefit unfairly from the project, then there may be resistance to the project.

The early wind energy literature began looking at the social acceptance of wind energy technology by examining individual perceptions of the technology and of individual developments. As the wind literature developed, a community-based understanding of the social acceptance of renewable energy technology developed. In contrast, solar PV technology has thus far been typically been studied from the perspective of individual social acceptance. This individual scale of social acceptance is perhaps less applicable to school-based solar PV projects (i.e., projects at the community scale); however, this literature provides some insights into the factors that affect an individual's social acceptance of solar PV technology. These individual perceptions of solar PV technology perhaps have some effect on the community scale of social acceptance, and therefore are important to consider when evaluating the social acceptance of a particular project or technology. The following paragraphs will outline the existing research on the (individual) social acceptance of solar PV technology.

Micro-generation is defined as the generation of electricity and/or heat in the home, such as by solar energy technologies (Keirstead, 2007). These micro-generation facilities require that not only must social acceptance exist on a societal and community level, but it must also exist at an individual level. This demonstrates that the social acceptance of solar PV technology can be important on all three scales, as presented by Wustenhagen et al (2007). As Raphael Sauter (2007) argues, micro-generation technologies require "passive" acceptance, which refers to an individual's willingness to accept the technology in their environment, and "active" acceptance, which refers to the individual's willingness to install these technologies on their own home (Sauter & Watson, 2007). Further, "micro-generation requires households' acceptance in terms of both positive

public and private attitudes to achieve market uptake of these technologies” (Sauter & Watson, 2007, p. 2772). This scale of examining the social acceptance of solar PV technology is based heavily on existing technology and innovation literature, and draws on Rogers’ Diffusion of Innovation Theory (Rogers, 2003).

Because individual acceptance is necessary for the adoption of solar PV technology, the existing literature on the social acceptance of solar PV technology generally focuses on identifying aspects of the technology that prevent general uptake, and also to identify characteristics of individuals who are more likely to adopt this technology so that effective marketing strategies can be devised. For example, several studies have been undertaken to understand the attitudes and perceptions of adopters versus non-adopters of solar energy technology (A. Faiers & Neame, 2006; Labay & Kinnear, 1981). Education and familiarity with the technology seem to be significant factors when people are considering purchasing solar technology; early adopters are more likely to be better educated about environmental issues and more educated about solar PV technology in general (Jager, 2006; Peter, Dickie, & Peter, 2006). Similar to the early wind energy studies, the solar PV research has generally identified that financial, economic, and aesthetic considerations are limiting the adoption of this technology (A. Faiers & Neame, 2006). Several studies have identified that early adopters of solar PV technology tend to have positive perceptions about the environmental characteristics of the technology, but are particularly deterred by the financial cost of solar PV technology (A. Faiers & Neame, 2006; Jager, 2006).

Studies have found that there is a social aspect to the individual decision to adopt solar PV technology. People who have been exposed to the technology through their social networks are more likely to consider their social network to play a key role in their decision to adopt the technology (Jager, 2006). As Huijts et al. (2007, p. 2780) explains, “social acceptance is not just a matter of individual feelings and perceived risks and benefits, but predominantly is a social process”. This research finding may also lead to the conclusion that inclusive, participatory planning of renewable energy projects not

only increases social acceptance through education, but also through the exposure of the technology through various social networks.

The literature describing the social acceptance of solar PV technology has thus far typically focused on installations on private residences. However, school-based solar PV projects may not experience the same challenges because individuals are not required to install the technology on their own home. In this way, the school-based project is more analogous to the community-based wind energy projects. However, the individual scale of social acceptance for solar PV technology is still important, as it will likely affect the community scale of social acceptance. Some similarities may exist between the challenges of implementing educational technology and school-based solar PV projects, and therefore, this literature will now be examined.

2.3 Social Acceptance of Educational Technology and Innovation in Schools

As mentioned in Chapter 1, solar PV technology has been installed on school roof-tops for environmental, economic, and educational reasons. There is a distinct lack of literature that examines the social acceptance of these projects, as well as a lack of literature that measures the success of these projects. However, there are some authors who have examined the educational benefits of solar PV projects on schools, as well as the barriers and issues that arise with school-based projects. This section of the literature review will explore these two themes.

In an examination of the published documents of existing solar school projects, overwhelmingly, the documents discuss the intended educational benefits of the solar PV projects (Power Up Renewable Energy Co-operative, 2005; Solar Schools, 2008; Sustainability Victoria, 2008; The Foundation for Environmental Education, no date). Some programs, such as the Hong Kong Solar School program, have been argued to have the potential to contribute to national renewable energy targets, and therefore have economic market implications (Close, 2003). However, education is generally the primary goal of most programs. This is to be expected, as choosing an educational

facility as the location for a project would likely lead to educational uses, and the choice of location is likely to be tied to the desire to use the technology for educational purposes. Solar PV projects installed on private residences or other public buildings may also have an educational component, but schools are a particularly convenient location for educational uses as they are educational facilities. Many existing solar projects were conceived as demonstration projects to educate the general public, create exposure for the technology and to prove applicability in various circumstances (e.g., Bosari, Elder, & Reynolds, 2004).

The Australian states of New South Wales, Queensland, Victoria, and Western Australia all have Solar School programs, each with the stated objective “to educate students about renewable energy sources, to reduce greenhouse gas emissions, to initiate cost-saving measures in schools; and, to increase societal awareness and acceptance of renewable energy sources” (Tabert, 2007). A recent evaluation of these programs found that solar PV technology could be a useful educational tool, but a holistic pedagogical approach to the project was needed rather than a purely technological approach, to ensure the project was reaching its stated goals (Tabert, 2007). This implies that installing solar PV technology on schools will not, in itself, result in an educational benefit, and additional effort is required to ensure that the technology is used as an educational tool.

An analogous example of the incorporation of technology into schools for educational purposes is the introduction of information and communication technology (ICT) into elementary and secondary schools. ICT has been suggested as an excellent (and perhaps essential) teaching tool in schools, and its implementation has been widely supported by governments around the world (Ma, Andersson, & Streith, 2005). This government-led model for implementing technology in schools is similar to the initial attempts in the United States and Australia to implement solar PV technology on schools. The literature examining the use of technology in schools for educational purposes strongly indicates that teachers are the actors within the school system who must be engaged to effectively use new technologies for educational purposes. Examining teachers’ acceptance of new technology used for educational purposes has been studied by a variety of authors

(Demetriadis et al., 2003; Hu, Clark, & Ma, 2003; Teo, Lee, & Chai, 2008; Zhao & Cziko, 2001).

Several researchers have noted that teachers do not appear to make effective use of technology for teaching (Ely, 1993; Pedretti, Mayer-Smith, & Woodrow, 1999; Zhao & Cziko, 2001). According to Demetriadis et al. (2003, p. 32), “many teachers find themselves in the difficult position of using technology products without being members of the technology culture”. In other words, in some cases, teachers are asked to provide instruction on and use technology with which they themselves are not familiar. Teacher knowledge and familiarity with a particular technology can affect their willingness (and ability) to introduce the technology in the classroom (Mooij & Smeets, 2001). Teacher attitudes have also been found to play a significant role in their willingness to consistently incorporate new technologies into the classroom; positive attitudes about the technology lead to a greater willingness to use new technology, both at home and at school (Lopez BG, Rodriguez JS, & Cervero GA, 2006). Huang and Liaw (2005) found that the sophistication of the technology is not as significant as the teachers’ attitudes in determining the extent to which the technology is implemented as an educational tool in the classroom (Huang & Liaw, 2005).

Perceived usefulness and perceived ease of use are also key determinants for teachers’ acceptance of new technology for use in the classroom (Hu et al., 2003; Ma et al., 2005; Teo et al., 2008). Mooij and Smeets (2001) also note that the school board and administration’s policy and budgetary decisions, and in particular the attitude of the school manager towards integrating the technology are expected to be relevant to the ICT innovation process. Demetriadis et al. (2003, p. 19) conclude that “although teachers express considerable interest in learning how to use technology, they need consistent support and extensive training in order to consider themselves able to integrate it into their instructional practice”.

Ely argues that there are eight conditions that affect the implementation of educational technology innovation: dissatisfaction with the status quo; existence of knowledge and

skills; availability of resources; existence of rewards or incentives; participation; commitment; and leadership (Ely, 1999). Participation is a condition that is particularly striking from the list, as it is similar to the conditions identified for improved social acceptance identified in Section 2.2. Participation can be stimulated by communication and shared decision-making (Mooij & Smeets, 2001).

The social acceptance of key stakeholders (namely the stakeholders most affected by the project) is critical to the successful implementation of educational technology in schools. Teachers are the actors responsible for using the technology in the classroom, and therefore their perception and attitudes toward the technology have the greatest impact on the extent to which the technology is used for educational purposes. However, as argued by Mooij et al (2001), the use of educational technology in schools can be affected by a variety of actors on a variety of levels (e.g., national policy level, school administration, subject-specific department, and even individual students). Therefore, supportive policies and actions by government, school boards, and administrators can have a significant impact on the level of acceptance of the educational technology, and in turn on how effectively the technology is used to educate students.

The following sections will combine the relevant literatures discussed in the previous three sections on the social acceptance of technology and innovation, renewable energy technology and innovation and educational technology and innovation in schools. The concepts from these literatures will be discussed in the context of a school-based solar PV project, and research hypothesis will be described.

2.4 Key Conclusions and Research Hypothesis

The literatures above outline how the issue of social acceptance has been studied in the context of technology and innovation, renewable energy innovation, and educational technology. Social acceptance as defined in these contexts can be understood from a societal scale, a community scale and an individual scale. At the societal scale, renewable energy technology has typically been evaluated positively in public opinion polls. However, as has been demonstrated in the wind energy literature, positive public

opinion does not always translate into positive perceptions of specific projects. Therefore, it should not be assumed that positive public perceptions of a specific technology in general will translate into high levels of either community or individual social acceptance. Turning to solar PV technology specifically, this technology has been most extensively studied from the perspective of individual acceptance. This scale of social acceptance draws heavily from the technology and innovation literature, and examines characteristics of the technology itself to determine why (or why not) a technology is adopted by individuals. This focus on individual social acceptance is because solar PV technology is typically implemented on private households. In this case, the individual home-owner's decision to adopt (or not adopt) the technology is determined generally by the home-owner's evaluation of the technology itself, and is also determined by the individual home-owner's personal characteristics. However, while this solar PV technology literature is relevant, it does not explore social acceptance for a community-scale solar PV project. Therefore, it is necessary to turn again to the wind energy literature, which in recent years has begun to extensively study the social acceptance of wind energy technology at the community scale. Key conclusions from this literature are that perceptions of the technology itself are important, but how a project is implemented can have a greater impact on the social acceptance of the project. Key community stakeholders should be involved early in the development process, and ideally should be involved directly in the decision-making process. An examination of wind energy policies around the world reveals that countries that have policies that encourage or favour small-scale, community-based renewable energy projects experience less community resistance to projects, and therefore are more successful in implementing renewable energy projects. Good stakeholder communication is key, and trust between the project proponents and the community also helps to increase community social acceptance. Finally, drawing on the educational technology literature, in order to facilitate the educational use of technology in schools, the social acceptance of key stakeholders such as teachers and school administrators is critical.

Based on the key conclusions of the literature review, it is expected that the social acceptance at a societal, community and individual level may be important to the overall

social acceptance of a school-based solar PV project. Characteristics of both the technology itself, as well as how (and by whom) the project is implemented may be important. Key stakeholders from within the school, and also from the wider community are likely to be important to include to both minimize the factors that may impede the development of a project, and also to maximize the potential benefits of the project.

In order to evaluate if *how and by whom* a project is implemented may affect the social acceptance of the projects, five funding models representing the range of models used to implement school-based solar PV projects worldwide were identified. Schools do not generally have the funds necessary to purchase solar PV technology outright, and therefore have resorted to creative funding models to finance school-based solar PV projects. However, the origin of the funding for a project determines, to some extent, what actors are involved in the planning and development of the project, and what role stakeholders can play in the process of implementing a project. The five funding models were used as a way to identify what aspects of *how and by whom* the school-based solar PV project was implemented would most greatly affect stakeholder social acceptance. The models vary in project proponent, project owner and operator, source of funding, and school and stakeholder involvement and responsibility in planning and implementing the project.

The five funding models identified were: renting school roof-space; corporate sponsorship; community fundraising; community co-operatives; and government/utility programs, and were identified through the literature review and through an online review of existing school-based solar PV projects, and were confirmed through Phase 1 interviews. Each of the five funding models can have a great deal of variation in actual real-life implementation; however, distinction among the five models allows them to be evaluated and will allow for the identification of specific characteristics of each model that may have an effect on social acceptance. In particular, the models involving a corporate entity may be less acceptable due to resistance to corporate involvement in schools (Bell McKenzie & Joseph Scheurich, 2004). Based on the wind energy literature, models that allow for greater stakeholder involvement are likely to result in greater social

acceptance at the community scale. Funding models that feature proponents perceived to be trustworthy by key stakeholders and the wider community are also likely to be more socially acceptable. In Section 2.4.1, the five funding models for school-based solar PV projects are described, and an example of how each specific model has been used to implement a solar PV project is given.

2.4.1 Describing the Models

The “renting school roof-space” model involves the renting or leasing school roof-space to a developer, who would develop the solar PV project on a for-profit basis. Developers are typically private companies, but utilities can also develop projects under this model. This funding arrangement is relatively uncommon for school projects, but is gaining recognition as a viable way to fund and develop solar PV developments. For example, in March 2008, ProLogis, the world’s largest owner, manager and developer of distribution facilities entered into an agreement to lease roof space to Southern California Edison (SCE), the largest electric utility in California, for the purpose of installing 250 MW of solar PV technology (PR Newswire, 2008).

With the “corporate sponsorship” model, project funding is obtained from a corporate partner. This corporate partner can either be a local small business or a large corporation. The business donates funding for the Solar School project, and in return, the company receives recognition for participating in the project. For example, Cochrane High School in Cochrane, Alberta raised enough money from corporate sponsors to fund a two-phase renewable energy project, including both solar PV and wind technology. The school has raised approximately \$80,000 since 2004, and corporate sponsors have been recognized on the school’s project website (Cochrane High School, 2006). Additionally, Cochrane High School and the corporate sponsors received a Calgary Educational Partnership Foundation Mayor’s Excellence Award in 2006, recognizing successful partnerships between the Calgary-area business and educational communities (Morton, 2006).

The “community fundraising” model involves soliciting private donations from individuals in the community. There are a variety of ways to raise the funds, including door-to-door solicitation, community bake sales, or sponsored events (e.g., a sponsored

run). Schools often must raise funds for extra programs, and therefore individual schools have come up with many creative ways to fundraise. Most school boards have foundations specifically charged with raising money for extra-curricular programs and projects. For example, Westbrook School in southern Alberta raised money for a school-based solar project funded primarily from community fundraising. The school has a “Friends of Westbrook” fundraising organization, and a portion of the proceeds of any fundraising activity is earmarked for environmental projects at the school (Friends of Westbrook, 2008).

The “community co-operative” model of project fundraising is similar to the community fundraising model in that the funds for the project are generally generated from the local community. However, this model is distinct in that the community actually owns the solar PV development. The Canadian Cooperative Association defines a cooperative as an “enterprise or organization owned by and operated for the benefit of those using its services – the members” (Canadian Co-operative Association, 2006). All cooperatives worldwide are guided by the following seven principles: voluntary and open membership; democratic member control; member economic participation; autonomy and independence; education, training, and information; co-operation among co-operatives; and concern for community (Canadian Co-operative Association, 2006). This model has been particularly successful in Europe in encouraging renewable energy development. For example, 80 percent of Denmark’s wind turbines were installed by cooperatives, and 10 percent of the overall energy mix is supplied by renewable energy (WindShare, 2006). Generally, membership in an energy cooperative entitles members to purchase energy shares. The investment is returned to co-op members through the profits from the production and sale of electricity. This model has not been used extensively to install solar PV projects or solar school projects. In fact, the Toronto Renewable Energy Co-operative (TREC) released a report in 2007 indicating that solar PV rooftop co-operatives are not profitable in Ontario without a \$3500 to \$5000/kW reduction in up-front costs, and equivalent subsidy or a substantial increase in the payment for solar PV technology under the ReSOP (Brigham & Gipe, 2007). However, the Power-Up Renewable Energy Co-operative in Ontario spearheaded a solar schools project on the Centre Dufferin

District High School in Shelburne, Ontario. The co-operative was the driving entity behind this project; however, government grants and subsidies were used to fund the project. This funding model has potential for future development, but has not often been used for the development of school-based solar PV projects.

The “government/utility” model can have a great deal of variation in the types of programs and incentives offered. However, this is a distinct model for Solar Schools development because many of the existing school-based solar PV projects have been spearheaded and administered through a government or utility programs. Generally, the government and/or utility provide the funding and expertise for the development of the project. The schools may have to apply to participate in the program, and may need to demonstrate that they meet certain criteria to participate. For example, the government of Western Australia contributes up to \$13,000 towards school-based solar PV projects on Western Australia State Government schools. Each individual school is required to raise a minimum of \$1000 towards the project, and must meet the program’s key eligibility requirements in order to participate (Government of Western Australia, no date).

2.5 Conceptual Framework and Research Gaps

The conceptual framework for this research is based on the assertion that the lack of social acceptance for renewable energy projects and school-based projects has been shown to be a barrier for successful project development. Previous renewable energy literature (particularly wind literature) demonstrates that social acceptance can significantly delay or even cancel projects if the project is not developed in a way that is deemed acceptable by relevant stakeholders and the local community. Wind energy literature points to the conclusion that how projects are funded and implemented can significantly affect social acceptance, while current solar PV technology literature has typically focused on individual acceptance of the technology. There is a significant gap in the literature in examining community-based solar PV projects. School-based solar PV projects are at a community-scale, but have the potential to be affected by social acceptance at the individual, community and societal levels.

Wind energy literature points to the conclusion that public participation in the planning and implementation of wind projects was found to significantly improve the level of social acceptance of the projects. Previous research on the social acceptance of renewable energy technology indicates that the same issues found with wind energy technology may also appear in other renewable energy projects. The educational technology literature also points to the fact that key stakeholders need to be involved in the decision-making process to improve the likelihood of project success. In particular, supportive school boards and administrations, and teacher willingness to incorporate the technology into the classroom are particularly important in achieving the educational goals of solar PV technology. However, stakeholder participation in itself may not be enough to encourage the social acceptance of the project. How the community is able to participate in the planning and implementation of the project can also be important. In the context of school-based solar PV project, the funding model chosen to implement the project somewhat dictates the extent to which particular stakeholders can be involved in the development of the project. In Ontario, schools have already begun to explore implementing solar PV projects on rooftops, but it is difficult to anticipate what factors may lead to resistance to the project. Existing school-based solar PV projects in Canada, the United States and abroad have used a variety of funding models to implement projects, with varying opportunities for stakeholder participation in the decision-making and funding stages of the project. From the perspective of social acceptance, some funding models may lead to higher levels of social acceptance, and may reduce barriers to development and implementation.

Based on the literatures reviewed in the sections above, the hypothesis was formed that the varying funding models may affect the social acceptance of school-based solar PV projects. Individual perceptions of the technology are expected to be important, although it is expected that the funding model chosen to develop the project (i.e., how and by whom the project is developed) will be of greater significance to the social acceptance of the school-based solar PV projects. Based on the renewable energy literature, it is expected that the projects that allow for greater stakeholder participation in the

development of the project will be evaluated more positively. It is also expected that the funding models that involve corporate actors may be evaluated less favourably due to the fact that the project will be located on a school. The research methods employed will test for the various factors identified by the solar PV literature, but will also take into account the school-based project literature and the other renewable energy literature that indicates that community-based projects have greater social acceptance when implemented with increased stakeholder involvement and input. These concepts have not been applied to school based solar PV projects, and this thesis research will fill that gap.

3 Methods

This research is exploratory in nature. As Palys states, exploratory research “aims to gain familiarity with or to achieve new insights into a phenomenon, often in order to formulate a more precise research question” (Palys, 2003, p. 73). Therefore, this research was designed to be flexible, with the early stages of the research process informing the design of the later stages. This exploratory approach was selected because research on the social acceptance of school-based solar PV projects is relatively rare, and it was not clear what characteristics would be most influential. The research was completed in two distinct phases. Figure 4 illustrates the two-phase approach.

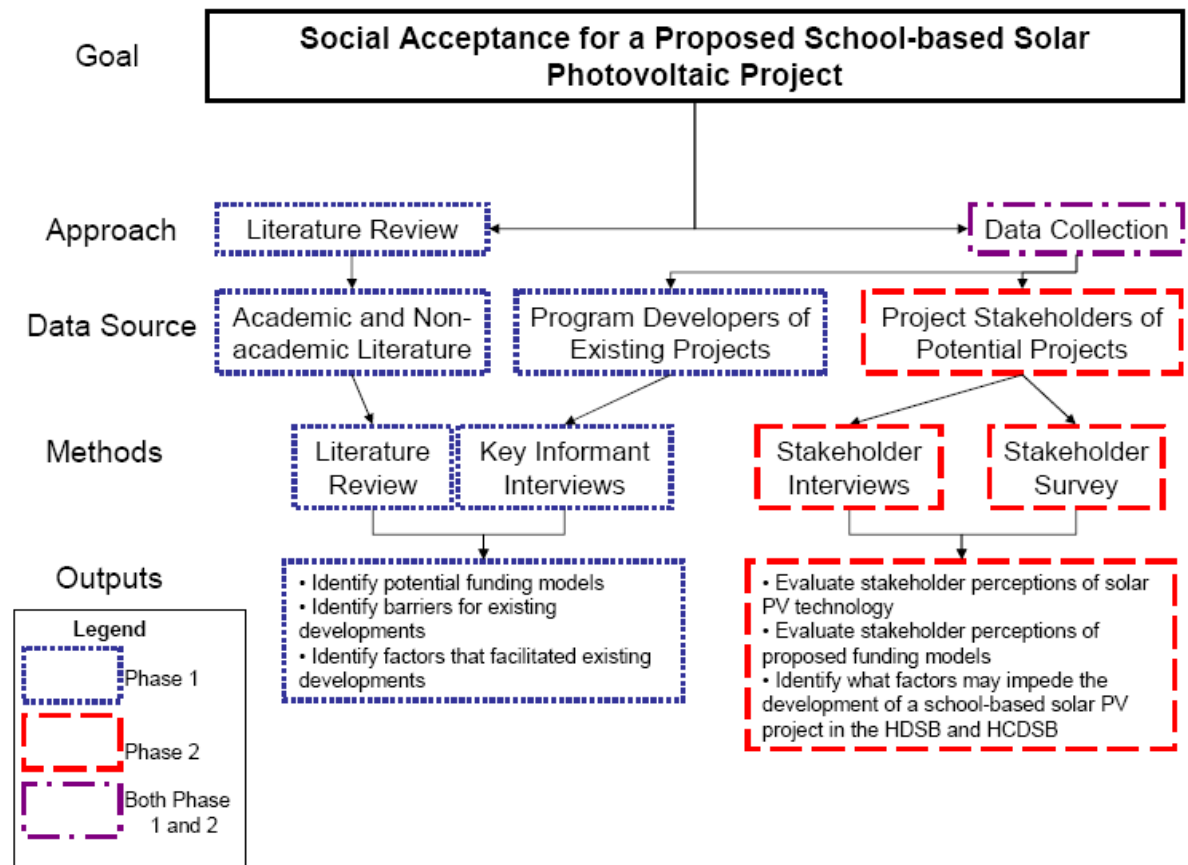


Figure 4 - Methods Flow Chart

Source: Adapted from (Mendis, 2004)

In Phase 1, a detailed literature review and key informant interviews were completed to identify common characteristics of successful school-based solar PV projects, as well as common barriers experienced by existing school-based solar PV projects. Funding models for school-based solar PV projects in Canada and abroad were also identified. A more detailed discussion of Phase 1 results can be found in Chapter 4; however, the three main outputs were:

1. Key stakeholders for school-based solar PV projects (as identified by Phase 1 interviewees) are: community members (including parents), school administration (including the principal and vice principal), teachers (particularly those potentially using the installation in conjunction with the curriculum), and custodial staff.
2. Stakeholder acceptance and support contribute to project success (i.e., installing solar PV technology on school grounds and using the technology for educational purposes).
3. Early and broad-based stakeholder involvement may improve the social acceptance of school-based solar PV projects.

Results from Phase 1 informed the design of the case study approach in Phase 2. Based on the above findings, in Phase 2, the five funding models were proposed to a selection of stakeholders in the Halton District School Board (HDSB) and the Halton Catholic District School Board (HCDSB). Data were collected from the HDSB and HCDSB stakeholders through two different methods: detailed stakeholder interviews and stakeholder surveys.

The Halton District School Board and the Halton Catholic District School Board were selected as the case study site for a variety of reasons. In practical terms, a relationship existed between researchers at the University of Waterloo, Milton Hydro and the Halton District School Boards, which facilitated the researcher's access to schools for data collection. There was a high degree of interest from the HDSB and HCDSB in implementing a school-based solar PV project and these districts were keen to learn how best to implement this kind of project. The district did not yet have any school-based solar PV projects planned or installed, and therefore this represented an opportunity to

learn what challenges may impede the development in these school districts, and to potentially mitigate these challenges prior to project implementation. This research has immediate practical implications for the future development of any school-based solar PV project in the two school boards. The selection of the HDSB and HCDSB as the case study site has implications for the wider applicability of the conclusions drawn from this research. The two school boards are not representative of all school boards in Ontario, let alone in Canada. However, because this research is designed as an exploratory study, the findings from this case study research can help direct further research and inquiry (Yin, 2003).

The methods used in Phase 1 and 2 can be summarized as follows:

1. Phase 1:
 - a. Literature Review: The literature, as detailed in Chapter 2, formed the theoretical grounding for this project. The themes identified in the literature served to inform the approach and design of the research project. Because of the paucity of literature relating directly to school-based solar PV projects, a literature review alone was not enough to form a solid foundation on which to base this project.
 - b. Key-informant interviews: To complement the literature review, nine interviews were completed with Solar School proponents between May and August 2007. The interviewees were all directly involved in a specific solar school project (or series of projects), and were either connected to the project through a school, or through an organization that specifically facilitated solar schools projects. The interview questions related to the motivation and goals of the participants for the project, the funding sources used, the level of involvement of the various project stakeholders, and the common barriers and challenges faced while developing the solar schools projects.
2. Phase 2: HDSB and HCDSB Case Study
 - a. Stakeholder Interviews: Thirty stakeholder interviews were conducted for this research. Five specific stakeholders were identified for interviews in

each of the eight schools that participated in this research. The five stakeholders identified at each school were the principal, the vice principal, the teacher leading any environmental club at the school, the head teacher of the science department, and the head custodian.

- b. Stakeholder Surveys: Fifty stakeholder surveys were collected during the eight schools' School Council meetings. The content of the surveys was virtually identical to the stakeholder interviews. The survey was designed to gather feedback from parents and other community members. Due to the number of School Council members who participated in the study, it was not appropriate to use the interview method.

Each method is discussed in detail in the sections below.

3.1 Phase 1 – Key Informant Interviews

Nine key informant interviews were conducted to gain a better understanding of existing solar schools projects. Potential research participants were identified through a broad-based online search for existing school-based solar PV projects. Individual schools were identified for recruitment as well as broader organizations that assisted elementary and secondary schools with the planning and implementation of solar PV projects. Local, national and international examples of school-based solar PV projects were identified for participation in this phase of the research project.

Based on the information available online, the individual identified as the project lead or the project organizer was approached to participate in the study. Recruitment emails were sent to prospective participants in early summer 2007. If necessary, one follow-up email and one follow-up phone call were placed to encourage participation. Seventeen individuals were approached to participate in the thesis project, and ten agreed to participate. This stage of the thesis project received approval from the University of Waterloo Office of Research Ethics in May 2007. Please see Appendix 1 for the ethics documents for this stage of the thesis project.

The interviews were conducted in person if possible, as in-person interviews typically provide a high response rate, ensure the correct respondent participates in the survey, allow for clarification of any ambiguities or misunderstandings, and allow the researcher to ask for embellishment if certain answers are too brief or incomplete (Palys, 2003, p. 159). However, in-person interviews are costly and time-consuming to complete (Palys, 2003, p. 159); therefore, due to geographical and financial constraints, two interviews were conducted in person and seven were conducted by telephone.

The interviews were approximately 30-45 minutes in length. The open-ended interview format allowed the interviewer to guide the discussion while at the same time allowing interviewees to answer in their own words with limited influence from the interviewer. The questions were designed to stimulate discussion about the motivations for developing the project, the process of planning and implementing the project, the characteristics that particularly facilitated or impeded project development, and to discover if the project had succeeded in achieving identified goals. Two sets of interview questions were designed: one was used with individuals involved in one specific solar school project (these interviews contained 11 questions), and the other was used with individuals working with organizations that facilitated school-based solar PV projects (these interviews contained 13 questions). The two sets of interview questions only had differences in the wording of questions, and not in the interview themes explored. The specific lists of questions can be found in Appendix 2 and Appendix 3.

The interviews were audio recorded to ensure accuracy. Notes and direct quotations were later documented when the audio-tapes were replayed by the researcher. The interview notes and direct quotations were then sent to each of the interviewees within one week of the interview for any corrections or clarifications.

Once the notes and direct quotations were reviewed and approved by each of the interviewees, the interview notes were analyzed to identify specific themes from the responses.

3.2 Phase 2 - Case Study – Halton District School Boards

3.2.1 Site Selection

The Halton District School Board (HDSB) and the Halton Catholic District School Board (HCDSB) were chosen as the study site for this research. These two school boards include the municipalities of Burlington, Halton Hills, Milton and Oakville in Ontario, Canada. Both boards have the same physical boundaries, but the HDSB administers the public school system and the HCDSB administers the separate (Catholic) school system. Please see Figure 5 for a map of the study site, which is highlighted in green (site #20).

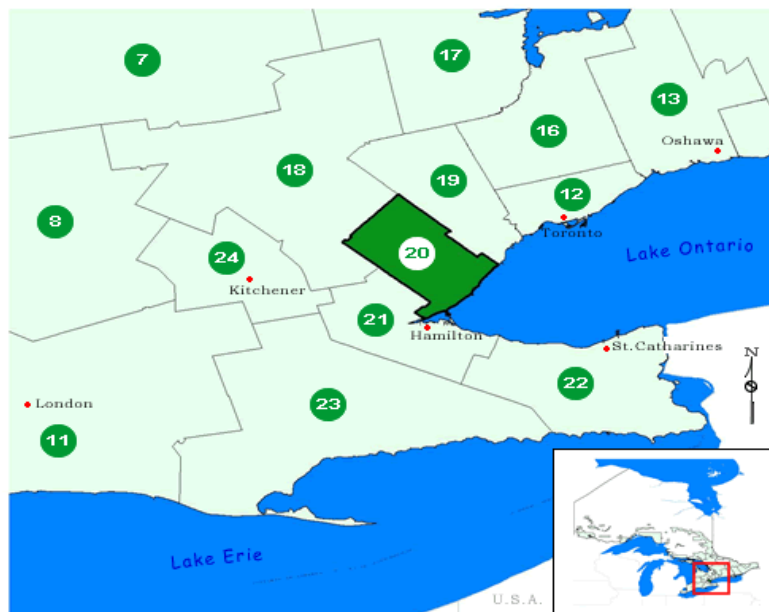


Figure 5 - Map of Halton District School Board and the Halton Catholic District School Board
Source: (Ontario Ministry of Education, 2003)

The site is located approximately 70 km southwest of Toronto, and has one of the fastest-growing populations in Canada. All the municipalities in the Halton School Boards have experienced growth well above the average level of urban growth in Ontario from 2001 to 2005: Burlington has grown by 9%; Halton Hills by 14.7%; Milton by 71.4%; and Oakville by 14.4% (Statistic Canada, 2007). This area is already home to various progressive energy programs that are being implemented by the local distribution companies (LDCs). Milton Hydro is recognized province-wide as a leader in energy conservation programs (OPA Conservation Bureau, 2007). In particular, the Energy Drill

Program™, implemented in partnership with IndEco Strategic Consulting Inc., has sought to engage schools and businesses in reducing energy usage during peak demand periods (Adamson, 2005).

The Halton District School Board has also recently launched the Conservation Education and Demand Management program. In this program, the Halton Learning Foundation has partnered with the LDCs in Burlington, Halton Hills, Milton, and Oakville to develop and implement strategies “that will result in significant reductions in electricity consumption within Halton schools” (Halton District School Board, 2007). This program will link conservation efforts to topics within the Ontario curriculum, and will endeavour to “identify and carry out actions that will realize savings both financially and environmentally” (Halton District School Board, 2007). This program was launched in addition to the implementation of the Ontario EcoSchools program in the HDSB and the HCDSB. The Ontario EcoSchools program is an environmental education program for Ontario elementary and secondary schools designed to focus on four key areas: waste minimization, energy conservation, school ground greening, and ecological literacy (York University, no date). Ontario schools can become EcoSchool certified by completing a standardized certification process in which schools must achieve designated benchmarks (York University, no date). Schools can be certified at the bronze, silver, and gold certification levels.

Keeping with the interest in progressive, environmental initiatives, Milton Hydro, the Halton District School Board, and the Halton Catholic District School Board expressed an interest in implementing solar PV projects on local schools. This presented a unique opportunity to examine the social acceptance of a proposed solar PV project. The existing connections among the Halton LDCs and the Halton school boards made for a cooperative atmosphere to organize and implement this research project. There was a high degree of stakeholder interest, which facilitated the data collection. As well, there already exists a positive working relationship between Milton Hydro and the Department of Environment and Resource Studies at the University of Waterloo. This research fits into an existing two-year project funded by the Ontario Centre for Energy.

Eight schools were selected to participate in Phase 2 of the thesis research. The schools were selected from both the Halton District School Board and the Halton Catholic District School Board. Initially, only four schools were intended to be included in the sample. However, in December 2007, the decision was made to increase the number of schools selected to participate was increased to eight to better represent the range of schools that exist in the Halton Districts. The process of selecting the participant schools will now be described in the paragraphs below.

The selected schools were geographically distributed in each of the municipalities in the Halton Districts. The eight schools are not statistically representative of all schools in the Halton School Boards, but do provide a cross section of the types of schools that are found in the Halton District School Boards, and therefore were selected as examples of ‘typical’ schools in the Halton District School Board and the Halton Catholic School Board. In other words, the sample was designed to include both high schools and elementary schools, Catholic and public schools, EcoSchools and non-EcoSchools, and schools from the large municipalities (>100,000 population) and schools from the small municipalities (<100,000 population). This purposive sampling of the schools “does not aim for formal representativeness. Locations are intentionally sought because they meet some criteria for inclusion in the study” (Palys, 2003, p. 142).

In addition to the University of Waterloo ethics procedures, the HDSB and the HCDSB each had separate ethics procedures that had to be completed and approved prior to any data collection. The researcher was required to demonstrate how the research will benefit the schools involved. Additionally, each school had the right to refuse to participate, even once the research project had been approved by the ethics boards. It was explicitly stated in the HDSB and HCDSB ethics documents that the research project must be approved by each individual school principal, and that each school retains the right to withdraw from participation at any time. Ethics approval was granted by the HDSB and the HCDSB on September 20, 2007 and September 25, 2007, respectively. Because of the additional restrictions placed on this research project by the stringent ethics

procedures, key administrative contacts at the HDSB and the HCDSB were used to initially identify four schools that would likely be enthusiastic about participating in this research project.

The process for selecting the schools to participate in the study was as follows:

1. Key administrative contacts at the HDSB and the HCDSB were asked to nominate two schools each (a total of 4 schools: two high schools and two elementary schools) to participate in this study.
2. An email was sent to the principals at each of the nominated schools by the board representative to introduce the project and the project researcher.
3. The researcher then sent a letter to each of the four school principals further explaining the project and what their participation would entail.
4. Once the principal responded affirmatively to participating in the project, the interview dates were determined, and the researcher was put on the agenda for an upcoming school council meeting.
5. If after receiving the email from the board representative and the email from the researcher, the principal had not replied to the request for participation, a follow up phone call was placed to the principal.
6. If the principal had not responded affirmatively after the two emails and the phone call, the key administrative contacts were asked to nominate a new school to participate in the study.

The schools were first contacted in November 2007. Two of the first four schools contacted agreed to participate and two schools declined to participate. Additional school recommendations were requested and made by the key administrative contacts, and a third school was found to participate. However, it became clear that the first three schools that agreed to participate in the research project were all EcoSchools. The two non-EcoSchools that had been nominated by the administrative contacts at the HDSB and HCDSB both declined to participate.

As mentioned, in December 2007, a decision was made to expand the number of schools included in the research project to eight, and to purposely include non-EcoSchools in the sample. The schools were selected to ensure that the range of schools in the Halton Boards were better represented by the schools in the study. The final sample (of eight schools) included the following characteristics:

1. Four certified EcoSchools and four non-EcoSchools
2. Four high schools and four elementary schools
3. Four schools from the HDSB and four schools from the HCDSB
4. Four schools from the larger municipalities (Burlington and Oakville), and four schools from the smaller municipalities (Milton and Halton Hills).

The four certified EcoSchools had achieved at least bronze certification at the time of the study. The recruitment process for all eight schools was the same as described above.

The four non-EcoSchools were selected according to the conditions identified above; however, there were many schools that fit the necessary selection criteria. From the pool of 125 schools that fit the listed criteria, the four non-EcoSchools were selected randomly. The HDSB and the HCDSB EcoSchools were removed from the pool of possible schools. As well, that schools that had already declined to participate in the research project were removed from the selection pool. The final sample of eight schools needed to include four EcoSchools and four non-EcoSchools, four high schools and four elementary schools, four schools from the HDSB and four schools from the HCDSB, and four schools from a larger municipalities and four schools from the smaller municipalities. As each school was (randomly) selected to participate in study, the pool of schools who fit the necessary criteria was reduced. For example, once four high schools had agreed to participate in the study, all other high schools were eliminated from the selection pool. The four non-EcoSchools that were approached at this point all agreed to participate in the research project.

The eighth and final school selected to participate in the study was a secondary school in the HCDSB. This school was not originally nominated by the key administrative

contacts, but was selected because it was the only secondary school that had achieved any level of EcoSchool Certification in the HCDSB.

Dividing the schools into the cohorts listed above allowed for comparisons to be made between the schools identified in each of the groups to determine if the identified school characteristics significantly affected survey and interview responses. The schools selected for this study are not statistically representative of all schools in the HDSB and the HCDSB. However, every effort was made to identify characteristics that would illustrate the range of schools in the HDSB and the HCDSB. Results from this research will only describe the particular schools included in the study. This may however point to trends that may exist, and will help to guide future research.

The four non-EcoSchools were selected in January 2008, and the choices were confirmed with representatives from the HDSB and the HCDSB, with the opportunity for the representatives to remove any of the selected schools from the list. No schools were vetoed at this point. The process for approaching the final four schools was done in the same way as described for the previous schools. All eight schools were recruited to participate in this research project between October 2007 and February 2008, and data collection was completed between November 2007 and April 2008.

The schools selected for the research project, in order of when the data were collected, are as follows:

1. T.A. Blakelock High School (Oakville) – certified EcoSchool
2. Guardian Angels Catholic Elementary School (Milton) – certified EcoSchool
3. Joshua Creek Public School (Oakville) – certified EcoSchool
4. E.C. Drury High School (Milton)
5. Lakeshore Public School (Burlington)
6. St. Catherine of Alexandria Catholic Elementary School (Halton Hills)
7. Notre Dame Catholic Secondary School (Burlington)
8. Christ the King Catholic High School (Halton Hills) – certified EcoSchool

Please see Appendix 4 for the ethics documentation submitted to the University of Waterloo Office of Research Ethics, the Halton District School Board, and the Halton Catholic District School Board for this phase of the thesis project.

3.2.2 Stakeholder Interviews

In each of the eight schools, interviews were requested with five key stakeholders: the principal, the vice principal, the head of the science department, the teacher in charge of any environmental activities in the school, and the head custodian. This purposive sampling of these five stakeholders was done because the Phase 1 results indicated these stakeholders would be the most important and informative to include in the sample. As Palys (2003, p. 143) indicates, this purposive sampling technique is particularly appropriate “in inductive, exploratory research where the researcher is trying to get a preliminary feel for the people or phenomenon being studied”. Every effort was made to interview each of the five identified stakeholders in each school; however, this was not always possible. Not all of the identified stakeholders existed in all of the schools, and some stakeholders were not available for interview or declined to participate. A total of 30 interviews were completed across the eight schools. Table 2 details the specific stakeholders interviewed at each school.

School Name	Stakeholders Interviewed	Interview Date
T.A. Blakelock Secondary School	Science teacher; environmental teacher; head custodian	November 22, 2007
Guardian Angels Catholic Elementary School	Vice principal; science teacher; environmental teacher	November 28, 2007
Joshua Creek Elementary School	Principal; vice principal; science teacher; environmental teacher	February 4, 2008
E.C. Drury High School	Principal; science teacher; environmental teacher; head custodian	February 13, 2008
Lakeshore Public School	Principal; environmental teachers (2); head custodian	February 19, 2008
St. Catherine of Alexandria Catholic Elementary School	Principal; vice principal; science teachers (2)	February 21, 2008
Notre Dame Catholic Secondary School	Principal; science teacher; environmental teacher; head custodian	February 25, 2008
Christ the King Catholic Secondary School	Principal; vice principal; environmental teacher; head custodian	February 27, 2008

Table 2 - HDSB and HCDSB Stakeholder Interviews

The interviews were conducted in-person, and were approximately 30 minutes in length. All the interviews were conducted in a private office with the door closed to ensure privacy. The interviews were recorded to ensure that key points raised were recorded accurately by the researcher. At the beginning of the interview, the interviewee was asked to fill out a one-page (double-sided) survey that was identical to the first page of the survey administered at School Council meetings (see Appendix 5). The survey had questions relating to demographic characteristics (seven questions), overall knowledge of energy technologies (seven questions), overall perceptions of different energy technologies (eight questions), and overall concerns about solar PV technology (14 questions). Following the completion of the survey, the interviewer began the interview portion of the data collection. The interviewees were first asked general questions about their position at the school, and their general opinions about the idea of a solar PV project being based at the school where they worked. Then, the interviewer presented the five school-based solar PV funding models (as described in Chapter 2) to the interviewee for evaluation. The interviewees were asked to evaluate the funding models in two ways: by

indicating on a Likert scale to what extent (if at all) their support for the school-based solar PV project would change if each of the five funding models were used to implement the project, and by ranking the five funding models from 1 (the most desirable) to 5 (the least desirable). The interviewees were also then asked 11 open-ended questions intended to evaluate the social acceptance of a school-based solar PV project. The question themes included further discussion about the five proposed funding models, other potential barriers that may affect the project, and the benefits and challenges of locating a solar PV project on a school. Please see Appendix 6 for a copy of the interview questions.

3.2.3 Stakeholder Survey

For each of the eight schools selected to participate in the research project, a stakeholder survey was administered at each school's School Council meeting. School Council membership includes parents and guardians of students, the principal, teachers, a student representative (student representation only present at the high school councils), a non-teaching school staff member as well as members from the community at large. Parents and guardians must make up the majority of council members (Halton Catholic District School Board, 2007; Halton District School Board, 2004).

The researcher was included on the agenda that was circulated in advance for each of the meetings. At each School Council meeting, the researcher gave a brief 15 minute verbal presentation introducing the research project, and also outlining the five potential funding models. The School Council members were then asked to complete a two page (double-sided) survey. The first page of the survey was identical to the one-page survey that the interview participants were asked to complete. As mentioned above, the survey contained questions about demographic characteristics (seven questions), overall knowledge of energy technologies (seven questions), overall perceptions of different energy technologies (eight questions), and overall concerns about solar PV technology (14 questions). In the second page of the survey, respondents were asked to evaluate the funding models by indicating on a Likert scale to what extent (if at all) their support for the school-based solar PV project would change if each of the five funding models were used to implement the project, and by ranking the five funding models from 1 (most

desirable) to 5 (least desirable). The survey also included 11 open-ended questions designed to allow the respondents to elaborate about their opinions and concerns about solar PV technology in general, the proposed funding models, and the implementation of a solar PV project on a school. See Appendix 5 for a complete version of the School Council survey.

The number of attendants at the eight School Council meetings ranged from three attendees to 20 attendees. At each meeting, the respondents were given approximately 20 minutes to complete the survey, and were asked to return the survey to the researcher immediately. This was done to ensure a higher response rate. With this personal contact, a response rate of 80 to 90 percent of the meeting attendees was expected (Palys, 2003, p. 151). However, if asked, a postage-paid, addressed envelope was provided by the researcher so that the respondents could return the survey by mail. This option was only offered if requested, as it could decrease the response rate significantly. As well, this format ensured that the researcher had some degree of control over the conditions in which the respondents filled out the survey, and was available if any clarifications were necessary.

The advantage of survey data collection is the fact that a relatively large data set can be collected reasonably cost-effectively (Palys, 2003, p. 152). As well, recruitment for participation did not need to be extensive because stakeholders were already in attendance at the regularly scheduled School Council meetings.

A total of 70 surveys were distributed across the eight School Council meetings, and 50 were completed. Forty-five of 45 (100%) surveys were returned when the School Council members agreed to complete the survey immediately during the time allotted for the School Council meeting, and 5 of 25 (20%) were returned when the participants asked to complete the survey at home and return it by mail. Table 3 identifies the number of completed surveys returned at each of the School Council meetings.

School Name	Total Completed School Council Surveys	School Council Date
T.A. Blakelock Secondary School	12	November 6, 2007
Guardian Angels Catholic Elementary School	8	December 3, 2007
Joshua Creek Elementary School	2	February 4, 2008
E.C. Drury Secondary School	4	February 7, 2008
Lakeshore Public School	6	February 25, 2008
St. Catherine of Alexandria Catholic Elementary School	3	February 4, 2008
Notre Dame Catholic Secondary School	7	February 25, 2008
Christ the King Catholic Secondary School	8	April 9, 2008

Table 3 - HDSB and HCDSB School Council Meetings

3.2.4 Data Analysis

There were both quantitative and qualitative data to analyze for Phase 2 of this thesis project. Both methods of data analysis will be described here.

The quantitative data were analyzed using SPSS, and were subjected to descriptive statistical tests. Frequencies and a chi-square test for independence were used to analyze the quantitative, Likert scale data. The Likert scale data are not expected to be normally distributed, but rather are categorical. As described by Siegel, et al (1988), chi-square test for independence is appropriate when “the researcher is interested in the number of subject, objects, or responses which fall into various categories” (Siegel & Castellan, Jr., N. John, 1988, p. 45). Specifically, the chi-square “may be used to test whether a significant difference exists between an *observed* number of objects or responses falling in each category and an *expected* number based upon the null hypothesis” (Siegel & Castellan, Jr., 1988, p. 45). However, it is important to note that the chi-square test results “should not be used if more than 20 percent of the expected frequencies are less than 5 or when any expected frequency is less than 1” (Siegel & Castellan, Jr., N. John, 1988, p. 49).

Frequency analysis shows the frequency of each response for each specific question, and shows the distribution of responses across the Likert scale. Frequency analysis will not identify if any observed differences between respondent groups are statistically significant, or simply due to chance. Therefore, the data were also subjected to the chi-square test for independence, which tests for independence between two variables by testing for differences between observed and expected frequencies in a contingency table. The null hypothesis for this statistical test states that the two variables are independent, and have no effect on one another.

As described above in Section 3.2.1, the respondents were distributed amongst four key categories: EcoSchool or non-EcoSchool, Catholic or public school, high school or elementary school, large city or small city. These categories were used as categories for analysis. The demographic data collected in Section 1 of the survey were used as categories for analysis as well.

The qualitative data for Phase 2 were collected in two different ways. They were collected from the interview respondents through semi-structured, open-ended questions. From the School Council survey respondents, the qualitative data were collected through written, short-answer, open-ended questions. In both cases, the qualitative data were reviewed, and key themes were recorded.

3.3 Overall Research Design Limitations

This thesis project was conducted in two phases. There are limitations associated with both Phase 1 and Phase 2.

For Phase 1, the most significant limitation is that the interview participants represented examples of *successful* projects. Any challenges or barriers that were identified by the interviewees were not significant enough to prevent the development of the solar PV project. It would have been useful to interview schools that attempted to install a solar PV project but were unsuccessful. This would have helped to identify the barriers that led to the failure of the project. This was recognized by the researcher and an attempt

was made to identify unsuccessful projects to investigate. However, these projects are difficult to identify, and it is even more difficult to identify participants who were involved in the projects. Several projects were identified that were successful in installing solar PV technology on school roof-tops, but were unsuccessful in having the technology hooked up to the electricity grid. However, all of these schools declined to be interviewed.

A second limitation is that the schools and organizations that were interviewed in Phase 1 are spread across a wide geographic area. However, it was not assumed that the results of Phase 1 interviews automatically applied to the Ontario case study. Instead, the results simply helped to focus the approach for Phase 2.

The limitations of Phase 2 of the thesis research will now be discussed. The most significant limitation of Phase 2 of the thesis project is that, because of the relatively small sample size, the results are not statistically representative. Statistically representative results could have been achieved by increasing the number of schools included in this research, and thereby increasing the number of research participants. However, due to time and resource constraints, this was not possible. The results of this research can only be used to describe the respondents of this thesis project. Every effort was made to include schools that represent the range of schools in the HDSB and the HCDSB, and to include stakeholders that have been identified as important when considering a school-based solar PV development. The results and analysis of this exploratory research point to possible wider trends that should be explored with further research.

Along the same vein, the HDSB and the HCDSB are not representative of all Ontario school districts. As discussed in section 3.2.1, the case study was chosen as the study site because of an existing working relationship between researchers at the University of Waterloo and representatives at the HDSB and HCDSB. These two school boards are also relatively progressive in implementing environmental and energy-related programs. Therefore, these two districts may be more enthusiastic and willing to implement a

school-based solar PV project than others in the province. Challenges, barriers and the overall social acceptance of school-based solar PV projects as identified in the HDSB and HCDSB cannot be directly generalized to other school districts in Ontario, let alone Canada. Again, the results from this exploratory case study will point to themes and trends that should be explored with further research.

As described in section 3.2.1, every effort was made to include schools in this research project that illustrated the range of schools that exist in the HDSB and the HCDSB. The four non-EcoSchools were selected randomly from a list of schools in the two school districts. However, due to the additional ethics procedures required by the HDSB and the HCDSB, schools that were not enthusiastic or interested in the idea of a school-based solar PV project were not likely to participate in this project. Each school principal retained the right to accept or decline participation. This limitation is demonstrated in the fact that two schools originally nominated by the HDSB representative declined to participate. These schools were not EcoSchools. In contrast, two schools that were randomly selected to participate, and agreed to participate, identified that they were in the process of becoming EcoSchool certified. This demonstrates that schools that have an environmental focus were more likely to participate in this research project. However, due to the constraints placed on researchers by the HDSB and HCDSB ethics procedures, it was necessary to accept this as a limitation of this project.

This research was designed to evaluate the social acceptance of a school-based solar PV project. However, there are other solar energy technology applications that can be implemented on schools. Solar PV technology was chosen specifically because this is the technology that is most frequently implemented when schools want to use the technology for educational purposes. However, because solar energy technologies are relatively new and unknown compared to other energy technologies, it is possible that some respondents were unaware of the differences between solar PV technology and solar thermal technology. The researcher tried to make explicit the difference between the two technologies, but it is possible that some confusion remained with some respondents.

The interview and survey respondents were asked to self-evaluate their level of knowledge of several different energy technologies. The self-reported level of knowledge, however, may not be an accurate measure of the actual level of respondent knowledge.

The interview and survey respondents completed the survey in the presence of the researcher. This may have resulted in some respondents answering some of the questions in a way that they believe would be viewed positively by the researcher. Every effort was made to avoid the introduction of bias into the interviews, both by careful consideration of the questions asked as well as by being aware of the verbal and non-verbal cues given during the interviews. As Palys (2003, p. 260) writes, “interviewees can be very attentive to cues that the interviewer emits, since they want to know whether they are doing well as participants”. To avoid influencing participant responses, the researcher made sure to appear busy organizing papers and reading notes while the respondent was completing the survey. Both interview and School Council respondents were also told that the survey and interview was anonymous, and that it was “not a test” and respondents would not be judged based on their answers. This was done in an attempt to reassure the respondents that the researcher was not scrutinizing their answers. However, the presence of the researcher may have influenced some respondents’ answers. Along the same vein, some disadvantages of a group administered survey can be that privacy may not be guaranteed if respondents are in close-quarters, and respondents sometimes did make comments out loud which may have influenced the data reported (Palys, 2003, p. 153). Finally, notwithstanding confidentiality, the interview participants may have been concerned about how their responses may impact their job position which may have affected some answers.

The researcher made every effort to ensure that the data were collected in the same way for each of the eight schools. However, at the request of the principals, two School Councils were given postage-paid envelopes to return the surveys. The researcher complied with this request as principal approval is necessary to be allowed to complete the data collection in each of the schools. Unfortunately, as expected, the response rate

for these two School Council surveys was significantly lower than the six School Councils that agreed to complete the surveys during the scheduled School Council meeting. However, interestingly, of the two schools that were given postage-paid envelopes, one School Council had a response rate of two out of 22 (10%), and the other had a response rate of three out of three (100%). This may be because at the second meeting, half of the respondents (three respondents) completed the survey immediately, which may have created some 'peer pressure' for the others to complete the surveys at home.

In recognizing these limitations, the researcher acknowledges the limits of the conclusions reached in this thesis. The limitations help to frame the research, and to identify the contributions it can make. These boundaries will also help to identify areas of future research, and will help to improve future study design.

The results from Phase 1 of the thesis research will now be presented in Chapter 4.

4 Phase 1 – Key Informant Interviews

4.1 Introduction and Rationale

School-based solar PV projects have not been studied from the perspective of social acceptance in the existing literature. The literature reviewed in Chapter 2 identified that the social acceptance of renewable energy projects can be a key barrier to the development and implementation of the project. According to the literature, the social acceptance of a project can be affected by aspects of the technology itself, the institutional barriers, and also the level of stakeholder involvement in the planning and implementation of the projects. However, none of the literature reviewed specifically relates to school-based solar PV projects. The social acceptance of school-based projects may provide a special case because of the educational aspect of the project, and the fact that children will be exposed to the project, which may raise some unique objections or concerns. To clarify the focus for the case study approach, key informant interviews were conducted with proponents of existing school-based solar PV projects. The purpose of the interviews was to get a more complete idea of what issues and barriers face existing school-based solar PV projects, and to confirm if the barriers suggested in the literature were borne out in actual school-based solar PV projects. Phase 1 also helped to identify key stakeholders to include in the development of school-based solar PV projects. This information was used in turn to develop the strategy for Phase 2 of the thesis research.

4.2 Methods

Nine key informant interviews were conducted to gain a better understanding of existing solar school projects. Potential research participants were identified through a broad-based online search for existing school-based solar energy projects. For practical reasons, only English-language projects were identified to participate in the thesis project. The online search identified that there were both individual schools as well as broader organizations pursuing school-based solar PV projects. Both individual schools and broader organizations were recruited to participate in this study. Local, national and international examples of school-based solar PV projects were identified for participation

in Phase 1 of the thesis project. Five solar school organizations, coded (S04), (S07), (S08), (S09), and (S10), and four individual schools, coded (I02), (I03), (I05), and (I06), participated in this phase of the thesis research.¹ Please see section 3.1 for a more detailed description of the method employed for Phase 1 of the thesis project.

4.3 Results

The semi-structured, open-ended interviews were designed to explore the motivation for pursuing the school-based solar PV projects, the goals the projects were designed to achieve, the challenges and barriers experienced while developing the projects, and what best practices and advice the project organizers would give to schools and organizations thinking of pursuing similar projects. The interviews were also designed to explore school-based solar PV project funding models. The broad interview themes and key results are summarized in Table 4 below. Results are listed in order of most frequently mentioned to least frequently mentioned in the nine interviews conducted, and the number of interviewees indicating the theme is also identified as an ‘n’ value in Table 4. The themes and key results listed in the table below were identified by both individual school interview participants and broader solar school organizations. There were some differences in how the interview participants qualified and explained their answers, which is discussed further in the text below. Each results sub-section below begins with a chart which summarizes interviewee responses for the section.

¹ All interviews were anonymous. Each interviewee is indicated with a numerical code and is also coded with either an ‘I’, indicating an individual school participant, or an ‘S’, indicating a broader solar school organization.

Interview Theme	Key Results
Motivations and Goals	<ul style="list-style-type: none"> • Student and youth education (n = 8) • Community and stakeholder education (n = 6) • Student and youth engagement and empowerment (n = 3) • Projecting a ‘green school’ image/philosophy (n = 3) • Economic motivations (n = 3) • Environmental motivations (n = 1)
Challenges and Barriers	<ul style="list-style-type: none"> • Getting and maintaining stakeholder (i.e., community members, parents, teachers, maintenance, and administration) support (n = 7) • Institutional barriers (e.g., dealing with regulatory bodies; complying with government regulations) (n = 4) • Fundraising (n = 4)
Best Practices and Advice	<ul style="list-style-type: none"> • Early and broad-based stakeholder involvement and support (n = 7) • Enthusiasm and (long-term) commitment from all stakeholders (n = 5) • Project champion (n = 3) • Make the project part of the school identity and focus (n = 2)

Table 4 - Phase 1 Interview Results: Themes

Each of the three themes identified in Table 4 will now be discussed in the sections below.

4.3.1 Motivations and Goals

Interview theme	Interviewees identifying the theme	
	Individual schools	Solar school organizations
Student and youth education	(I02), (I05), (I06)	(S04), (S07), (S08), (S09), (S10)
Community and stakeholder education	(I05), (I06)	(S04), (S07), (S08), (S09)
Student and youth engagement and empowerment	(I02)	(S04), (S08)
Projecting a ‘green school’ image/philosophy	(I03), (I05), (I06)	
Economic motivations	(I02), (I06)	(S08)
Environmental motivations	(I02)	

Table 5 - Phase 1 Interview Results: Motivations and Goals

The motivations and goals identified by the interviews include: student and youth education, engagement, empowerment; community and stakeholder education; projecting a ‘green school’ image and philosophy; economic motivations; and environmental motivations.

Overwhelmingly, the interviewees identified that education was the primary motivation for pursuing the school-based solar PV project. Eight of nine interviewees identified that education was a goal of the project, and most indicated that it was the primary goal of the project. As interviewee (I05) articulates, “the project was intended to be an educational tool.”

Students and youth were most often identified as the primary target of the educational uses of the solar PV project. It was identified by individual school interview participants and solar school organization interview participants that the technology could be used in conjunction with the curriculum (Interviewees I02, S04, I06, S07, S10). As interviewee (I02) notes, when the high school curriculum was revised to include environmental and energy related topics, the school was motivated to pursue the solar PV project because of the link to the curriculum. Interviewee (S07) stated that “they [the solar school organization] would like [teachers] to use live data from the solar project...in conjunction with the curriculum.”

While both groups of interviewees viewed the school-based solar PV project as primarily an educational project, the solar school organizations viewed the projects as an opportunity for broad-based education and awareness-raising beyond renewable energy issues. It was identified that locating a solar PV project on a school served as an educational tool to address other environmental and energy issues, such as climate change, conservation and energy efficiency. “Our goal was to infuse more renewable energy and energy efficiency into the curriculum of schools. This [solar PV project] would give the schools a boost. This project wasn’t just about renewable energy. We saw this as a way of making energy efficiency sexy” (Interviewee S09). Interviewee (S07) noted they “wanted these projects to prompt the schools and the school districts to look at the other places that energy is possibly being wasted and to make other changes” (e.g., efficient lighting, time of use goals). The individual school interviewees did not mention this as a potential use or benefit of the Solar School project. Instead, they were more focused on using the technology to educate about renewable energy technology.

The goal of many school-based solar PV projects was to educate administrators, teachers and community members about renewable energy and broader environmental issues. “The projects teach the students and the districts. You can build awareness from the ground up” (Interviewee S07). The projects were also intended to be a demonstration to the community of solar PV technology’s viability. “We are hoping that other people will see those panels, and say ‘oh, I can do that on my house’” (Interviewee S08). Visibility of the solar PV technology was identified as key to its educational impact on the wider community. “The community can drive by and see the panels” (Interviewee I05). “We also saw this as a learning opportunity for the communities, and we tried to place the arrays where they would be noticeable to parents and other community members” (Interviewee S09). “The renewable energy system is a visible reminder to everyone who comes to that school about renewable energy generation, and to think about energy in a new way” (Interviewee S04). Interviewee (S07) noted that “other energy projects (like efficiency projects) are more difficult to organize, and are not as visible. Because of the logistics, teachers and students get left out of the process of implementing a district-wide efficiency project. The efficiency projects do not raise environmental awareness in the schools.”

The solar PV projects were not only designed to educate students and youth; they were also designed to engage and empower youth. Locating the solar PV project on a school was intentional in order to target students and youth with the educational aspects of the project. Interviewee (S08) identified that the goal of the school-based project was “to showcase solar PV technology, with the goal to engage and inspire youth.” Interviewee (S04) stated that, “we thought that young people were the ones who should be engaged in the process of finding solutions [to environmental issues]. The goal of the project was to engage young people and to leave a legacy for future students and teachers so that it would become part of the curriculum structure.” Interviewee (I02) stated that by engaging students in the solar PV project, they “saw social spin-offs, such as student self-esteem, motivation, and self-confidence.”

Three of the four individual schools interviewed identified that they were motivated to pursue the school-based solar PV project because their school had adopted a 'green' focus or identity (Interviewee I03, I05, I06). "The school tries to have a green focus" (Interviewee I05). The solar PV project was pursued to further advance this broader goal. For some schools, the solar PV project helped to foster a 'green' focus for the school. "It became more than 'let's do these projects', it became a philosophy" (Interviewee I06). Schools also adopted solar PV projects because they wanted to "make a statement" and project an environmental image (Interviewee I03). The solar school organizations, however, did not identify that the school-based solar PV projects were motivated by a desire to project a green identity.

Economic motivations also were identified as a motivation for pursuing the solar PV projects by two individual schools interviewed, and by one of the solar school organizations. "We wanted to install a technology that would help to save money. If people are raising money, they want to know that there will be some kind of cost savings" (Interviewee I06). "Economically, we are saving 'X' number of dollars per month, and we have saved almost \$1000 in the two years that this project has been up and running" (Interviewee I02). It was also identified that energy savings from the solar panels could be reinvested into more solar panels for the schools (Interviewee S08).

Environmental motivations were explicitly identified as important by one of the individual school interviewees. "Environmentally, the data show that this school is cutting back on carbon dioxide emissions" (Interviewee I02). Environmental motivations for pursuing the project were implicit in many of the interviews, but many interviewees were realistic about the measurable impact their individual project was having in terms of energy consumption. It was identified that the greater environmental impact of the project could be had through increased education and awareness.

4.3.2 Challenges and Barriers

Interview theme		Interviewees identifying the theme	
		Individual schools	Solar school organizations
Getting and maintaining stakeholder support	Community members	(I03), (I05), (I06)	
	Teachers	(I06)	(S07), (S09)
	Administration	(I02), (I05), (I06)	(S07), (S09)
	Custodial staff	(I02)	(S04), (S07)
Institutional barriers (e.g., dealing with regulatory bodies; complying with government regulations)		(I02), (I05)	(S07), (S10)
Fundraising		(I02), (I03)	(S08), (S10)

Table 6 - Phase 1 Interview Results: Challenges and Barriers

The key challenges and barriers identified were getting and maintaining stakeholder support, institutional barriers, and project fundraising.

The primary challenge identified through the interviews was gaining and maintaining acceptance and support from the relevant stakeholders during the planning and implementation of the school-based solar PV project. The stakeholders identified throughout the interviews included: community members, school administration, teachers, custodial staff, and project partners.

As mentioned in section 4.3.1., community education was a goal of many of the solar school projects. In order to educate the community, many project organizers attempted to engage community members in the planning and implementation of the school-based solar PV project. However, in many cases, this was a significant challenge. “We decided that instead of a large scale project, we were going to look at small scale projects that were grassroots in nature. Trying to coordinate the community has been probably the biggest challenge” (Interviewee I06). Other project organizers identified that community engagement and participation in the project was a good idea, but was difficult to coordinate. “I think that it is something that we need to improve on in our project. I don’t think [the project] has reached enough people” (Interviewee I05).

Administrative support was also identified as a significant challenge and barrier. The solar school organizations identified that an unsupportive administration was a particularly difficult barrier to overcome. For example, one interviewee recounted how a project was downscaled, and almost cancelled when the administration of the school changed mid-project (Interviewee S09). “It is very important to make sure that the teachers and the administration of the selected schools are on-board with the project” (Interviewee S09). As Interviewee (S07) argues, “if you can convince a principal about a project, he can make it happen very fast”. In contrast, the individual schools interviewed identified that having a particularly supportive administration and school board particularly facilitated project development (Interviewees I02, I05, I06).

Teachers were also identified as key stakeholders; they are especially critical, because they are the ones who must deliver the educational message to the students. As Interviewee (I06) describes, “it has been a challenge to get the teachers on-board, and incorporating these projects in the curriculum. Teachers are busy and they have lots to do.” One solar school organization identified that it was critical that “the project needs teacher training. The organization wants to make sure that they really understand the project, so that the school can have ‘in-house’ experts” (Interviewee S07).

Maintenance and facilities personnel were the final stakeholders identified whose support (or lack thereof) was a significant challenge and barrier to the success of the project (Interviewees I02, S04, S07). “Facilities people often resist the installation of new technology because it may mean more maintenance responsibility” (Interviewee S07). “There was resistance from the facilities management. They were concerned about changes to the building, and were also concerned about students walking around on the roof” (Interviewee S04).

Stakeholder support and enthusiasm (or lack thereof) can be a key barrier to the development of a school-based solar PV project. However, the interviews also identified that maintaining support and enthusiasm for the project over time is also a significant challenge. “I am often concerned that partners and stakeholders do not have a long-range

view of the projects and that the project may fall victim to neglect as many did in the 80s and 90s. That's what we hope to do here – keep the discussion going to keep the teacher support in place so that the systems continue to be utilized as teaching tools” (Interviewee S10). Similarly, Interviewee (S09) notes that “some schools show great interest in the beginning, but then it drops off as the project moves forward”.

Many times initial support for the project exists, but after installation, the project is forgotten or is not utilized for educational purposes. “Since the installation of the project, the challenge has been trying to engage teachers to make curriculum modifications to involve the solar PV system” (Interviewee S04). As Interviewee (I03) further comments, “it has not been set-up [in the curriculum] and it has not been utilized the way that it could, or the way it was intended.” This challenge was most often cited by individual school interview participants. This challenge has also been recognized by the solar school organizations, and they have taken steps to encourage the further use of the solar PV technology for educational purposes. For example, one organization recommends, “to have an effective education component to the project, it helps to have a real education partner involved in the project” (Interviewee S09). Another organization maintains a website so that schools can compare solar PV data (Interviewee S07).

Besides the stakeholder challenges identified above, the interviews also revealed that there were institutional barriers to overcome while developing the school-based solar PV projects (Interviewees I02, I05, S07, S10). These included dealing with regulatory bodies, and complying with government regulations. For example, Interviewee (I02) described the challenges with dealing with the provincial/state utility board, and the difficulties experienced in filing paperwork and getting approval for their school-based project. Often, the institutional challenges existed because of a lack of experiences both on the side of the school and on the side of the government and regulators. “There was a steep learning curve for the people involved in the project” (Interviewee S08). “There is substantial red-tape for these projects” (Interviewee S10). As Interviewee (S07) describes, in his experience, the biggest resistance to these school-based solar projects comes from government officials at the provincial/state and local levels who are trying to

protect the utilities; the resistance does not necessarily come from the utilities themselves.

Obtaining funding for school-based solar PV projects was also identified as a significant challenge by both the individual school respondents and the solar school organizations (Interviewees I02, I03, S08, S10). As Interviewee (I02) identifies, fundraising was a major obstacle. “That [fundraising] was a difficult sell. But now that it is up and running, we have accomplished a lot of our goals” (Interviewee I02). Interviewee (S08) identified that it was difficult to raise the necessary funds, and was also difficult to keep the various funding partners happy. It was also acknowledged that the high cost of solar PV projects is a significant deterrent and barrier for the development of school-based solar PV projects. The projects require a large initial investment of capital. One interviewee identified that, “greening is great, but it has to make economic sense” (Interviewee I03). Interviewee (S10) identified that it is critical to ensure that ample resources were raised not only for the initial cost of the project, but also enough to support the project long-term.

Interestingly, one interviewee stated that project funding was not a significant barrier to the school-based solar PV project (Interviewee S07). However, this interviewee was the president of an organization that specifically funds solar school projects. Schools working with this organization are only required to fund-raise a fraction of the total project cost.

4.3.3 Best Practices and Advice

Interview theme	Interviewees identifying the theme	
	Individual schools	Solar school organizations
Early and broad-based stakeholder involvement and support	(I02), (I03), (I05), (I06)	(S04), (S07), (S09), (S10)
Enthusiasm and (long-term) commitment from all stakeholders	(I02)	(S04), (S07), (S09), (S10)
Project champion	(I06)	(S09), (S10)
Make the project part of the school identity and focus	(I06)	(S04)

Table 7 - Phase 1 Interview Results: Best Practices and Advice

The individual schools and solar schools organizations interviewed for this project were chosen because, despite any challenges or barrier identified, they were successful in planning and ultimately implementing a school-based solar PV project. Therefore, many of the interview questions were designed to learn what aspects of the projects particularly aided successful development. The best practices identified were: early and broad-based stakeholder involvement and support; having a project champion; making the project part of the school identity and focus; and getting and maintaining enthusiasm and commitment from all stakeholders.

Eight out of nine interviewees identified that early and broad-based stakeholder involvement and support was critical for project success (Interviewees I02, I03, S04, I05, I06, S07, S09, S10). The stakeholders identified in section 4.3.2. (i.e., community members, administrators, teachers, custodial staff) were all mentioned as important to include. “What we need from the school is the support of the principal, at least one teacher that is keen and interested, and we need a group of students who are willing to work on the project” (Interviewee S04). As Interviewee (I06) identified, “you have to have a lot of people behind you. You have to have your community behind you. That’s absolutely essential.” Interviewee (I02) continues: “all stakeholders need to be involved in the planning of the project right from the get-go. Everyone has a stake in what we are doing.” “Involve as widely as possible in the planning of what exactly is going to happen with the project. Identify everyone that you want to be involved, and identify how it is going to be integrated in the school community. Everything about the project should be widely discussed in the school community prior to the beginning” (Interviewee S04). Some projects that did not specifically try to engage and include the wider community in the project recognized that it could be beneficial to do so. “If you could get community support for the project, I think that you would have better administrative support” (Interviewee S09).

Teacher and administrative support for the project was identified as a key aspect to many successful projects (Interviewees I02, I05, I06, S07, S09). “It is important to make sure

that the teachers and the administration of the selected schools are on-board with the project” (Interviewee S09). The facilities and maintenance personnel were specifically mentioned as an important stakeholder to include in the discussions (Interviewees S04, S09).

Early stakeholder involvement and support was also identified as a way to ensure ongoing enthusiasm and commitment to the project. “Teachers leave, I’ll leave, but the parent group is the one that will carry this on. If the project is based on only one person, once that person is gone, the project is over. You have to make sure you have a legacy, and it will continue beyond one person” (Interviewee I06). As Interviewee (S04) notes, “looking back, engaging the community and students in the fundraising for the project is a good idea. It is just one more way to ensure commitment to the process and the [solar PV] system”.

However, although involving a broad-base of stakeholders in the school-based solar PV is recognized as key for project success, it is also recognized that it is beneficial to have a project champion directing the project (Interviewees I06, S09, S10). As one interviewee from a solar school organization describes, “key for the program is to have a champion teacher who is really involved, and who will really take it to their students and other teachers” (Interviewee S09). The key, some interviewees argue, is to have a strong project champion, but allow other stakeholders to be involved in the project planning and implementation. “The charismatic leader is instrumental, but they can’t do it all” (Interviewee I06). “It is very important to have a teacher champion, and it is helpful to have more than one teacher training in solar PV technology, so that if the one teacher leaves there is still someone who understands the system” (Interviewee S09). It seems that a project champion is necessary to organize the project and to help direct and maintain stakeholder enthusiasm. However, if the project champion is the *only* driving force for the project, it seems more likely that challenges in maintaining the project in the long-term may arise.

The interviewee also identified that making the project part of the school's identity and focus is critical. "[To be truly effective], the school must consider the installation to be a focal point and priority for development. If the school makes it a priority, and makes it part of its self-concept, it can transform awareness. If it is just something cool, but not fundamental to how the school functions, [it is not as effective]" (Interviewee S04). One of the individual school interviewees identified that the project is a huge focus for the school, and is incorporated into the curriculum at every grade level, and is part of the philosophy of the school (Interviewee I06). The idea of making the solar PV project part of the focus for the school ties into the recommendation from the majority of the solar schools organizations that it is very important to select schools that are enthusiastic about the solar PV installation (Interviewee S07, S09). As Interviewee S07 notes, "If you don't really want to do the project, then even if it is free, don't take it" (Interviewee S07).

4.3.4 Funding Models

Through the review of existing school-based solar PV projects, and through the Phase 1 interview responses, it became clear that there were five distinct sources of project funding (as described in Section 2.4). Typically, projects would use a combination of two or more of the five funding models to fund a single project. However, in this thesis for comparative purposes, the models were described as distinct choices in order to isolate aspects of each of the five funding models that potentially affect the social acceptance of the school-based solar PV project as a whole

The five distinct funding models were: renting school roof-space, corporate sponsorship, community fundraising, community co-operatives, and government/utility programs. These five models represent the range of ways funding is found for school-based solar PV projects, and as mentioned above, combinations of the models are possible to fund individual projects.

All of the interviewees were asked how each of their projects were funded, and were asked why the projects were funded in this way. They were also asked if various funding models were considered before a selection was made. Each interviewee described how funding was raised for their specific project. It was typically identified in the interviews

that different funding models were not considered prior to beginning the project. Schools typically were willing to raise funds from wherever they were most readily available (due to time or resource constraints), and did not think that *how* funding was raised would have an effect on the success of the project. As Interviewee (S07) identified, “all the different funding models work. Different models work for different schools”.

However, project fundraising was identified by the interviewees as a significant barrier to the development of the project, particularly by the individual school projects (Interviewees I02, I03, S08, S10). The solar school organizations typically helped provide partial funding for the school-based solar PV projects, but did acknowledge that fundraising was a challenge for the schools involved. .

4.3.5 Schools that Declined to Participate

The individuals who declined to participate in this study provided some unexpected insight into the importance of this thesis project. As mentioned in section 3.1, 17 invitations to participate in this thesis project were sent out. Nine individuals agreed to participate. However, interestingly, three of the eight individuals who declined to participate (all were principals of identified solar schools) declined because they were unaware that there was a solar PV installation on their school. In all three cases, there was documentation to confirm that the installation existed. This indicates that the solar PV projects were paid for and installed, but then basically forgotten about. It was not possible to confirm if the solar PV system was hooked up to the electricity grid, or perhaps was charging a battery. Nevertheless, the installations were not being used for educational purposes (at least to the knowledge of the school principals), and were not effectively raising awareness about environmental or energy issues.

4.4 Discussion

The results as presented above in section 4.3 provide insight as to the characteristics that aid or impede the planning and implementation of school-based solar PV projects, as well as how, in practical terms, the projects are funded and implemented. The implications of these results are discussed below.

The primary goal of the school-based solar PV projects interviewed for this research was overwhelmingly to educate both students and the wider community. It was identified in the interviews that the solar PV technology could be used in conjunction with the curriculum, but also could be a demonstration project that could help to educate the wider community. Despite this being a major justification for the school-based solar PV projects, it was identified that it was challenging to use the installed solar PV technology effectively as an educational tool. As identified in section 4.3.2, it was a significant challenge to get teachers to use the technology in conjunction with the curriculum. This corresponds to the findings in the literature examining the teacher's acceptance of technology in the classroom. Similarly, some of the interviewees identified that engaging the wider community in the project was often difficult. It was explicitly identified by Interviewee (I03) that once the technology was installed, interest in the project waned and was not used for educational purposes as originally intended. As demonstrated in Section 4.3.5, some schools have successfully raised funds and installed a solar PV project on their school only to essentially forget about the installation once the project was complete.

The interviewees who participated in this research identified that the main motivation for the solar school project was to use the technology for educational purposes. However, many are not used effectively for that purpose. In fact, the projects that participated in this research were not specifically planned to maximize the educational benefit of the installation. For example, none of the individual schools that were interviewed for this project had specific plans as to how to use the technology with the curriculum (even after the project had been installed), and none had any educational outreach programs to help educate the wider community. Community and stakeholder education was mentioned by six interviewees as a motivation for pursuing the project, but three identified that placing the solar PV technology in a location that was visible to the community was the extent of the community outreach and education effort.

The fact that the educational aspects of the projects were challenging to implement effectively was recognized by many of the interviewees. Some identified it as an area for improvement for the project. However, others suggested that the early involvement of key stakeholders (identified as the community members, school administration, teachers, and custodial staff) could help to create ‘buy-in’ and a sense of ownership for the project. This could improve both the likelihood of successfully installing the solar PV technology, and it was acknowledged, could potentially improve the educational impact of the project. In fact, the solar school organizations did recognize that it was very important to couple solar school projects with educational programs specifically designed to take advantage of the unique educational opportunity afforded by having solar PV technology installed on school grounds.

Early and broad-based stakeholder involvement was a theme that was apparent in the interviews with both the individual schools and the solar school organizations. The interviewees identified that this was a significant ‘best practice’ and that key stakeholders should be involved in the planning and implementation of the project as early as possible. As mentioned above, the interviewees identified that early stakeholder involvement can help to create a sense of ownership for the project, and can help to create momentum when first trying to implement a school-based solar PV project. As well, as identified in section 4.3.3, the involvement of many stakeholders helps to ensure the longevity of the project (i.e., the success of the project does not depend on just one person). However, as reported in the interviews, the early involvement of key stakeholders was viewed as a way to facilitate the installation of the project, not as a strategy to improve the educational impact of the project.

The interviewees were also asked to describe how funding was raised for each project. As described in Section 4.3.4, there are a variety of possible funding models. However, when probed as to *why* a specific funding model was chosen for the project, the interviewees typically did not have specific reasons as to why one funding model was chosen over another. In fact, many interviewees commented that they had not considered other funding models, and simply raised the money in whatever way would raise the

capital needed in the least amount of time. Despite this ‘path-of-least-resistance’ approach to project funding, fundraising was still identified as a significant barrier to project development.

Inherently, as described in Section 2.4, some of the funding models allowed for greater stakeholder participation in the planning and implementation of the project than others. For example, the community fundraising model involves community at a minimum through the solicitation of donations, whereas the government or utility program does not require extensive stakeholder participation to raise the necessary funds. The early involvement of stakeholders was emphasized as a critical way to improve the chance of project success. However, it is very interesting that how the projects were funded was not considered by the interviewees as an aspect of the project that could affect the level of stakeholder involvement.

As mentioned in Section 4.3.5, the discovery of solar PV installations that have been installed and ostensibly forgotten (that is, are not producing electricity or used as an educational tool) demonstrates that simply successfully installing a project on a school roof-top does not guarantee that the solar PV technology will be used for educational purposes, let alone to produce electricity. To achieve the educational goals identified by project organizers, school-based solar PV installations must be used to produce electricity and to educate students and community members long after the excitement of the initial installation has passed. This reinforces the idea that how a school-based solar PV project is funded and implemented, and what role key stakeholders play in the planning, installation and maintenance of the project can drastically affect the success of the project.

4.4.1 Formulation of Case Study Approach

The interviews that were conducted as part of phase 1 of this thesis project were intended to inform the design of the case study in the Halton District School Board and the Halton Catholic District School Board, to be carried out in phase 2. Based on the results and discussion in Section 4.3 and Section 4.4, three key observations were made:

4. Key stakeholders for school-based solar PV projects (as identified by Phase 1 interviewees) are: community members (including parents), school administration (including the principal and vice principal), teachers (particularly those potentially using the installation in conjunction with the curriculum), and custodial staff.
5. Stakeholder acceptance and support contribute to project success (i.e., installing solar PV technology on school grounds and using the technology for educational purposes).
6. Early and broad-based stakeholder involvement may improve the social acceptance of school-based solar PV projects.

The Phase 1 interviews revealed that stakeholder acceptance has been identified as important for the successful implementation of a project. It was also suggested that early and broad-based stakeholder involvement could help to mitigate some of the objections stakeholders may have concerning a specific installation, as well as potentially improve the educational impact of the project. However, the interviews did not reveal what aspects of the school-based solar PV project may positively or negatively affect stakeholder acceptance once the stakeholder has been involved in the project. As suggested by the literature review in Chapter 2, social acceptance of renewable energy projects can be affected by perceptions of the technology itself, or by how the project is introduced and implemented in the community, including how the project is funded. How a school-based solar PV project is funded inherently changes the role each stakeholder plays in the planning and installation of the project, and also changes the extent to which each stakeholder can be involved. As mentioned in Chapter 2, the funding model chosen to develop a school-based solar PV project could have a significant impact on the social acceptance of the solar PV installation as a whole.

Therefore, the case study was designed to examine what aspects of a school-based solar PV project affect the social acceptance of the project in the Halton District School Board (HDSB) and the Halton Catholic District School Board (HCDSB). As described in section 3.2, eight schools were selected from the HDSB and the HCDSB. The key stakeholders (as identified through Phase 1 interviews) in each of the schools were asked

to evaluate a potential school-based solar PV project. The interviews and surveys were designed to evaluate the respondents' perception of solar PV technology itself, as well as the five funding models (as identified in Section 2.4). Both the stakeholder interviews and surveys contained open-ended questions to try to capture any unanticipated factors that may affect the social acceptance of a school-based solar PV project. Phase 2 results will now be presented in Chapter 5.

5 Phase 2 – Case Study Results

The results from Phase 2 of the research project will now be presented. It should be noted that no analysis of these results will be completed at this point. The analysis of the results will be presented in Chapter 6.

Section 5.1 is an overview of the methods used to collect the data for Phase 2 of the thesis project. Section 5.2 describes the profile of the Phase 2 respondents. In Section 5.3, the respondents' perceptions of solar PV technology are presented. In Section 5.4, the respondents' perceptions of the five funding models are described.

5.1 Methods

As discussed previously in Section 3.2, the stakeholders selected to participate in this study were not selected randomly. As per the key informant interviews, a purposive sampling technique was used. The key stakeholders selected to participate in the study were: school administration (including both the principal and vice principal), teachers, custodial staff, parents and community members. Respondents were asked to fill out a one-page (double-sided) survey. The principal, vice principal, teachers and custodial staff were asked to complete the survey as the first part of an approximately 30-minute interview (subsequently referred to as “stakeholder interviews”). Due to time and resource constraints, this same method could not be undertaken with parents and community members. Therefore, the researcher attended School Council meetings and asked the members of the School Councils to fill out the same one-page (double-sided) survey administered during the interviews. Then, School Council members completed 11 open-ended survey questions, which covered similar themes to the questions asked during the stakeholder interviews. The qualitative data were used to provide context and depth to the quantitative answers presented in this chapter, and will be more extensively used for discussion in Chapter 6.

A total of 80 surveys were completed, 30 during the stakeholder interviews and 50 during the School Council meetings. However, only 79 surveys were included for analysis. One survey was rejected because the respondent was less than 18 years old at the time of

completing the survey and therefore had to be excluded to comply with the University of Waterloo, Halton District School Board (HDSB) and Halton Catholic District School Board (HCDSB) ethics requirements. Figure 6 identifies the distribution of respondents among the stakeholder groups. The respondents that make up the “School Council Members” include parents and community members. Teachers and administrative staff who were in attendance at the School Council meeting did not complete the stakeholder survey, as this cohort of respondents completed a survey during the stakeholder interviews. The data from the 79 valid respondents will now be presented below.

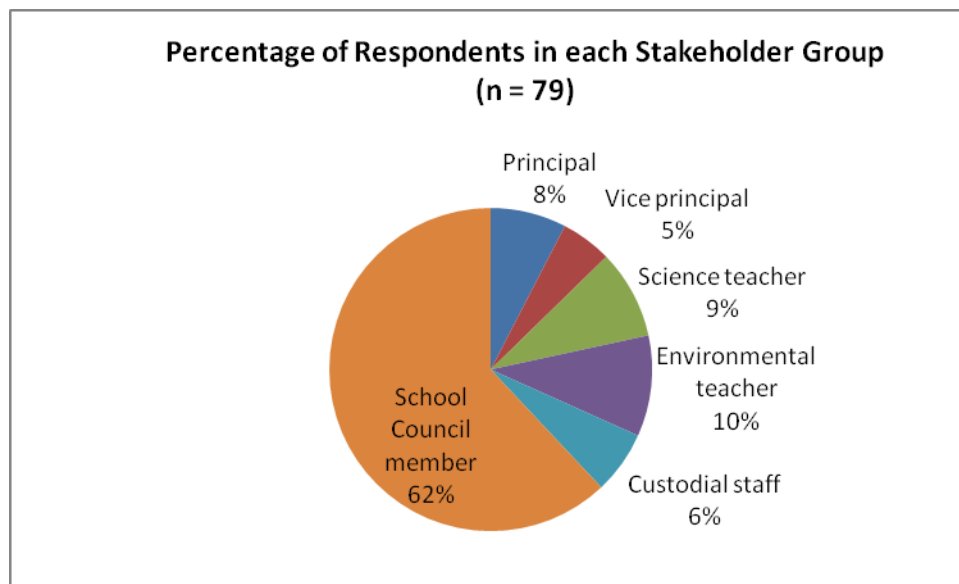


Figure 6 - Percentage of Respondents in each Stakeholder Group (n = 79)

5.2 Profile of Respondents

As discussed in Section 3.2.1, eight schools were selected from across the HDSB and HCDSB to provide a cross-section of the range of the schools in the two districts. Schools were selected to ensure a particular range of schools in the study sample. The study sample included both: EcoSchools and non-EcoSchools (Figure 8); Catholic schools and public schools (Figure 9); high schools and elementary schools (Figure 10); and schools from both large municipalities (population > 100,000) and small municipalities (population < 100,000) in the HDSB and HCDSB (Figure 11). The distribution of respondents across the categories is represented below in a series of pie

charts. The graphs show the distribution (as a percentage of the total respondents) across the four categories identified above, as well as across the eight schools that participated in the thesis research (Figure 7).

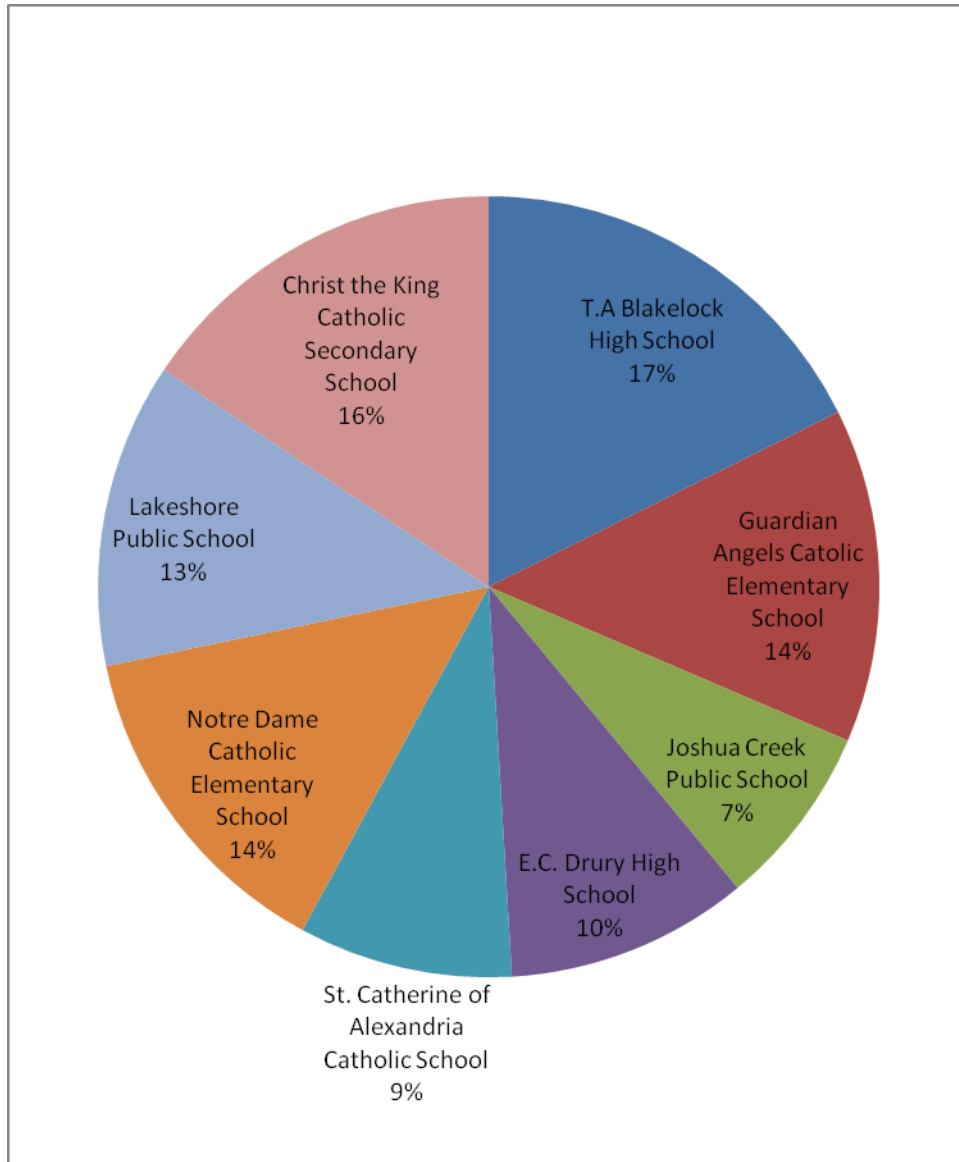


Figure 7 - Percentage of Respondents from each Participant School (n = 79)

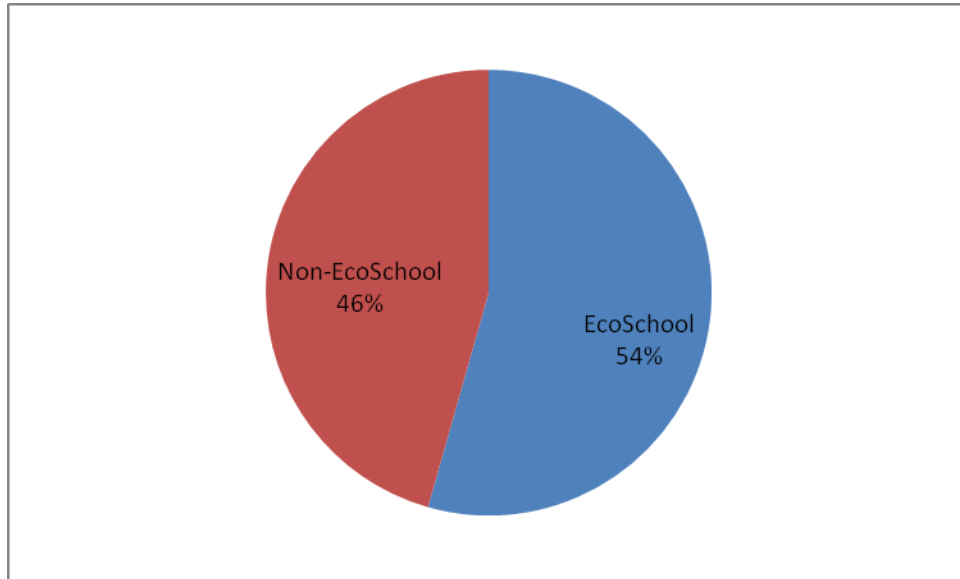


Figure 8 - Percentage of EcoSchool or non-EcoSchool Respondents (n = 79)

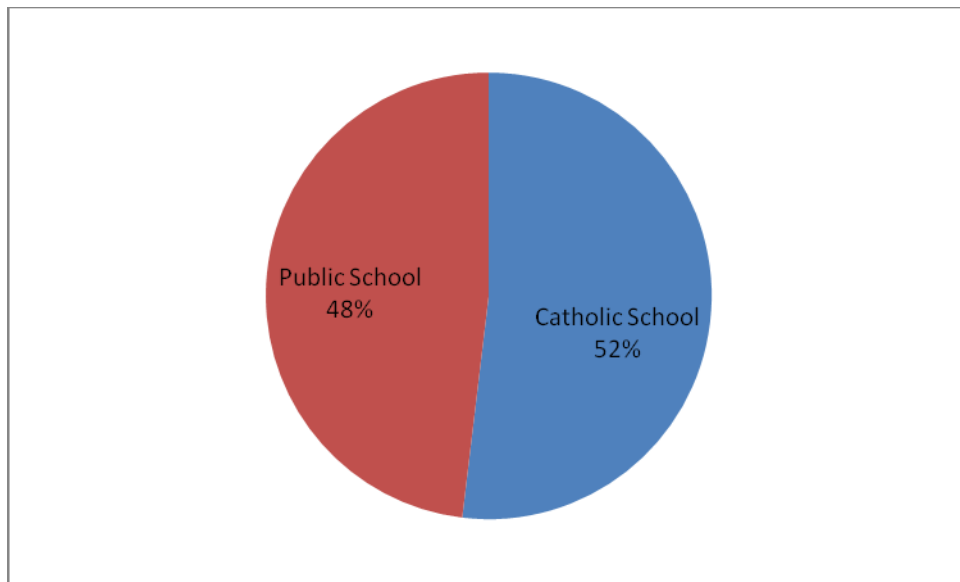


Figure 9 - Percentage of Catholic or Public School Respondents (n = 79)

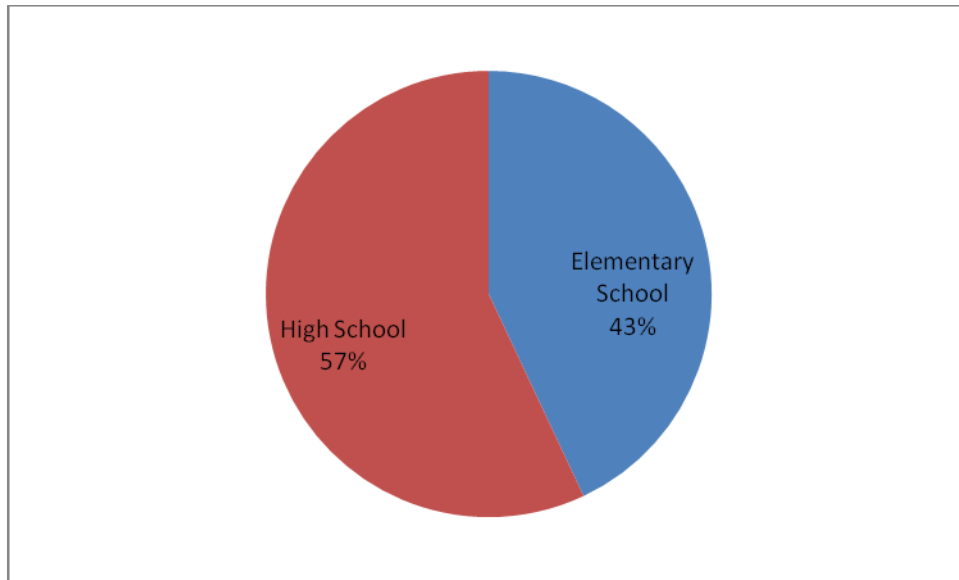


Figure 10 - Percentage of Elementary or High School Respondents (n = 79)

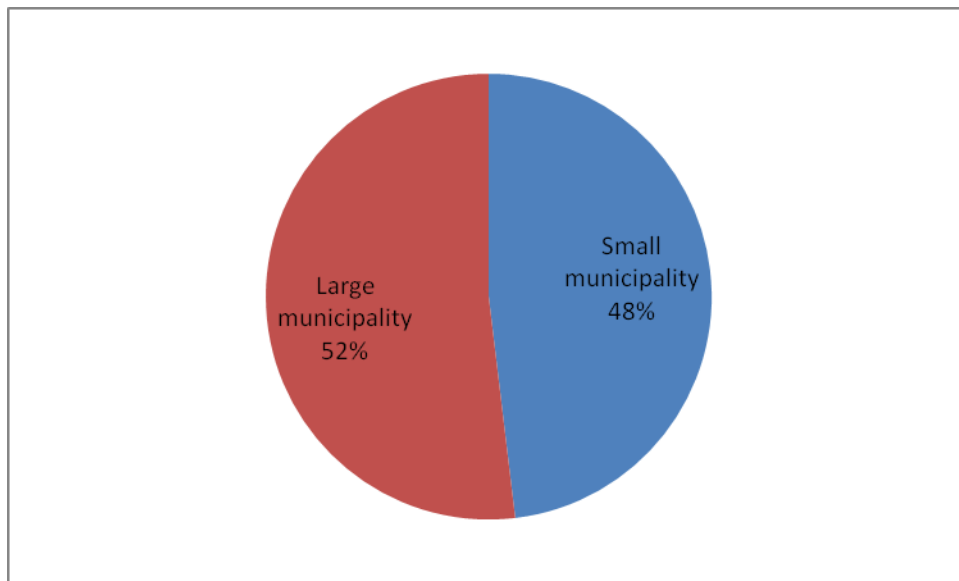


Figure 11 - Percentage of Small Municipality or Large Municipality Respondents (n = 79)

The respondents within each of the categories identified above were also asked to report demographic data as part of the one-page survey. The demographic data that they were asked to identify were: age; gender; income; highest level of education achieved; whether the respondent has children who attend (or who have attended) school in the HDSB or the HCDSB; distance respondent lives from the school; and length of time living in the area.

As mentioned above, the participants in this study were not selected randomly from the population of the Halton region, and therefore are not necessarily representative of the larger population. The demographic characteristics are not expected to match the demographic make-up of the Halton District School Board (HDSB) and the Halton Catholic District School Board (HCDSB), nor of the broader communities in which these boards are located. However, demographic characteristics were collected in Section 1 of the survey for analysis purposes, and are useful to understand the profile of the study participants. The demographic profile of the respondents is reported in Table 8.

	All respondents	Interview respondents	School Council respondents
What decade were you born?	Total valid responses: 75 1940s – 2.6% (2) 1950s – 28.2% (22) 1960s – 48.7% (37) 1970s – 15.4% (13) 1980s – 1.3% (1)	Total valid responses: 28 1940s – 0% (0) 1950s – 28.6% (8) 1960s – 50.0% (14) 1970s – 17.9% (5) 1980s – 3.6% (1)	Total valid responses: 47 1940s – 4.3% (2) 1950s – 29.8% (14) 1960s – 48.9% (23) 1970s – 17.0% (8) 1980s – 0% (0)
Are you female or male?	Total valid responses: 78 Male – 34.6% (27) Female – 65.4% (51)	Total valid responses: 30 Male – 53.3% (16) Female – 46.7 (14)	Total valid responses: 48 Male – 22.9% (11) Female – 77.1% (37)
What is the highest level of education that you have completed?	Total valid responses: 77 High School – 10.3% (8) College/University – 56.4% (44) Post-graduate degree – 32.1% (25)	Total valid responses: 29 High School – 3.4% (1) College/University – 48.3% (14) Post-graduate degree – 48.3% (14)	Total valid responses: 48 High School – 14.6% (7) College/University – 62.5% (30) Post-graduate degree – 22.9% (11)
What was your household's income last year?	Total valid responses: 67 Less than \$40K – 3.8% (3) \$40K - \$60K – 5.1% (4) \$60K - \$80K – 11.5% (9) \$80K - \$100K – 14.1% (11) \$100K - \$120K – 10.3% (8) More than \$120K – 41.0% (32)	Total valid responses: 26 Less than \$40K – 3.8% (1) \$40K - \$60K – 7.7% (2) \$60K - \$80K – 23.1% (6) \$80K - \$100K – 11.5% (3) \$100K - \$120K – 11.5% (3) More than \$120K – 42.3% (11)	Total valid responses: 41 Less than \$40K – 4.9% (2) \$40K - \$60K – 4.9% (2) \$60K - \$80K – 7.3% (3) \$80K - \$100K – 19.5% (8) \$100K - \$120K – 12.2% (5) More than \$120K – 52.2% (21)
Do you have children who attend (or who have ever attended) schools in the HDSB or HCDSB?	Total valid responses: 78 Yes – 74.4% (59) No – 24.4% (19)	Total valid responses: 29 Yes – 48.3 (14) No – 51.7% (15)	Total valid responses: 49 Yes – 91.8% (45) No – 8.2% (4)
How far away do you live from [name of specific school]?²	Total valid responses: 78 < 1km – 19.2% (16) 2-3km – 29.5% (23) 4-5km – 7.7% (6) > 5km – 42.3% (33)	Total valid responses: 29 < 1km – 0.0% (0) 2-3km – 13.8% (4) 4-5km – 10.3% (3) > 5km – 75.9% (22)	Total valid responses: 49 < 1km – 32.7% (16) 2-3km – 38.8% (19) 4-5km – 6.1% (3) > 5km – 22.4% (11)
How long have you lived in this area?	Total valid responses: 78 < 1yr – 2.6% (2) 1yr – 3yrs – 7.7% (6) 3yrs – 5yrs – 15.4% (12) > 5 yrs – 73.1% (57)	Total valid responses: 29 < 1yr – 3.4% (1) 1yr – 3yrs – 6.9% (2) 3yrs – 5yrs – 6.9% (2) > 5 yrs – 82.8% (24)	Total valid responses: 49 < 1yr – 2.0% (1) 1yr – 3yrs – 8.3% (4) 3yrs – 5yrs – 20.4% (10) > 5 yrs – 67.3% (33)

Table 8 - Demographic Characteristics of Respondents³

² An error was noticed on the surveys after the data collection had taken place. The ranges of 1km-2km and 3km-4km were not represented as possible response options. However, the response rate for this question was very high (98.7%), and therefore it is assumed that respondents selected the response option that *most closely* represented the distance they live from the particular school.

³ Percentages are reported as a percentage of the total valid respondents in each category and were rounded to one decimal point. This rounding may mean that the percentages do not add up to 100%. The frequency of each specific response is included in brackets following the percentage. In the 'interview respondents' and 'school council respondents' columns, the percentages are reported as a percentage of *total valid interview respondents* and *total valid school council respondents* respectively.

5.3 Perceptions of Solar PV Technology

Section 2 of the survey was designed to evaluate respondents’ knowledge (Section 2(A)), attitudes (Section 2(B)) and opinions (Section 2(C)) about solar PV technology in general. School-based projects were not mentioned as the researcher wanted to focus on respondents’ knowledge, attitudes, and opinions about solar PV technology itself, regardless of the application. A Likert scale was given for each question, and respondents were asked to circle the appropriate response. Table 9 below identifies the possible Likert scale responses for each question.

Theme	Possible responses
Section 2(A) – Knowledge	1 – None 2 – Below Average 3 – Average 4 – Above Average 5 – Expert
Section 2(B) – Attitudes and Perceptions	1 – Strongly Negative 2 – Negative 3 – Neutral/No opinion 4 – Positive 5 – Strongly positive
Section 2(C) – Opinions and Concerns ⁴	1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree

Table 9 - Possible Likert Scale Responses for Section 2 of Survey

Prior to reporting and analyzing the data, the following decision rules were applied to the survey responses to clean the data:

1. If no response was circled for a question, no response was recorded (n = 93, 20 surveys had one or more question left blank).
2. If two Likert scale numbers were circled for a question (e.g., the respondents circled both 2 and 3 for one question), no response was entered as it was not possible to interpret why two answers were given (n = 4, four surveys had one question with two answers circled).

⁴ No “Neutral/No opinion” option was given for “Section C – Opinions” because the researcher wanted to identify the intensity respondents agreed or disagreed with each specific statement, and wanted to avoid a high frequency of “Neutral/No opinion” responses. A further discussion of this strategy can be found in (Presser & Schuman, 1989). However, this design decision had an effect on the response rate for Section C – Opinions, and in the future the researcher would include a “Neutral/No opinion” option on similar survey questions.

The data collected in Section 2 of the survey will now be reported in Tables 10, 11 and 12 below. The results are reported as a percentage of the total number of responses (i.e., 79 respondents). The frequency of each response is reported in brackets following the percentage. As mentioned in Section 5.1, 79 valid surveys were submitted for analysis; however due to the decision rules identified above, there are not always 79 valid responses for each question below.

Section 2(A) – Knowledge

Please **CIRCLE** the number indicating your level of knowledge of the following topics:

	1 (None)	2 (Below average)	3 (Average)	4 (Above average)	5 (Expert)	Mean	Median
Global climate change (n = 79)	0.0% (0)	6.3% (5)	54.4% (43)	39.2% (31)	0.0% (0)	3.33	3
Energy issues (e.g., supply, demand, production, conservation) (n = 79)	0.0% (0)	10.1% (8)	53.2% (42)	34.2% (27)	2.5% (2)	3.29	3
Energy system issues (e.g., grid reliability, peak energy demand) (n = 79)	2.5% (2)	24.1% (19)	54.4% (43)	17.7% (14)	1.3% (1)	2.91	3
Conventional energy technologies (i.e., coal, nuclear, hydro) (n = 79)	2.5% (2)	12.7% (10)	60.8% (48)	22.8% (18)	1.3% (1)	3.08	3
Solar photovoltaic (i.e., solar electric) (n = 79)	7.6% (6)	29.1% (23)	49.4% (39)	12.7% (10)	1.3% (1)	2.70	3
Wind energy technology (n = 79)	3.8% (3)	31.6% (25)	46.8% (37)	16.5% (13)	1.3% (1)	2.80	3
Biomass energy technology (n = 79)	24.1% (19)	40.5% (32)	31.6% (25)	3.8% (3)	0.0% (0)	2.15	2

Table 10 - Section 2(A) Responses

Section 2(B) – Attitudes and Perceptions

Please **CIRCLE** the number indicating your perception of the use of the following technology:

	1 (Strongly Negative)	2 (Negative)	3 (Neutral/No opinion)	4 (Positive)	5 (Strongly Positive)	Mean	Median
New technology in general (n = 79)	0.0% (0)	0.0% (0)	19.0% (15)	58.2% (46)	22.8% (18)	4.04	4
Conventional energy technology in general (n = 79)	1.3% (1)	17.7% (14)	45.6% (36)	35.4% (28)	0.0% (0)	3.15	3
Nuclear power plants (n = 79)	3.8% (3)	24.1% (19)	34.2% (27)	34.2% (27)	3.8% (3)	3.10	3
Coal power plants (n = 79)	22.8% (18)	50.6% (40)	24.1% (19)	2.5% (2)	0.0% (0)	2.06	2
Hydro dams (n = 78)	1.3% (1)	11.5% (9)	33.3% (26)	46.2% (36)	7.7% (6)	3.47	4
Wind turbines (n = 79)	0.0% (0)	0.0% (0)	10.1% (8)	49.4% (39)	40.5% (32)	4.30	4
Solar photovoltaic panels (n = 79)	0.0% (0)	0.0% (0)	12.7% (10)	49.4% (39)	38.0% (30)	4.25	4
Biomass energy technology (n = 77)	0.0% (0)	0.0% (0)	67.5% (52)	20.8% (16)	11.7% (9)	3.44	3

Table 11 - Section 2(B) Responses

Section 2(C) – Opinions and Concerns

Please **CIRCLE** the number that indicates your level of agreement with the following statements:

	1 (Strongly disagree)	2 (Disagree)	3 (Agree)	4 (Strongly Agree)	Mean	Median
I am supportive of developing and implementing new renewable energy technologies. (n = 78)	0.0% (0)	0.0% (0)	37.2% (29)	62.8% (49)	3.63	4
I prefer conventional sources of electricity to renewable sources of electricity. (n = 74)	28.4% (21)	59.5% (44)	10.8% (8)	1.4% (1)	1.85	2
I think that solar photovoltaic (PV) technology is a good idea, and would like to see it implemented on a large scale. (n = 73)	0.0% (0)	4.1% (3)	50.7% (37)	45.2% (33)	3.41	3
I think that more research is needed before solar PV technology should be implemented on a large scale. (n = 74)	4.1% (3)	37.8% (28)	43.2% (32)	14.9% (11)	2.69	3
I think solar PV technology should be integrated into new and existing building designs. (n = 71)	0.0% (0)	2.8% (2)	62.0% (44)	35.2% (25)	3.32	3
I am concerned that solar PV technology is not safe for birds or other animals. (n = 72)	15.3% (11)	75.0% (54)	9.7% (7)	0.0% (0)	1.94	2
I think solar PV technology is very safe compared to other energy technologies. (n = 73)	1.4% (1)	0.0% (0)	56.2% (41)	42.5% (31)	3.40	3
I think solar PV technology is too expensive. (n = 64)	6.3% (4)	32.8% (21)	39.1% (25)	21.9% (14)	2.78	3
I would be willing to purchase solar PV technology. (n = 69)	5.8% (4)	21.7% (15)	56.5% (39)	15.9% (11)	2.83	3
I would <i>not</i> like to see solar PV technology on a building near my home. (n = 72)	33.3% (24)	59.7% (43)	5.6% (4)	1.4% (1)	1.75	2
I think solar PV technology enhances the look of a building. (n = 72)	2.8% (2)	69.4% (50)	20.8% (15)	6.9% (5)	2.39	2
I think solar PV technology installed in my neighbourhood may negatively affect my property value. (n = 74)	25.7% (19)	66.2% (49)	6.8% (5)	1.4% (1)	1.84	2
I would actively support (financially or by volunteering) a solar PV project in my neighbourhood. (n = 74)	1.4% (1)	16.2% (12)	66.2% (49)	16.2% (12)	2.97	3
I would <i>not</i> like to see solar PV technology installed on my home or in my neighbourhood. (n = 72)	34.7% (25)	62.5% (45)	2.8% (2)	0.0% (0)	1.68	2

Table 12 - Section 2(C) Responses

In addition to the three sections of Likert scale responses described above, survey respondents were given space to provide additional comments about solar PV technology; interviewees were asked to comment further on solar PV technology. The comments from the qualitative data collected by these two means largely revolved around three themes: the (expensive) cost of solar PV technology and its economic viability; education and lack of information on solar PV technology; and general positive comments to support the future development of solar PV technology. These themes will be further explored in the discussion in Chapter 6.

5.4 Perceptions of Funding Models

Section 3 of the survey was designed to gauge respondents' perceptions about various funding models that could be used to fund school-based solar PV projects. The respondents were asked to evaluate five funding models in two different ways. First, respondents were asked to indicate on a Likert scale how their overall level of support for a school-based solar PV project would change if the project was implemented with each of the five funding models. The Likert scale was: (1) dramatically decrease; (2) decrease; (3) no change in support; (4) increase; (5) dramatically increase. Second, respondents were asked to rank the five models on a scale from (1) "most desirable for [insert specific school name]", to (5) "least desirable for [insert specific school name]". The respondents were asked to evaluate the funding models in two different ways in order to give more context and depth to the analysis of the data. The data in Table 13 help to understand how (if at all) the funding models will affect respondents' social acceptance of the school-based solar PV project as a whole. Table 14 indicates respondents' preference for each of the five funding models. Both the interview respondents and the School Council survey respondents were introduced to the five funding models by the researcher through a brief presentation prior to responding to these questions.

Before the data were recorded and analyzed, the following decision rules were applied to clean the data set:

1. In Section 3(A), if no response was entered for the Likert scale question, no response was recorded (n = 36, eight surveys had one or more Likert scale question left blank).
2. In Section 3(B), if no rank was entered, no response was recorded (n = 64, 14 surveys had no rank entered for one or more of the five funding models).
3. When ranking the funding models, if one number (i.e., rank) was used more than once, all ranking responses were rejected (n = 10, two surveys used at least one rank more than once).

Please see Table 13 below for the results of the Likert scale responses.

Funding Models	Likert Scale					Mean	Median
	1 Dramatically decrease support	2 Decrease support	3 No change in support	4 Increase support	5 Dramatically increase support		
Renting School Roof Space (n = 72)	4.2% (3)	13.9% (10)	38.9% (28)	33.3% (24)	9.7% (7)	3.31	3
Corporate Sponsorship (n = 72)	2.8% (2)	11.1% (8)	33.3% (24)	36.1% (26)	16.7% (12)	3.53	4
Community Fundraising (n = 73)	9.6% (7)	23.3% (17)	38.4% (28)	23.3% (17)	5.5% (4)	2.92	3
Community Co-operative (n = 71)	5.6% (4)	9.9% (7)	49.3% (35)	28.2% (20)	7.0% (5)	3.21	3
Government / Utility Program (n = 71)	1.4% (1)	2.8% (2)	32.4% (23)	38.0% (27)	25.4% (18)	3.83	4

Table 13 - Likert Scale Responses for Section 3 of Survey

Table 13 gives the percentage of total respondents who indicated how their support would change (i.e., increase, decrease, or no change) given a specific funding model. The column indicating “no change in support” has the highest frequency of responses for all funding models except corporate sponsorship and government/utility program. With both corporate sponsorship and government/utility programs, “no change in support” has the second highest frequency of responses. However, 78.1% of respondents reported that

at least one of the five models would cause their support for the project to either increase or decrease. This is true because there were many respondents who indicated that some models would cause no change in their support of the project, while other models would either increase or decrease their support. Only 21.9% of respondents indicated the same level of support regardless of the funding model chosen.

Table 14 presents the results of how the survey respondents ranked each of the five funding models. The results are reported as a percentage of total respondents, and the frequency of each response is indicated in brackets next to the percentage.

Funding Model	Rank					Mean	Median
	1	2	3	4	5		
Renting School Roof Space (n = 65)	20.0% (13)	12.3% (8)	20.0% (13)	20.0% (13)	27.7% (18)	3.23	3
Corporate Sponsorship (n=67)	26.9% (18)	34.3% (23)	13.4% (9)	14.9% (10)	10.4% (7)	2.48	2
Community Fundraising (n = 68)	8.8% (6)	8.8% (6)	14.7% (10)	23.5% (16)	44.1% (30)	3.85	4
Community Co-operative (n = 65)	6.2% (4)	23.1% (15)	23.1% (15)	35.4% (23)	12.3% (8)	3.25	3
Government / Utility Program (n = 66)	42.4% (28)	19.7% (13)	27.3% (18)	6.1% (4)	4.5% (3)	2.56	3

Table 14 – Ranking the Funding Models

This chapter has presented the quantitative data collected through the stakeholder interviews and School Council surveys. Chapter 6 will now analyze these results, and provide a discussion complemented by the qualitative responses of Phase 2 respondents and the literature review found in Chapter 2.

6 Discussion

Chapter 5 outlined the results from the 79 respondents of Phase 2 of the thesis project. The results were compiled from both the stakeholder interviews and the School Council surveys; they communicate respondent perceptions of solar PV technology, of project funding models, and of school-based solar PV projects. These results will now be analyzed and discussed.

This chapter begins with Section 6.1, which contains an analysis of the statistical tests performed on the results examining the perceptions of solar PV technology as presented in Section 5.3. Section 6.2 follows with an analysis of the results presented in Section 5.4, which detail the perceptions of the five funding models. Section 6.1 and Section 6.2 will both contain a discussion of the significant results, and will suggest factors that most significantly affect the social acceptance of a school-based solar PV project.

6.1 Perceptions of Solar PV Technology

Before the analysis is presented, it should be noted that the chi-square test for independence was performed on the data as reported in Chapter 5. However, it was found that in all cases, the data were too sparsely distributed across the Likert responses to make appropriate inferences from the tests with any confidence. As mentioned in Section 3.2.4, when performing the chi-square test, appropriate inferences from the results cannot be made if “more than 20 percent of the expected frequencies are less than 5 or when any expected frequency is less than 1” (Siegel & Castellan Jr., 1988, p. 49). If this occurs, then “expected frequencies sometimes can be increased by combining adjacent categories into a single pooled category” (Siegel & Castellan Jr., 1988, p. 49). Therefore, the Likert scale responses were collapsed to improve the results from the chi-square tests. Similarly, the data were too sparsely distributed across some of the demographic categories, and therefore, some demographic categories were also collapsed to facilitate statistical analysis. Table 15 below describes how the categories were collapsed.

Survey Section	Original responses	Collapsed responses
Section 1 – Age	1 – 1930s (0) 2 – 1940s (2) 3 – 1950s (22) 4 – 1960s (37) 5 – 1970s (13) 6 – 1980s (1)	1 – 1950s or earlier (24) 2 – 1960s or later (51)
Section 1 – Education	1 – Some high school (0) 2 – Complete high school (8) 3 – College or University (44) 4 – Post-graduate degree (25)	1 – High school (some or completed) (8) 2 – College, University or Post-graduate (69)
Section 1 – Household income	1 – Less than \$40K (3) 2 – \$40K - \$60K (4) 3 – \$60K - \$80K (9) 4 – \$80K - \$100K (11) 5 – \$100K - \$120K (8) 6 – More than \$120K (32)	1 – Less than \$80K (16) 2 – \$80K - \$120K (19) 3 – More than \$120K (32)
Section 1 – Distance from school	1 – Less than 1km (16) 2 – 2-3km (23) 3 – 4-5km (6) 4 – More than 5km (33)	1 – Less than 1km (16) 2 – 2-5km (29) 3 – More than 5km (33)
Section 1 – Time living in the area	1 – Less than 1yr (2) 2 – 1yr – 3yrs (6) 3 – 3yrs – 5yrs (12) 4 – Greater than 5 yrs (57)	1 – Less than 1yr (2) 2 – 1yr – 5yrs (18) 3 – Greater than 5yrs (57)
Section 2(A) - Knowledge ⁵	1 – None 2 – Below Average 3 – Average 4 – Above Average 5 – Expert	1 – Below Average 2 – Average 3 – Above Average
Section 2(B) – Attitudes and Perceptions	1 – Strongly Negative 2 – Negative 3 – Neutral/No opinion 4 – Positive 5 – Strongly positive	1 – Negative 2 – Neutral/No opinion 3 – Positive
Section 2(C) – Opinions and Concerns	1 – Strongly Disagree 2 – Disagree 3 – Agree 4 – Strongly Agree	1 – Disagree 2 – Agree

Table 15 - Original and Collapsed Demographic and Likert Scale Responses

It also should be noted that when the frequency data are discussed, the original (expanded) demographic and Likert scale responses are used. However, the chi-square tests for independence are performed using the collapsed categories. Using collapsed categories reduces the strength of the conclusions because the data set is less differentiated. However, this was necessary to perform any statistical tests beyond simple frequencies.

⁵ Please see Appendix 7 for a complete description of how the responses for questions in Section 2(A), 2(B), and 2(C) were collapsed.

The data were analyzed using four school characteristic categories: EcoSchool vs. Non-EcoSchool; Catholic School vs. Public School; Elementary School vs. High School; large municipality vs. small municipality. Demographic data were also used for analysis. Using the school characteristics and the demographic information, the chi-square test was run on the qualitative responses from sections 2(A), 2(B), 2(C), 3(A) and 3(B) of the survey. Table 16 presents a summary of the chi-square test results for Sections 2(A), 2(B), and 2(C), and Table 17 (in Section 6.2) presents the chi-square results for Sections 3(A) and 3(B).

The null hypothesis for the chi-square test for independence states that the variables compared are independent, and that any observed differences are due to chance. If no significant results are found using the chi-square test, then the null hypothesis is not rejected. If the chi square result is significant for a survey question, it means that the variables used for comparison are not independent and therefore influence how the respondents answer the survey question. For example, in Table 16 below, household income is significant when answering the question: I think that more research is needed before solar PV technology is implemented on a large scale. Therefore, it can be interpreted that household income has an influence on how respondents answer this question.

As a reminder to help interpret Tables 16 and 17, the chi-square test results “should not be used if more than 20 percent of the expected frequencies are less than 5” (Siegel & Castellan, Jr., 1988, p. 49). If this occurred even when the chi-square test was performed on the data after it had been collapsed into fewer categories, it is indicated in Table 16 and 17 as ‘data too sparse. Chi-square result invalid’. Please see Table 16 for a complete list of chi-square results for Sections 2(A), 2(B), and 2(C), and Table 17 for a complete list of chi-square results for Sections 3(A) and 3(B).

Variable for Comparison	Result of Chi-square tests⁶
EcoSchool vs. Non EcoSchool	No statistical significance. The null hypothesis is not rejected.
Catholic School vs. Public School	No statistical significance. The null hypothesis is not rejected.
Elementary vs. High School	Significant questions: S2-B-Q5: Please indicate your perception of the use of hydro dams to produce electricity. S2-C-Q13: I would actively (financially or by volunteering) support a solar PV project in my neighbourhood.
Small municipality vs. Large municipality	Significant question: S2-C-Q6: I am concerned that solar PV technology is not safe for birds or other animals
Interview respondents vs. School Council respondents	Significant questions: S2-A-Q2: Please indicate your level of knowledge of energy issues (supply, demand, production, conservation). S2-B-Q7: Please indicate your perception of the use of solar PV technology to produce electricity. S2-C-Q9: I would be willing to purchase solar PV technology
Title of respondents	Data too sparse. Chi-square result invalid.
Age	Data too sparse. Chi-square result invalid.
Gender	Significant questions: S2-A-Q3: Please indicate your level of knowledge of energy system issues (e.g., grid reliability, peak energy demand). S2-A-Q4: Please indicate your level of knowledge of conventional energy technologies (e.g., coal, nuclear, hydro). S2-A-Q5: Please indicate your level of knowledge of solar PV technology S2-A-Q6: Please indicate your level of knowledge of wind energy technology. S2-B-Q5: Please indicate your perception of the use of hydro dams to produce electricity
Level of education	Data too sparse. Chi-square result invalid.
Household income	Significant question: S2-C-Q4: I think that more research is needed before solar PV technology is implemented on a large scale.
Children attending HDSB or HCDSB schools	Significant question: S2-A-Q6: Please indicate your level of knowledge about wind energy technology.
Distance from school	Data too sparse. Chi-square result invalid.
Time living in the area	Data too sparse. Chi-square result invalid.

Table 16 - Results of Chi-square Analysis for Section 2 of the Survey

⁶ For a complete table of the calculations performed, please see Appendices 8 and 9.

The significant results from the chi-square test for independence from each category in Table 16 will now be discussed in detail in the paragraphs below.

There were no statistically significant differences between the responses given by EcoSchools as compared to Non-EcoSchools. This result is not entirely surprising because, as mentioned in Chapter 3, due to the stringent ethics requirements, it is likely that schools that have ‘environmental leanings’ – even if they were not (yet) EcoSchools – participated in this thesis project. Similarly, there were no statistically significant differences in the responses given by Catholic Schools as compared to Public Schools. The lack of significant findings in these two comparative categories indicate that these school characteristics do not affect how individuals associated with these schools responded to the survey questions.

The responses from elementary schools as compared to high schools yielded two significant results, indicating that respondents’ responses to the following questions were significantly correlated with their association with either an elementary school or a high school. The first significant result was the perception of the use of hydro dams to produce electricity. High school respondents were more likely to be polarized (either a positive or negative view of the use of the technology), and elementary school respondents were more likely to have a neutral opinion when asked the same question. The second significant result was the response to the question: would you actively support a solar PV installation in your neighbourhood? Respondents from the high schools were more likely to respond ‘no’ to this question. However, the majority of both the high school and elementary school respondents indicated that they would actively support a solar PV installation in their neighbourhood. This indicates that there is fairly widespread support for solar PV installations, but that project proponents in high schools may find that stakeholders are less willing to actively participate in the project (as compared to stakeholders in elementary schools). Six percent (6.3%) of elementary school respondents indicated that they would not actively support a solar PV installation in their neighbourhood as compared to 26.2% of high school respondents who responded in the same way. Previous studies have found that individuals with families with children

less than 16 years of age are less willing to donate time to environmental projects (e.g., Zhang, Yaoqi, Hussain, Anwar, Deng, & Letson, 2007), presumably because of the additional time-commitment of having young children. It is thus interesting that the elementary school respondents indicate that they are *more* willing to donate time and/or money to a school-based solar PV project than high school respondents. The qualitative data provide some insight into this result. Many stakeholders from high schools indicated that there were already many school-related activities and projects that they actively supported. High schools generally offer more extra-curricular activities than elementary schools, and therefore high school stakeholders likely have greater demands on their time and money. This may be why they are more hesitant about actively supporting a school-based solar PV project. Nevertheless, it is worth noting that 73.8% of high school respondents still reported that they would actively support a solar PV installation given these additional demands.

The responses from large municipalities compared to those from small municipalities yielded only one significant result. The data indicate that responses to the question “I am concerned that solar PV technology is not safe for birds or other animals” is significantly correlated to whether the respondent’s school is located in a small municipality or a large municipality. Respondents from both the large municipalities and the small municipalities overwhelmingly disagreed with the statement. However, 17.6% of respondents from the small municipalities indicated that they were concerned that solar PV technology was not safe for birds or other animals, while only 2.6% of the respondents from the large municipalities indicated the same response. This perhaps indicates that some education may need to take place with projects implemented in the smaller municipalities in the HDSB and HCDSB to reassure stakeholders of the safety of solar PV technology. In response to the open-ended questions, the safety of birds and animals was not generally discussed, although some stakeholders were concerned about children’s safety if they were to climb up on the roof to examine the solar panels. Still other respondents were concerned about the “safety” of the solar PV technology, as they mentioned vandalism as a potential concern.

The data were also analyzed to discover if there were significant differences in responses between information collected during the stakeholder interviews as compared to stakeholder surveys. This comparison was done for two reasons. First, the individuals who participated in the stakeholder interviews were stakeholders from “inside” the schools (i.e., administrators, teachers, and custodial staff). It is possible that their perspective on a school-based solar PV installation may differ from respondents not directly involved in the day-to-day operation of the school. Respondents who completed the School Council survey (parents and community members) have a stake in the operation of the school, but are not involved on a day-to-day basis. Second, the method used for data collection was different with each group, and therefore this may have also resulted in differences in the respondents’ answers. In fact, in a comparison between stakeholder interview respondents and School Council survey respondents, three questions were found to be significant. They were:

- knowledge about energy issues (e.g., supply, demand, production, conservation);
- perceptions of the use of solar PV technology; and
- opinion about whether the respondent would be willing to purchase solar PV technology.

It is likely that the method of data collection affected the respondents’ answers for the three questions listed above. For the knowledge of energy issues, the majority of stakeholder interview respondents (56.7%) indicated above-average knowledge of energy issues, as compared to the majority of School Council respondents (67.3%) who indicated an average knowledge of energy issues. In this case, two explanations are possible for the differences in responses. It is possible that the interview respondents are genuinely more educated about energy issues. However, because this measure of knowledge is self-reported, it is possible that interview respondents wished to demonstrate a certain (higher) level of knowledge to the interviewer.

For the perceptions of the use of solar PV technology, 100% of stakeholder interview respondents indicated that they had a positive perception of the technology, as compared to 79.6% of School Council respondents. Similarly, 88.9% of stakeholder interview respondents indicated that they would be willing to purchase solar PV technology,

compared to 61.9% of School Council respondents. In both cases, the majority response from both groups of respondents was the same. Both groups had a generally positive perception of the use of solar PV technology, and the majority of respondents from both groups were willing to purchase solar PV technology. However, the statistically significant difference was possibly due to the fact that the interview respondents were aware that the researcher was conducting solar PV technology-related research and perhaps felt obliged to convey a 'pro-solar' attitude. As Palys (2003, p. 160) notes, "most people are used to the idea that researchers are experts in their field who have some particular thing in mind when they seek participants for a study." Further, research participants look for cues that they are "doing well" as participants; thus the stakeholder interview respondents may have attempted to convey a "pro-solar" attitude to receive approval from the interviewer (Palys, 2003, p. 160).

The demographic data were also used for analysis. The three demographic characteristics that yielded significant results were: gender, income, and respondents having children who attend (or who have attended) school in the HDSB or the HCDSB.

Gender was found to be significant for five questions. They were:

- level of knowledge pertaining to energy system issues (i.e., grid reliability, peak energy demand);
- level of knowledge pertaining to conventional energy technologies (i.e., coal, nuclear, hydro);
- level of knowledge pertaining to solar photovoltaic technology;
- level of knowledge pertaining to wind energy technology; and
- perception of the use of hydro dams to produce electricity.

The first four questions pertain to the level of knowledge respondents have about each of the listed technologies. In each case, men were more likely to report a higher level of knowledge than women. However, this level of knowledge was self-reported, and there were no corresponding questions on the survey to evaluate if the self-reported level of knowledge corresponded with the actual level of respondent knowledge. As Slevin et al. (1993) also note in their study of gender differences in self-evaluations, this thesis

research would have benefited from an impartial evaluation of respondents' actual level of knowledge to compare to the reported level of knowledge. It is possible that the differences found in the reported level of knowledge are due to differences in how men and women self-evaluate. As the psychology literature has found, women often underestimate their knowledge and abilities, while men engage in a self-enhancing bias (Berg, Stephan, & Dodson, 1981; Slevin & Aday., 1993). In a 1997 study which examined the accuracy of self-evaluations, it was found that women's self-evaluation of performance were inaccurately low (Bayer & Bowden, 1997). The researcher also noticed that during the stakeholder interviews, women interviewees often looked for confirmation that their responses were 'acceptable' to the researcher. It was noticed that women often prefaced their responses with self-deprecating comments about their level of knowledge and expertise regarding solar PV technology. One female interview respondent elected to halt the interview half-way through because she felt so uncomfortable with her perceived lack of knowledge. This is notable because the questions the researcher was asking related to the respondents' perceptions, attitudes and opinions about school-based solar PV technology; level of knowledge has an effect on responses, but does not preclude an answer.

The fifth and final question that is significantly correlated to gender is the reported perception of the use of hydro dams to produce electricity. Women are more likely to report a neutral perception of hydro dams, whereas men are more likely to report a positive perception. It is interesting to note that of all the technologies presented on the survey, gender was only found to be significant for hydro electricity. None of the respondents who participated in the study commented (either in the interviews or on the surveys) further on their perceptions of hydro electricity; therefore, suggestions as to why this significant result exist are somewhat speculative. However, it is possible that the same phenomenon that caused women to under-estimate their level of knowledge also affected their response for this question. As Slevin et al. (1993) discuss, women are hesitant to participate in discussions that are typically viewed as "stereotypically male in orientation" (Slevin & Aday, David P. Jr., 1993). Traditionally, men are the individuals responsible for paying the 'hydro bill' (Ontario colloquialism for the electricity bill), and

therefore this may have caused some women to be hesitant about offering a non-neutral perception of the technology. However, gender was not found to be significant with other energy technologies on the survey, and therefore it is suggested that more research would be necessary to explain this finding.

Ultimately, the statistically significant results pertaining to gender do not indicate a difference in how men and women perceive solar PV technology. However, they do suggest that future research should be conducted with the response style of different genders in mind. Specifically, as mentioned, self-evaluations should be coupled with impartial measures of actual knowledge to determine if the disparity between the genders' stated knowledge is also present in the level of actual knowledge. If future research reveals that women do in fact possess a lower level of knowledge about energy systems and technologies, then targeted education programs should be developed.

Income was also found to be statistically significant for one question. Respondents were asked to agree or disagree with the following statement: "I think that more research is needed before solar PV technology should be implemented on a large scale." It was found that respondents with an annual household income of greater than \$120,000 were more likely to disagree with the statement above. This is consistent with the literature that indicates that individuals with higher income are more likely to have positive perceptions (and higher usage) of technology in general (Porter & Donthu, 2006), and also the literature that indicates that income is positively related to an individual's perception of 'green electricity' (Batley, Colbourne, Fleming, & Urwin, 2001; Roe, Teisl, Levy, & Russell, 2001). However, it is somewhat surprising to find a statistically significant result for income in this data set. The HDSB and the HCDSB are in a wealthy part of Canada, and most respondents would be considered wealthy, even for the area. However, solar PV technology is still perceived as relatively expensive as compared to other energy technologies, and this may contribute to the fact that only the wealthiest respondents believe that more research is not necessary before solar PV should be implemented on a large scale. It is possible that, for the wealthiest respondents, the

economic considerations do not influence their opinion as dramatically as for other respondents.

The last demographic characteristic that yielded some significant results was if respondents had children who attend school in the HDSB or the HCDSB. Only one question was significant for this variable. The question was about respondents' self-reported level of knowledge about wind energy technology. Those respondents who had children in the HDSB or HCDSB were more likely to report "below average knowledge" as compared to those without children who attend school in either of the two districts. This result is likely due to a combination of factors discussed above. Respondents who did not have children in the school system were more likely to participate in this thesis project by completing a stakeholder interview. This is true because although School Council meetings are open to all members of the community, members were generally parents of children in the school. Therefore, non-parents were more likely to be a teacher, administrator, or member of the custodial staff at the school. As mentioned above, stakeholder interview respondents were more likely to overstate their level of knowledge in order to please the interviewer. Stakeholder interview respondents, therefore, may have felt that their responses were not as anonymous as School Council respondents, because the stakeholder interviews were conducted one-on-one. As well, respondents who completed the School Council surveys were more likely to be women. As discussed in the paragraphs above, women may have been more likely to underestimate their level of knowledge. This also demonstrates that, given the modest size of the dataset, it is difficult to control for other variables when looking at a specific variable. However, as was true for the hydro dams, respondents did not elaborate on wind energy technology in the open-ended sections of the interviews and surveys. Therefore, more research would be necessary to further explore this research finding.

The other demographic data collected (including age, education, distance respondent lives from school, and length of time living in the area) were not able to be analyzed using the chi-square test for independence, as the sample size collected was not large enough to interpret the results of the statistical tests with confidence. However, the

frequency data for these variables (and the others already discussed) provide some interesting results, which will be discussed in the paragraphs below.

In Section 2(A) of the survey, respondents were asked their level of knowledge about solar PV technology, as well as their level of knowledge about other conventional and renewable energy technologies. As discussed previously, because the level of knowledge is self-reported, this indicator is not very useful in evaluating actual levels of respondent knowledge. However, in analyzing the frequencies, at least one piece of useful knowledge can be extracted. Respondents report a lower level of knowledge for solar PV technology as compared to all other energy technologies listed on the survey, except for biomass energy technology. A frequent comment on the qualitative portion of both the stakeholder interviews and the School Council surveys was that respondents did not feel like they had enough information to properly evaluate both solar PV technology and school-based solar PV projects. This suggests that some of the perceptions and opinions indicated on the survey may be based on misinformation. However, despite this lower level of knowledge as compared to other energy technologies, the aggregated responses were positive about the use of solar PV technology to generate electricity. In fact, respondents rated solar PV technology second only to wind energy technology when indicating their positive perceptions of different energy technologies. This finding is supported by the literature that states that positive attitudes are not necessarily indicative of high levels of knowledge (Diamantopoulos, Schlegelmilch, Sinkovics, & Bohlen, 2003). This finding also demonstrates that a lack of knowledge does not necessarily lead to negative perceptions of a technology as argued by some authors (e.g., Bosley & Bosley, 1992).

In general, positive perceptions and opinions of solar PV technology were reflected throughout the survey. Respondents preferred renewable energy technologies to conventional energy technologies, and were strongly supportive of implementing solar PV technology on a large scale. Interestingly, respondents indicated that they did not think solar PV technology enhances the look of a building; however, respondents also indicated that they did not think that a solar PV installation in their neighborhood would

negatively affect their property value. This indicates that, on average, respondents do not necessarily *like* the look of solar PV technology, but also do not *dislike* it enough to believe that it would have a negative effect on their neighbourhood (and by extension, property value). On average, respondents indicated that they would be supportive of a solar PV installation in their neighbourhood. Aesthetic considerations have been mentioned in the literature as a possible barrier to the uptake of solar PV technology (A. Faiers & Neame, 2006). Therefore, the research findings indicate that aesthetic considerations can play a role in stakeholders' evaluation of a project, but do not, at this point, appear significant enough to oppose the implementation of a school-based solar PV project. Instead, respondents seem willing to at least passively accept the technology in their neighbourhood (Sauter & Watson, 2007).

The cost and economic viability of solar PV technology was one of the most frequent written-in comments about the technology. In the quantitative responses, 60.9% of respondents either agreed or strongly agreed with the statement "I think solar PV technology is too expensive". Interestingly, 72.5% of respondents would still be willing to purchase solar PV technology. The results from the evaluation of the perception of the solar PV technology itself generally agree with the findings in the literature that indicate that people generally have a positive perception of solar PV technology, but are nevertheless still deterred (at least to some extent) by the financial cost of the technology (A. Faiers & Neame, 2006; Jager, 2006).

Overall, characteristics of the technology itself seem to be relatively positively evaluated by study respondents. The characteristics of the technology that provoked the greatest response in the qualitative portion of the survey were the cost and economic viability of the technology and the school-based solar PV project itself. However, despite the stated concerns, the technology itself (besides the cost) does not appear to significantly impede the implementation of a school-based solar PV project.

6.2 Perceptions of Funding Models

As presented in Section 5.4, the funding models were evaluated by respondents in two ways: first, by indicating how their support of the project would change given each of the five funding models; second, by ranking the five models. The data presented in Section 5.4 were analyzed using the chi-square test for independence. For each variable listed in Table 17 below, a chi-square was calculated for the Likert scale response (how support for the project would change), and how the respondents ranked each of the models. The null hypothesis states that the two variables compared are independent, and that any observed differences are due to chance. As a reminder, if there is a significant chi-square result for a survey question, the null hypothesis is rejected and it can be interpreted that the variables used for comparison are not independent and had an effect on the way respondents answered the significant questions. For example, in Table 17 below, a significant result was found when responses from elementary school respondents were compared to high school respondents for the question: please indicate how your support of a solar PV project at (insert name of school) would change if implemented using a Corporate Sponsorship funding model. This indicates that whether a respondent was affiliated with an elementary school as compared to a high school had an affect on how they answered this question. All significant chi-square results are indicated in Table 17 below. Similar to Table 16, if the data were too sparse to use the chi-square results, it is indicated in the table by: 'Data too sparse. Chi-square result invalid'. The results of the chi-square test for independence for Sections 3(A) and 3(B) are presented in Table 17.

Variable for Comparison	Result of Chi-square tests⁷
EcoSchool vs. Non EcoSchool	No statistical significance. The null hypothesis is not rejected.
Catholic School vs. Public School	No statistical significance. The null hypothesis is not rejected.
Elementary vs. High School	Question S3-A-Q2: Please indicate how your support of a solar PV project at (insert name of school) would change if implemented using a Corporate Sponsorship funding model.
Small municipality vs. Large municipality	No statistical significance. The null hypothesis is not rejected.
Interview respondents vs. School Council respondents	Question S3-A-Q4: Please indicate how your support of a solar PV project at (insert name of school) would change if implemented using a Community Co-operative funding model.
Title of respondents	Data too sparse. Chi-square result invalid.
Age	Data too sparse. Chi-square result invalid.
Gender	No statistical significance. The null hypothesis is not rejected.
Level of education	Data too sparse. Chi-square result invalid.
Household income	No statistical significance. The null hypothesis is not rejected.
Children attending HDSB or HCDSB schools	No statistical significance. The null hypothesis is not rejected.
Distance from school	Data too sparse. Chi-square result invalid.
Time living in the area	Data too sparse. Chi-square result invalid.

Table 17 - Results of Chi-square Analysis for Section 3 of the Survey

The only variable associated with school characteristics that resulted in a significant chi-square result was high school respondents', as compared to elementary school respondents', indication of how their support for a school-based solar PV project would change if a corporate sponsorship funding model was used. See Figure 12 for a comparison of the responses.

⁷ For a complete table of the calculations performed, please see Appendices 8 and 9.

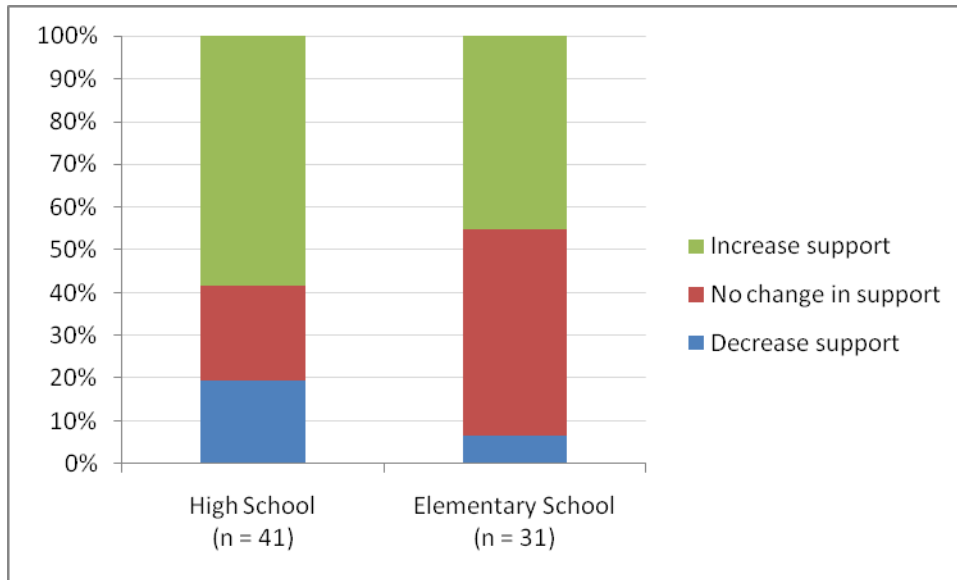


Figure 12 - High School vs. Elementary School: Change in Support based on the Corporate Sponsorship Model (n = 72)

The corporate sponsorship model was more polarizing for respondents associated with the high schools. Seventy-eight percent of high school respondents indicated that the corporate sponsorship model would cause their support for a school-based solar PV project to either increase or decrease. In comparison, 51.6% of elementary school respondents indicated that a corporate sponsorship model would cause a change in their support for the project (either positively or negatively). High school respondents were also more likely to report that the corporate sponsorship model would have a negative effect on their support: 19.5% of high school respondents reported that a corporate sponsorship model would cause their support to decrease, as compared to 6.5% of elementary school respondents. Based on these results, the corporate sponsorship model is more likely to cause greater controversy, but potentially also greater support, if implemented in a high school.

The other significant finding in this section is found in a comparison between the stakeholder interview respondents', as compared to School Council respondents', indication of how their support for a school-based solar PV project would change if a community co-operative funding model was used. Please see Figure 13 for a comparison of the results.

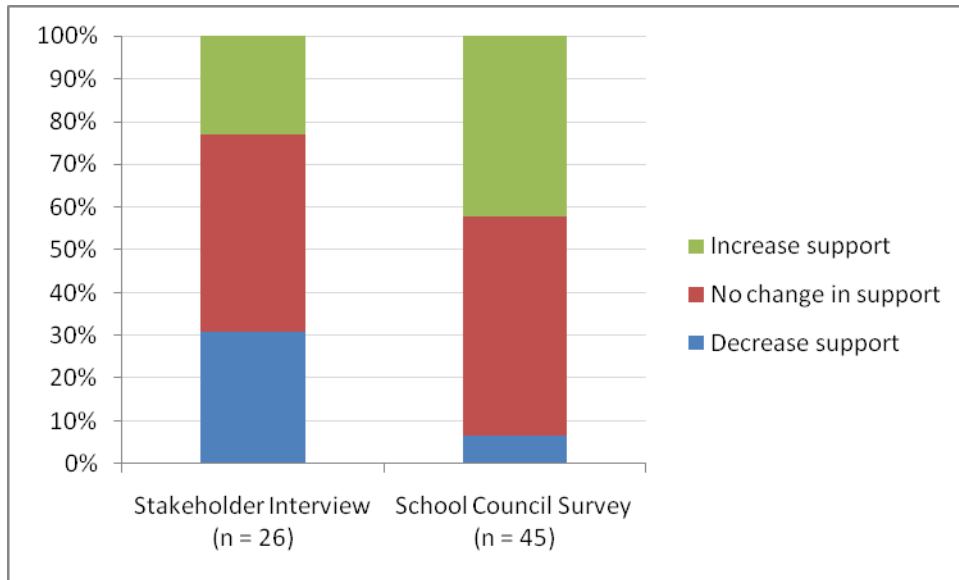


Figure 13 - Stakeholder Interview vs. School Council Survey: Change in Support based on the Community Co-operative Funding Model (n = 71)

Stakeholder interview respondents were much more likely to report that the community co-operative model would cause a decrease in their level of support for the project. Conversely, School Council respondents were more likely to report that this funding model would cause an increase in their level of support for the project. A potential explanation for this result is that the School Councils are made up of parents and members of the community who participate in the School Council as a way to have an influence in the operation of the school. These stakeholders would not necessarily have influence on day-to-day operations of the school without their participation in the School Council. The Community Co-operative model is the model that allows for the greatest amount of community influence in the funding and control of the school-based solar PV project. Therefore, this is a potential reason why School Council members may view this model more positively. Conversely, stakeholders from ‘within’ the school (administrators, teachers, and custodial staff) may view this model in a negative as it may be seen as a loss of influence and control over the project. For example, one stakeholder interviewee indicated that he would not be in favour of any model that allowed greater community access and influence in the operation of the school.

The lack of significant findings for the other school variables (i.e., EcoSchool vs. Non-EcoSchool, Catholic School vs. Public School, and large municipality vs. small municipality) indicates that these school variables did not significantly affect respondents' evaluation of the funding models. Although the results of this study cannot claim to be representative, the schools in this study were selected to represent the range of schools in the HDSB and HCDSB; therefore, it is possible to suggest that any differences in social acceptance for a particular funding model in the HDSB and HCDSB are not likely to be dependent on these three school characteristics.

Gender, income, and whether respondents had children who attend (or who attended) school in the HDSB and HCDSB were not found to be statistically significant in how respondents evaluated the funding models. Unfortunately, it was not possible to calculate the significance of age, level of education, distance from the school, and length of time in the area on the evaluation of the five funding models. The data for these four demographic variables, even when collapsed into smaller categories, were too sparsely distributed to interpret the chi-square with confidence. However, the descriptive frequencies, which will be discussed below, provide some interesting insights.

As presented in Section 5.4, for each funding model, respondents were asked to indicate how their support would change given the implementation of the school-based solar PV project. Please see Figure 14 for the results across the five-point Likert scale for all five funding models.

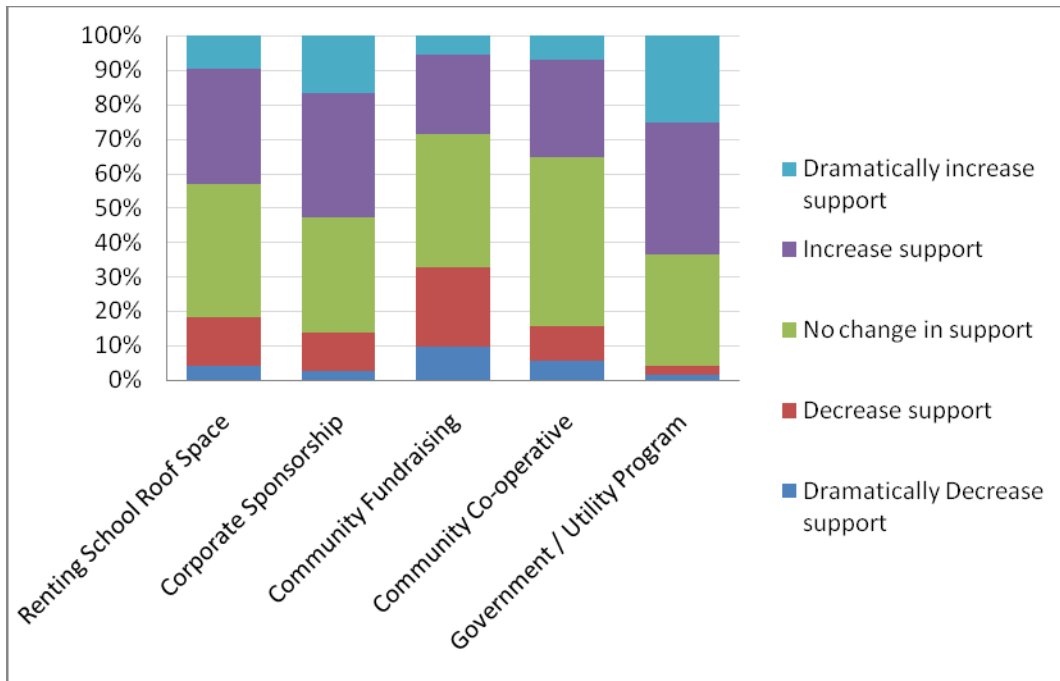


Figure 14 - Likert Scale Responses for the Five Funding Models

No funding model had the majority of respondents (i.e., greater than 50%) indicate no change in support. As mentioned in Section 5.4, only 21.9% of respondents indicated that they would have no change in support when asked about each of the five funding models. In other words, for 78.1% of respondents, *at least* one of the funding models would cause a change (either positive or negative) in their overall support of the project.

This finding indicates that at least one or more of the funding models influenced stakeholders’ perception and acceptance of the project. However, it is useful to investigate this claim further to discover which of the funding models are preferred and why. This will help to discover what aspects of the funding models affected social acceptance. It is useful in the context of this discussion to also look at the Likert scale data collapsed into three categories: decrease support, no change in support, and increase support. The information about the intensity of the change in support is removed by collapsing the categories, but it helps to see the models that invoke the strongest reaction, either positively or negatively. See Figure 15 for the graphical representation of the collapsed responses.

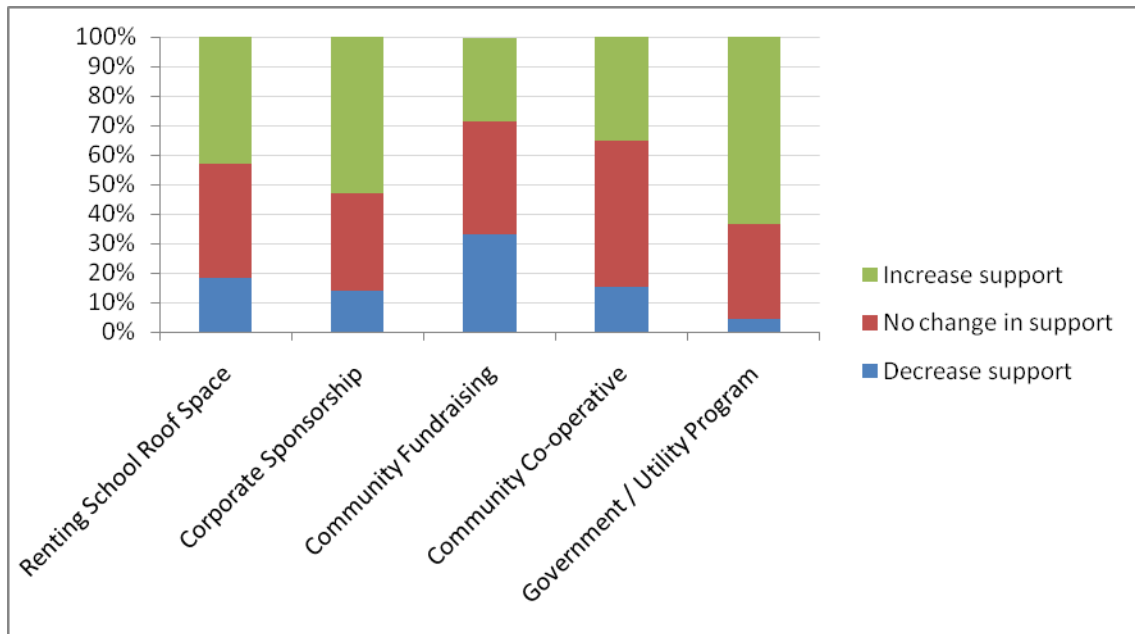


Figure 15 - Collapsed Likert Scale Responses for the Five Funding Models

It is also useful for this discussion to examine how respondents ranked each of the five funding models. It is interesting to note that no model was preferred (i.e., rank 1) by the majority of respondents. See Figure 16 for full details.

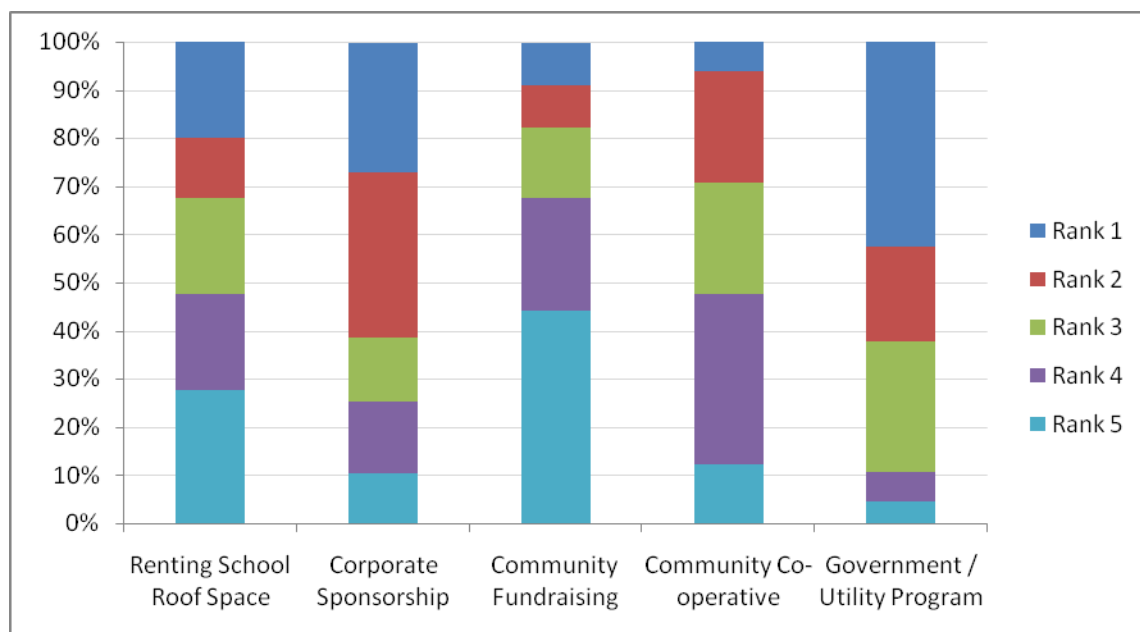


Figure 16 - Ranking the Funding Models

Starting with the most striking result, it is apparent that the government/ utility program is most popular among respondents. More than 60% of respondents indicated that government or utility funding would increase or dramatically increase their support of the project, with 25.4% of respondents indicating a dramatic increase of support for the project with the use of this funding model. Only 4.2% of respondents indicated that government/utility program would either decrease or dramatically decrease their support of the project. This is further reflected in Figure 16, as 42.4% of respondents ranked government/utility program as their number one choice.

Conversely, the community fundraising model was clearly identified in Figure 16 as the least favorite funding option. Forty-four percent (44.1%) of respondents ranked community fundraising as the last (i.e., number 5) choice. From Figure 15, 32.9% of respondents indicated that a community fundraising model would decrease or dramatically decrease their support of the project. At first glance, the corporate sponsorship model seems to be relatively popular, with 52.8% of respondents indicating that this model would cause their support of the project to increase or dramatically increase (Figure 15). As well, many respondents ranked corporate sponsorship as either their first or second choice of model (Figure 16). However, some qualitative comments about corporate sponsorship were cautious or concerned about this model. For example, one School Council respondent commented, “I don’t think corporations have the best interests of the community in mind”, and another commented that they “dislike corporate advertising in schools.” Compared to the other five models, it was the model that raised the most concern and discussion in the qualitative portion of the data collection. Many people indicated that they would be concerned about potential advertising in the school, and they were also concerned about the level of influence the company would be able to exert on the school and on the students. There were those who recognized however that the corporate funding model is already used to fund programs at schools. Respondents (even those in favour of the model) seemed to express a lower level of trust with the corporate actors, and were cautious about this model. This perception was also expressed, though to a lesser extent, about the renting school roof-space model. Respondents liked that this model would allow an outside entity to fund and manage the

solar PV installation, but were cautious about how much influence the company would exert in the school. As one respondent noted, “I like a corporation paying the cost, but I think the school should still have control.” This finding is consistent with the literature that indicates that there is concern about corporate influence and involvement in the education system (Bell McKenzie & Joseph Scheurich, 2004; Feuerstein, 2001).

Taking the evaluation of the five funding models as a whole, it seems clear that the funding model selected for a school-based solar PV project does affect the social acceptance of the project. However, no one model is inherently preferred or inherently disliked by most respondents. This indicates that any funding model *could* be implemented successfully, and that it is *how* and *by whom* the project is implemented that is important.

Based on the qualitative responses, generally, the government/utility funding model was preferred because the money would come from a source perceived as reliable and trustworthy, and the funding was seen as stable. As one School Council respondent noted, “if the money is coming from the government, it is an easier sell to the community.” Another respondent from the same school also noted that with government funding, “stakeholders would have a greater degree of confidence in the operation.” Several respondents noted that schools already have many responsibilities, and therefore governments/utilities should fund and promote school-based solar PV projects if they are a worthwhile project. “If the government wants to decrease greenhouse gases, it should be willing to assist with the funding of such initiatives.” Conversely, for community fundraising, many respondents indicated that schools already have many priorities, and already have to fundraise for essential items such as textbooks and computers. “Community fundraising is a lot of work for a community already involved in many activities”. Another respondent noted that it would be difficult to get community support for community fundraising. “Most parents would want their money going towards materials for the classrooms.” Respondents from both the interviews and school council meetings indicated that there is little appetite or energy for additional school fundraising. Despite the unwillingness to take on more fundraising responsibilities, there were

respondents who recognized the value of involving the community in the project. Indeed, many of the comments about both the Community Fundraising model and the Community Co-operative model indicated that involving the community in the school-based solar PV project was a good idea, echoing the Phase 1 interview respondents. The conclusion that the funding model (i.e., how a project is implemented) affects the social acceptance of a project corroborates the conclusions from the wind energy literature that indicate that how a project is implemented can significantly affect the social acceptance of the project at the community scale (Devine-Wright, 2005; Gross, 2007; Jobert, Laborgne, & Mimler, 2007; Mallett, 2007; Ornetzeder & Rohracher, 2006; Toke, 2005; van der Horst, 2007; Wolsink, 2007a; Wolsink, 2007b; Wustenhagen, Wolsink, & Burer, 2007).

Chapter 6 has attempted to analyze and explain the results of Phase 2 of this research project. Chapter 7 will now conclude this study by outlining the key conclusions and recommendations.

7 Conclusions

7.1 Bringing Phase 1 and Phase 2 Together

This thesis demonstrates that respondents generally have a positive perception of solar PV technology. The cost and economic viability of the technology is a frequently-cited concern, but nonetheless respondents generally indicate that they would be willing to purchase solar PV technology themselves, or would actively participate in a solar PV project in their neighbourhood. However, funding models that place much of the fundraising burden on the individual schools (and thus the school stakeholders) are less well-received than corporate or government/utility-run programs. Schools are already required to fundraise for many of their extra-curricular activities, and in some cases fundraise to cover some of their basic operating costs. High school stakeholders in particular are less likely to actively support a school-based solar PV project simply because their time and resources are already in short supply. Stakeholders recognize that a school-based solar PV project is potentially environmentally and educationally valuable, but they argue that school funds are already stretched, and that a solar PV project should not take priority over other existing financial commitments.

The government/utility funding model was the most popular funding model, as it was seen to take the financial and planning burden off the schools. There were fewer reservations about relinquishing project control to the government or utility, and stakeholders seemed to have greater trust for the reliability of government funding, as compared to corporate sources (either through the corporate sponsorship or renting school roof-space models). The corporate sponsorship model was the second-most popular funding model, but was also shown to be the most controversial. Stakeholders were concerned with corporate advertising and corporate influence in the education system. Despite wanting assistance in funding the school-based solar PV projects, stakeholders were wary of relinquishing their input and control of the project to a corporate entity. Some stakeholders were quite adamant about preventing corporate influence in the school system, and therefore this funding model for school-based solar PV projects should be undertaken with caution. Stakeholder input and participation in the planning and implementation of a project can help to build trust between the school

stakeholders and the corporate sponsor (and between the different stakeholder groups), which could help alleviate some of the concerns about this funding model. This stakeholder involvement and communication can also improve the educational impact of the project.

For Phase 2 of the research project, the data collection itself was a participatory process. Stakeholders that would not have necessarily been asked to participate in the implementation of a school-based solar PV project were asked their opinion of the technology itself, and the funding models for implementation. Although there was less support among stakeholders for funding models that required the school itself to take the lead in funding and implementing the project, stakeholder participation in the project was still important for knowledge transfer and education. As indicated in Phase 1 of the project, simply raising the necessary funds is not the end of the story in terms of maximizing the benefits of a school-based solar PV project. Stakeholders (particularly administrators and teachers) need to be actively involved in the project to ensure that the solar PV technology is used in an effective, educational way. As demonstrated, stakeholders generally do have a positive perception of solar PV technology, but tend to prefer funding models that limit to some extent stakeholder responsibility for the project. As was shown in both Phase 1 and Phase 2, time and resources need to be dedicated to developing corresponding educational materials to ensure that once the solar PV technology is installed it can be used effectively for educational purposes.

7.2 Implications and Recommendations

This research demonstrates that in order to minimize the barriers and maximize the benefits of a school-based solar PV project, aspects of the project that may affect the social acceptance of the project should be considered. The factors that may impede development from the perspective of social acceptance include stakeholder perceptions of the technology itself, and perceptions of the way the project is implemented. This research has shown that respondents in the HDSB and HCDSB districts generally have a positive perception of solar PV technology, but are concerned to some extent about the cost and economic viability of implementing this kind of project. Because schools have

challenges funding existing elementary and secondary programs and activities, school-based solar PV projects must be implemented in a way that maximizes the potential benefits of the project, in order to justify the economic cost. Therefore, it is very important to consider stakeholder perception of how (and by whom) a project is implemented.

In the HDSB and HCDSB, ideally, a project could be implemented using the government and utility model. Provincial funding does exist in Ontario for community-based projects (through, for example, the Ontario Community Power Fund); however, there is not currently specific funding for school-based solar PV projects. Creating a government-run funding program for school-based solar PV projects would be one way to encourage the development of these kinds of projects, particularly because this is the model that is most positively viewed by project stakeholders.

The Corporate Sponsorship model is still a viable option for funding school-based solar PV projects in the HDSB and the HCDSB. This model is certainly the most controversial of the five funding models, but still could be used to fund a project. Critical to the success of projects using this model would be a high level of stakeholder involvement and communication. This may help to alleviate some of the concerns that stakeholders may have about the corporate involvement in schools by building trust between the stakeholders.

Regardless of the funding model, communication among project stakeholders is key. As mentioned, communication helps to build trust among stakeholders; however, communication also helps to facilitate education and knowledge transfer. The more project stakeholders (including students and community members) are involved in the development process, the greater the educational impact of the project (which aids to maximize the benefit of the project). Perhaps most importantly, to maximize the benefits of a school-based solar PV project (particularly the educational benefits), the social acceptance of teachers and administrators is paramount. If teachers are not willing (or able) to incorporate the solar PV technology into the classroom, then the primary goal

and benefit of this kind of project cannot be realized. Resources and support to teachers must be made available in order to help them learn about the technology themselves, and thus be able to integrate the technology into the classroom.

With any of the funding models, this thesis recommends that concurrent to any implementation of school-based solar PV projects, educational funding and materials also need to be explicitly developed. The educational use of the technology is one of the key benefits to this kind of project, and therefore support and materials need to be planned and made available, particularly to teachers, in order to maximize this project benefit.

7.3 Future Work

This study has shone some light on what factors may impede the development of school-based solar PV projects in the Halton District School Board and the Halton Catholic District School Board. It also has given some indication of factors likely to maximize the potential benefits of the projects. However, the findings from this study could be expanded into areas of future work. The examination of the HDSB and HCDSB case study could be strengthened with a longitudinal study that reexamines perceptions about school-based solar PV projects after the technology has been installed. Perceptions towards a specific renewable energy installation can change depending on when (pre-, post- or during installation) the data were collected (Wolsink, 2007a). Public attitudes tend to be highest pre- and post- project installation, and lowest during the installation of the project.

This thesis research was highly theoretical, as respondents were asked about a *potential* installation, and therefore perceptions may change if an installation is actually developed. Further, expressing positive perceptions, and expressing a willingness to pay for a *potential* project does not necessarily translate into actual actions (Parker, Rowlands, & Scott, 2003).

This research would have benefited from a larger, representative sample, particularly in Phase 2 of the study. Therefore, replicating this study with a larger sample size to get

representative, distributed results would be beneficial. This study should also be replicated in other local, national and international case studies to strengthen the conclusions of this study.

School-based solar PV projects have the potential to combine environmentally-positive energy technology, youth and community engagement and education, and potential economic gains. These projects can help to find sustainable energy solutions for Ontario, while at the same time engaging students to think about (and find solutions to) the world's environmental and energy challenges. School-based solar PV projects are only a small part of the solution, but if implemented properly, can contribute to creating a more sustainable world.

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Appendices

Appendix 1 Phase 1 Ethics Documents

Participant Recruitment Letter

Dear (*insert participant's name*):

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the Department of Environment and Resource Studies at the University of Waterloo under the supervision of Professor Ian Rowlands. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Renewable energy has been identified by the Ontario provincial government as a strategy to reduce the greenhouse gas and smog-causing emissions that are usually associated with the production of electricity through coal. The Ontario Standard Offer Program is a policy designed to encourage the installation of small-to-medium size renewable energy projects, and will pay electricity providers a premium price for electricity produced from renewable sources. Renewable energy is also being incorporated into the Ontario curriculum at various levels as a way to educate students about issues related to energy, technology and the environment. As a result, schools in Ontario (and elsewhere) have installed solar photovoltaic technology for economic, educational and environmental reasons. The purpose of this study, therefore, is to identify successful models for development for a school-based solar photovoltaic (PV) project, and then to assess the social acceptance and applicability of the models for implementation in Southwestern Ontario. The anticipated potential benefits are that this research will help develop a model for installing a school-based solar PV project that will be acceptable to communities in Southwestern Ontario. Ideally, this research will result in the installation of a school-based solar photovoltaic project.

I would like to include you as one of several participants to be involved in my study. I believe that because you have experience in developing a school-based solar PV project, you are best suited to speak to the various issues, such as the successes, challenges and barriers experienced during the development of the project.

Participation in this study is voluntary. It will involve an interview of approximately 30 - 45 minutes in length to take place in a mutually agreed upon location or by telephone. The questions are quite general. For example, one question I'm planning on asking is: Who was involved in the conception and development of the solar PV project? You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. With your permission, the interview will be tape-recorded to facilitate collection of information, and the researcher will later replay the tape to record key points raised during the interview. Shortly after the interview has been completed, I will send you a copy of the notes to give you an opportunity to confirm the accuracy of our

conversation and to add or clarify any points that you wish. All information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained for 2 years in a locked filing cabinet in my supervisor's office. Only researchers associated with this project will have access to the data with personal identifiers. There are no known or anticipated risks to you as a participant in this study.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at (519) 504-0155 or by email at clbeckst@fes.uwaterloo.ca. You can also contact my supervisor, Professor Ian Rowlands at (519) 888-4567 ext. 32574 or email irowland@fes.uwaterloo.ca.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes of this office at 519-888-4567 Ext. 36005.

Please reply to this email if you are willing to participate in this study. Once I have received your reply, I will contact you by phone to arrange the time and place for the interview. All efforts will be made to conduct the interview in person; however, it is possible that the interview will take place by telephone. Prior to the interview, you will be asked to sign a consent form confirming that you understand the information presented in this information letter. I very much look forward to speaking with you and thank you in advance for your assistance in this project.

Yours Sincerely,

Claire Beckstead
Master's Candidate
University of Waterloo
Department of Environment and Resource Studies
Waterloo, Ontario
Phone: (519) 504-0155
Email: clbeckst@fes.uwaterloo.ca

Telephone Recruitment Script

P = Potential Participant; I = Interviewer

I - May I please speak to [name of potential participant]?

P - Hello, [name of potential participant] speaking. How may I help you?

I - My name is Claire Beckstead and I am a Master's student in the Department of Environment and Resource Studies at the University of Waterloo. I am currently conducting research under the supervision of Dr. Ian Rowlands on solar photovoltaic technology and schools. As part of my thesis research, I am conducting interviews to identify particular successes, challenges and barriers associated with the implementation of a school-based solar PV project.

As you played a key role in your own school's solar PV initiative, I would like to speak with you about your perspectives on the significant challenges, barriers and successes of your particular project. Is this a convenient time to give you further information about the interviews?

P - No, could you call back later (agree on a more convenient time to call person back).

OR

P - Yes, could you provide me with some more information regarding the interviews you will be conducting?

I - Background Information:

I will be undertaking interviews starting at the end of May. The interview would last 30-45 minutes, and would be arranged for a time convenient to your schedule. Involvement in this interview is entirely voluntary and there are no known or anticipated risks to participation in this study. The questions are quite general. For example, one question I'm planning on asking is: Who was involved in the conception and development of the solar PV project? You may decline to answer any of the interview questions you do not wish to answer and may terminate the interview at any time. With your permission, the interview will be tape-recorded to facilitate collection of information, and replayed to record key points raised in the interview. The notes will be made available 2-3 days after the interview and you will have the opportunity to confirm that your answers were correctly interpreted. All information you provide will be considered confidential. The data collected will be kept in a secure location and disposed of in 3 years time. If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact Dr. Ian Rowlands at 519-888-4567, Ext. 32574.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. Should you have any comments or concerns

resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at 519-888-4567, Ext. 36005.

After all of the data have been analyzed, you will receive an executive summary of the research results. With your permission, I would like to mail/fax you an information letter which has all of these details along with contact names and numbers on it to help assist you in making a decision about your participation in this study.

P - No thank you.

OR

P - Sure (get contact information from potential participant i.e., mailing address/fax number).

I - Thank you very much for your time. May I call you in 2 or 3 days to see if you are interested in being interviewed? Once again, if you have any questions or concerns please do not hesitate to contact me at 519-504-0155.

P - Good-bye

I - Good-bye

Participant Feedback Letter

Dear (*Insert Name of Participant*),

I would like to thank you for your participation in this study. As a reminder, the purpose of this study is to identify successful models for development of a school-based solar photovoltaic (PV) project, and then to assess the social acceptance and applicability of the models for implementation in Southwestern Ontario.

The data collected during interviews will contribute to a better understanding of the successes, challenges and barriers experienced by existing school-based solar PV projects. Please find attached a summary of your responses to the interview questions, including a list of direct quotations that may be used anonymously in future publications. If there are any errors, omissions, or clarifications, please contact me at either the telephone number or email address listed below. If I do not hear from you by (*insert date exactly three weeks after this letter is dated*), I will assume that the summaries and quotations are correct and may be used in future publications.

Please remember that any data pertaining to you as an individual participant will be kept confidential. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles. If you are interested in receiving more information regarding the results of this study, or if you have any questions or concerns, again please contact me. If you would like a summary of the results, please let me know now by providing me with your email address. When the study is completed, I will send it to you. The study is expected to be completed by April 2008.

As with all University of Waterloo projects involving human participants, this project was reviewed by, 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. Susan Sykes in the Office of Research Ethics at 519-888-4567, Ext., 36005.

Sincerely,

Claire Beckstead
Master's Candidate
University of Waterloo
Department of Environment and Resource Studies
Waterloo, Ontario
Phone: (519) 504-0155
Email: clbeckst@fes.uwaterloo.ca

Consent Form

I have read the information presented in the information letter about a study being conducted by Claire Beckstead of the Department of Environment and Resource Studies at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be tape recorded to ensure an accurate recording of my responses.

I am also aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at 519-888-4567 ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

YES NO

I agree to have my interview tape recorded.

YES NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research. I understand that I will have the opportunity to clarify, correct or omit any quotations taken from my interview.

YES NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

Appendix 2 Individual Solar School Interview Questions

1. To start, I'd like to set a bit of context. Tell me about your school and how this project was first conceived. Why the school decided to pursue the project?
2. What is your role at the school, and what was your role in developing the project?
3. What goals did the school want to achieve by developing this solar PV project? Were these goals achieved over the course of the project? How did you measure if you were successful?
4. Why did you choose solar PV to achieve those goals (as stated above)? Was the solar PV project in competition with any other projects (that may or may not have been developed)? Why was the solar PV project pursued over other possible projects that may have achieved similar goals as the solar PV project?
5. Who else was involved in the conception and development of the project? Whose involvement particularly facilitated the development of the project? Where there any groups that were not involved in the development whose involvement would have been beneficial?
6. How was the project funded? Were there a variety of funding models considered? If so, why did you select the model that you did?
7. What were the greatest challenges faced when developing the solar PV project? What were specific barriers during the planning, implementation and maintenance stages of the project?
8. How were these barriers overcome? What could have been done to lessen the effect of the barriers?
9. Has the solar PV technology been incorporated into day-to-day lessons and/or projects for the students? If so, how? Is the solar array used by any groups on campus for educational purposes?
10. What was students' reaction to the project? How about the wider community? Was there any specific resistance to developing the solar PV project?
11. Were there any unexpected outcomes from the solar PV project (either positive or negative)? Looking back are there any things that you would have done differently? What is one piece of advice would you give to a school considering a similar solar PV project?

Appendix 3 Solar School Organization Interview Questions

1. To start off, I'd like to set a bit of context. Tell me about your organization, and how it helps schools install solar PV projects?
2. What is your role in the organization?
3. What goals did the organization want to achieve by developing this solar PV project? Were these goals achieved over the course of the project? How did you measure if you were successful?
4. Why did you choose solar PV to achieve those goals (as stated above)? Was the solar PV project in competition with any other projects (that may or may not have been developed)? Why was the solar PV project pursued over other possible projects that may have achieved similar goals as the solar PV project?
5. How were the specific schools selected to participate in the solar schools project? What role did the students and teachers play in developing and implementing the project?
6. Who else was involved in the conception and development of the project? Whose involvement particularly facilitated the development of the project? Where there any groups that were not involved in the development whose involvement would have been beneficial?
7. How was the project funded? Were there a variety of funding models considered? If so, why did you select the model that you did?
8. Why was a school selected as the site for the solar PV project (as opposed to private residences or other public buildings)?
9. What were the greatest challenges faced when developing the solar PV project? What were specific barriers during the planning, implementation and maintenance stages of the project?
10. How were these barriers overcome? What could have been done to lessen the effect of the barriers?
11. Has the solar PV technology been incorporated into day-to-day lessons and/or projects for the students? If so, how? Is the solar array used by any groups on campus for educational purposes?
12. What was students' reaction to the project? How about the wider community? Was there any specific resistance to developing the solar PV project?

13. Were there any unexpected outcomes from the solar PV project (either positive or negative)? Looking back are there any things that you would have done differently? What is one piece of advice would you give to a school considering a similar solar PV project?

Appendix 4 Phase 2 Ethics Documents

Interview Participant Recruitment Letter

Dear (*insert participant's name and/or title*):

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the Department of Environment and Resource Studies at the University of Waterloo under the supervision of Professor Ian Rowlands. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Renewable energy has been identified by the Ontario provincial government as a strategy to reduce the greenhouse gas and smog-causing emissions that are usually associated with the production of electricity through coal. The Ontario Standard Offer Program is designed to encourage the installation of small-to-medium size renewable energy projects, and will pay electricity providers a premium price for electricity produced from renewable sources. Renewable energy is also being incorporated into the Ontario curriculum at various levels as a way to educate students about issues related to energy, technology and the environment. As a result, schools in Ontario (and elsewhere) have installed solar photovoltaic technology for economic, educational and environmental reasons. Solar photovoltaic technology (more commonly known as solar panels) converts sunlight directly to electricity. Solar panels produce electricity as long as light shines on them, and are considered an environmentally-friendly way to produce electricity. The purpose of this study, therefore, is to identify successful funding models that have been used to develop school-based solar photovoltaic (PV) projects, and then to assess the social acceptance and applicability of the models for implementation in the Halton District School Board. The anticipated potential benefits are that this research will help develop a model for installing a school-based solar PV project that will be acceptable to communities in Southwestern Ontario. Ideally, this research will result in the installation of a school-based solar photovoltaic project.

I would like to include you as one of several participants to be involved in my study. You have been identified as a potential stakeholder of a proposed school-based solar PV project. Your interpretation and assessment of the various proposed funding models will provide valuable feedback that will assist in the evaluation of the potential development models, and will assist in the implementation of the project.

This project has the support of the Halton District School Board and the Halton Catholic District School Board; however the decision to participate in this study is yours. It will involve an interview of approximately 30 - 45 minutes in length to take place in a mutually agreed upon location. The questions are quite general. For example, one question I'm planning on asking is: Do you have any concerns about any of the models for use in a school environment? You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time

without any negative consequences by advising the researcher. With your permission, the interview will be audio-recorded to facilitate collection of information, and the researcher will later replay the tape to record key points raised during the interview. All information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained for 2 years in a locked filing cabinet or on a password protected computer, and then confidentially destroyed or deleted. Only researchers associated with this project will have access to the data with personal identifiers. There are no known or anticipated risks to you as a participant in this study.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at (519) 504-0155 or by email at clbeckst@fes.uwaterloo.ca. You can also contact my supervisor, Professor Ian Rowlands at (519) 888-4567 ext. 32574 or email irowland@fes.uwaterloo.ca.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes of this office at 519-888-4567 Ext. 36005.

Please reply to this email if you are willing to participate in this study. Once I have received your reply, I will contact you to arrange the time and place for the interview. All efforts will be made to conduct the interview in person; however, it is possible that the interview will take place by telephone. Prior to the interview, you will be asked to sign a consent form confirming that you understand the information presented in this information letter. I very much look forward to speaking with you and thank you in advance for your assistance in this project.

Yours Sincerely,

Claire Beckstead
Master's Candidate
University of Waterloo
Department of Environment and Resource Studies
Waterloo, Ontario
Phone: (519) 504-0155
Email: clbeckst@fes.uwaterloo.ca

Telephone Interview Recruitment Script

P = Potential Participant; I = Interviewer

I - May I please speak to [name of potential participant]?

P - Hello, [name of potential participant] speaking. How may I help you?

I - My name is Claire Beckstead and I am a Master's student in the Department of Environment and Resource Studies at the University of Waterloo. I am currently conducting research under the supervision of Dr. Ian Rowlands on solar photovoltaic technology and schools. As part of my thesis research, I am conducting interviews with stakeholders of a proposed school-based photovoltaic (PV) project in the Halton (Catholic) District School Board. Solar PV technology, also known as solar panels, is used to produce electricity from the sun's rays. It does not create any emissions, and therefore is considered to be an environmentally-friendly way to produce electricity. As you are a key stakeholder in this project, I would like to speak with you about your perspectives on the potential funding models for this project. Is this a convenient time to give you further information about the interviews?

P - No, could you call back later (agree on a more convenient time to call person back).
OR

P - Yes, could you provide me with some more information regarding the interviews you will be conducting?

I - Background Information:

I will be undertaking interviews starting at the end of September.

The interview would last 30-45 minutes, and would be arranged for a time convenient to your schedule. Involvement in this interview is entirely voluntary and there are no known or anticipated risks to participation in this study. The questions are quite general. You may decline to answer any of the interview questions you do not wish to answer and may terminate the interview at any time. With your permission, the interview will be audio-recorded to facilitate collection of information and will be used by the researcher to record key points raised in the interview. All information you provide will be considered confidential and your name will not appear in the thesis or any publication. The data collected will be kept in a secure location and disposed of in 2 years time. If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact Dr. Ian Rowlands at 519-888-4567, Ext. 32574.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. Should you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes in the Office of Research Ethics at 519-888-4567, Ext. 36005. After all of the data have been

analyzed, if you so choose, you will receive an executive summary of the research results. With your permission, I would like to email/fax you an information letter which has all of these details along with contact names and numbers on it to help assist you in making a decision about your participation in this study.

P - No thank you.

OR

P - Sure (get contact information from potential participant i.e., mailing address/fax number).

I - Thank you very much for your time. May I call you in 2 or 3 days to see if you are interested in being interviewed? Once again, if you have any questions or concerns please do not hesitate to contact me at 519-504-0155.

P - Good-bye.

I - Good-bye.

School Council Survey Participant Recruitment Letter

Dear (*insert school name*) stakeholder:

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the Department of Environment and Resource Studies at the University of Waterloo under the supervision of Professor Ian Rowlands. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Renewable energy has been identified by the Ontario provincial government as a strategy to reduce the greenhouse gas and smog-causing emissions that are usually associated with the production of electricity through coal. The Ontario Standard Offer Program designed to encourage the installation of small-to-medium size renewable energy projects, and will pay electricity providers a premium price for electricity produced from renewable sources. Renewable energy is also being incorporated into the Ontario curriculum at various levels as a way to educate students about issues related to energy, technology and the environment. As a result, schools in Ontario (and elsewhere) have installed solar photovoltaic technology for economic, educational and environmental reasons. Solar photovoltaic technology (more commonly known as solar panels) converts sunlight directly to electricity. Solar panels produce electricity as long as light shines on them, and are considered an environmentally-friendly way to produce electricity. The purpose of this study, therefore, is to identify successful funding models that have been used for development for school-based solar photovoltaic (PV) projects, and then to assess the social acceptance and applicability of the models for implementation in the Halton District School Board. The anticipated potential benefits are that this research will help develop a model for installing a school-based solar PV project that will be acceptable to communities in Southwestern Ontario. Ideally, this research will result in the installation of a school-based solar photovoltaic project.

I would like to include you as one of several participants to be involved in my study. Members of the (*insert school name*) School Council have been identified as potential stakeholders of a proposed school-based solar PV project. Your interpretation and opinion on the various proposed funding models will provide valuable feedback that will assist in the evaluation of the potential development models, and will assist in selecting the most appropriate model for the Halton District School Board.

This project has the support of the Halton District School Board and the Halton Catholic District School Board; however the decision to participate in this study is yours. Participation involves looking at 5 potential funding models, and completing a short survey-questionnaire. The survey-questionnaire will ask you to identify aspects of each funding model that you like or do not like, and will ask you to elaborate why. The survey will take approximately 15 -20 minutes to complete. You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. You

will have the opportunity to complete the questionnaire-survey at the School Council meeting on (*insert date*). Blank or completed surveys will be collected in a sealed drop-box at the end of the meeting.

The survey is completed anonymously and all information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained for 2 years in a locked filing cabinet in my supervisor's office or on a password protected computer, and then confidentially destroyed or deleted. Only researchers associated with this project will have access to the research data. There are no known or anticipated risks to you as a participant in this study.

Upon completion of this study, the researcher will provide a summary of the research results to the Chair of the (*insert school name*) School Council. If you would like to receive an individual copy of the research summary, please contact Claire at the email address listed below. Results from the study are anticipated to be completed by the end of April 2008.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at (519) 504-0155 or by email at clbeckst@fes.uwaterloo.ca. You can also contact my supervisor, Professor Ian Rowlands at (519) 888-4567 ext. 32574 or email irowland@fes.uwaterloo.ca.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes of this office at 519-888-4567 Ext. 36005.

Yours Sincerely,

Claire Beckstead
Master's Candidate
University of Waterloo
Department of Environment and Resource Studies
Waterloo, Ontario
Phone: (519) 504-0155
Email: clbeckst@fes.uwaterloo.ca

Participant Feedback Letter

Dear (*Insert Name of Participant*),

I would like to thank you for your participation in this study. As a reminder, the purpose of this study is to identify successful funding models for the development of school-based solar photovoltaic (PV) projects, and then to assess the social acceptance and applicability of the models for implementation in Southwestern Ontario.

The data collected through interviews and surveys will contribute to a better understanding of the social acceptance of school-based solar PV projects. Please remember that any data pertaining to you as an individual participant will be kept confidential. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles. If you are interested in receiving more information regarding the results of this study, or if you have any questions or concerns, please contact me. If you would like a summary of the results, and you have not already done so, please email me at clbeckst@fes.uwaterloo.ca with your request for the study results. When the study is completed, I will send you an executive summary. The study is expected to be completed by April 2008.

As with all University of Waterloo projects involving human participants, this project was reviewed by, 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. Susan Sykes in the Office of Research Ethics at 519-888-4567, Ext., 36005.

Sincerely,

Claire Beckstead
Master's Candidate
University of Waterloo
Department of Environment and Resource Studies
Waterloo, Ontario
Phone: (519) 504-0155
Email: clbeckst@fes.uwaterloo.ca

Consent Form

I have read the information presented in the information letter about a study being conducted by Claire Beckstead of the Department of Environment and Resource Studies at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio-recorded to ensure an accurate recording of my responses.

I am also aware that excerpts from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at 519-888-4567 ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

YES NO

I agree to have my interview audio-recorded.

YES NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research

YES NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

If you wish to receive an executive summary of the study results, please provide your email address here: _____

Appendix 5 Phase 2 School Council Survey

This survey has been developed by researchers at the **University of Waterloo**. All the information that you provide will be confidential, and will be used only by project researchers.

Please complete this survey and place it in the sealed drop-box provided by the researcher. Your opinions are valued in exploring the social acceptance of solar photovoltaic (PV) technology, and how funding models affect the acceptance of school-based solar PV projects.

Thank you for your participation!

Section 1 – Information about you

Please check the appropriate response:

- What decade were you born?
 1930s 1940s 1950s 1960s 1970s 1980s 1990s
- Are you female or male?
 Female Male
- What is the highest level of education that you have completed?
 Some high school High school College or University Post-graduate degree
- What was your household's income last year?
 less than \$20,000 \$20,001 to \$40,000 \$40,001 to \$60,000 \$60,001 to \$80,000 \$80,001 to \$100,000 \$100,001 to \$120,000 more than \$120,000
- Do you have children who attend (or who have ever attended) schools in the Halton District School Board or the Halton Catholic District School Board:
 Yes No
- How far away do you live from (**insert school name**)?
 less than 1 km 2 – 3 km 4 – 5 km more than 5 km
- How long have you lived in this area?
 Less than 6 months 6 months – 1 year 1 year – 3 years 3 years – 5 years Greater than 5 years

Section 2 – Knowledge, Attitudes and Opinions

This section is designed to assess your knowledge, attitudes and opinions about solar photovoltaic technology.

A. Knowledge

Please **CIRCLE** the number indicating your level of knowledge:

	None	Below Average	Average	Above Average	Expert
Global climate change	1	2	3	4	5

	None	Below average	Average	Above average	Expert
Energy issues (e.g., supply, demand, production, conservation)	1	2	3	4	5
Energy system issues (e.g., grid reliability, peak energy demand)	1	2	3	4	5
Conventional energy technologies (i.e., coal, nuclear, hydro)	1	2	3	4	5
Solar photovoltaic (i.e., solar electric)	1	2	3	4	5
Wind energy technology	1	2	3	4	5
Biomass energy technology	1	2	3	4	5

B. Perceptions

Please **CIRCLE** the number indicating your perceptions of the use (to produce electricity) of the following:

	Strongly negative	Negative	Neutral/ No Opinion	Positive	Strongly positive
New technology in general	1	2	3	4	5
Conventional energy technology in general	1	2	3	4	5
Nuclear power plants	1	2	3	4	5
Coal power plants	1	2	3	4	5
Hydro dams	1	2	3	4	5
Wind turbines	1	2	3	4	5
Solar photovoltaic panels	1	2	3	4	5
Biomass energy technology	1	2	3	4	5

C. Concern

Please **CIRCLE** your level of agreement with the following statements.

	Strongly disagree	Disagree	Agree	Strongly agree
I am supportive of developing and implementing new renewable energy technologies.	1	2	3	4
I prefer conventional sources of electricity to renewable sources of electricity.	1	2	3	4
I think that solar photovoltaic (PV) technology is a good idea, and would like to see it implemented on a large scale.	1	2	3	4
I think that more research is needed before solar PV technology should be implemented on a large scale.	1	2	3	4
I think solar PV technology should be integrated into new and existing building designs.	1	2	3	4
I am concerned that solar PV technology is not safe for birds or other animals.	1	2	3	4
I think solar PV technology is very safe compared to other energy technologies.	1	2	3	4
I think solar PV technology is too expensive.	1	2	3	4
I would be willing to purchase solar PV technology.	1	2	3	4
I would not like to see solar PV technology on a building near my home.	1	2	3	4
I think solar PV technology enhances the look of a building.	1	2	3	4

I think solar PV technology installed in my neighbourhood may negatively affect my property value.	1	2	3	4
I would actively support (financially or by volunteering) a solar PV project in my neighbourhood.	1	2	3	4
I would <i>not</i> like to see solar PV technology installed on my home or in my neighbourhood.	1	2	3	4

1. Do you have any other comments about solar PV technology that you would like to add?

Section 3 – Questions about development models

Solar photovoltaic (PV) projects have been installed on schools around the world for environmental, economic, and educational reasons. Your opinions are valued in exploring how funding models affect the acceptance of a potential solar PV project on **(insert school name)**.

Please spend a couple of minutes looking at the five proposed funding models. Then, please answer the following questions as completely as you can.

1. Would the funding model used to implement the solar PV project affect (either increase or decrease) your support of the project? Why or why not?

2. Please indicate how your support a solar PV project at **(insert school name)** would change if the project was funded by each of the following funding models:

	Dramatically decrease support	Decrease support	No change in support	Increase support	Dramatically increase support
Renting School Roof Space	1	2	3	4	5
Corporate Sponsorship	1	2	3	4	5
Community Fundraising	1	2	3	4	5
Community Co-operative	1	2	3	4	5
Government / Utility Program	1	2	3	4	5

3. Please rank the development model from **(1)** “Most Desirable for **(insert school name)**” to **(5)** “Least Desirable for **(insert school name)**”.

___ Renting ___ Corporate ___ Community ___ Community ___ Government
 Roof Space Sponsorship Fund-raising Co-operative or Utility Program

4. What criteria did you use to rank the models?

5. What specific factors did you *like* about the model that you ranked number 1?

6. What specific factors did you *dislike* about the model that you ranked number 5?

7. Do you have any concerns about any (or all) of the models for use *in schools*? If yes, what are your concerns?

8. Are there any specific characteristics of a solar PV installation that would decrease your support of the project?

9. Would you actively (i.e., financially or by volunteering) support a solar PV installation on **(insert school name)**? Why or why not?

10. Are there any *non-financial* reasons that you would have concerns about a solar PV installation on **(insert school name)**?

11. Does the fact that the solar PV installation is installed on a *school* rather than any other building in your neighbourhood affect your support of the project?

12. Should a solar PV installation be a *higher priority* for **(insert school name)**? If no, why not?

13. Do you have any other comments about any of the topics addressed on this survey?

Do you agree to the use of anonymous quotations in any thesis or publication that may result from the research?

YES

NO

THANK YOU FOR YOUR ASSISTANCE WITH THIS PROJECT

Appendix 6 Phase 2 Stakeholder Interview Questions

Questions for all interview respondents:

1. Do you have any other comments about solar PV technology that you would like to add?
2. Would solar PV technology be useful for use in the classroom? How easy do you think it would be to incorporate into the curriculum? Do you think teachers at this school would be willing to use solar PV technology in the classroom?
3. Would the funding model used to implement the solar PV project affect (either increase or decrease) your support of the project? Why or why not?
4. What characteristics did you like about the five funding models?
5. What characteristics did you dislike about the five funding models?
6. Do you have any concerns about any (or all) of the models for use *in schools*? If yes, what are your concerns?
7. Are there any specific characteristics of a solar PV installation that would decrease your support of the project?
8. Would you actively (i.e., financially or by volunteering) support a solar PV installation on (**insert school name**)? Why or why not?
9. Does the fact that the solar PV installation is installed on a *school* rather than any other building in your neighbourhood affect your support of the project?
10. Should a solar PV installation be a *higher priority* for (**insert school name**)? If no, why not?
11. Do you have any other comments about any of the topics addressed on this survey?

Appendix 7 Collapsed Likert Scale Categories for Sections 2(A), 2(B), and 2(C)

Section 2(A) – Knowledge

Please **CIRCLE** the number indicating your level of knowledge of the following topics:

Survey Question	Original responses	Collapsed responses
Global climate change (n = 79)	1 – None (0) 2 – Below Average (5) 3 – Average (43) 4 – Above Average (31) 5 – Expert (0)	1 – Below Average (5) 2 – Average (43) 3 – Above Average (31)
Energy issues (e.g., supply, demand, production, conservation) (n = 79)	1 – None (0) 2 – Below Average (8) 3 – Average (42) 4 – Above Average (27) 5 – Expert (2)	1 – Below Average (8) 2 – Average (42) 3 – Above Average (29)
Energy system issues (e.g., grid reliability, peak energy demand) (n = 79)	1 – None (2) 2 – Below Average (19) 3 – Average (43) 4 – Above Average (14) 5 – Expert (1)	1 – Below Average (21) 2 – Average (43) 3 – Above Average (15)
Conventional energy technologies (i.e., coal, nuclear, hydro) (n = 79)	1 – None (2) 2 – Below Average (10) 3 – Average (48) 4 – Above Average (18) 5 – Expert (1)	1 – Below Average (12) 2 – Average (48) 3 – Above Average (19)
Solar photovoltaic (i.e., solar electric) (n = 79)	1 – None (6) 2 – Below Average (23) 3 – Average (39) 4 – Above Average (10) 5 – Expert (1)	1 – Below Average (29) 2 – Average (39) 3 – Above Average (11)
Wind energy technology (n = 79)	1 – None (3) 2 – Below Average (25) 3 – Average (37) 4 – Above Average (13) 5 – Expert (1)	1 – Below Average (28) 2 – Average (37) 3 – Above Average (14)
Biomass energy technology (n = 79)	1 – None (19) 2 – Below Average (32) 3 – Average (25) 4 – Above Average (3) 5 – Expert (0)	1 – Below Average (51) 2 – Average (25) 3 – Above Average (3)

Section 2(B) – Attitudes and Perceptions

Please **CIRCLE** the number indicating your perception of the use of the following technology:

Survey Question	Original responses	Collapsed responses
New technology in general (n = 79)	1 – Strongly Negative (0) 2 – Negative (0) 3 – Neutral/No opinion (15) 4 – Positive (46) 5 – Strongly positive (18)	1 – Negative (0) 2 – Neutral/No opinion (15) 3 – Positive (64)
Conventional energy technology in general (n = 79)	1 – Strongly Negative (1) 2 – Negative (14) 3 – Neutral/No opinion (36) 4 – Positive (28) 5 – Strongly positive (0)	1 – Negative (15) 2 – Neutral/No opinion (36) 3 – Positive (28)
Nuclear power plants (n = 79)	1 – Strongly Negative (3) 2 – Negative (19) 3 – Neutral/No opinion (27) 4 – Positive (27) 5 – Strongly positive (3)	1 – Negative (22) 2 – Neutral/No opinion (27) 3 – Positive (30)
Coal power plants (n = 79)	1 – Strongly Negative (18) 2 – Negative (40) 3 – Neutral/No opinion (19) 4 – Positive (2) 5 – Strongly positive (0)	1 – Negative (58) 2 – Neutral/No opinion (19) 3 – Positive (2)
Hydro dams (n = 78)	1 – Strongly Negative (1) 2 – Negative (9) 3 – Neutral/No opinion (26) 4 – Positive (36) 5 – Strongly positive (6)	1 – Negative (10) 2 – Neutral/No opinion (26) 3 – Positive (42)
Wind turbines (n = 79)	1 – Strongly Negative (0) 2 – Negative (0) 3 – Neutral/No opinion (8) 4 – Positive (39) 5 – Strongly positive (32)	1 – Negative (0) 2 – Neutral/No opinion (8) 3 – Positive (71)
Solar photovoltaic panels (n = 79)	1 – Strongly Negative (0) 2 – Negative (0) 3 – Neutral/No opinion (10) 4 – Positive (39) 5 – Strongly positive (30)	1 – Negative (0) 2 – Neutral/No opinion (10) 3 – Positive (69)
Biomass energy technology (n = 77)	1 – Strongly Negative (0) 2 – Negative (0) 3 – Neutral/No opinion (52) 4 – Positive (16) 5 – Strongly positive (9)	1 – Negative (0) 2 – Neutral/No opinion (52) 3 – Positive (25)

Section 2(C) – Opinions and Concerns

Please **CIRCLE** the number that indicates your level of agreement with the following statements:

Survey Question	Original responses	Collapsed responses
I am supportive of developing and implementing new renewable energy technologies. (n = 78)	1 – Strongly Disagree (0) 2 – Disagree (0) 3 – Agree (29) 4 – Strongly Agree (49)	1 – Disagree (0) 2 – Agree (78)
I prefer conventional sources of electricity to renewable sources of electricity. (n = 74)	1 – Strongly Disagree (21) 2 – Disagree (44) 3 – Agree (8) 4 – Strongly Agree (1)	1 – Disagree (65) 2 – Agree (9)
I think that solar photovoltaic (PV) technology is a good idea, and would like to see it implemented on a large scale. (n = 73)	1 – Strongly Disagree (0) 2 – Disagree (3) 3 – Agree (37) 4 – Strongly Agree (33)	1 – Disagree (3) 2 – Agree (70)
I think that more research is needed before solar PV technology should be implemented on a large scale. (n = 74)	1 – Strongly Disagree (3) 2 – Disagree (28) 3 – Agree (32) 4 – Strongly Agree (11)	1 – Disagree (31) 2 – Agree (43)
I think solar PV technology should be integrated into new and existing building designs. (n = 71)	1 – Strongly Disagree (0) 2 – Disagree (2) 3 – Agree (44) 4 – Strongly Agree (25)	1 – Disagree (2) 2 – Agree (69)
I am concerned that solar PV technology is not safe for birds or other animals. (n = 72)	1 – Strongly Disagree (11) 2 – Disagree (54) 3 – Agree (7) 4 – Strongly Agree (0)	1 – Disagree (65) 2 – Agree (7)
I think solar PV technology is very safe compared to other energy technologies. (n = 73)	1 – Strongly Disagree (1) 2 – Disagree (0) 3 – Agree (41) 4 – Strongly Agree (31)	1 – Disagree (1) 2 – Agree (72)
I think solar PV technology is too expensive. (n = 64)	1 – Strongly Disagree (4) 2 – Disagree (21) 3 – Agree (25) 4 – Strongly Agree (14)	1 – Disagree (25) 2 – Agree (39)
I would be willing to purchase solar PV technology. (n = 69)	1 – Strongly Disagree (4) 2 – Disagree (15) 3 – Agree (39) 4 – Strongly Agree (11)	1 – Disagree (19) 2 – Agree (50)
I would <i>not</i> like to see solar PV technology on a building near my home. (n = 72)	1 – Strongly Disagree (24) 2 – Disagree (43) 3 – Agree (4) 4 – Strongly Agree (1)	1 – Disagree (67) 2 – Agree (5)
I think solar PV technology enhances the look of a building. (n = 72)	1 – Strongly Disagree (2) 2 – Disagree (50) 3 – Agree (15) 4 – Strongly Agree (5)	1 – Disagree (52) 2 – Agree (20)
I think solar PV technology installed in my neighbourhood may negatively affect my	1 – Strongly Disagree (19) 2 – Disagree (49) 3 – Agree (5)	1 – Disagree (68) 2 – Agree (6)

property value. (n = 74)	4 – Strongly Agree (1)	
I would actively support (financially or by volunteering) a solar PV project in my neighbourhood. (n = 74)	1 – Strongly Disagree (1) 2 – Disagree (12) 3 – Agree (49) 4 – Strongly Agree (12)	1 – Disagree (13) 2 – Agree (61)
I would <i>not</i> like to see solar PV technology installed on my home or in my neighbourhood. (n = 72)	1 – Strongly Disagree (25) 2 – Disagree (45) 3 – Agree (2) 4 – Strongly Agree (0)	1 – Disagree (70) 2 – Agree (2)

Appendix 8 Chi Square Results for School Characteristics

	EcoSchool vs. Non-EcoSchool		Catholic School vs. Public School		Elementary School vs. High School		Small municipality vs. Large Municipality		Interview vs. School Council	
	Pearson Chi-Square	Asymp. Sig.	Pearson Chi-Square	Asymp. Sig.	Pearson Chi-Square	Asymp. Sig.	Pearson Chi-Square	Asymp. Sig.	Pearson Chi-Square	Asymp. Sig.
S2-A-Q1	1.768	0.413	0.959	0.619	1.545	0.463	1.879	0.391	8.728	0.013
S2-A-Q2	1.727	0.422	0.421	0.810	0.550	0.760	0.793	0.673	10.621	0.005
S2-A-Q3	1.203	0.548	1.354	0.508	0.313	0.855	0.024	0.988	3.580	0.167
S2-A-Q4	1.108	0.575	1.028	0.598	0.460	0.795	5.556	0.062	0.955	0.620
S2-A-Q5	1.714	0.424	0.313	0.855	3.886	0.143	0.930	0.628	2.449	0.294
S2-A-Q6	4.749	0.093	1.846	0.397	2.399	0.301	0.559	0.756	3.141	0.208
S2-A-Q7	0.720	0.698	2.812	0.245	0.438	0.803	2.673	0.263	0.568	0.753
S2-B-Q1	0.450	0.502	0.487	0.485	0.099	0.752	0.203	0.652	3.813	0.051
S2-B-Q2	4.766	0.092	0.398	0.820	0.902	0.637	0.541	0.763	0.639	0.727
S2-B-Q3	1.196	0.550	2.743	0.254	0.954	0.621	0.457	0.796	0.380	0.827
S2-B-Q4	4.060	0.131	2.745	0.253	1.594	0.451	6.642	0.036*	1.505	0.471
S2-B-Q5	4.593	0.101	1.715	0.424	6.185	0.045	4.871	0.088	4.098	0.129
S2-B-Q6	1.518	0.218	0.401	0.527	0.176	0.675	2.580	0.108	0.636	0.425
S2-B-Q7	0.961	0.327	1.503	0.220	0.226	0.634	0.017	0.898	7.010	0.008
S2-B-Q8	0.000	0.985	1.680	0.195	0.222	0.638	0.424	0.515	1.685	0.194
S2-C-Q1	*	*	*	*	*	*	*	*	*	*
S2-C-Q2	0.033	0.855	0.072	0.788	0.027	0.868	0.009	0.923	0.147	0.701
S2-C-Q3	0.508	0.476	3.044	0.081	2.309	0.129	0.220	0.639	2.062	0.151
S2-C-Q4	1.125	0.289	2.481	0.115	2.713	0.100	0.399	0.528	0.017	0.896
S2-C-Q5	0.010	0.919	2.001	0.157	1.506	0.220	0.010	0.919	1.340	0.247
S2-C-Q6	0.008	0.929	1.082	0.298	0.000	0.991	4.610	0.032	1.276	0.259
S2-C-Q7	0.884	0.347	0.934	0.334	0.748	0.387	1.163	0.281	1.629	0.202
S2-C-Q8	0.323	0.570	0.740	0.390	1.135	0.287	0.006	0.798	0.294	0.588
S2-C-Q9	0.629	0.428	1.268	0.260	0.084	0.771	0.539	0.463	5.997	0.014
S2-C-Q10	0.112	0.737	0.159	0.690	0.006	0.938	2.527	0.112	0.003	0.958
S2-C-Q11	0.055	0.815	1.814	0.178	1.088	0.297	3.296	0.069	0.948	0.330
S2-C-Q12	2.061	0.151	2.548	0.117	1.707	0.191	0.849	0.357	0.028	0.867
S2-C-Q13	1.832	0.176	0.655	0.418	4.987	0.026	0.494	0.482	0.625	0.429
S2-C-Q14	0.026	0.873	1.841	0.175	0.059	0.808	0.002	0.968	0.107	0.744
S3-A-Q1	1.336	0.513	1.150	0.563	1.327	0.515	0.252	0.882	2.126	0.345
S3-A-Q2	0.284	0.868	1.214	0.545	6.467	0.039	0.988	0.610	1.331	0.514
S3-A-Q3	0.015	0.993	0.188	0.910	0.904	0.636	0.725	0.696	1.694	0.429
S3-A-Q4	2.410	0.300	1.999	0.368	0.717	0.699	0.465	0.792	7.977	0.019

S3-A-Q5	2.387	0.303	2.882	0.237	0.330	0.848	0.911	0.634	3.570	0.168
S3-B-Q1	3.178	0.529	4.221	0.377	3.332	0.504	5.024	0.285	1.585	0.811
S3-B-Q2	2.215	0.696	0.787	0.940	2.281	0.684	1.455	0.835	4.195	0.380
S3-B-Q3	2.641	0.620	9.399	0.052	5.346	0.254	2.860	0.581	3.478	0.481
S3-B-Q4	1.510	0.825	2.993	0.559	2.706	0.608	0.161	0.997	2.016	0.733
S3-B-Q5	4.231	0.376	6.813	0.146	6.079	0.193	2.857	0.582	3.731	0.444

Legend

* - result is a constant – no chi square test was performed

bold number - significant result

bold number* - false significant result due to sparsely distributed data

Appendix 9 Chi Square Results for Demographic Characteristics

	Respondent Title		Age		Gender		Level of Education		Household income		Children attending HDSB or HCDSB schools		Distance from School		Time living in the area	
	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.	Pearson Chi-Square	Asymp . Sig.
S2-A-Q1	20.058	0.029*	4.802	0.779	6.596	0.037*	3.508	0.477	6.331	0.176	4.335	0.114	3.717	0.446	2.702	0.609
S2-A-Q2	25.601	0.004*	8.600	0.377	4.572	0.102	12.786	0.012*	5.747	0.219	2.796	0.247	4.880	0.300	2.470	0.650
S2-A-Q3	18.658	0.045*	5.128	0.744	6.894	0.032*	12.846	0.012*	9.394	0.052	2.001	0.368	1.397	0.845	5.493	0.240
S2-A-Q4	16.734	0.080	8.169	0.417	10.985	0.004*	3.543	0.471	8.015	0.091	0.946	0.623	10.870	0.028*	3.721	0.445
S2-A-Q5	9.162	0.517	10.390	0.239	18.773	0.000*	3.792	0.435	3.040	0.551	8.064	0.018*	2.913	0.573	2.855	0.582
S2-A-Q6	13.552	0.194	8.103	0.423	19.054	0.000*	6.570	0.160	3.809	0.432	7.337	0.026*	4.698	0.320	2.443	0.655
S2-A-Q7	17.391	0.066	2.381	0.967	7.189	0.027*	6.516	0.164	8.779	0.067	1.909	0.385	2.635	0.621	1.394	0.845
S2-B-Q1	9.455	0.092	2.969	0.563	1.784	0.182	0.229	0.892	2.066	0.356	0.054	0.817	2.851	0.240	1.410	0.494
S2-B-Q2	13.226	0.209	8.419	0.394	0.185	0.912	1.508	0.825	4.347	0.361	0.450	0.799	6.711	0.152	2.415	0.660
S2-B-Q3	7.569	0.671	7.918	0.442	0.091	0.956	4.831	0.305	4.549	0.337	0.921	0.631	1.902	0.754	2.319	0.677
S2-B-Q4	10.364	0.409	4.397	0.820	4.013	0.134	5.345	0.254	3.504	0.477	1.589	0.452	6.805	0.147	1.476	0.831
S2-B-Q5	7.854	0.643	13.815	0.087	6.957	0.031	3.650	0.455	2.181	0.703	2.307	0.316	6.438	0.169	5.765	0.217

Q5																	
S2-B-Q6	2.938	0.709	4.485	0.344	0.033	0.856	4.377	0.112	4.552	0.103	0.680	0.409	0.722	0.697	4.828	0.089	
S2-B-Q7	7.010	0.220	3.448	0.486	1.083	0.298	2.795	0.247	0.762	0.683	3.694	0.055	2.957	0.228	2.946	0.229	
S2-B-Q8	5.779	0.328	1.293	0.863	0.852	0.356	1.199	0.549	1.943	0.378	0.583	0.445	0.007	0.997	1.364	0.506	
S2-C-Q1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
S2-C-Q2	14.092	0.015*	2.217	0.696	0.044	0.834	2.483	0.289	3.906	0.142	1.014	0.314	2.126	0.345	2.237	0.327	
S2-C-Q3	2.062	0.840	11.127	0.025*	0.007	0.933	1.700	0.427	1.114	0.573	1.043	0.307	1.530	0.465	1.145	0.564	
S2-C-Q4	0.956	0.966	2.843	0.584	0.052	0.819	0.377	0.828	7.942	0.019	0.671	0.413	1.917	0.383	3.281	0.194	
S2-C-Q5	1.340	0.931	34.537	0.000*	0.197	0.657	0.458	0.795	1.049	0.592	0.660	0.416	0.605	0.739	0.783	0.676	
S2-C-Q6	2.609	0.760	1.561	0.816	1.601	0.206	0.715	0.699	1.906	0.386	0.162	0.687	3.342	0.188	0.719	0.698	
S2-C-Q7	17.490	0.004*	1.043	0.903	0.561	0.454	2.160	0.340	1.118	0.572	0.313	0.576	1.341	0.511	0.371	0.831	
S2-C-Q8	0.393	0.996	0.917	0.922	0.000	0.993	0.919	0.631	2.974	0.226	1.265	0.261	0.571	0.751	3.202	0.202	
S2-C-Q9	8.193	0.146	5.566	0.234	1.779	0.182	5.772	0.056	1.618	0.445	2.478	0.115	0.567	0.753	1.130	0.568	
S2-C-Q10	4.756	0.446	7.968	0.093	4.486	0.034*	6.703	0.035*	2.487	0.288	0.081	0.775	2.092	0.351	0.994	0.608	
S2-C-Q11	2.887	0.719	4.435	0.350	0.001	0.981	3.330	0.189	1.387	0.500	0.836	0.361	0.129	0.937	1.543	0.462	
S2-C-Q12	8.777	0.118	2.349	0.517	0.045	0.832	2.456	0.293	2.743	0.254	0.160	0.689	1.643	0.440	2.346	0.309	
S2-C-Q13	4.480	0.483	1.996	0.736	1.044	0.307	1.414	0.493	4.213	0.122	0.185	0.667	1.785	0.410	4.904	0.086	
S2-C-Q14	6.190	0.288	1.804	0.772	0.172	0.678	1.506	0.471	1.170	0.557	0.661	0.416	0.525	0.769	0.767	0.681	
S3-A-	6.859	0.739	9.851	0.276	4.088	0.130	4.313	0.365	4.594	0.332	1.971	0.373	11.349	0.023	2.348	0.672	

Q1															*		
S3-A-Q2	7.529	0.675	11.411	0.179	0.705	0.703	3.373	0.498	4.066	0.397	0.138	0.993	2.207	0.698	5.371	0.251	
S3-A-Q3	9.828	0.456	14.071	0.080	0.677	0.713	2.446	0.654	0.643	0.958	0.251	0.882	4.539	0.338	5.517	0.238	
S3-A-Q4	15.203	0.125	5.074	0.750	1.869	0.393	3.923	0.417	1.531	0.821	0.405	0.817	5.136	0.274	4.138	0.388	
S3-A-Q5	10.075	0.434	4.743	0.785	1.811	0.404	2.538	0.638	1.279	0.865	0.203	0.903	3.942	0.414	5.078	0.279	
S3-B-Q1	23.748	0.254	17.217	0.372	3.796	0.434	10.228	0.249	6.698	0.570	1.331	0.856	14.947	0.060	4.807	0.778	
S3-B-Q2	24.890	0.206	22.892	0.117	5.078	0.279	15.577	0.049 *	13.507	0.096	1.315	0.859	18.143	0.020 *	4.826	0.776	
S3-B-Q3	14.865	0.784	31.427	0.012 *	1.189	0.880	9.648	0.291	2.740	0.950	6.203	0.184	14.233	0.076	10.355	0.241	
S3-B-Q4	13.389	0.860	12.771	0.689	2.529	0.640	6.767	0.562	4.265	0.832	2.323	0.677	13.867	0.085	1.807	0.986	
S3-B-Q5	16.776	0.667	19.002	0.269	4.394	0.355	3.449	0.903	16.469	0.036 *	1.183	0.881	6.996	0.537	4.682	0.791	

Legend

* - result is a constant – no chi square test was performed

Bold number - significant result

Bold number* - false significant result due to sparsely distributed data