The Adoption of Residential Solar Photovoltaic Systems in the Presence of a Financial Incentive: A Case Study of Consumer Experiences with the Renewable Energy Standard Offer Program in Ontario (Canada)

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 revision, as accepted by my examiners.

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Chris William Junji Adachi

Abstract

Traditionally, high initial capital costs and lengthy payback periods have been identified as the most significant barriers that limit the diffusion of solar photovoltaic (PV) systems. In response, the Ontario Government, through the Ontario Power Authority (OPA), introduced the Renewable Energy Standard Offer Program (RESOP) in November, 2006. The RESOP offers owners of solar PV systems with a generation capacity under 10MW a 20 year contract to sell electricity back to the grid at a guaranteed rate of $0.42/kWh. While it is the intent of incentive programs such as the RESOP to begin to lower financial barriers in order to increase the uptake of solar PV systems, there is no guarantee that the level of participation will in fact rise. The "on-the-ground" manner in which consumers interact with such an incentive program ultimately determines its effectiveness.

The purpose of this thesis is to analyze the relationship between the RESOP and solar PV system consumers. To act on this purpose, the experiences of current RESOP participants are presented, wherein the factors that are either hindering or promoting utilization of the RESOP and the adoption of solar PV systems are identified.

This thesis was conducted in three phases – a literature review, preliminary key informant interviews, and primary RESOP participant interviews – with each phase informing the scope and design of the subsequent stage. First, a literature survey was completed to identify and to understand the potential drivers and barriers to the adoption of a solar PV system from the perspective of a consumer. Second, nine key informant interviews were completed to gain further understanding regarding the specific intricacies of the drivers and barriers in the case of Ontario, as well as the overall adoption system in the province. These interviews were conducted between July and September, 2008. Third, interviews with 24 RESOP participants were

conducted; they constitute the primary data set. These interviews were conducted between November and December, 2008.

Findings of this thesis suggest that the early adopters of solar PV systems have been motivated by their self-identified sustainability-oriented social attitudes, rather than the lowering of the financial barrier. Only six of 24 respondents noted that they would not have purchased a solar PV system in the absence of the RESOP. For nine of 24 respondents, the catalyst for the purchase of the solar PV systems was not the creation of the RESOP, but instead the presence of a community-based co-operative purchasing group (CBCPG) that had selected a vender and that provided a support service to help the consumer navigate the administrative processes associated with the RESOP.

Regarding the functioning of the RESOP, interview respondents reported lengthy periods of time to secure electrical connection, hidden additional fees, and arduous administrative processes. Based on their experiences interacting with Local Distribution Companies, vendors, and the OPA, respondent evaluations of the overall adoption process ranged from extremely positive (some interviewees praised the RESOP for its ease of participation and utility), to extremely negative (other interviewees condemned the RESOP because of its administrative complexity and hidden costs and fees). A key finding from this research is that weaknesses in the administration and promotion of the RESOP have been mitigated by the presence of CBCPGs and third parties aiding consumers in the purchase, installation, administration, and connection of their solar PV system. Recommendations of this thesis include the creation of new and enhancement of existing CBCPGs, a simplification of the required administrative processes, and an increase in the rates of compensation.

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1 Introduction

1.1 Introduction and Background

1.1.1 Sustainability and Energy

Within current literature, sustainability is defined (if not in this precise form, some related or derivative version) as "patterns of economic, environmental, and social progress that meet the needs of the present day without reducing the capacity to meet future needs" (Randolph & Masters, 2008, p.3). While communities and peoples have been concerned with their continual existence since the beginnings of human evolution (Gibson, Hassan, Holtz, Tansey, & Whitelaw, 2005), more recent concerns over sustainable development (e.g. the work of the Bruntland Commission) and the current threat of climate change have revitalized the discussion of sustainability and brought it to the forefront of social discourse (Fuchs & Arentsen, 2002).

Amidst the various factors that affect the sustainability of societies across the globe, the production and consumption of energy are of great concern. Currently, global practices can be described not only as unsustainable (Sims et al., 2007), but as in a state of crisis, the causes of which have been attributed to i) the scarcity and political volatility of oil, ii) climate change, and iii) an increasing global demand (Randolph et al., 2008). Consider the following:

- Energy production and consumption have become intertwined with geopolitics. The increase of global consumption combined with diminishing and less accessible resources has led to increased competition amongst nation-states for the fulfillment of their energy demands (Haar & Theyel, 2006).
- The threat of climate change and environmental damage has placed the future livelihood and survival of humanity and all life forms into question (Del Rio, 2007; Jacobsson & Lauber, 2006; Vachon & Menz, 2006).

- In 2007, the International Energy Agency predicted that fossil fuels will account for 84% of the overall increase in energy demand between 2005 and 2030 (International Energy Agency, 2007, p.4). This dependence presents a challenge as, despite the varying predictions regarding current and yet-to-be-found reserves, the finite nature of fossil fuels suggests their pending exhaustion (Haar et al., 2006; Randolph et al., 2008; Vachon & Menz, 2006).

These challenges are amongst the greatest facing the global future of energy.

A future that is sustainable will need to have reformed the unsustainable energy practices of today. According to Randolph and Masters (2008), societies interested in a sustainable energy future must strive to achieve three objectives: i) improve efficiency of energy to reduce demand growth, ii) replace oil, and iii) increase carbon-free energy sources. While no single action is able to address all three objectives, renewable energy sources and their associated technologies present a solution that is able to address the latter two objectives.

Ultimately, knowing *where* we would like to go (i.e. a sustainable energy system, composed to some degree with renewable energy technologies (RET)), and *how* to get there, are two quite different challenges. It is the latter question, the 'how' of effective on-the-ground RET diffusion, that is addressed by this thesis.

A history of government subsidies and legislative support for fossil fuels and nuclear energy have led to the 'locking-in' of these energy generating sources into modern energy supply mixes, effectively locking-out other energy generation sources such as renewables (Bradford, 2006; Unruh, 2000). To 'level the playing field', Bradford (2006) notes that an emerging strategy has been the creation of "incentives for the production and installation of renewable-energy alternatives" (p.173). According to Jacobsson and Bergek (2004), government policies

have been the major inducement mechanisms. The most commonly used incentives for the acceleration of adoption include rebates, feed-in tariffs, R&D support programs, and Renewable Portfolio Standards (Bradford, 2006; REN21, 2008). Still, Fuchs and Arentsen (2002) have noted that "it is questionable whether the kind of policy strategies currently pursued will be able to initiate the changes needed for sustainable electricity production" (p.530).

Since 2006, two programs have been implemented in Ontario, Canada, to compensate generators of electricity from a renewable energy source. In early 2006, the Ontario government introduced its Net-Metering Program, wherein which generated electricity is used to meet the demands of the consumer/generator. When generation exceeds consumption, surplus electricity is exported to the grid. Customers pay the "net" difference between their electricity consumption and export – thereby selling electricity under the same rate structure from which they are purchasing it from the grid (Ontario Ministry of Energy and Infrastructure, 2008). In late 2006, the Renewable Energy Standard Offer Program was created, presenting a different approach to financial compensation. As opposed to directly consuming the electricity generated by a renewable energy source, consumers sell all of the electricity they generate directly to the grid (Ontario Power Authority, 2006).[1]

An in-depth investigation of the unique developments in Ontario presents the opportunity to better understand why the required energy transition is not occurring. By focusing on recent experiences with the Renewable Energy Standard Offer Program (RESOP) and solar PV systems, this thesis will be able to contribute to the current understanding of the relationship between financial incentives and rates of adoption of renewable energy technologies.

[1] For the sake of efficiency, most Local Distribution Companies have consolidated their billing systems so that the consumer only receives a single bill.

With respect to the scope of analysis, while some authors compare the types of policy tools meant to promote the adoption of RETs (for an example, see David Toke's (2007) comparison between feed-in tariffs and market-based systems or Menanteau et al.'s (2001) more encompassing discussion), this thesis focuses on a single policy tool, the Renewable Energy Standard Offer Program, and its effectiveness in facilitating the diffusion of residentially-mounted solar photovoltaic systems in the province of Ontario (Canada).

1.1.2 Solar Photovoltaic Systems

Amongst the current and viable renewable energy technologies (RET), solar photovoltaic (PV) systems have demonstrated both technological and economic competitiveness (Bradford, 2006), and are the focus of this thesis. While a single RET is discussed in this thesis, it should be noted that experts in the field of sustainable energy are not suggesting that our current needs can or should be met entirely by solar PV generation. The prevailing view is that solar PV systems will be *part* of a portfolio of technologies required to achieve a sustainable energy future (Boyle, 2009; Bradford, 2006; Jaccard, 2005).

Solar PV systems generate electricity by converting sunlight into electricity by means of the photoelectric effect (Jackson & Oliver, 2000). Deployment of these systems occurs, typically, in one of two configurations: i) large-scale solar PV farms, wherein numerous solar PV modules are aligned to generate large quantities of electricity, on the order of megawatts, or ii) microgeneration configurations on building rooftops, typically in the order of kilowatts (Bradford, 2006). This research focuses on the latter, and specifically on residential installations.

At the end of 2007, approximately 7.8 gigawatts (GW) of total installed PV power existed internationally. Of that total, Canada had a cumulative installed capacity, including both

on- and off-grid applications, of approximately 25.8 megawatts (MW) or 0.3% of the global total (International Energy Agency, 2008).

When compared to other electricity generating technologies, solar PV systems offer a number of attractive features:

- Solar PV systems have no moving parts and require little maintenance (International Energy Agency Renewable Energy Working, 2002).
- Installation is quick and easy, and solar PV systems can be arranged to meet a wide range of power requirements (International Energy Agency Renewable Energy Working, 2002).
- Compared to fossil fuel generation, such as coal and natural gas, when generating electricity, solar PV systems produce no greenhouse gasses (Oliver & Jackson, 1999).
- Because there are no physical resource inputs, there are no direct harmful byproducts of generation.
- Solar PV systems are flexible due to their modular nature and can easily be expanded to increase generation (International Energy Agency Renewable Energy Working, 2002).
- Although there are challenges of intermittency due to cloud cover and nightfall, on a monthly or annual scale, the output of a solar PV system is both predictable and reliable (Faiers & Neame, 2006; International Energy Agency Renewable Energy Working, 2002).

Alongside such technical benefits are others, social in nature. For example, Bahaj and James (2007) state that

> PV technology can also be considered in terms of both its direct and indirect energy benefits. The direct benefit is clearly one of sustainable electrical power generation and also in financial savings. Indirect benefits are more subtle and span 'softer' issues such as pride in housing and increased energy awareness to technical issues such as generation at point of use, grid strengthening and, as will be highlighted here, the potential for demand reduction. It can also be argued that the use of PV when combined with occupier

> perception and behaviour can result in further environmental benefits or additionality that has not been previously reported. (p.2123)

While there are apparent reasons to adopt solar PV systems, one must also assess the feasibility of doing so. Bahaj and James (2007) have argued that "there is a huge potential to utilize this type of technology in the urban built environment not only to satisfy demand and provide decentralized generation but also to help tackle fuel poverty and achieve reduction in emissions" (p.2122). Faiers and Neame (2006) further this argument when they state that "past research shows that [solar PV systems] are well-suited to an urban environment" (p.1798).

Still, the total grid-connected capacity of solar PV systems in the province of Ontario remains minimal; of the 31,600 MW of grid-connected generation capacity, less than 1 MW stems from solar PV systems (Independent Electricity System Operator, 2008). Peters, Cobb, and Winfield (2007) note that "the fledging solar power industry in Canada is dominated by off-grid systems. In 2005, of the 16.75 MW of solar PV installed in Canada, 93% was off-grid…In effect, Canada and Ontario have negligible amounts of grid-connected solar power" (p.39). While there is reason to advocate the adoption of solar PV systems in the province, diffusion is yet to occur at a significant scale. The following section describes the challenges that have hindered the diffusion of solar PV panels to date.

1.1.3 Traditional Barriers to Diffusion

To improve the diffusion of renewable energy technologies, it has been argued that we must better understand the factors that are inhibiting adoption (Faiers et al., 2006; Faiers, Cook, & Neame, 2007). A plethora of barriers to the diffusion of solar PV systems have been identified in the literature (Cooke, Cripps, Irwin, & Kolokotroni, 2007). Amongst them, high initial capital costs and lengthy payback periods are most often cited as the primary barriers to diffusion and

are supported by evidence from the United States, Spain, and the United Kingdom (Boyle, Everett, & Ramage, 2003; del Rio & Unruh, 2007; Faiers et al., 2006; Jacobsson & Johnson, 2000). This appears to be the case in Ontario as well. In 2007, a feasibility analysis produced by Michael Brigham and Paul Gipe of the Toronto Renewable Energy Co-operative concluded that "unfortunately, after extensive analysis, TREC found that rooftop PV projects are not profitable in Ontario without a reduction in up-front costs of $3,500-$5,000/kW, an equivalent subsidy, or a substantial increase in tariff payments under Ontario's Standard Offer Contract program" (Brigham & Gipe, 2007, p.4).

While economic challenges are those most often cited, it should be noted that other hypotheses have been posited to explain the slow diffusion of solar PV systems. For example, it has been argued that a financial explanation for the limited nature of solar PV diffusion provides only limited explanatory power; institutional factors have also been found to play a decisive role in the fostering or inhibition of solar PV diffusion (del Rio et al., 2007). Supporting this argument is Liberatore (1995) who warns of the dangers of a process design that fails to adequately account for institutional capacity:

> As far as assumptions about institutions are concerned, they are the result of analysis and evaluation regarding whether the institutions relevant for the problems at hand … have the resources and capabilities needed to perform their task, whether they are adaptive to changes in the socio-economic environment and whether it is possible to reform them and/or establish new ones.
>
> Problems may arise also with respect to this sort of assumption. If it is assumed, for example, that local administrations have enough money and specialized personnel to ensure that ambient or emission standards are met and this is not the case, lack of or poor implementation of certain regulations will result. Similarly, if it is assumed that existing taxation systems work well or can be easily reformed and this is not true, the adoption of fiscal incentives may be problematic.
>
> In other words, if no explicit and careful consideration is paid to the actual working of institutions …, the formulation and implementation of any kind of policy instrument will be based on rather unsteady ground. (p.57)

As this thesis proceeds, the presence and prominence of such barriers will be further discussed.

1.1.4 The Renewable Energy Standard Offer Program

The Ontario Government, through the Ontario Power Authority (OPA), in November, 2006, introduced the Renewable Energy Standard Offer Program (RESOP). The intent of the RESOP, as stated by the Ontario Power Authority (2006), is "to help Ontario meet its renewable energy supply targets by providing a standard pricing regime and simplified eligibility, contracting and other rules for small renewable energy electricity generating projects" (summary).

The RESOP provides a generator of electricity from a renewable resource a 20 year contract with the OPA, over which "solar PV generators will be paid a fixed price of 42.0 cents per kWh" (Ontario Power Authority, 2006, summary). Projects must be located in Ontario and have an installed capacity no greater than 10 MW.

The formal agreement between the OPA and the consumer is called a Standard Offer Contract (SOC). To obtain a SOC, a proponent must complete an online application and meet a number of planning requirements for eligibility. For microgenerating solar PV systems (<10kW), required approvals include an Ontario Energy Board license, an Electricity Distributors Connection Agreement, and approval by the Electrical Safety Authority. It is the responsibility of the consumer to ensure that they are properly connected to an electricity distribution system located in Ontario and to the Independent Electricity System Operator-controlled grid (Ontario Power Authority, 2006). The consumer is also solely responsible for "coordinating metering configuration and requirements with [their] local distribution company, and for all connection and metering costs" (Ontario Power Authority, 2006, p.14). Once the above steps are complete, it is the OPA that is responsible for payments to the consumer and not

the Local Distribution Company (LDC), although it is through the LDC billing infrastructure that consumers receive their payments.

As of the December, 2008 RESOP Progress Report, 290 contracts have been executed for solar PV projects, 121 of which are in commercial operation and have a generation capacity of 1,617 kW of electricity. Of the 121 projects in commercial operation, 120 are at the scale of microgeneration (<10kW), and have a cumulative generation capacity of 617 kW (Ontario Power Authority, 2008).

1.2 Rationale and Thesis Statement

In the case of solar PV system diffusion in Ontario, with the exception of the Brigham and Gipe (2007) report, little empirical data have demonstrated or identified which drivers and barriers are of greatest prevalence or prominence. In addition, with the recent implementation of the RESOP, the landscape of solar PV system adoption in Ontario has been altered; the financial challenge, while not overcome, has been reduced. As a result, the current solar PV system adoption process and the factors that influence it are, aside from hypotheses presented by the literature, largely unknown.

It has been argued that, compared to traditional command and control approaches, economic instruments, such as the RESOP, "tend to influence behaviour affecting the environment rather more sensitively and effectively" (Hawke, 2002, p.207). The idea is that economic instruments create incentives "to develop and apply clean technology and other innovation in environmental management" (Hawke, 2002, p.207) while limiting the costs of environmental protection. They have also been argued to be more flexible, and thus able to produce quicker and more effective results than regulations (Boyd, 2003).

Such arguments, however, are often made from a theoretical standpoint, and may not in actuality play out as assumed (Boyd, 2003). Valentina Dinica (2006) explains this point:

> Classifications and analyses of support instruments' characteristics are mainly made from the perspective of policy-makers ... Policy makers, analysts and advisers should be asking questions such as: To what extent are policy instruments able to unlock the financial resources of potential investors? … Taking an investor perspective on the analysis of support systems contributes to the academic discussion as it helps open the black box between policy design and policy results. It also enables policy-makers to perform ex ante analysis of the diffusion potential of policy proposals for RET-E support frameworks. (p.462)

Dinica's paragraph speaks to the heart of this research. While a well designed policy selection process is important, the implementation and effectiveness of an economic instrument is what ultimately matters. Though it is the intent of incentive programs such as the RESOP to begin to lower financial barriers and increase the affordability of solar PV systems, there is no guarantee that their presence will result in a rise in adoption. The "on-the-ground" manner in which consumers interact with such incentive programs ultimately determines their effectiveness.

Thus far, three gaps in our current knowledge have been identified:

i) Understanding of the drivers and barriers for solar PV system adoption in Ontario;

ii) The influence of the RESOP on solar PV system diffusion; and

iii) The on-the-ground functioning of the RESOP and the manner in which consumers interact with it.

With the intention of improving understanding in these areas, it is the purpose of this thesis to explore the relationship between the Renewable Energy Standard Offer Program and the adoption of microgenerating and residentially mounted solar PV systems in Ontario. Specifically, research findings seek to:

i) understand why RESOP participants have purchased a solar PV system;

ii) identify whether or not the RESOP influenced this decision;

iii) identify the drivers and barriers to the utilization of the RESOP; and

iv) identify the relative prominence of said drivers and barriers.

To achieve these objectives, a sample of current RESOP participants was selected for study. It has been suggested, however, that to improve the diffusion of RETs one must understand the gap that exists between early adopters and the early majority (Faiers et al., 2006; Faiers et al., 2007). While such an argument appears to advocate the sampling of both populations, the sole selection of early adopters (RESOP participants) in this thesis is justified for three reasons.

First, an attempt to sample both populations while utilizing appropriate methods of data collection would require resources beyond the scope of this research. For this reason, a sample of the most experienced consumers – the adopters - was targeted. Second, there are logistical challenges in attempting to identify a sample of the early majority population. Because the diffusion process has not sufficiently progressed, the 'theoretical' early majority population is yet to adopt. As such, one could not be certain whether the participants sampled would in fact become part of the early majority population. Third, there is much that can be learned from the experiences of the early adopter population. By focusing solely on the early adopter population, results will be able, though limited, to:

1. Identify and describe the current adoption process, inclusive of the drivers and barriers present to adoption as well as the operation of the RESOP from the perspective of adopters;
2. Discover and explain any causal relationships present within such data and experiences.

Thus, all conclusions drawn from this thesis are with respect to the given sample. When appropriate, implications for the greater population are explored with caution.

1.3 Chapter Summaries

In this chapter, background information pertinent to this thesis has been presented. A thesis statement and rationale have been provided, and will serve to frame the remaining structure of this thesis. In chapter 2, a review of the literature illuminates the potential drivers and barriers to the adoption process of solar PV panels. Lessons are drawn from solar PV system specific experiences, as well as general renewable energy technology (RET) and energy efficient technology experiences. The outcome of this review is a framework, later applied for the identification of drivers and barriers during primary data collection. Chapter 3 describes the methodology employed for the effective collection and analysis of data, providing justification for the choice of methods where appropriate. The study sample and the associated sampling process are also described here. Results of the primary method used – that is, in-depth interviews – are presented in chapter 4. Data have been organized with respect to the RESOP-integrated PV adoption. Analysis of these data is the focus in chapter 5, wherein emergent correlations across the presented variables are discussed to lend further insight to the objectives of this thesis. Chapter 6 concludes by discussing the findings, exploring their implications on the greater research community, and offering recommendations for the future direction and design of policies meant to promote the diffusion of RETs.

The results of this thesis will contribute to our current understanding of financial incentives and their effectiveness in promoting the adoption of solar PV systems, and where appropriate, to the broader spectrum of renewable energy technologies. Ultimately, the identification of drivers and barriers is meant to result in their promotion or removal,

respectively, the consequence of which is the improvement of RET diffusion. As an increasing number of governments across the globe begin to implement programs similar to the RESOP, this thesis will prove to be a valuable tool in designing institutions that effectively aid the diffusion of RETs.

2 Drivers and Barriers to the Utilization of the Renewable Energy Standard Offer Program

2.1 Introduction

As stated in chapter 1, the objectives of this thesis seek to illuminate the relationship between the Renewable Energy Standard Offer Program and the adoption of microgenerating and residentially mounted solar PV systems in Ontario. In the context of this research, when identifying and characterizing the factors influencing the consumer decision to utilize the Renewable Energy Standard Offer Program, the term 'factor' includes both drivers and barriers. To identify these factors, three methods are used: i) a literature review, ii) preliminary interviews with non-consumers, and iii) interviews with consumers. Prior to collecting primary data, a literature review has been performed to produce a preliminary list of drivers and barriers. These drivers and barriers have been organized to create a framework that will serve two purposes. First, the drivers and barriers identified present a set of credible hypotheses to be tested with respect to the diffusion of residential microgenerationg solar PV systems in Ontario. Second, this work contributes to the literature by organizing previous writings in a simplified manner that can potentially be applied in other research on analogous issues.

It is important to understand the nature of diffusion in Ontario as it provides an example of how drivers and barriers identified by a consumer may be in relation to *either* the solar PV systems *or* to the policy tool meant to promote their adoption. In certain cases, it may be to both. Without empirical data, identifying the level at which drivers and barriers occur is challenging. It is not the role of this literature review to identify which is the case in Ontario. This is left to the interview stages of this research. It is the role of this review, however, to complete a comprehensive examination of the literature to ensure that the subsequent empirical investigation

is adequately informed and able to accurately identify the prevalent drivers and barriers. This implies that the factors identified in this chapter can only be seen as *potential* drivers and barriers faced by the consumer, as their presence is yet to be shown in Ontario.

At the conclusion of this chapter, the reader will possess a comprehensive understanding of the potential drivers and barriers to the consumers' decision to adopt a solar PV system in the presence of a policy tool, the RESOP, at the residential level and the microgeneration scale in the province of Ontario. This understanding will be based solely on evidence from the literature, and as such, the reader must remain aware that novel drivers and barriers may emerge in the given case study.

This chapter begins by presenting the criteria by which literature was selected to contribute to this research (section 2.2). It then explores this literature, discussing broad distinctions within it (sections 2.3.1 and 2.3.2). Section 2.3.3 draws from the literature to create categories in which factors may be organized. Using these categories, drivers and barriers are then presented in section 2.3.4 in the final framework format. This chapter is then concluded in section 2.4, summarizing findings from this chapter and how they will relate to the remainder of the thesis.

2.2 Literature Survey: Criteria for Inclusion and Composition

A preliminary survey of literature pertaining to the diffusion of RETs displays a tendency for the discussion of drivers and barriers to focus on technological adoption. This research differs in that, while it is interested in the diffusion of a technology, a solar PV system, its focus is primarily on the policy tool meant to promote its diffusion.

Though rare, literature does exist with a specific focus on policy tools meant to accelerate the diffusion of renewable energy technologies. Vanetina Dinica (2006) has discussed drivers

and barriers to ‘support systems’, wherein support systems are synonymous with the concept of financial policy tools, though Dinica limits her investigation to feed-in tariffs and a quota model for RET integration. Also, as previously referred to, David Toke (2007) has compared feed-in tariffs and market-based systems. Dinica and Toke are, however, the exception rather than the rule. As such, a framework created solely of policy-oriented literature might be less able to identify those factors present in Ontario when used as a guide for identification during the primary data collection phases. For this reason, the decision was made to proceed with caution, assume that some factors may be yet to be identified within the policy-oriented literature, and search other bodies of literature that could improve and inform an identification of drivers and barriers.

The literature review was first broadened to include literature pertaining to any and all RETs. The justification for such an expansion is grounded in the shared qualities of electricity generation, lock-out by traditional energy sectors, and the capability for generation in smaller, more modular levels. In practice, much of the literature (e.g. Painuly (2001), Sathaye and Bouille (2001), and Fisher and Nakicenovic (2007)) tends to aggregate all renewable energy technologies together as a homogeneous entity in terms of diffusion and policy. The value of these general RET discussions is that they may present drivers and barriers relevant to this research that are yet to be identified within the solar PV system specific literature. Furthermore, while solar PV specific literature provides a more focused and comparable analysis, an approach limited to this single technology may fail to incorporate analogous and useful lessons from other RET case studies.

The tradeoff, however, is that the greater the number of drivers and barriers identified, the greater the probability that a portion will not be relevant to the case of solar PV, and whose

presence serves to exacerbate an already comprehensive list. The challenge of dealing with such exacerbation is dealt with through the use of preliminary interviews, discussed in chapter 3.

This literature review was also broadened to incorporate discussions pertaining to energy efficiency technologies. The choice to include literature pertaining to the diffusion of energy efficiency technologies may be less analogous than that of the RET literature, and thus, less apparent. Nevertheless, their inclusion contains merit. Similarities between the diffusion of solar PV systems and energy efficient technologies include: i) both are specific to technologies (as opposed to practices or habits), ii) both are related to energy use, iii) both tend to have a premium associated with their pricing, and iv) both are associated with 'progressive' behaviour. Alongside such similarities, some differences also present. Energy efficiency technologies tend to be more familiar to consumers than solar PV systems, and they reduce the use of, as opposed to generate, energy. They are also often associated with a cost-savings to the consumer, while PV, in the given case, is not. Nonetheless, the use of energy efficiency technology literature was employed for two reasons. First, compared to other non-RET technologies, energy efficiency technologies have the greatest number of similarities and comparable qualities as to be of use for this research. Second, as the literature review was conducted, similarities across frameworks and driver and barrier lists suggested that both types of technologies encounter similar challenges and drivers.

Another criterion used for literature selection was a focus on content specific to developed nations, as the political, social, economic, and environmental landscapes are significantly different between developed and developing nations. Though this preference was expressed, acting upon it with strictness presented a challenge. Relevant works of literature were typically designed as either general frameworks or case-specific studies – as such, they could be

applied anywhere in the world. While case studies explicitly state the region from which their data are collected, thus allowing for proper selection and discrimination, frameworks often failed to explicitly state whether their primary data came from developing nations, developed nations, or both. As such, articles pertaining to frameworks and developed-nation specific case studies were used, while developing-nation specific case studies were excluded. All literature reviewed was treated in a similar manner with respect to their incorporation into the driver and barrier framework. Further discussion about the development of the barrier framework is presented in section 2.3.

In total, 27 articles were reviewed. This meta-study identifies 14 factor variables categorized under five factor categories. Findings are presented in section 2.3.4.

2.3 Literature Survey: Barriers and Driver Categorizations and a Framework

A survey of the identified literature reveals a plethora of factors and manners in which they are categorized. A similar literature review performed by Cooke et al. (2007) observed that "International research reflects the large and diverse number of barriers to [alternative energy technologies] in different contexts ...These barriers vary throughout the world, are site and situation specific. They also vary with each technology ..." (p.2321).

One challenge to this research has been to organize and to present the multiplicity of approaches and bodies of literature into a unified and simple framework. This section performs this task. The following subsections describe the key differences within the literature and explain how such differences were reconciled within the final framework.

2.3.1 Frameworks and Case Studies

Within the literature, the first manner in which diffusion factors are addressed and presented differently is with respect to the research strategy taken. One approach taken by researchers is a form of meta-analysis, presenting frameworks which provide an overarching look at diffusion factors across multiple cases. The result is a generalized list of drivers and barriers. Second, some researchers employ a case study approach, identifying detailed barriers or drivers in a specified context (e.g. time period, geographic area).

Incorporation of both bodies of literature is essential, as each contains strengths that compliment the other's weakness. Framework articles were useful in identifying a comprehensive list of drivers and barriers, as well as categories by which they could be organized. In doing so, framework articles helped to construct a general layout of the barrier and driver landscape. The factor categories later used in Table 2.1, for example, have been derived largely from Painuly's (2001) framework, as it provided the most comprehensive identification of factor types. The weakness of such articles, however, was that the breadth of drivers and barriers listed was so great that details of each factor were often vague and overly general. For example, multiple frameworks (e.g. Painuly (2001), Fisher and Nakicenovic (2007)) identified a lack of information as a general barrier to diffusion, although information about *what* was missing was not explicitly stated.

Martinot and McDoom (1999) note that:

> The generic treatment of barriers … is inadequate for the purposes of preparing projects. Only some of the barriers … will be present in any specific situation. The challenge in preparing projects to overcome these barriers is to identify the most relevant and operative barriers in a specific context and to address only those. Barriers are extremely dependent upon local and national contexts, including macroeconomic and policy frameworks, the degree of market development, the presence of potential intergroups and proponents, and a host of other factors. (p.39)

While there is merit in Martinot and McDoom's assessment that the generic treatment of barriers is inadequate when conducting specific projects, such a downfall would only be pertinent if frameworks were consulted in isolation. In the case of this research, the drivers and barriers identified by Martinot and McDoom contribute only one aspect of a more encompassing approach to the identification of factors. The point is taken, however, that it is important to identify context specificity. It is for this reason that case-studies have also been consulted and integrated into the framework development.

Case studies provided greater in-depth detail when describing each factor, thus providing greater understanding and explanatory power. In their discussion of solar PV system diffusion in Spain since the mid 1990s, and in contrast to the example presented above, Del Rio and Unruh (2007) noted that the lack of information as a barrier was pertaining to the issues of "feasibility and costs of the technology and existing subsidies, difficulties and regulatory vagueness regarding grid connect and rights of solar PV generators" (p. 1508). This specificity reduces the ambiguity of identified barriers or drivers, and provides context specific details which may improve accuracy and utility when applied in other case studies.

In light of the greater accuracy and explanatory power of case studies, the content of such articles was used to supplement drivers and barriers obtained from frameworks. Ultimately, as demonstrated by the above examples, the utilization of both kinds of studies in the literature contributed to a comprehensive and in-depth identification and discussion of drivers and barriers.

2.3.2 Diffusion versus Market Barriers

A second distinction in the literature is the division between analyzing drivers and barriers at the level of market barriers (e.g. Oliver et al., 1999; Sathaye & Bouille, 2001), and at the level of the diffusion process (e.g. Painuly, 2001; Reddy & Painuly, 2004). To clarify this

distinction, Sathaye and Bouille (2001) note that market factors are those influencing market potential, whereas diffusion factors are those affecting all of the market, economic, socioeconomic, and technological potentials. In this context, market drivers and barriers are a subset of diffusion factors.

While market drivers and barriers are treated here as a subset of all diffusion factors, their treatment within the literature is comparable to that of diffusion factors; as one analyzes those factors identified within market discussions, it becomes apparent that many of them correlate to those identified within the diffusion literature. Both bodies of literature demonstrate a tendency to organize their factors across categories such as economics, institutions, the environment, and so forth. In fact, when reading both bodies of literature, it is difficult to identify a distinction as clear as that made here between market and diffusion factors.

An example of a factor that can be categorized in different manners is high cost. In the context of a market barrier (i.e. Oliver et al., 1999), the high cost of the product hinders the ability of solar PV systems to compete with traditional forms of energy, thus preventing it from penetrating the market. High cost can also, however, be considered as a financial barrier to diffusion. In the case where solar PV systems are competitive with other forms of electricity generation, consumers may not be able to afford the loading of the costs up front (Painuly, 2001). Thus, high cost may be seen as both a market barrier and a financial barrier. While these approaches differ slightly, the identification of barriers in each case remains pertinent, as both types affect the consumer.

2.3.3 Driver and Barrier Categorization

In this work, as in others, drivers and barriers are characterized and detailed at multiple levels. In light of the multitude of factors presented within the literature, numerous attempts to

manage and categorize them have been made. For example, Cooke et. al (2007) note that Lovins et al. (2002) have identified 207 barriers to distributed energy generation, Painuly (2001) suggests 40 barrier elements within seven categories, Maldonado and Marquez (1996) offer four barrier categories, while Foxon et al. (2005) list four risk factors and six other barriers. Amongst these and other articles, each author delineates their categories differently.

The categories created and used in this research were developed through a dual and iterative approach. First, a comprehensive list of factors was created by reviewing the aforementioned literature. Second, categorizations and the basis upon which they were made within the literature were identified. Previous categorizations were amalgamated and unified appropriately to create an initial revised version of factor categories. Next, a bottom-up approach was used to ensure that all factors fit within a category, and that those drivers and barriers listed within a category were adequately similar to one another, while also ensuring that factors across categories were sufficiently different.

The outcome of this process is the designation of five factor categories: i) those dealing with money (e.g. economics, finances, and markets); ii) those dealing with social factors (e.g. social perspectives, cultural practices, politics); iii) those dealing with institutions (e.g. policy, administrative, and systemic); iv) those dealing with technology (e.g. constraints related to the physical elements of a device); and v) those dealing with the biophysical environment.

The first category of drivers and barriers, those dealing with money, is labeled as monetary factors. Drivers and barriers classified as monetary factors may be drawn from three areas defined by the literature: i) economic factors, ii) financial factors, and iii) market factors.

The first subcategory[2], economic factors, refers to a technology's 'expensiveness' (Dinica, 2006, p.463). Put another way, an economic factor is one which determines the price of an innovation. High manufacturing costs in the infancy of a new technology are an example of an economic barrier (Painuly, 2001). Financial factors, the second subcategory, refer to "the difficulty of obtaining project finance loans or the interest of equity investors" (Dinica, 2006, p.463). Financial drivers and barriers, thus, relate to the attainment of funding. The inability to get a loan to purchase a RET is a tangible example. Finally, market factors are those that explain why technologies that appear cost effective at current prices are not taken up (Reddy et al., 2004). Examples of market factors include subsidies to conventional energy pricing, and the non-consideration of externalities in conventional energy pricing. All three subcategories have been lumped into one in this framework for two reasons. First, while distinct definitions have been provided for all three of the subcategories, other authors within the literature often fail to do so (e.g. Painuly, 2001). Second, considering the heterogeneity amongst factors and their ability to be cross-listed amongst categories, reducing the classification of factors to five divisions provides a simplified and more accessibly categorization, while retaining accuracy. This approach has been used and supported by other research: "In conducting the survey, it was found that the distinctions between these barriers could not always be sustained. Thus, in the results reported in the following sections, a slightly simplified taxonomy is used" (Reddy et al., 2004, p.1435).

Social factors constitute the second category. This category incorporates factors related to the influence of social and cultural perceptions and paradigms with regards to the adoption of

[2] Monetary and institutional subcategories have been presented in this section to illustrate to the reader how the categorizations have been formed and defined with respect to the literature. The remainder of this thesis will refer solely to factors and the five categories under which they are categorized.

a solar PV system, as well as the psychological and behavioural factors specific to individuals. Such factors occur at the level of the consumer and pertain primarily to human perception and the influences that form such perceptions. Examples of factors that are characterized under this category are the lack of consumer acceptance of a technology, for example, due to aesthetic considerations (Painuly, 2001), or fascination with the technology itself (e.g. technophilia (Thayer, 1994)).

One noteworthy factor under the social category is that which has been labeled as 'sustainability concerns'. Sustainability, in the context of this thesis, is in specific reference to Gibson et al.'s (2005) eight criteria of sustainability assessment. Two of the criteria, the maintenance of socio-ecological system integrity (e.g. watershed stewardship) and intergenerational equity (e.g. to benefit their children and grandchildren), are useful in categorizing factors found within this literature review. In reference to socio-ecological system integrity, authors have identified drivers for adoption, such as concerns over climate change (e.g. Dinica, 2006) and air pollution (e.g. Bradford, 2006). Such appeals to climate change and threats to the biophysical environment can also be tied to the livelihood and sufficiency of material resources for future generations, thus motivating consumers to act with the interests of future generations in mind.

The third category of drivers and barriers is institutions, defined as "systems of rules, decision-making procedures, and programmes that give rise to social practices, assign roles to participants in these practices, and guide their interactions" (Sathaye et al., 2001, p.364). This broad definition was chosen purposefully so that it could encompass the numerous types of factors most closely identified with a form of institution, and because "in the literature … this category has been found to include absence of institutional structures and mechanisms as well as

practices that act as barriers" (Painuly, 2001, p.81). Similar to the monetary category, institutional factors have been drawn from three subcategories characterized within the literature. The first institutional subcategory is policy, which encompasses regulations and policy tools. This subcategory addresses how the presence, absence, and nature of certain policies influence the decision-making process of the consumer. The second institutional subcategory is administration, where drivers and barriers arise when a consumer interacts with the administrative processes required to engage in a policy tool. An example of an administrative factor would be the lead-time required to have a fully operational and policy-integrated RET due to the processing time of an application for regulatory approval or financial reimbursement (del Rio, 2007). The third subcategory is defined as systemic factors and addresses overall system institutional infrastructure. This final category addresses weaknesses in program or institutional design and capacity, such as the lack of skilled personnel and the institutions that educate and develop such personnel to perform tasks such as RET grid connections (Jacobsson et al., 2000). In contrast, while the administration subcategory addresses challenges that arise during the actual administrative process, systemic factors speak to institutional infrastructure, or capacity, and its ability to influence a successful administrative process. In the case of time-delays in an approval process, such a challenge may be attributed to a poorly designed application process, hence qualifying it as an administrative barrier, or it may be that the administering body simply does not have the capacity to process the volume of applications received, thus qualifying it as a systemic institutional barrier. In some cases, it may be a combination of both.

The fourth category, technological factors, includes the consideration of the technical feasibility and viability of a technology. Examples include the ability to install a solar PV system on one's roof and the durability of the product. In the case of solar PV systems, their low

maintenance is often described as a benefit to their use and hence would be categorized as a driver in this category (Faiers et al., 2006; Painuly, 2001).

Environmental factors constitute the fifth and final category. Factor elements in this category may include the lack of adequate solar resources (i.e. not enough sunshine) or the lack of access to solar resources (e.g. blockage by trees/buildings).

In setting specific categorical definitions, it is important to remain cognizant that many drivers and barriers will overlap in their categorization. For example, the lack of financial incentives can be seen both as a financial barrier as well as an institutional one. Therefore, while the categorizations are meant to identify areas in which solar PV systems are being both encouraged and discouraged, one must be aware that certain factors can be the product of different causes.

2.3.4 Potential Drivers and Barriers to the Adoption of Microgenerating Solar PV Systems and the Use of the RESOP

Stemming from the above discussions pertaining to the literature, a barrier and driver framework has been constructed. This framework has been created solely from the literature, and consists of five categories and 14 factors (see Table 2.1). It was anticipated that, after the collection of primary data throughout the interview stages, unexpected factors may arise and thus be added to supplement this framework.

Table 2.1 Drivers and barriers to the consumer decision to adopt a solar PV system

Category	Factor (sources)	Description
Monetary	*Cost and payback period* (1,3,4,5,8,9,12,13,14,11,22,23,24,26,27)	Consumers may be unable or unwilling to invest large amounts of money in a single transaction or to wait a long time for a return on their investment. Consumers may also lack access to capital. Hidden or added costs such as transaction and interconnection costs may increase the overall cost, making the purchase unfeasible.
	Alternative energy sources and associated pricing (1,2,7,8,9,10,13,14,15,17,21,22,23)	Green energy technologies need to be competitive with other energy products in order to successfully diffuse into a population. A failure to account for negative externalities and subsidies to conventional energy has allowed consumers to pay below marginal costs for electricity, making it difficult for new technologies to enter.
	Economic support and job creation(4)	Consumers may be motivated to purchase a renewable energy technology in order to support the economy and the developing renewable energy technology field.
Social	*Consumer perceptions and values*(1,3,12,15,17,19,24,26,27)	Perceptions may be shaped by numerous factors and may be inaccurate, irrational, or unrealistically optimistic. Consumers may misunderstand the technology or the program (e.g. the adequacy of local solar resources and payback periods). Consumers may also perceive technologies or policies as being risky or unproven.
	Social influence (4,8,10,16,17,19,23,27)	Social paradigm or interactions may affect the consumer's decision. Examples includes: i) the presence of a champion promoting the technology, such as a local leader, ii) previous experience with the technology, and iii) negative experiences with other technologies, such as nuclear power, and the resultant communal perception of such a technology.
	Sustainability concerns (3,11,12,23,27)α	The desire to act socially responsible and to reduce environmental impacts (e.g. climate change, air pollution) for current and future generations may motivate consumers to adopt.
Institutional	*Poorly articulated demand*(2,14,23)	Consumers may not be interested in an innovation or they may fail to communicate this interest.
	Presence and adequacy of laws, regulations, and policy tools (1,3,4,5,6,11,13,14,15,16,18,22,24,26)	Policy tools, laws, or regulations may be required to support adoption.
	Awareness and availability of program information (2,4,9,10,14,17,24,26)	Potential consumers need access to information pertaining to both policy tools and technologies. Grid-connected PV suffers from a lack of information regarding feasibility and costs of the technology and existing subsidies, difficulties and regulatory vagueness regarding grid connection and rights of solar PV generators and may dissuade potential adopters. As such, interested purchasers may have to undertake lengthy investigations to find out where to obtain what they need – the burden is placed on the consumer and the added work may act as a disincentive. Conversely, interested purchasers may be given, unprompted, clear and detailed information on how to

		obtain a system.
	Administrative processes[1,3,4,26,27]	Institutional infrastructure and capacity is required to effectively and efficiently administer the program or to distribute a PV system. Cumbersome administrative procedures, such as connection to the grid, may delay the operation of the system or prevent their purchase altogether. Consumers may also be required to interact with numerous administration bodies, requiring several applications.
	Administrative capacity and institutional connectivity [1,2,4,10,12,14,15,16,26,27]	Service structures, such as distribution, sales, technical assistance and maintenance, are required for the actual administration of a policy tool or the installation of a solar PV system. Because of their long histories, conventional energy sources (e.g. fossil fuels) and systems have institutional support, such as established engineering practices and understanding of how to manage a grid system, whereas emerging technologies are weakly connected within their industry.
Technological	*Technical feasibility* [1,4,18,23,24]	A technology needs to be deployable to be adopted. Influential factors include the existence and presence of experienced installers, the ability to integrate the technology onto one's residence, and the ability to connect to the grid. Consumers may also be concerned with the risk of adopting a technology (e.g. technological viability – see next factor).
	Technological viability [1,4,8,12,23,27]	Consumers may consider how well a technology will function once installed. Examples include the degree of maintenance required, the intermittency of the technology, technological improvements, and the complexity of the technology.
Environmental	*Natural capital and site suitability*[3,4,11]	Adequacy of solar exposure.

Coding of articles: (1) Bradford, 2006; (2) Brown, 2001; (3) Cooke et al., 2007; (4) del Rio & Unruh, 2007; (5) Dinica, 2006; (6) Faiers et al., 2006; (7) Faiers, Cook, & Neame, 2007; (8) Faiers, Neame, & Cooke, 2007; (9) Fisher & Nakicenovic, 2007; (10) Fuchs & Arentsen, 2002; (11) Haar & Theyel, 2006; (12) Halsnaes & Shukla, 2007; (13) Jackson & Oliver, 2000; (14) Jacobsson et al., 2000; (15) Jacobsson & Bergek, 2004; (16) Jacobsson & Lauber, 2006; (17) Jaffe & Stavins, 1994; (18) Jager-Waldau, 2007; (19) Kaplan, 1999; (20) Martinot & McDoom, 1999; (21) Menanteau, Finon, & Lamy, 2001; (22) Oliver & Jackson, 1999; (23) Painuly, 2001; (24) Reddey et al., 2004; (25) Rohdin, Thollander, & Solding, 2007; (26) Sathaye & Bouille, 2001; (27) Sherk & Parker, 2008

[α] This factor could also be categorized as a particular case under both consumer perception and values or social influence. It has been identified specifically here, however, due to its significance later on in this thesis.

Two additional comments are made with regards to the listing of drivers and barriers in Table 2.1. First, the factors identified in Table 2.1 provide concrete examples that can further illuminate the complex relationship amongst factors and categories. Within his framework, Painuly (2001) notes that:

> The classification of barriers in a category is not very rigid. Some barriers can belong to more than one category and in some cases, readers may want to assign a barrier to a different category than assigned here. Some barriers may also be related to each other, or in some cases may have a cause-effect relationship even within a level. (p.81)

For example, high capital costs, aside from being a monetary barrier, can also be seen as an institutional one. High capital costs are 'high' because of their relationship to other forms of electricity generation within the electricity market. This has been described by Unruh (2000) as the 'lock-in' effect, where electricity grids are already locked-in to the incumbent arrangement and often subsidized technologies, thus preventing the entry of newer and alternative forms of generation. Therefore, the attribution of high costs to a solar PV system may be caused by the policies that have subsidized and locked-in other electricity generating technologies.

The second point that must be made is that the above framework treats all factors as of equal importance, demonstrating no inclination towards the relative importance of one factor compared to another. This is not the case throughout much of the literature, as numerous authors argue for the prevalence of certain barriers. High costs and long payback periods, as previously mentioned, are the traditional claims for the inhibition of adoption. Menanteau et al. (2001) argued that "insufficient incentives to lower costs are considered to be the principal weakness of fixed feed-in tariffs" (p.15). Del Rio and Unruh (2007) have argued, however, that "proximate causes, like differential costs of the two technologies or available resources, provide only limited explanatory power" (p.1499), suggesting that institutional factors may play a decisive role in the diffusion process. This idea can be further supported by Jacobsson and Johnson (2000), who stated that "networks and institutions are also constituent parts of a technological system and influence, therefore, the processes of discovery and selection" (p.631). Lastly, Haar and Theyel (2006) have concluded that, in terms of motivations for utilities to adopt renewable energy sources into their portfolios, "the strongest driver for the adoption of renewable energy is

political, namely tax incentives, while the availability of renewable resources, market forces, and social influences are not significantly related to leading adoption of renewable energy" (p.280).

Furthermore, if one were to simply look at the frequency of the factors listed within the literature considered, a great deal of variability would be seen. For example, 13 of the 27 articles used identified the presence of a supporting policy tool as integral to improving adoption rates, while only one article touched upon the incentive of job creation as a motivator for RET adoption. Frequency of identification in the literature is not argued here to be a strong proxy for determining the significance of any given diffusion factor, as it fails to address the extent to which each diffusion factor is considered within each specific article.

There is no shortage of opinions from within the literature as to which drivers and barriers are most prevalent. At the conclusion of this study, such hypotheses may aid in explaining the outcomes of the study at hand. Prior to the collection of first-hand data, despite a multiplicity of hypotheses pertaining to the significance of different factors, all factors will be treated equally so as to remain potentially relevant in the specific case of Ontario to be investigated.

2.4 Summary

This chapter has performed three tasks. First, it has defined the criteria by which literature was selected and presented the rationale for such a decision. Second, it has presented a discussion regarding this literature. Thirdly, it has synthesized the literature to produce a barrier and driver framework with respect to the diffusion of solar PV systems.

Five factor categories and 14 factors have been identified. Each of the 14 factors has also been briefly described, providing greater explanatory power for each diffusion factor. Painuly (2001) suggests that "it can be seen that the advantage of decomposition of a barrier into its

elements is clarity on causes for presence of a barrier that stakeholders may find easy to understand and respond to" (p.78). This is of particular use since this framework will be used as the basis for the coming empirical data collection. Similar to research performed by Reddy and Painuly (2004), "the aim is to test each claim through the analysis of survey data of stakeholders" (p.1435). Chapter 3 addresses the manner in which this framework will be applied empirically, describing the methods used for primary data collection.

3 Research Design and Methods

3.1 Introduction

This chapter presents the methodology used in this thesis. Prior to addressing the specific methods of data collection, section 3.2 presents a description of the adoption process hereafter referred to in this thesis. This is of importance, as such a conceptualization of the adoption process frames the methodology used for appropriate data collection.

Following this, section 3.3 introduces the research strategy employed in this thesis, with an in-depth discussion of the primary method used for data collection, the interview. Sections 3.4 and 3.5 then address the sampling approach and interview design of both stages of data collection, the preliminary and primary interviews, respectively. Section 3.6 presents the strategy taken for data analysis, while section 3.7 presents noteworthy limitations to the methodology used.

3.2 The RESOP-Integrated PV Adoption Process

In this thesis, adoption refers to the acquisition and installation of electricity generation by a solar PV system. The process of adoption can also be characterized by the term diffusion, defined by Rogers (2003) as the process by which alteration occurs in the structure and function of a social system. Adoption occurs at the scale of the individual (e.g. a consumer adopts a solar PV system), whereas diffusion refers to the change in prevalence of PV systems within a population. Specific to the case study of this thesis, the adoption process referred to is that which utilizes the RESOP. Because of the formal requirements of the program, use of the RESOP to adopt an electricity-generating solar PV system that is both grid-connected and receiving financial reimbursement entails a similar adoption process amongst all participants. To

describe this progression, the RESOP-integrated adoption process has been divided into three phases: the planning phase, the execution phase, and the operating phase.[3]

The first, or planning, phase is characterized by the decision-making process that occurs *prior* to the physical adoption of a solar PV system. This phase entails any preparatory work influential to the consumer's eventual actions, such as the gathering of information through research and consultation or the management of finances. The planning phase is the most influential to the adoption process in terms of whether or not one ultimately adopts the technology. It has been found in this thesis' primary interviews that, regardless of the complications that arise during the execution phase, consumers prefer to complete the adoption process once they have begun to invest in the technology rather than to walk away. Reasons for this preference are described throughout the coming chapters of this thesis (i.e. chapters 4-6).

Once a decision has been made, consumers go through the actual process of obtaining a solar PV system. In this second phase, the execution phase, three procedures must be completed; diagrammatically, these procedures (or stages) are illustrated in Figure 3-1. First, one must purchase and install the actual solar PV system on the rooftop. The retailer from whom one purchases a solar PV system typically mounts and installs the system for the consumer, though this is not necessarily always the case. In some instances, consumers were adequately knowledgeable as to be able to mount and connect their own solar PV system. In this thesis's sample, however, this was seen to be the exception rather than the rule. Second, the solar PV system must be connected to the grid. To do so, consumers must contact their Local Distribution Company (LDC) in order to set up their connection to the grid. It is then typically the retailer and the LDC who work together to complete the grid connection. Thirdly, one must complete

[3] Because of the unique nature of the RESOP-integrated solar PV system adoption process, the structuring of the adoption process into three phases has been performed by the author, and is based on the experiences described by the preliminary interview and primary interview participants of this thesis.

the online RESOP application in order to receive a Standard Offer Contract (SOC) – the actual agreement guaranteeing the financial remuneration.[4] This application is processed by the Ontario Power Authority. In some cases, consumers hired an independent party to complete this administrative procedure. These parties are referred to as Third Party Administrators (TPA) throughout this thesis.

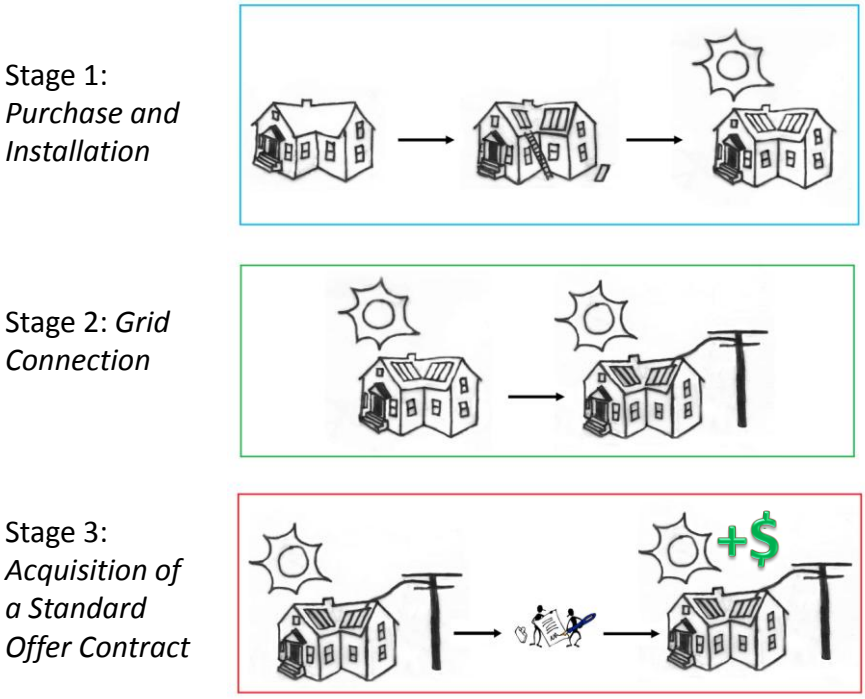

Figure 3-1 The three stages of the execution phase (source: author)

With respect to the chronology of the execution phase, one should be aware of the following caveat. While a Connection Agreement with the consumer's LDC is required prior to the granting of a SOC, the physical processes of installing the solar PV system and connecting it to the grid may occur after a participant has received his or her contract.

Once a solar PV system is mounted and fully functional, grid connected, and being reimbursed by the RESOP, consumers continue to interact, though relatively minimally, with

[4]A copy of the application form can be found at http://www.powerauthority.on.ca/SOP/Page.asp?PageID=122&ContentID=1282&SiteNodeID=162&BL_ExpandID=161

their solar PV systems and the RESOP (e.g. billing and payments). This final phase is labeled as the operation phase.

3.3 Research Strategy

This thesis performs each of the exploratory, descriptive, and explanatory purposes of research. First, the RESOP is a relatively new policy tool that has received little research attention. While literature exists pertaining to the drivers and barriers to the adoption of both RETs and solar PV systems, few have analyzed the shifting of drivers and barriers once a policy tool has been implemented. In light of this gap of knowledge, this thesis can be considered to be exploratory in nature, wherein a study is designed to probe a subject that is relatively new or about which little is known (Babbie, 2007). The intentions of this thesis are also to fully understand and describe the drivers and barriers observed in the process, what Babbie (2007) refers to as the descriptive purpose of research. Upon identification, said drivers and barriers will be used to explain why a subset of consumers has chosen to utilize the RESOP in order to purchase a solar PV system. This final objective qualifies this research as being explanatory in nature, as it seeks to answer the 'why' of the topic (Babbie, 2007; Yin, 2003). By identifying variables, in this case drivers and barriers, research results may provide a detailed answer to the research questions posed at the outset of this thesis.

In designing a research methodology, a preliminary survey of the literature was performed at the outset. This review provided fruitful insight. Still, the unique nature and Ontario-specific context of this thesis required the further collection of primary data to develop a contextually appropriate understanding.

Field research provides a comprehensive perspective and a deep and full understanding of a given topic (Babbie, 2007). Babbie (2007) notes that field research "is especially, though not

exclusively, appropriate to research topics and social studies that appear to defy simple quantification" (pp.287-288). Thus, it was determined that, to fully understand a decision making-process, one must engage those peoples making the decisions. This is supported in the specific case of RETs by Painuly (2001) who argues that stakeholder perspectives are important because they are directly involved with the studied system, and may be better able help identify and elucidate intricacies.

Prior to the collection of first-hand data, however, it was important to gain a foundational understanding of solar PV system adoption and the associated policy tools for their diffusion. Doing so ensured that an appropriate investigation could be undertaken, where one is adequately informed to employ an appropriate method of data collection. A literature survey and preliminary key informant surveys were deemed as the appropriate preparatory measures. Once a base knowledge was established, primary surveys could be undertaken with RESOP participants. Such a methodology was designed to produce a set of comprehensive, yet refined, results. Methodology experts Singleton and Straits (2005) support such an approach as they note that:

> A social scientist might utilize two or three sets of interviews, beginning with very loosely structured interviews and progressing to a final set of highly structured interviews. A freer interviewing style in the preliminary stages would yield rich and varied information. This would assist the researcher in formulating or refining hypotheses, clarifying objectives, and specifying subtopics for subsequent semistructured interviews. (p.223)

When one also takes into consideration the exploratory nature of this thesis, the value of such an approach increases further.

Ultimately, this research design follows a case study research strategy, described by Yin (2003) as being of utility "to understand complex social phenomena" (p.2). A cross-sectional design has been utilized, in which the data collected on a sample of respondents "chosen to represent a particular target population" were gathered at one point in time (Singleton & Straits,

2005, p.238). Specifically, this research took place in three phases. First, a literature survey was used to identify and understand the potential drivers and barriers to the adoption of a solar PV system from the perspective of a consumer. Second, nine key informant interviews were completed to gain further understanding to the specific intricacies of the drivers and barriers in the case of Ontario, as well as the overall adoption system in the province. These interviews were conducted between July and September, 2008. The third phase consisted of 24 RESOP participant interviews and constitutes the primary data set. Primary interviews took place between November and December, 2008. These elements are summarized in Figure 3-2 and are elaborated below. The research protocol used received approval from the Office of Research Ethics at the University of Waterloo.

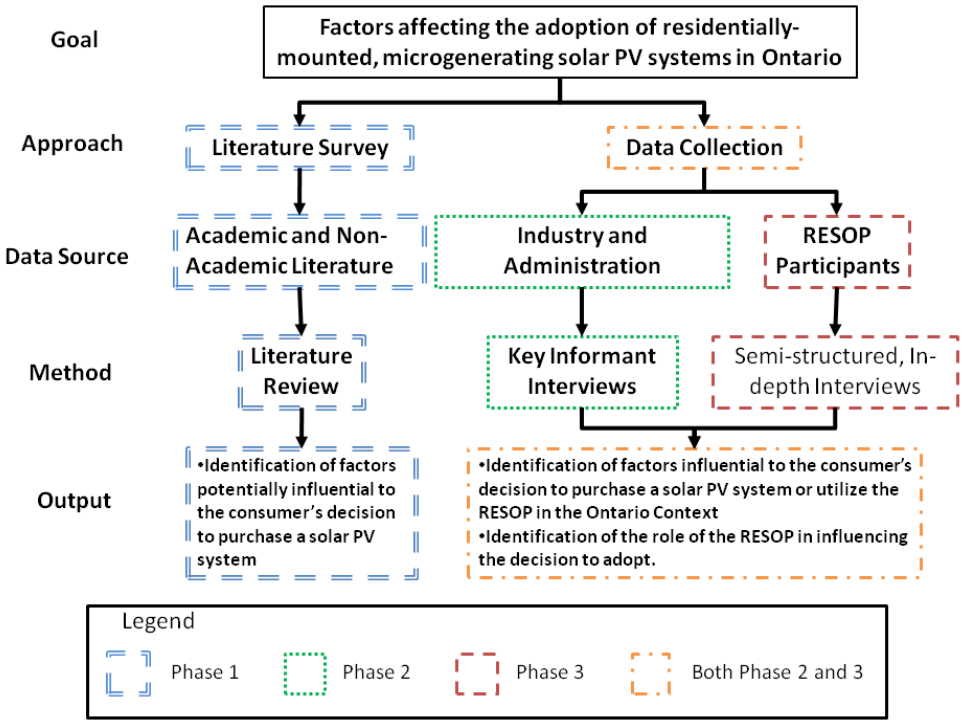

Figure 3-2 Thesis methodology

3.3.1 The Interview as Method

Having determined the overarching research strategy to be employed, it was next necessary to select an appropriate method for data collection. In both the preliminary and primary data collection phases, interviews were selected.

Three arguments presented by Dunn (2000) support the selection of the interview as the method for data collection specific to the kind of research undertaken in this thesis. First, Dunn (2000) argues that the interview is to be used to "fill a gap in knowledge which other methods, such as observation or the use of census data, are unable to bridge efficaciously" (p.52). The second reason to employ the interview as method is to "investigate complex behaviours and motivations" (Dunn, 2000, p.52). Thirdly, the interview is used "to collect a diversity of opinion and experiences" (Dunn, 2000, p.52). While a questionnaire or focus group could meet the first and third arguments presented here by Dunn, it is the second argument, the complexity of behaviour and motivation, deemed to be most appropriately met by the interview. Babbie (2007) supports this point as he states that interviews are more effective for complicated issues. Further supporting the choice of the interview as the chosen method are the following four points:

i) Interviews allow for question design and data acquisition to be targeted, focusing directly on the case study topic (Yin, 2003).

ii) Interviews have the ability to provide perceived causal inferences (Yin, 2003).

iii) Unlike questionnaires, an interview provides the opportunity to clarify or restate questions which a respondent may not understand (Singleton et al., 2005; Yin, 2003).

iv) During an interview, the researcher is able to clarify respondent answers through probes (Singleton et al., 2005).

For the production of accurate results, it was important to be made aware of methodological challenges to the interview and to address them prior to and during data collection. According to Babbie (2007), survey research is generally weak on validity and strong on reliability. Within methodological literature, three challenges relevant to this interview method are commonly presented: question bias, poor recall, and reflexivity (Babbie, 2007; Singleton et al., 2005). While these weaknesses are inherent to the interview process, their noted permeation across the leading alternative methods, the questionnaire and the focus group, suggests that they do not undermine the interview as a choice of research method. Furthermore, to reduce the prevalence of such challenges, a number of strategies were implemented within the interviews themselves and are discussed below.

First, the validity of interviewee responses is threatened by bias due to the poor construction of questions (Yin, 2003). Questions may bias responses if their wording leads a respondent towards a certain answer. In the case of social science research, almost any survey method is subject to the potential of this danger. Strategies taken to overcome this challenge included the pretesting of questions, as well as the proactive refining of questions within and across the interviews themselves (Babbie, 2007). Ultimately, pretesting proved to be sufficient as few refinements were required throughout the interview process. Any refinements made are noted explicitly in subsequent sections.

The second challenge of the interview process is inaccuracy due to poor recall on the part of the participant (Yin, 2003). Singleton and Straits (2005) note an inherent weakness in the use of surveys as they "rely almost exclusively on reports of behaviour rather than observations of

behaviour. As a consequence, measurement error may be produced by… [the] inability to recall past events accurately and by the instability of [interviewees'] opinions and attitudes" (p.227). Recall inaccuracy may be due to either the inability to recall information or memory distortion. To address recall failures, interviews should be performed as close, in time, to the event being studied as possible as it is more likely that a respondent will accurately recall their experience (Singleton et al., 2005). This research was conducted within two years of the creation of the RESOP. To adjust for inaccuracies due to memory distortion, participants were contacted prior to their interview and were given details pertaining to the research at hand. This strategy allowed for interview participants to prepare themselves before meeting with the researcher, familiarizing themselves with their previous experience. In some cases, the interviewee would consult their spouse (or another key player) prior to or during an interview to recall their experience. Such consultation never demonstrated a disagreement of recalled memories, but was used to fill in the gaps that one of the two participants could not recall. Other techniques utilized to minimize recall inaccuracy included giving respondents more time to search their memories for a response, having respondents check their personal records, and the use of closed-ended questions as probes (Singleton et al., 2005).

Finally, reflexivity may arise, wherein respondents produce "socially desirable answers to sensitive questions" (Singleton et al., 2005, p.227). Strategies used to address these challenges included the use of indirect questions, the careful placement and wording of sensitive questions, assurances of anonymity and scientific importance, and the building of rapport between interviewer and respondent (Singleton et al., 2005). Some of these strategies are described in greater depth in the coming sections.

Interviews were of a semistructured nature, utilizing open-ended questions and probes to acquire the information desired. Semistructured interviews have a specific objective, though "the interviewer would be permitted some freedom in meeting them. The scope of the interview would be limited to certain subtopics, and key questions" (Singleton et al., 2005, p.222). The semistructured approach was selected for two reasons. First, the freedom permitted within this structure allowed for the question set to absorb and adapt to unexpected or novel responses. Such responses were anticipated in light of the exploratory nature of this research. Second, some structure was desired to ensure that the responses elicited met the objectives of the interviews, while also allowing for comparable analysis. Questions were primarily open-ended, as Palys and Atchison (2008) state that they "are clearly superior if the researcher is interested in hearing respondents' opinions in their own words, particularly in exploratory research, where the researcher isn't entirely clear about what range of responses might be anticipated" (p.171).

3.4 Preliminary Interviews

While a literature survey established an extensive list of drivers and barriers prior to the collection of primary data, its results produced a framework that lacked context specificity to the case of Ontario. To address this weakness, non-consumer stakeholders and non-residential consumers were consulted as key informants in order to: i) identify any barriers or drivers which had not emerged from the literature survey, ii) identify which drivers and barriers were perceived to be of greatest significance to consumers and potential consumers in the province, and iii) provide a greater overall understanding of the role and function different parties play within the three phases of the RESOP-integrated adoption process. This section describes the sampling procedure and methodology employed for the preliminary interview stage of this thesis.

Unlike respondents who provide information about themselves that allows the researcher to create a composite picture of the group they represent, a key informant is well versed in the social phenomenon that one wishes to study and who can talk directly about the group being studied (Babbie, 2007). The choice to interview key informants is predicated upon two premises. First, there is an assumption that certain members of the population possess a greater level of knowledge or expertise pertaining to a subject in comparison to the remainder of the population. The second premise is that such experts are, in some manner, identifiable and therefore desirable to interview. Following from these two premises, the logical approach to sampling is to use a purposive sampling strategy, as the alternative, probability sampling, would be both inappropriate and impractical. Purposive sampling is a type of nonprobability sampling in which the "units to be observed are selected on the basis of the researcher's judgment about which ones will be the most useful or representative" (Babbie, 2007, p.184). According to Singleton and Straits (2005), when using purposive sampling, "the general strategy is to identify important sources of variation in the population and then to select a sample that reflects this variation" (p.133).

The population to be interviewed in this stage was conceptualized as being inclusive of individuals or groups that interact with the process of solar PV system adoption in Ontario. This process is characterized by all steps required to move from the planning phase, where a consumer is yet to purchase a solar PV system or receive an SOC, to the operational phase, where a solar PV system is fully installed, generating electricity, and receiving financial remuneration from the OPA (i.e. the RESOP-integrated PV adoption process). This population was divided into three categories:

Category 1) groups or individuals that interact with the consumer at the level of the purchase and installation of a solar PV system

Category 2) groups or individuals that interact with the consumer through the administration of the RESOP

Category 3) consumers purchasing a solar PV system

Within Category 1, two subcategories were consulted. The first were the vendors selling and installing the solar PV systems. The second were the community-based co-operative purchasing groups (CBCPG) who organized and facilitated the bulk purchase of solar PV systems. Under Category 2, parties interacting with the administration of the RESOP, three subcategories were identified: i) Local Distribution Companies, responsible for connecting SOC holders to the grid, ii) Independent Facilitators, companies that have emerged to aid in and complete the administrative work associated with RESOP participation for the consumer, and iii) the Ontario Power Authority, the body responsible for the creation and implementation of the program. Category 3 consisted of non-residential consumers, so as not to utilize potential primary interview participants. With a total of three categories containing six subcategories, it was desired to complete at least one key informant interview per subcategory.

In the initial recruitment phase, a sample of 10 LDCs, seven vendors, two CBCPGs, one third-party administrator, and the OPA were selected. Participants were selected based on consultation with other academic colleagues who were experts in the field of solar PV energy and personal experience. All participants were contacted by email (see Appendix A for a script of the communication). Participant contact information came either from their organization's website or from the Canadian Solar Industry Association Website. Of the 21 initial emails, six contacts failed to respond, six contacts responded once but failed to respond to follow up emails,

one contact declined participation, one potential interviewee was away on vacation, and seven contacts were willing to participate. Seven interviews were ultimately completed: two LDCs, two vendors, two CBCPGs, and one third-party administrative group. The lack of an interview with the OPA is noteworthy, as it was the primary body responsible for the RESOP. Such an interview may have yielded responses that explained either participant experiences with the RESOP, or why elements of the RESOP application process that would later be questioned by interviewees were necessary.

Two interviews were later added to the preliminary interview stage. These interviewees were recruited through the primary data collection recruitment phase (discussed in section 3.3.1). Both participants failed to meet the criteria for participation in the primary data collection phase, however, they possessed experience that shed further light onto the purposes of the preliminary phase. One interviewee was a commercial solar PV system owner, while the other was a household that had obtained an SOC, but who had ultimately failed to purchase a solar PV system.

Both in-person interviews and telephone interviews were used. Interviews took place in two waves. First, the category 1 and 2 interviews took place between July and August 2008, and lasted between 20 and 45 minutes each. The second wave consisted of the two Category 3 interviews, taking place in November of 2008, and lasting 43 and 79 minutes. The final composition of preliminary interviews is shown in Table 3.1. Results of these interviews are presented in Chapter 4.

Table 3.1 Preliminary interview participant breakdown by category, subcategory, and prevalence.

Category	Subcategory	Number of participants and interview type
1) Purchase and installation	Retailers	2 Telephone
	CBCPG	2 Telephone
2) RESOP administration	LDCs	2 In-person
	Third-party administrator	1 In-person
	OPA	0
3) Consumers	Small-scale commercial	1 In-person
	SOC achieved	1 In-person

A set of standardized questions (Figure 3-3) was used as an interview guide and was supplemented by probes used to further explore respondent answers. This process is defined by Palys and Atchison (2008) as funneling, where one first asks broad and open-ended questions to broach a topic and then follows up participants' responses with successively more well-defined and structured questions (Palys & Atchison, 2008).

1. Why are people (not) adopting solar PV systems?

2. What factors do you think are influencing these decisions?

3. Which factors do you think are most influential?

4. How has the RESOP influenced people's choices to (not) adopt a solar PV system?

5. Why are people (not) participating in the RESOP?

6. What role does money play as a consideration when purchasing the system/participating in the RESOP?

7. What role do laws and policy tools, such as the RESOP and rebates, play in influencing consumers?

8. What influence do technological considerations have on the consumers (e.g. efficiency of technology, life span, solar availability, connection to the grid)?

9. What influence do social factors (e.g. word of mouth, awareness, co-ops) have on consumers?

10. What influence do environmental considerations (e.g. pollution, climate change) have on consumers?

Figure 3-3 Standardized questions for the guidance of preliminary interviews

According to Singleton and Straits (2005), the three methods available for recording data are an audiotape recorder, a notebook and pencil, and one's memory. Responses were recorded entirely by hand for interviews of the first and second categories, and audio recorded for the third category interviews. Handwritten notes were used out of the concern that an audiotape recorder would be highly obtrusive, thus compromising the openness of participant responses. The supporting rationale for this decision was that, since participants were responding on behalf of their employing organization, they might have been hesitant to compromise the reputation of the organization or their own standing within the organization, notwithstanding the confidentiality agreements that had been completed (see Appendix A for a copy of the consent form).

To ensure the validity and accuracy of the notes taken, two strategies suggested by Babbie (2007) were used:

a) "Don't trust your memory any more than you have to … It's a good idea to take notes either during the observation or as soon afterward as possible. If you take notes during the observation, do it unobtrusively, because people are likely to behave differently if they see you taking down everything they say or do." (p.311)
b) Babbie suggests taking notes in stages and rewriting one's notes in greater detail. Notes were rewritten more completely within an hour of the conclusion of each interview.

Ultimately, the relatively simple nature of the preliminary interviews and the clear objectives at hand made the use of handwritten notes adequate for data collection.

3.5 Primary Interviews

Primary interviews were conducted with members of the population who had executed a Standard Offer Contract and who had either entirely completed the execution phase, and hence the installation and connection process, or who were in the process of doing so. Twenty-four interviews were conducted between November 19, 2008 and December 5, 2008. Interview lengths ranged from 19 to 55 minutes, with an average length of 33 minutes. Ten interviews took place in person, nine at the residence of the participant(s) and one at a diner near a participant's residence; 14 took place over the telephone.

3.5.1 Participant Selection

Standard Offer Contracts are listed publically on the Ontario Power Authority website through the RESOP progress reports.[5] As of July, 2008, 152 Standard Offer Contracts had been

[5] Progress Reports can be accessed at

executed for solar PV systems qualifying as microgeneration (<10kW).[6] Based on the focus of this research, proponents possessing multiple contracts aggregating to more than 10kW on the same location were eliminated. This resulted in 129 contracts for microgeneration.

The Renewable Energy Standard Offer Program Progress Reports provide four pieces of information identifying contracts: the Project Name, Project City, Proponent Name, and Gross Capacity. The Proponent Name category was used as the main identifier of contract owners. Within the reports, proponents were identified in one of two manners: either as an individual's name (e.g. John Smith), or as the name of an organization (e.g. Renewable Energy Properties Inc.). Of the 129 microgeneration contracts listed, proponent names that were not an individual's name but that of an organization, of which there were 24, were eliminated under the assumption that such proponents would not have installed their systems on residences, and thus would have had distinct motivations, means, and experiences. This left a sample size of 105.

It should be noted that, despite this assumption, there was no way prior to contacting individuals as to whether or not the solar PV system that received a Standard Offer Contract was installed on a household or commercial property. Once participants were contacted, confirmation was made as to whether or not this was the case.

Of the 105 potential participants, mailing addresses and phone numbers were identified by using an internet search on both the Canada 411 and YellowPages.ca databases.[7] Seventy-three candidates were selected for recruitment: 61 identified with both a mailing address and a phone number and an additional 12 candidates identified with a mailing address only. It is

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http://www.powerauthority.on.ca/sop/Page.asp?PageID=1224&SiteNodeID=308&BL_ExpandID=161. Accessed, September 19, 2008.

[6] At the time of this research design, this was the most recent program update. Since this time, more contracts have been executed.

[7] The websites can be found at: http://www.canada411.ca/index.html, and http://www.yellowpages.ca/. These websites were accessed in September, 2008.

acknowledged that there was no way prior to contact to confirm whether the person listed was the same as the person who had received the contract.

According to Singleton and Straits (2005), "respondent cooperation…will be enhanced by a good cover letter. In interview surveys, the cover letter is usually mailed a few days before the interviewer is to call on the respondent." (p. 249). Candidates were initially contacted by mail, including a recruitment flyer and a cover letter (Appendix A). The recruitment flyer noted that participants could either contact the researcher directly by phone or email, or that they would otherwise be contacted by phone in the case where a phone number could be acquired.

Of the 73 candidates contacted by mail, 27 contacted the researcher within two weeks of receiving the recruitment package from the researcher, 24 of whom were ultimately interviewed. The other three participants, after being contacted by the researcher, failed to continue communication. As noted previously, two of the 24 interviews did not fit the criteria set for primary interviews; however, they were still interviewed and added to the preliminary interview data set. Of the 46 candidates who did not contact the researcher, one mail package was returned due to an invalid address, one person was deceased, and 11 did not have a telephone number listed. The remaining 33 people were contacted by telephone. Of these 33 people, 25 messages were left on answering machines, one telephone number was confirmed to be the wrong person, one had no answering machine upon which to leave a message, one telephone number was no longer in service, three people were not interested, and two people agreed to be interviewed. Of the 25 messages left on answering machines, only one respondent got back to the researcher for an interview, totaling three additional interviews from the call-back phase. Only two of these interviews were conducted, as one participant was not present at the arranged interview time, never returning the phone call of the researcher despite a follow up phone call. See Figure 3-4 for

a summary of the sampling frame, the list of individuals comprising the population from which the sample was selected (Babbie, 2007).

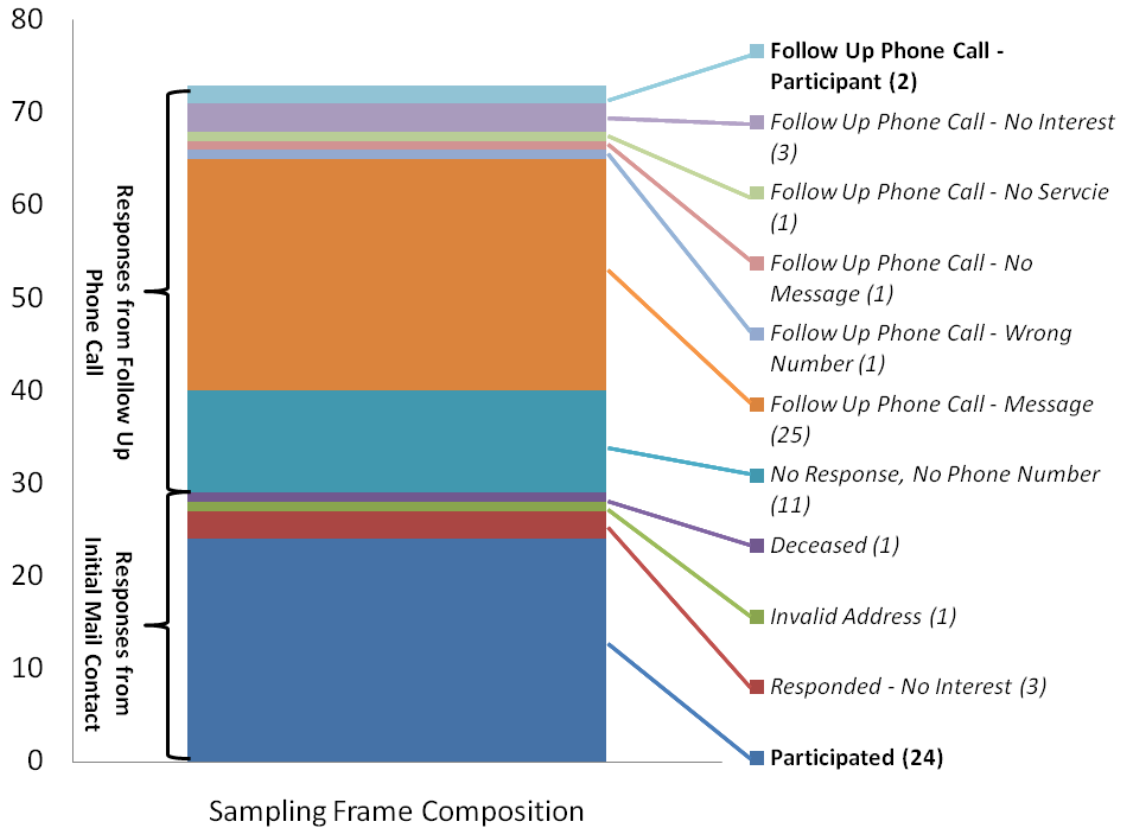


Figure 3-4 Sampling frame composition

3.5.2 Interview Design and Methods

In light of the exploratory nature of this research, while an interview guide was utilized to direct conversation, it was anticipated that novel responses would arise. To acquire data from RESOP participants, in-depth interviews were employed in an open-ended, semi-structured design for many of the same reasons previously mentioned under section 3.3. A semi-structured approach permitted questions to be targeted towards the purposes of the research, while allowing for the flexibility to explore other relevant topics which arose. The use of open-ended questions enabled participants to provide answers with greater depth and less framing in comparison to a

questionnaire or survey interview. It was presumed that because of the complexity and depth of the topic being researched, a questionnaire would either be unable to produce results of adequate depth and accuracy, or would be so tedious that participants would be dissuaded from participating to the fullest of their capacity.

To collect data, interviews were audio recorded.[8] Palys and Atchison (2008) note that audio recording:

> frees the interviewer to pay attention to the interviewee, although some would advise that the interviewer should occasionally jot down notes in any event, because doing so helps the interviewer retain the flow of the interview, because most respondents expect you to write something down every so often, and because notes give you some backup in case a technical foul-up renders the tape useless and you must regenerate the content of the interview from memory. (p.158)

Audio recording was performed utilizing both a laptop microphone, as well as a hand-held voice recorder. Handwritten notes were also taken during interviews to identify future follow up questions and to aid the flow of discussion, not for the purpose of recording answers. When interviews were performed in person, a number of strategies were employed to minimize the distraction or discomfort produced by audio recorders and note-taking. The use of the laptop microphone appeared to minimize distraction. Often, participants were so fascinated by the "tablet" nature of the laptop (e.g. the ability of the screen to pivot and fold down) being used that it appeared as if they had quickly forgotten that it was recording. Secondly, the ability of the tablet to fold down allowed it to sit on a kitchen table or work desk along with other print objects (i.e. newspapers, magazines), blending it into the setting. The hand-held audio recorder was also so small that it blended in similarly, and was often overshadowed by fascination with the tablet. The influence of audio recording the interviews on the response of participants was not considered to be significant. When informed that the interviewer would be the only person

[8] Although audio-recording was not a requirement for participation in the interview process, every participant consented to be audio recorded.

listening to the recordings, most interviewees openly stated that they didn't care who listened to the recording afterwards, suggesting that they had nothing to hide and that their responses would be honest.

In Figure 3-5, 12 procedures employed by the researcher as a general strategy throughout the interviews are listed.

1. Initiate the interview.
2. Put the respondent at ease.
3. Be businesslike.
4. Keep the interview situation as private as possible.
5. Avoid stereotyping.
6. Be thoroughly familiar with the survey instrument.
7. Ask every question in its proper sequence and exactly as written.
8. Do not assume the answer to any question.
9. Speak slowly in a clearly understood, well-modulated voice.
10. Do not put answers in the respondent's mouth.
11. Use an appropriate, neutral probe when needed.
12. Record responses on the interview schedule as you go along.

Adapted from Singleton and Straits (2005), pp.252-254.

Figure 3-5 Procedures in conducting an interview

Supplementing these 12 procedures were the following considerations.

Eye-contact was often made to demonstrate interest and engagement, though without doing so to such a degree as to make the participant uncomfortable. The notepad was laid flat on the researcher's lap so that it did not appear as if responses were being hidden, though it was ensured that the researcher was at an adequate distance so that the interviewee could not read and anticipate the coming questions.

While it is also important to achieve a rapport between the interviewer and interviewee, it was noted that "interviewees can be very attentive to cues that the interviewer emits, since they want to know whether they are 'doing well' as participants" (Palys et al., 2008, p.158). Palys and Atchison (2008) continue that "what you choose to write down out of their verbal responses and

even your supportive and encouraging 'uh-huhs' or nods of the head may be taken as cues about what the interviewee 'should' be talking about" (p.158). To avoid bias or leading of the interview, the words and tone used by the researcher to continue the flow of conversation were meant to be neutral. The words "OK", or "I see" were often used to relate to the interviewee that they were being listened to, while also avoiding the suggestion of a positive or negative reflection.

While the interview is the method used for the acquisition of data, its effectiveness as a tool relies heavily on the design of questions which comprise the interview. The following considerations were accounted for in designing the questions for this interview.

Singleton and Straits (2005) suggest that the opening topic and first question "should be congruent with respondents' expectations: It should be a question they might reasonably expect to be asked, on the basis of what they have been told by the interviewer about the study" (p. 278). They continue that:

> This sometimes involves using a question that has no research purpose other than motivating respondents by conforming to their preconceptions about what should occur in a competent survey. The first question also should be relatively easy to answer, thus preventing respondents from becoming discouraged or feeling inadequate to fulfill their role as respondents…If both open-ended and closed-ended questions are used, the beginning is a good place to have an open-ended question. Most people like to express their views and have someone listen and take them seriously. (Singleton et al., 2005, p.278)

The opening questions (questions 1-3 in Figure 3-6), met each of the criteria set out by Singleton and Straits (2005).

Question sensitivity was also considered. Questions pertaining to the challenges of purchasing a solar PV system and the RESOP process were considered to be of a sensitive nature as the former anticipates responses of personal sensitivity, such as the inability to finance a system, while the latter may have led to discomfort if respondents felt adverse to speaking of an

experience that reflected poorly on other parties. For this reason, such questions were positioned towards the middle of the interview, so as to have established interest, trust, and rapport with the participant. While the positioning of sensitive questions is important, Singleton and Straits (2005) also note that sensitive questions ought to still fit logically into the sequence of questions. Ultimately, in practice, participants were candid about the cost of the system, and the anticipated sensitivity of such questions may have been over-estimated.

Thirdly, question order was accounted for in the interview schedule design. For example, participants were asked about their original decision-making process prior to asking about their actual experience since. In the reverse order, the participant may have transposed their more recent experiences onto their original decision, resulting in memory distortion. It has been shown that "since respondents tend to truncate memory searches as soon as they have enough information for an acceptable answer, the most accessible information is likely to be that used recently to answer previous questions" (Sudman, Bradburn, and Schwarz (1996) cited in Singleton et al., 2005, p.280). These considerations, coupled with the objectives of data collection, produced the interview guide, presented in Figure 3-6.

1. When did you first become interested in purchasing solar panels?
2. How did you become interested in solar panels?
3. In your own words, why are you interested in purchasing solar panels?
4. What would you suggest were the most significant factors affecting your decision?

Follow-up questions/Probes for researcher:

These probes are to be used if these topics are not touched upon by the interviewee.

Money:

M1 - Did money play a role in your decision? (e.g. did the initial cost of the system or the length of payback influence your decision?)

Social:

S1 - Did the perception of members in your community affect your decision to purchase solar panels?

S2 - Did the stance of the government affect your decision? (e.g the degree to which Canadian governments are supporting or promoting Renewable Energy)

S3 - Did considerations pertaining to the environment influence your decision?

Institutional:

I1 - Did the administrative requirements or processes (i.e. OPA application, System Connection) factor into your decision? (e.g. time requirements)

Technical/Technological:

T1 – Would you suggest that the technological nature influenced your decision?

Are there any major factors you considered that you wanted to mention at this point?

5. Would you mind describing the overall process with a general time line, beginning with the decision to purchase a solar PV system to your current status?
6.a. Would you have purchased solar panels without the Standard Offer Program?
6.b. Would you have purchased solar panels if [co-operative group] had not been in place?
6.c. If [co-operative group] had been in place but the RESOP payback was not present, do you believe you would have purchased solar PV panels?
7. To what degree did you fill out the RESOP application?
8. How did you find the RESOP administrative process? For example, how did you find the process of acquiring a Standard Offer Contract?
9. How would you describe your overall experience, including:

i) Finding, purchasing, and installing a system

ii) Completing the SOP requirements (i.e. executing a contract, getting connected)

10. What would you recommend to someone interested in purchasing a solar PV system? Have you made this recommendation to anyone?
11. Would you recommend using/participating in the RESOP? Have you?
12. How would you improve the RESOP process?
13. Is there anything you would like to mention that you feel I didn't ask about or should have asked about?

Figure 3-6 Standardized questions for the guidance of primary interviews

As noted in section 3.1.1, the proactive refining of questions throughout the interview process occurred. During the first interview, it was deemed useful by the researcher to have the interviewee describe the timeline and process of their adoption, including the purchase, installation, grid connection, and completion of the Standard Offer Contract (see question 5 in Figure 3-6). This question proved to provide great insight, and was integrated into the remainder

of the interviews. A second addition to the interview schedule was questions 6b and 6c (Figure 3-6). These questions and their importance emerged early in the interview process when participants who had participated in a CBCPG would note its significance in their responses to questions 1 through 4. It became apparent that, similar to the hypothesis that the RESOP may have been the purchase catalyst, so too may have been the CBCPGs. Questions 6b and 6c were asked to all respondents who had utilized a CBCPG.

3.6 Data Analysis

According to Babbie (2007), "… the aim of data analysis is the discovery of patterns among the data, patterns that point to theoretical understandings of social life" (p.384). He continues that "the key process in the analysis of qualitative social research data is coding – classifying or categorizing individual pieces of data – coupled with some kind of retrieval system" (Babbie, 2007, p.384). This section describes the coding method used to produce the results presented in Chapter 4.

For closed-ended questions, the coding of responses was straightforward, as one simply assigned a different code to each category (Singleton et al., 2005). For example, questions 6a, 6b, and 6c of the primary interviews prompted clear yes or no responses, and were thus coded.

In the case of open-ended questions, "the researcher tries to develop a coding scheme that does not require a separate code for every respondent or case but that adequately reflects the full range of responses. The idea is to put the data in manageable form while retaining as much information as practical" (Singleton et al., 2005, p.448). According to Singleton and Straits (2005), "developing coding categories for open-ended questions, like many other research activities, involves interplay between theory and data" (p.449).

Following an exercise presented by Singleton and Straits (2005) in their textbook *Approaches to Social Research*, the practice of coding took place in the following stepwise manner. Participant responses were first thoroughly listed with respect to each question asked in the interview. As noted, preliminary interview data were collected through real-time note-taking by the interviewer, while primary interviews were audio-recorded. When coding preliminary interviews, written notes were consulted. For the coding of primary interview data, audio-recordings were partially transcribed and listened to a minimum of two times each.

Next, "coding categories were formed by grouping together reasons that seemed similar from the research perspective" (Singleton et al., 2005, p.449). Singleton and Straits (2005) warn that it is "the tendency for novice researchers … to use too few categories" (p.448). Bearing this in mind, the initial coding process ensured the use of numerous categories. For example, though treated at times as one and the same, high cost and long payback periods were distinctly coded. The development of categories was then refined by consulting previous categorizations in the literature, namely those presented in Table 2.1. Palys and Atchison (2008) further note that:

> since the act of counting requires categorization, having to decide whether to count an event as a *this* or a *that* will have the positive effect of always demanding that we define and redefine our categories. Over time, this steady refinement will in turn require us to reexamine whether our preliminary categories are workable or not, adequate or in need of revision; it may also suggest other possibilities that might be even more useful. This result will be particularly likely if we ensure that we remain attuned to **negative cases**, that is, cases that don't "fit" the categories we've identified or that don't follow the pattern of relationships we imagine are there. (p.311)

Ultimately, adherence to the above coding process resulted in the identification of more precise factors, in comparison to Table 2.1. For example, while money generation was identified specifically by RP-01, it was not explicitly labeled in the list of literature identified factors (Table 2.1). Money generation can, however, be categorized as a cost and payback period factor, since it decreases the length of one's payback period; it is identified with specificity in Table 4.3

so as to retain the richness of the data collected. An explicit comparison and analysis of all factors identified in this thesis across the literature review, preliminary interviews, and primary interviews is made in chapter 5 (Table 5.1).

3.7 Limitations

Aside from challenges already discussed, there are three noteworthy limitations to this study. The first is that, based on the primary sample, findings cannot be generalized to the entire target population, nor can they be expanded to the greater provincial population. A sample of 24 participants out of a target population of 129 is insufficient to extrapolate representativeness to said population. Even if this sample had been representative, results could not be expanded to apply to the general population since those members of the target population can most likely be characterized as early adopters, and thus will tend to have different behavioural, attitudinal, and demographic characteristics than later adopters (Rogers, 2003). Therefore, one should be cautious not to generalize results.

Second, as noted in section 1.2, to fully understand the diffusion process, a preferred sampling design would have sampled both those who have adopted (the early adopters) and those who are most likely to be the next adopters, but who are yet to do so. Justification for the approach taken is provided in section 1.2, however, one should remain aware that future adopting populations may differ from this study's sample of early adopters.

A third limitation to this study is with respect to its explanatory power. While preliminary interviews aided in describing the role that different stakeholders play within the adoption process, the limited number of LDCs, vendors, and so forth interviewed restricts the ability of this research to explain the entire range of experiences encountered throughout primary interviews. This challenge is symptomatic of exploratory research and simply could not be

incorporated into this study without largely broadening its scope and means. As noted in the results and discussion sections, however, the interviews completed were able to provide an adequate amount of information that could produce preliminary results and direct future research efforts.

4 Results

4.1 Introduction

In this chapter, data collected during the nine preliminary and 24 primary interviews are presented in a summarized format.

In chapter 2, a review of the literature produced a framework for the identification of potential drivers and barriers to the adoption of a solar PV system. Although a comprehensive number of drivers and barriers were identified, their presence within the literature did not necessarily mean that they were present within the Ontario case. The awareness and understanding of drivers and barriers developed by the framework creation process did, however, help to improve the appropriateness of the scope and framing of the interview questions. Such a methodology, as noted in chapter 3, improved the likelihood that this research would accurately capture the landscape of drivers and barriers present in the RESOP-integrated solar PV adoption process in Ontario.

The preliminary interview stage was designed to act as a bridge between the literature review and the collection of primary data. Preliminary interview results served two related, though distinct, purposes. The first objective was to refine the list of drivers and barriers in chapter 2 to those that are most likely to be present in the Ontario case, while also identifying those yet to be identified in the literature. The second purpose was to improve the researcher's understanding of the overall adoption process, and the role that specific actors (i.e. retailers, Community-Based Co-operative Purchasing Groups (CBCPG), Local Distribution Companies (LDC), etc.) play within it. Though not presented in this chapter, some data derived from the preliminary interview stage also helped to explain the intricacies of the overall RESOP-

integrated solar PV system adoption process, and are integrated into the analysis of these research observations in chapter 5.

Primary interviews were conducted with the intent of collecting first-hand data able to describe the consumer's experience in utilizing the RESOP to adopt a solar PV system. The factors identified in the framework development of chapter 2 have served as hypotheses against which these data are assessed. Primary interview research observations comprise the majority of this chapter, and address the all three phases of the RESOP-integrated adoption process.

Section 4.2 presents the information acquired during the preliminary interview stage. This information has been drawn from nine different participants over approximately 4.5 hours. Results are presented in aggregated form, though can be found in greater detail in Appendix B.

Section 4.3 presents the data collected from the 24 primary interviews over approximately 13.2 hours. In this chapter, results are presented in aggregated form though individual results can be found in Appendix B. Further breakdown of these results will be of use in the analysis of these results in chapter 5, and will be explored there.

4.2 Preliminary Interview Observations

The preliminary data set of this research was collected during nine interviews conducted both in person and over the telephone. Interview methodology and data analysis are discussed in chapter 3.

Section 4.2.1 identifies and describes the drivers and barriers that are believed to be prominent in the consumer's decision to purchase a solar PV system. Interviewees identified 16 distinct factors, each of which is briefly described. The frequency with which each is identified across participants is also noted within this section. Section 4.2.2 presents four roles identified by interviewees that the RESOP does, or is at least meant to, play. Finally, section 4.2.3 presents

drivers and barriers specific to the utilization of, or participation in, the RESOP. In the case of the RESOP, 11 distinct factors have been identified and are described.

As noted previously in chapter 3, preliminary interviews were largely of an exploratory nature and meant to help refine the parameters for the primary interview schedule. For this reason, only those results directly related to the methods and objectives laid out in this thesis are presented. Where appropriate, other information provided during these interviews will emerge in the data analysis phases of this research as they may aid in explaining the results of the primary interviews. The reader should also remain aware that the results presented, while pertaining to the consumer adoption experience, are the expressed opinions of non-consumers and non-residential consumers and not the consumers themselves. Those perspectives are reported in section 4.3.

4.2.1 Factors Influencing the Consumer Decision to Purchase a Solar PV System

Preliminary interview participants were asked to describe the set of drivers and barriers that had either been reported to them by consumers or which they believed to be relevant to the consumer decision to purchase a solar PV system in Ontario. The opinions voiced by participants stem from a variety of experiences, as the preliminary interview sample consisted of retailers, LDCs, CBCPGGs, a TPA, and non-residential consumers. Below are the factors described by preliminary interview participants, each accompanied by a brief description (Table 4.1).

Table 4.1 Factors believed to be influential in the consumer decision to adopt a solar PV system

	Factor	Description
Monetary	*Cost and Payback*	The high initial and overall capital cost and the lengthy period of time required for a financial payback make the technology either unaffordable or undesirable as an investment.
	Financial Assistance	Counteracting the effects of cost and payback, respondents believed that the financial reimbursement provided by the RESOP created a financial incentive for consumers to purchase a solar PV system. Respondents also acknowledged that such an incentive did not necessarily eliminate the financial burden, it simply made the investment more palatable.
	Unexpected Costs	Exacerbating the financial challenge is the emergence of unexpected costs, such as highly priced meters required for connection under the RESOP, or home renovations required for the installation of systems (e.g. roofing upgrades).
Social	*Lead by Example*	Consumers may desire to set an example with the hope that their actions will motivate others to follow.
	Political Leadership	Consumers may be prompted to adopt because a political leader supports or promotes the technology.
	Technological Fascination	Consumers may purchase a solar PV system in light of a fascination with the technology.
	Understanding of Technology	Consumers may be ill-informed about the technology with regards to how it functions and what it actually produces.
	Joy of Generating	Generating electricity may provide a consumer with a degree of joy. This joy could be, though is not necessarily, related to normative claims.
	Sustainability	Consumers may purchase solar panels to address sustainability related concerns, such as intergenerational equity (e.g. to benefit their children and grandchildren) and maintenance of socio-ecological system integrity (e.g. land stewardship).
	Professional Advice	Consumers may be influenced by the advice of professionals within the field of solar PV systems.
	Previous Experience	Previous experiences with either the same or similar technologies (e.g. solar water heaters) may influence the consumer's decision.
Institutional	*Community-Based Co-operative Purchasing Groups (CBCPG)*	The presence of a CBCPG may reduce the "leg-work" (e.g. investigating the technology, finding a retailer, evaluating different retailers) for the consumer, and may act as an incentive for interested purchasers.
	Installation Delays	Delays with regards to the installation of a system may cause a consumer to retract their decision to purchase.[9]

[9] Participant Pre-P1 failed to adopt after a delay in the installation of his/her system. Though perhaps fortuitous for that participant, it was during the delay of the installation that the potential consumer changed his/her mind. S/he did openly state, however, that had the retailer been adequately organized to install the PV system on time, the participant would have gone through with the adoption process.

Technological	*Adequate Roofing*	A house must have a roof structure able to physically support a PV system.
	Home Ownership	People uncertain about the future of the ownership of their home may be unwilling to invest.
	Reliability	Solar PV systems require relatively little maintenance over their operating lifetime.

Barrier

Driver

Neutral

Combination

Factors were coded under one of three classifications: driver, barrier, and neutral. In one case, adequate roofing, factors were identified as more than one of these three combinations, and have been identified. Drivers were factors that either provided an incentive to adopt, or that helped to facilitate the adoption process. Conversely, barriers were those factors identified as either motivating consumers not to adopt, or that hindered the facilitation process. Finally, home ownership and (in one of two cases) adequate roofing did not necessarily influence whether or not consumers should adopt, as much as whether or not they could, and as such were classified as neutral. The reader should also note that, while factors have been coded in Table 4.1 with respect to preliminary interview participant responses, they may present in a different manner to other adopters. For example, although professional advice presented as a barrier to one participant, it is also possible that it may present as a driver for other adopters.

While 16 different factors were identified by participants, only seven were identified more than once (Figure 4-1). Considerations related to sustainability and money dominated in frequency. Concerns over the environment and the presence of the RESOP compensation were the primary drivers, while the cost and payback of the system were seen as the primary barriers.

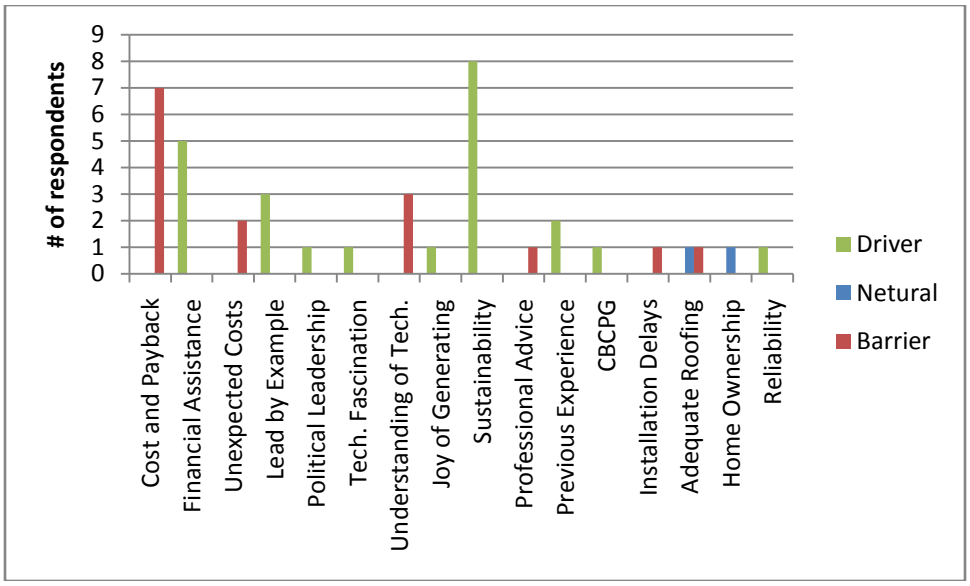


Figure 4-1 Factors perceived to be influential in the consumer decision to purchase a solar PV system

4.2.2 Role of the RESOP

Though not directly asked as part of the interview protocol, preliminary interview respondents were motivated to describe the role of the RESOP in terms of facilitating solar PV system adoption.

The most frequently described role of the RESOP was the increase in affordability of the solar PV systems due to the improved payback period. It should be noted that this view was not held by all participants. One participant adamantly stated that, because of the poor rate of compensation and the related lengthy payback period, the RESOP was not meant to increase affordability on any significant scale, as the cost of a system remained too high for the average consumer. The alternative explanation provided by this participant was that the RESOP was simply a case of political 'green-washing.'

One respondent suggested that the creation of the RESOP was partially meant to send a political message of support for 'green' electricity. Unlike the aforementioned respondent, this respondent believed the political message to be an honest one.

Two respondents suggested that the role of the RESOP was not solely to improve the affordability of a solar PV system, but also to increase awareness about solar PV systems.

Finally, one respondent noted that the RESOP had created the conditions upon which the purchase of a solar PV system could now be pursued. This statement was unique in that it was not in reference to the direct financial incentive for the individual consumer, but with regards to the *opportunity for the creation* of a CBCPG that could effectively execute a bulk purchase of solar PV systems *because* of the financial conditions. The further implications of this statement are explored in chapter 5.

4.2.3 Factors Influencing Utilization of the RESOP

Similar to question 1 of the preliminary interview schedule (see Figure 3-3), question 5 asked respondents to describe the drivers and barriers they believed to be influential in the consumer's decision to utilize the RESOP for their purchase, as opposed to their decision to adopt a solar PV system. Eleven factors – eight barriers, two drivers, and one combination factor (both a barrier and a driver) – were identified by participants (Table 4.2).

Table 4.2 Factors believed to be influential in the consumer decision to utilize the RESOP

	Factor	Description
Monetary	*Unexpected costs*	Processes required under the RESOP, such as the appropriate meter-configuration, often incurred unexpected costs, such as the price of a meter that could range anywhere from $300 to over $1,400.
	Monthly fee	RESOP participants are typically charged a monthly administrative fee by their LDC.
Social	*Other consumer experiences*	Negative consumer experiences may influence the decisions of potential program participants.
	Political legitimization	The perception of the RESOP as a political initiative may act as an incentive.
Institutional	*Cooperation of LDC*	The willingness of a LDC to cooperate and aid consumers in connecting to the grid may dissuade a participant from participating.
	Program awareness	People may not be aware of the existence of the RESOP.
	Administrative requirements	The administrative requirements and multiplicity of organizations which one must interact with create a lengthy and often frustrating process.
	Program ramifications	Uncertainty with regards to implications of participation in the program, such as tax or insurance implications, may dissuade consumers from participating.
	Policy uncertainty	With respect to the 20 year length of a SOC, as well as the set rate of compensation, participants may be concerned with rising electricity prices or the emergence of a program with a payback rate greater than $0.42/kWh.
	Administrative assistance	Awareness that retailers, TPAs, or CBCPGs may assist a consumer through the adoption process was comforting and enticing for consumers.
Technological	*Technical configuration*	The requirement for specific meter configurations and the ability to physically connect to the grid may be challenging for consumers based on their LDC and proximity to an available grid connection.

Barrier

Driver

Neutral

Combination

While 11 factors were identified across the participants, they were not identified with the same frequency (Figure 4-2). The only factor considered to be both a driver and a barrier was the cooperation of the LDCs. While two participants suggested that dealing with the bureaucracy of

the LDCs was often challenging and frustrating, one participant noted that their LDC had been integral in supporting their solar PV system installation and grid connection.

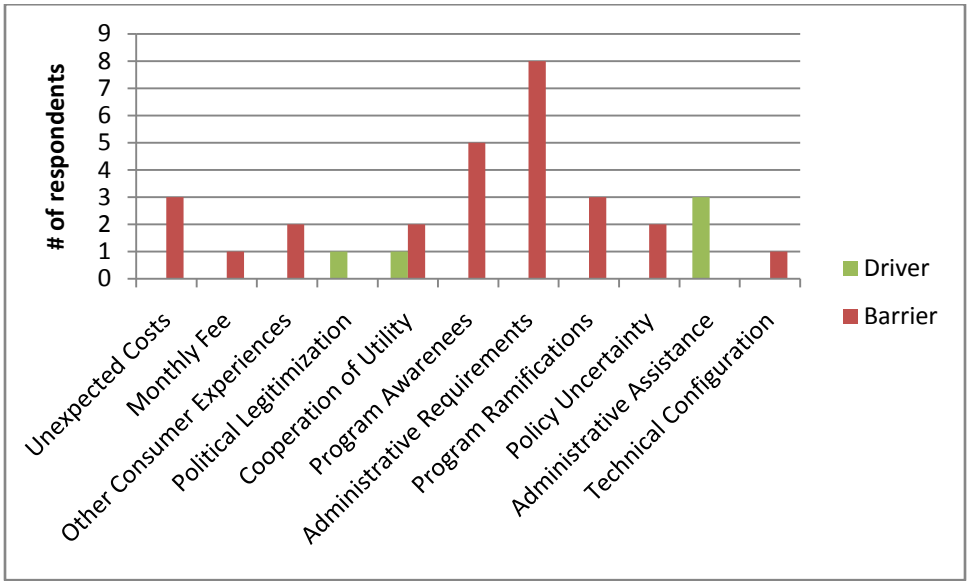


Figure 4-2 Factors perceived to be influential in the decision to utilize the RESOP

4.3 Primary Interview Observations

The primary data for this research were collected from the ten in-person and 14 telephone interviews. Methodological considerations for these interviews are described in sections 3.3 and 3.5. Interviews were later transcribed and coded using the methods described in section 3.6. Primary interview participants have been coded with the abbreviation RP to denote "RESOP Participant", and have been assigned a number at random so as retain the specific identification of responses without sacrificing anonymity. The results have been organized in this chapter into the three phases of adoption outlined in Figure 3-1. Results are presented in a summarized format, though further detail can be found in Appendix B.

Section 4.3.1 explores the planning phase of adoption, focusing on the consumer's decision-making process prior to the physical act of adopting. Results identify and describe the factors that influenced the decision to purchase a solar PV system and the circumstances that allowed

them to do so. Results addressing the specific influence of the RESOP in the planning phase are also presented.

Section 4.3.2 presents results pertaining to the execution phase of the adoption process, including i) the purchase and installation of the solar PV system, ii) connection to the grid, and iii) completion of a SOC. The role of CBCPGs is also explored in this section, as their presence proved to be influential in the experiences of those participants who utilized their services.

Section 4.3.3 concludes with results pertaining to the outcomes of the execution phase and the continuing operation of the solar PV systems.

4.3.1 Planning Phase Results: Why RESOP Participants Purchased a Solar PV System

Results of this section identify and describe the factors influential to the consumer's decision to purchase a solar PV system and participate in the RESOP. Three themes are discussed: i) the factors involved with the decision to purchase, ii) the role of the RESOP, and iii) the role of CBCPGs.

4.3.1.1 Influential Factors in the Decision to Purchase a Solar PV System

To gain a better understanding of why participants wanted to purchase a solar PV system, as well as what made them actually go through with the purchase, it was important to identify and understand the range of factors that influenced their initial decisions. It should be noted that the drivers and barriers and their frequency presented here are those that influenced the original decision process. In coming sections, the drivers and barriers encountered throughout the actual adoption process (i.e. during the execution phase) are presented.

The factors considered were wide ranging, with 21 different factors identified (Table 4.3). Every factor presented solely as either a barrier or driver across all participants, with the

exception of the cost of a system that, while predominantly seen as a barrier, was considered to be a driver by one participant.

Table 4.3 Factors considered by RESOP-participants when deciding to purchase a solar PV system

	Factor	Sample Quotation
Monetary	*Cost and payback*	"I guess the only factor against it would be that it costs a lot of money." (RP-07)
	Money generation	"It's the only energy retrofit you can do that produces money. All other retrofits are about saving money, from a residential standpoint." (RP-01)
	Investment	"…we actually figured that investing $[disclosed amount] in this system would be more profitable than leaving it in the bank or investing in a [Guaranteed Investment Certificate]." (RP-24)
	Support the economy	"Try and do what you can for the economy." (RP-02)
Social	*Lead by example*	"To start an example…once people saw what we had, it would generate interest in the neighbourhood." (RP-05)
	Familial culture	"My family's influence mostly. My parents built a passive solar home." (RP-01)
	Previous experience with solar PV panels	"We've got a cottage that's off-grid." (RP-01)
	Education and awareness	"It was also a way of communicating or making people aware of the technology." (RP-06)
	Sustainability	"I'm worried about the future of the planet…we related environment to everything." (RP-04)
	Joy of generating	"As opposed to just buying carbon credits or signing up with Bullfrog, it seemed a more tangible thing. It's kinda neat to see the meter spinning backwards." (RP-07)
	Political leadership	"[Politician] is a good friend of mine. I have a lot of respect for him, and [they were] part of this. I wasn't throwing money down the sink. I had a sense it was stable." (RP-10)
	Policy support	"[The RESOP]'s a significant policy initiative, so I was interested in participating in that program as a way to support that policy initiative." (RP-17)
	Political statement	"I don't really have a say in what the government does. I disagree with nuclear power and this is my own way of casting my vote against that." (RP-14)
Institutional	*Presence of a program*	"With the introduction of the RESOP, it was now financially feasible." (RP-22)
	Program administration	"I was definitely leery about how long it was going to take." (RP-09)
	Administrative assistance	"So that was another incentive. Somebody was going to do it." (RP-23)
Technolgical	*Reliability/ Maintenance*	"Because they make sense. They're reliable. They have no moving parts." (RP-14)
	Technological risk	"Part of it is the risk of the technology." (RP-10)
	Backup power	"My [partner] was interested in participating primarily because we got a backup battery." (RP-18)
	Technical configuration	"It was primarily technical considerations on how the system would be set up." (RP-06)

Environmental	*Solar exposure*	"We have a southern exposure, but part of the problem is we have a tree that completely shaded our backyard." (RP-10)

Barrier

Driver

Neutral

Combination

During the coding process, a number of specific responses were categorized under "sustainability." Sustainability concerns demonstrated the greatest diversity of responses within its categorization. The specific responses classified under this category include (with frequencies in parentheses):

- *General Environmental (20)*: "It seemed neat to have something that generated power that didn't produce pollution." (RP-14)
- *Climate Change (4)*: "Since the late 80s, when we first heard of climate change…we wanna make a difference for our future." (RP-05)
- *Energy Concerns (5)*: "To get off oil and gas as much as possible." (RP-23)
- *Air Quality (1)*: "I think the big environmental problem I'd like to be part of the solution of is air quality." (RP-23)
- *Future Generations (5)*: "I think it was environmentally…I have a young family here." (RP-13)

Participant responses fell under one of the above five subcategories of sustainability. Furthermore, individual participants often identified more than one of the sustainability subcategories in their response. Participant RP-23 (quoted above) provides an example, where both concerns over the presence of oil and gas in our current energy supply mix in Ontario and

the desire to improve air quality were of importance in their decision. Similarly, participant RP-13's response (quoted above) could have also been categorized under the General Environmental category.

While Table 4.3 presents the range of factors considered by participants, the manner in which each of these was noted differed across participants. As laid out in Figure 3-3, the interview schedule began by asking an open-ended question with regards to the factors considered during the original decision. When a participant's response failed to address any of the categories laid out in the interview schedule (e.g. money, social, institutional, technology, environmental), a prompt was used to probe those categories yet to be discussed. For example, if a respondent suggested that their decision was between sustainability and cost, each of the social, institutional, technological, and environmental categories was then probed by the use of a prompt – being the specific questions laid out in the schedule. The frequency of responses with respect to their prompted nature is displayed in Table 4.4.

Table 4.4 Identification of presence of barriers and driver by RESOP participants

Factor	Barrier, Unprompted	Barrier, Prompted	Neutral, Unprompted	Neutral, Prompted	Driver, Unprompted	Driver, Prompted
Monetary:						
1. Cost and payback	11	6	2	1	1	
2. Money generation						1
3. Investment					1	
Social:						
4. Support the economy					1	
5. Lead by example					4	3
6. Familial culture					1	
7. Previous experience					3	
8. Sustainability					22	2
9. Joy of generation					1	1
10. Political leadership						3
11. Policy support						2
12. Political statement						2
Institutional:						
13. Presence of a program					4	1
14. Education and awareness						4
15. Program administration		1				
16. Administrative assistance						1
Technological:						
17. Reliability/maintenance					1	11
18. Technological risk	1					
19. Backup power					3	1
20. Technical configuration			1		1	
Environmental:						
21. Solar exposure			4		2	1

It is evident from the results that a wide number of factors may contribute to one's decision, though sustainability and the cost and payback of a system most prominently polarize the debate. In addition to these two, the low-maintenance and simple nature of the technology was the only other factor considered by at least half of the respondents.

While the purpose of categorizing factors with relation to whether they were expressed with or without being prompted is to demonstrate salience for later analysis, an unprompted

response did not always imply that it was prominent. For example, numerous respondents would state, unprompted, that while cost is often a major factor for people, it was insignificant in their personal consideration. For this reason, the prominence of the factors displayed in Table 4.4 has also been identified.

Prominence was categorized in two mutually exclusive manners. At the more general level, three conditions, all of which had to be met, classified a factor as prominent:

i) The factor was identified without prompt;

ii) The factor was not identified as being insignificant; and

iii) The factor was not explicitly identified as being the most prominent.

In certain cases, respondents explicitly expressed that a certain factor was the most prominent in their decision. Expressions that merited such coding included:

- "The biggest…"
- "The big choice was..."
- "The big factor…"
- "The most significant factor…"
- "The most important…"

If not apparent, a factor could not be identified as both prominent and the most prominent, as doing so would produce a case of double counting.

Results (Figure 4-3) again demonstrate a polarization of sustainability considerations and cost and payback. When considering prominence, the range of factors influential to the decision-making process is greatly reduced. This is not to say that other factors do not play a significant role, only that those presented are the only ones explicitly noted by participants to be of importance.

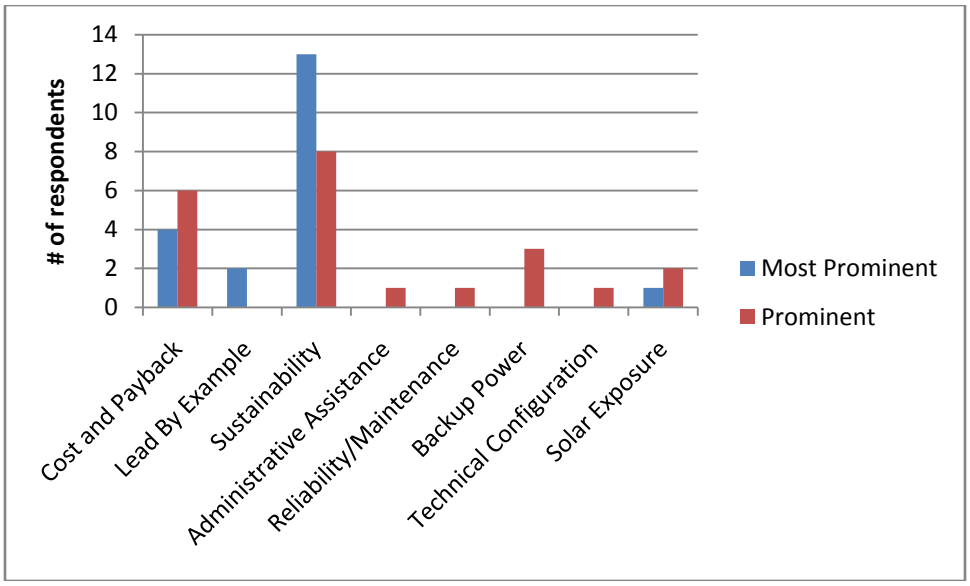


Figure 4-3 Identified significance of factors influential to the decision to purchase a solar PV system

4.3.1.2 Catalysts for Adoption

The factors identified in section 4.3.1.1 explain why a participant believes the adoption of a solar PV system to be a good idea, and can be described as their rationale for adoption. They are the answers to the question: why would one purchase a solar PV system? The defining quality of a rationale is that, while it is the expressed *theoretical* reason(s) why a participant thinks that adoption is a good idea, it does not necessarily motivate or enable a consumer to actually purchase a PV system.

Whereas a rationale is the theoretical reason why, a catalyst produces concrete action. The catalyst helps to explain why a participant did, in fact, purchase a solar PV system, and can be defined as the occurrence or set of circumstances that enabled the action of purchasing a solar PV system.

It is possible that the rationale and the catalyst are either one and the same or distinct entities. Two examples elucidate the distinctions and overlap between these two aspects. Participant RP-02 explained that their reasons for purchasing a solar PV system were a desire to have backup electricity system and a desire to support the economy. While these factors

explained why RP-02 wanted to purchase a solar PV system (the rationale), they were inadequate in explaining why s/he actually went through with the purchase. Participant RP-02 explicitly noted that his/her motivation to purchase such a system did not become a reality until s/he received some inheritance from the death of a family member (the catalyst). Similarly, the inheritance did not explain why participant RP-02 wanted to purchase a solar PV system, though it did explain why RP-02 actually went through with the purchase. In this case, the rationale and catalyst were distinct entities.

In some instances, the rationale and catalyst were indistinguishable. Participants RP-04, RP-06, and RP-14 provide appropriate examples. In all three cases, concerns for the environment, while explaining why these participants wanted to purchase a solar PV system, were also adequate motivation to explain why participants actually made a purchase. It is for this reason that the definition of a catalyst involved an occurrence or a set of circumstances, since no specific occurrence explains the progression from motivation to action.

It should also be noted, if not yet evident, that in some cases, participants possessed multiple rationales or multiple catalysts influencing their decision and action.

While the rationales, or factors, presented in the previous section have explained why people thought it to be a good idea to purchase a solar PV system, Table 4.5 shows why participants were motivated or enabled to act upon their beliefs. Nine catalysts have been identified.

Table 4.5 Representative examples of RESOP-participant catalysts

Catalyst	Sample Quotation
1. Financial inheritance	"I have had some inheritance from a grandfather that died and said that's a better way to spend it I guess." (RP-07)
2. Renewable Energy Standard Offer Program (RESOP)	"When we heard about the ministry's standard offer 42 cents per kilowatt hour." (RP-05)
3. Community-based co-operative purchasing groups (CBCPG)	"I've been thinking about it for years, but it didn't really become a possibility until the [CBCPG] project started in my neighbourhood." (RP-19)
4. Technological improvement	"I kept my eye on prices … prices weren't lowering, but power was increasing." (RP-08)
5. Home improvements	"Well we bought my wife's grandmother's house, so I figured, what the heck, might as well get into it." (RP-21)
6. Higher income	"I've been wanting to do this for a long time. I have not been able to afford it until recently ... my income increased to a point where I felt like I could do this." (RP-20)
7. Lead by example	"Time to put your money where your mouth is." (RP-01)
8. Sustainability concerns	"Concerns about energy in general…a combination of environment and energy issues." (RP-06)
9. Other or previous solar experiences	"We were really happy with [our solar water heater]. So from that experience, which was a good one … why don't we try to make our own electricity." (RP-09)

As previously mentioned, catalysts can either be specific occurrences, or a set of circumstances that motivated a participant to act. Of the nine identified, six can be identified as specific occurrences – financial inheritance, the RESOP, technological improvement, CBCPGs, home improvements, and higher income - while the remaining three – lead by example, sustainability concerns, and other or previous solar experiences - may be identified as circumstantial. There frequencies are presented in Figure 4-4.

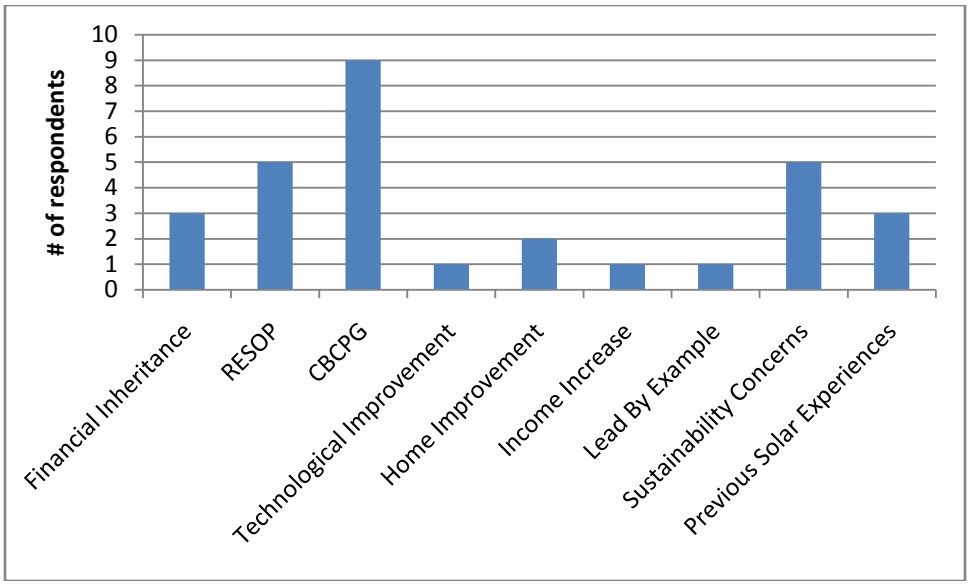


Figure 4-4 RESOP-participant catalysts for the purchase of a solar PV system (n=24)

The first specific-occurrence catalyst was the inheritance of finances. In one case, a family member donated money to the participant to aid in the purchase of the solar PV system. In the other two instances, inheritance came from a death in the family.

The RESOP was identified by five respondents as being the catalyst for their purchase. This was due to the financial assistance provided by the program.

The most frequent catalyst identified by participants was the creation and presence of a CBCPG in their community. Reasons attributed to this catalyst were the preparatory research actions taken by the CBCPG, reduction of the workload otherwise placed on the consumer, the reduction of price due to bulk purchase, and the support system present to deal with any questions or complications pertaining to the purchase and administration of a solar PV system and the RESOP, respectively.

One respondent noted that it was the improvement in technology that drove him/her to action. S/he stated that they had been following the technology for years and that, while prices had not sufficiently decreased, the improvement in module efficiency made the purchase sufficiently cost-effective.

Two respondents noted that home improvements provided the opportunity to act upon their beliefs. In one case, the participant was renovating an existing home, while in the other, the participant was building a new home.

Finally, one participant noted that an increase in their personal income provided him/her with an adequate amount of disposable income as to be able to afford the investment in a solar PV system. The participant suggested that, prior to his/her raise, the purchase of a solar PV system was unaffordable.

The first circumstantial catalyst, labeled as lead by example, came from a respondent who suggested that s/he had come to place value in acting upon one's values, as opposed to simply possessing them in dialogue and belief. In his/her opinion, the physical expression of values through action was equally important to possessing said values.

The second circumstantial catalyst arose from the adequacy of a rationale to produce action. This occurred in the case of sustainability related concerns, such as climate change and the desire to leave a suitable environment for their children. In both cases, participants did not identify any specific occurrence that drove them into action other than the rationale they had previously provided.

Thirdly, three respondents explained how previous experiences with either solar water heaters or off-grid solar PV systems are what provided them with adequate confidence and trust to go forward with the purchase of a solar PV system.

4.3.1.3 Role of the RESOP

While the above rationales and catalysts were explored with participants, the specific focus of the RESOP to this thesis required further exploration. The second objective laid out in this thesis has been to understand the influence of the RESOP on the adoption process. The most

obvious question stemming from this is whether or not the RESOP motivated an increase in the rate of adoption.

Though not asked directly, responses provided by participants enabled the researcher to describe which participants had installed a solar PV system prior to the existence of the RESOP. Ten of the 24 participants (42%) adopted their systems prior to the presence of the RESOP, later applying for the program. Of the 14 participants who adopted once the RESOP was in place, it was important to understand whether or not they would have adopted in the absence of the RESOP. If they would have done so, it would suggest that the RESOP, while utilized, did not instigate the adoption; the RESOP simply supported adopters.

When all 14 post-RESOP adoption participants were asked whether or not they would have purchased a solar PV system in the absence of the RESOP, five distinct answers were produced (Figure 4-5). The first two, and most straightforward, responses were yes and no. Of those participants who answered 'yes', a number provided further detail, suggesting that either a) they would have adopted, only they would have used the province's Net-Metering Program, or b) they would have adopted, but would have purchased fewer modules. One respondent provided a unique response, suggesting that s/he were simply unsure of what they would have done.

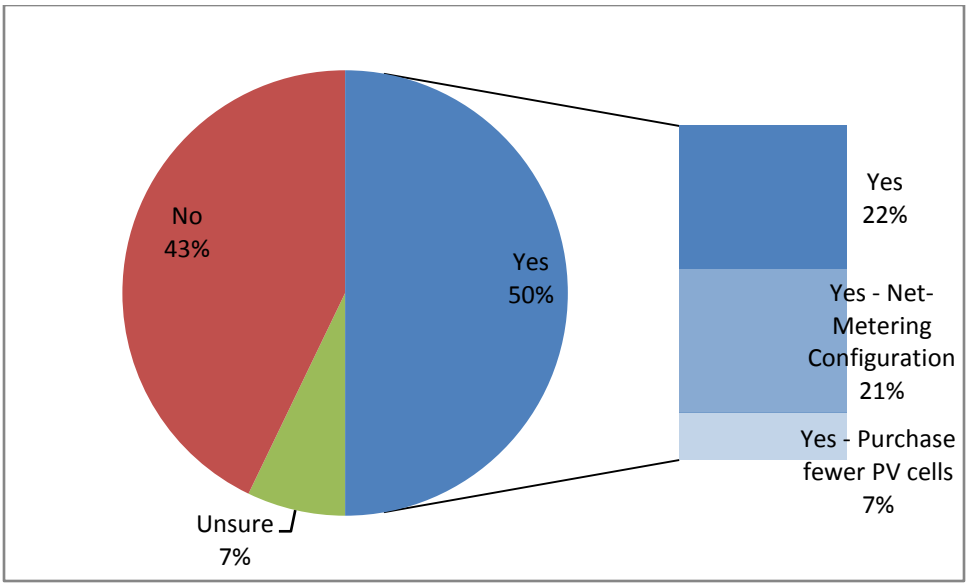


Figure 4-5 Frequency of responses to Q6 "Would you have purchased solar panels had the RESOP not been present?" (n=14)

4.3.1.4 Role of CBCPGs

It became apparent from the first interview in which a CBCPG had been utilized that their role in the adoption process might be influential. An important question that required answering was whether or not the CBCPGs had facilitated the purchase of solar PV systems by people who would have not otherwise adopted, or if they had simply helped to support determined purchasers.

Of the four CBCPGs utilized by study participants, one was inappropriate to compare to the other three in light of the nature of the group. Three of the groups provided a full investigation into the retailers used and helped to facilitate the adoption process, while the fourth group simply organized a discounted bulk purchase. In light of these differences, the single participant of this fourth group was not included in the two added questions.

In the Primary Interview Schedule, Question 6b asked “Would you have purchased solar panels had a CBCPG not been present?” Of the ten CBCPG participants who responded, nine stated that they would not have purchased a solar PV system had the CBCPG not been present to

reduce the costs and to help facilitate the adoption process.

When followed up with the question "If [co-operative] had been in place but the RESOP payback was not present, do you believe you would have purchased solar PV panels?" three unique answers emerged. Six participants stated that they would not have purchased, two stated that they would have, and one participant suggested that they were unsure (Figure 4-6). Only nine respondents answered this question (see section 3.5.2 for further explanation).

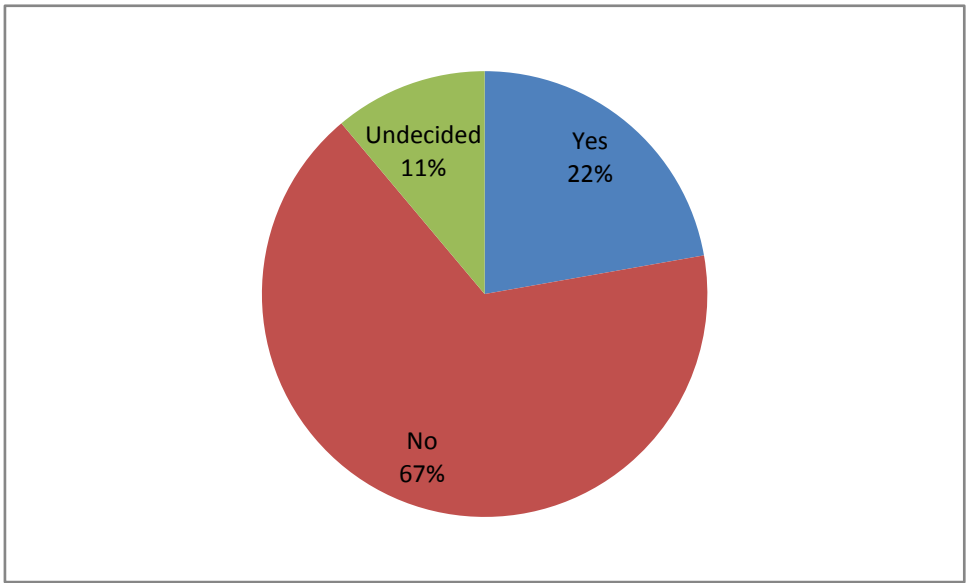


Figure 4-6 Frequency of CBCPG participants who would have adopted in the presence of a CBCPG and the absence of the RESOP (n=9)

4.3.2 Execution Phase Results: Consumer Experiences with the Adoption Process and the RESOP

The results presented thus far have addressed the consumer decision-making process up to the point of adoption. This section describes the experiences of participants throughout the actual uptake process, inclusive of the purchase and installation of the solar PV system itself, the acquisition of the Standard Offer Contract, and the connection to the grid. Section 4.3.2.1 presents the composition of actors that consumers interacted with throughout their adoption, including retailers, Local Distribution Companies (LDC), and Community-Based Co-operative Purchasing Groups (CBCPG).

Section 4.3.2.2 presents the range of experiences encountered by the consumer throughout this process, providing examples of the statements made pertaining to such experiences.

4.3.2.1 Actors and their Frequency of use by Consumers

The multiplicity of retailers, Local Distribution Companies (LDC), and community-based cooperative purchasing groups (CBCPG) meant that each consumer may have gone through the adoption process through a variety of paths (see Figure 4-10). Ultimately, the experiences of each consumer are dependent upon those interactions he or she encountered while adopting. In this section, the number and frequency of the primary actors encountered across the adoption process are presented.

Two retailers were prominent amongst those participants interviewed for the sale and installation of their PV systems (Figure 4-7). These two retailers (Pre-R1 and Pre-R2) are the same retailers interviewed in the preliminary interview stage of this research. While most – 20 of 24 – participants were willing to specify the retailer and installer they used in the confidence of the interview, four participants chose not to identify their retailer and installer.

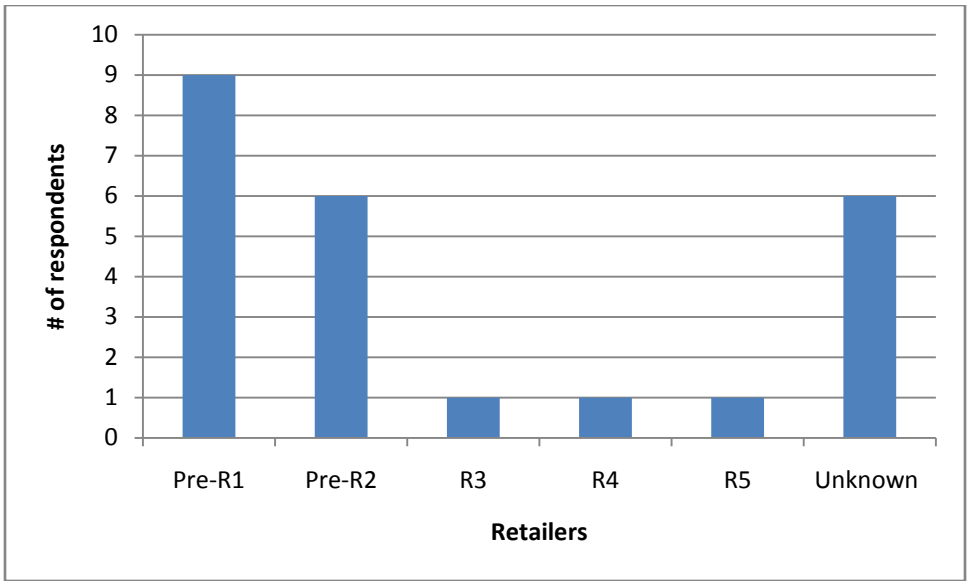


Figure 4-7 Frequency of consumers per retailer (n=24)

Geographically, participants were dispersed across the province, from southwestern Ontario to eastern Ontario. Such a distribution resulted in grid connections in the jurisdiction of nine different LDCs. Half of all connections fell under a single LDC. For the remaining grid connections, participants were typically the first, and often only, RESOP participant in their LDC's jurisdiction. Of the two LDCs interviewed in the preliminary interview phase (Pre-LDC1 and Pre-LDC2), neither served as host to any of the 24 participants.

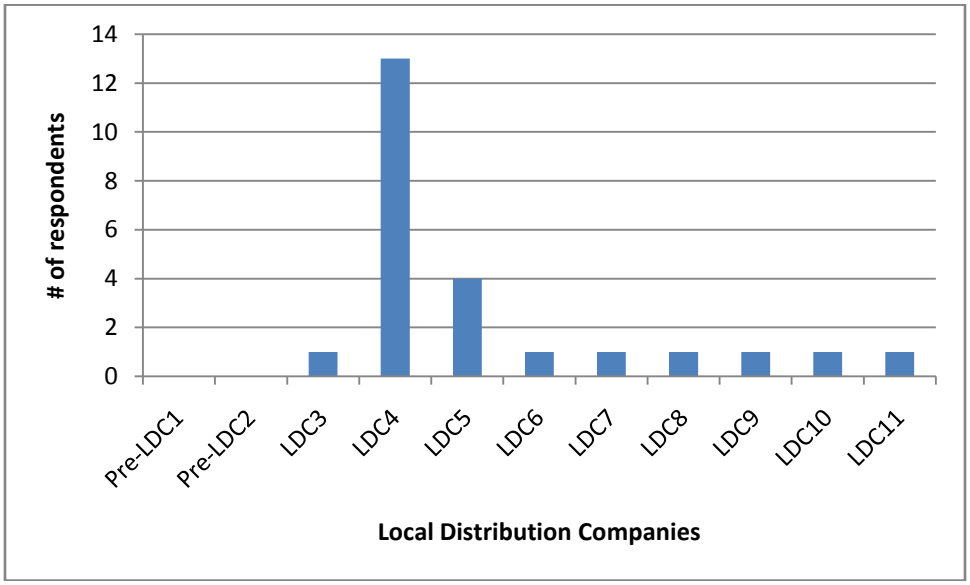


Figure 4-8 Frequency of consumers per LDC (n=24)

The third and final stage, though not necessarily the chronologically last in the adoption process, is the acquisition of a Standard Offer Contract. Acquisition of the contract is the only direct interaction with the Renewable Energy Standard Offer Program, although the requirement for solar PV systems to be grid-tied suggests that interaction with one's LDC is an indirect interaction with the RESOP. The bulk of the interaction with the RESOP is the filling out of the application and its associated documents, submission, and the confirmation of one's contract. To understand the consumer experience with the RESOP, it was first important to understand the degree to which consumers filled out the application. Among the interviewees, there were three degrees to which one may have filled out an application. The first, and most obvious, is to complete the application on one's own. Seven participants chose this path. Second, some participants filled out the majority of the application, but received assistance in one of two manners. In one case, a retailer provided a guideline document as well as an example of a completed RESOP application for its consumers to use. In the second case, consumers contracted their retailer and installer to aid them through the process. In total, seven participants received one of the two forms of assistance when completing the RESOP application process. Thirdly, consumers, other than signing the appropriate documents and providing the personal documentation required by the RESOP, may have contracted another party to fill in the entire application for them. Ten participants followed this path. The 'other party' who completed the application for the participant was one of two groups. First, many of the retailers completed the application as part of an installation package for its consumer. In the case of smaller retailers, the vender, installer, and RESOP administrative aide were all the same person. In the case of some of the larger retailers, it was the position of someone within that organization to specialize in and complete the SOC. I have defined the second group as Third Party Administrators (TPA)

– an independent business whose sole responsibility is the completion of the SOC. The sole TPA group contracted amongst interview participants charged a $300 fee for completion. Six participants used this TPA.

While the above figures and data have addressed the interactions required for the successful installation of a solar PV system under the RESOP, there is one other interaction that permeated the process. As noted in chapter 3 and section 4.1.3.4, Community-Based Co-operative Purchasing Groups (CBCPGs) facilitated the adoption process, from the selection of an appropriate vendor, to the completion of the SOC. Just over half (13 of 24) of the participants did not go through a CBCPG for their adoption, while the remaining 11 were spread across four different CBCPGs, one of whom had been interviewed in the preliminary interview stage (Figure 4-9). Ultimately, four different CBCPGs were utilized by study participants.

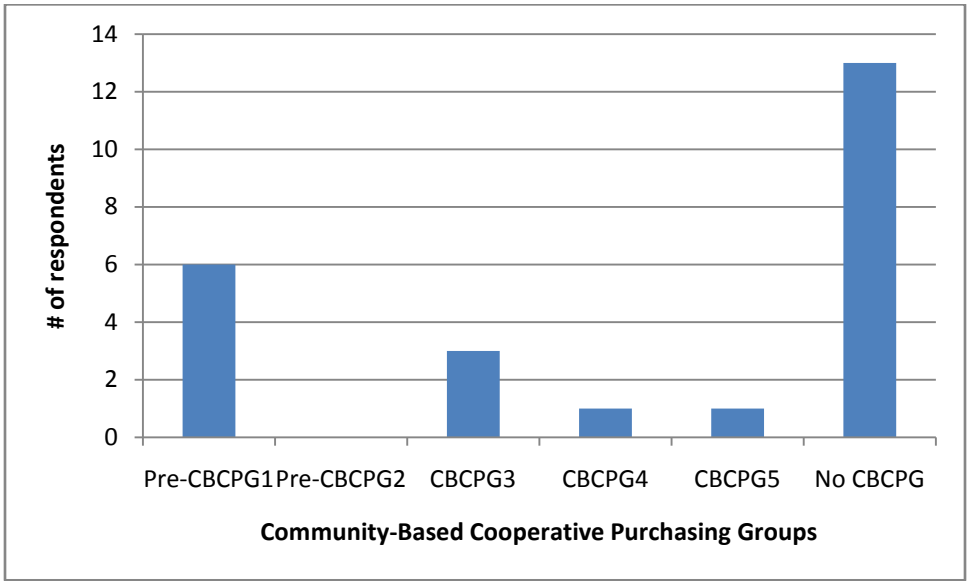


Figure 4-9 Frequency of consumers per CBCPG (n=24)

The above four figures (Figures 4-7 to 4-9) were presented so that, as the consumer experience across this process is now presented, one remains aware of the diversity and range of actors with which the consumer may have interacted. Figure 4-10 displays each primary

interview participant's adoption path across retailers and installers, LDCs, CBCPGs, and the RESOP application.

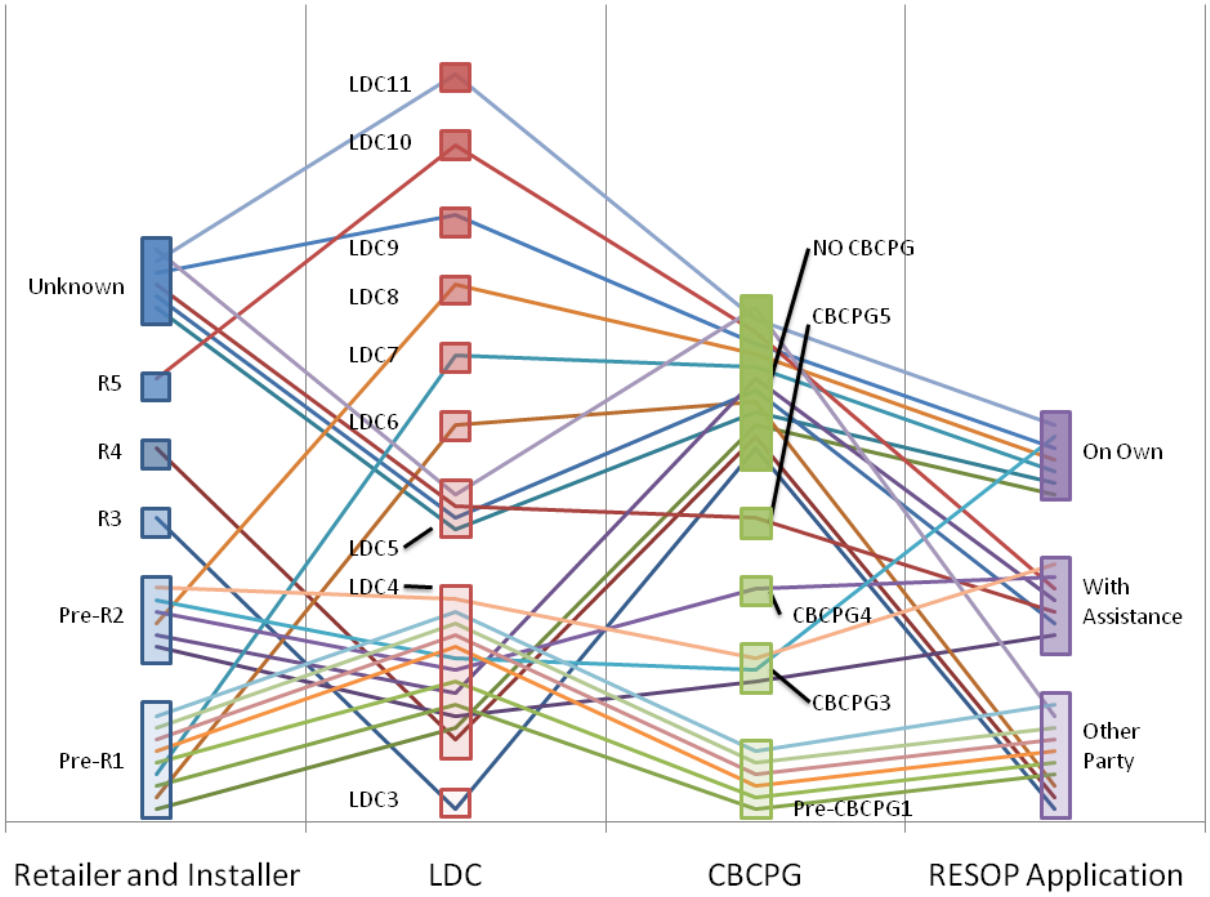


Figure 4-10 Execution Phase adoption aathways for 24 respondents

4.3.2.2 Rated Experiences

Consumers were asked to describe their experiences across the three stages of adoption in the execution phase. Experiences ranged from the negative to the positive, and have been categorized as positive, negative, or mixed (Tables 4.6 to 4.8). A positive experience corresponded with the absence of a negative statement by an interviewee and the presence of at least one positive statement. A negative experience corresponded with the exact opposite; the presence of at least one negative statement and the absence of a positive. In the middle of these two options is the mixed category, in which at least one positive comment and one negative

comment was presented.

Table 4.6 Examples of the consumer experience with the purchase and installation stage

Experience	Representative Quotation
1. Positive	"They … did a really fantastic, professional, clean, safe worksite." (RP-11)
2. Mixed	"Since we were so early, I don't think they even knew what they were doing." (RP-04)
3. Negative	"… it's the installer. My installer really screwed up." (RP-01)

Table 4.7 Examples of the consumer experience with the grid connection stage

Experience	Exemplary Quotation
1. Positive	"Getting them to actually come out, it was actually pretty good communication. In general, it was good." (RP-06)
2. Mixed	"Once [LDC] came online with this, everything was ok. But, for like 6 months, they didn't know what to do." (RP-08)
3. Negative	"The BS that we got from [LDC] … that was a real hassle. I left that with [installer]. If it had been up to me, I woulda washed my hands and walked away … I've heard other nightmare stories about them." (RP-02)

Table 4.8 Examples of the consumer experience with the Standard Offer Contract acquisition stage

Experience	Exemplary Quotation
1. Positive	"The OPA … they were pretty good." (RP-02)
2. Mixed	"It wasn't that it was bad, because [retailer] gave me a whole outline on what to fill out … Everything's on a timeframe. That's what kinda bugged me…a lot of paperwork." (RP-13)
3. Negative	"I ended up reading the instructions for hours and hours and hours … It was really just a case of bull shit. If the instructions were decent and all the people had their act together, it should be just a Saturday afternoon of work." (RP-11)

While one may suspect that the range of comments may have been broken down further, with greater nuances between the categories, respondent answers fell precisely into these categories. Participants at the ends of the scale literally had nothing but either positive or negative comments to express, while participants in the mixed category almost always balanced each of their positive or negative statements with one of the opposite polarity. One note of importance, in terms of the coding of responses, is that delays in any process were categorized as

negative.

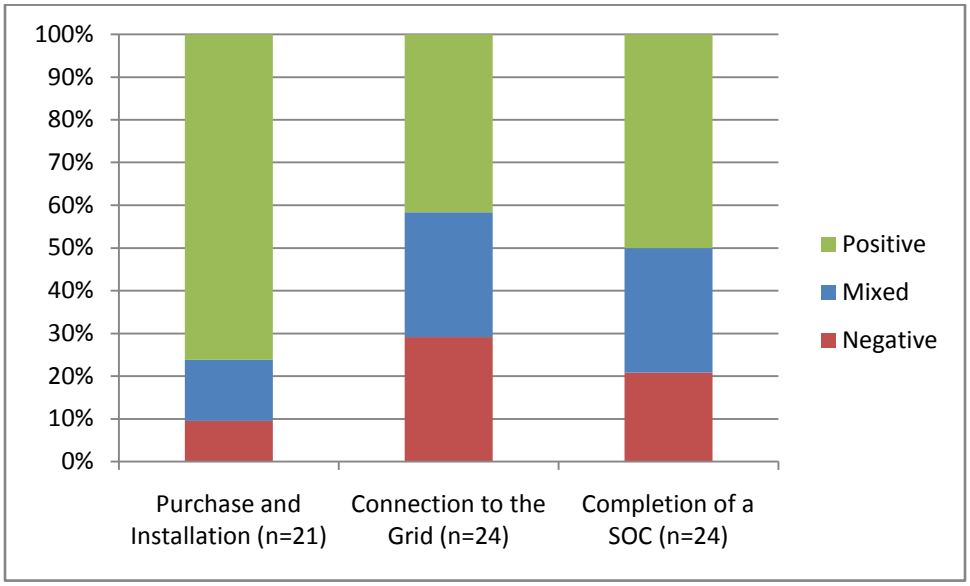


Figure 4-11 Impressions of the execution phase stages

A second note of importance is that, in Figure 4-11, the sample sizes for the connection to the grid and the SOC experience were all 24 participants, while the purchase and installation sample size was only 21 participants. The three participants missing were omitted because of their unique installation processes. All three participants assembled their own PV systems over several component purchases and installed them themselves. It has been assumed that the majority of adopters, based on the current technology and its complexity of installation, would not install systems on their own.

4.3.3 Operation Phase Results: Continued Interaction with the RESOP and Final Impressions of the Execution Phase

Results presented in this section describe the consumers' experiences with their solar PV system and the RESOP upon completion of the execution phase, as well as their final impressions of the execution phase adoption process. Section 4.3.3.1 presents the post-adoption experiences of consumers, highlighting three key patterns. Section 4.3.3.2 presents the range of

final impressions left with consumers after the adoption process, providing examples of the statements made pertaining to such experiences.

4.3.3.1 Post-Adoption Experiences

Once the solar PV systems were fully functional and consumers were receiving their payments from the OPA, respondents voiced few concerns pertaining to the RESOP's function. For example, a common comment amongst participants was that "Since it's been in, I haven't had any problems" (RP-02). The majority of issues emerged during the execution phase. It should be noted, however, that no question directly addressed the post-adoption experience of the consumer. Still, discussion pertaining to the continuing function of the program post-adoption consistently arose as respondents answered questions 5 and 7-13 (Figure 3-3). Upon coding and reviewing the data, three issues consistently arose that warrant mention.

The first issue pertained to billing and administrative fees charged to consumers on a monthly basis by their LDC. This issue was mentioned by seven participants, always with disdain. Although the billing rates vary across LDCs, typically between $10.00 and $15.00 per month, those respondents charged such a fee consistently noted their frustration. The following examples illuminate such discussions:

- "This is the bone I have to pick with the whole thing is the fact that we have to pay some sort of an administrative fee around the billing of the SOP. I mean I think that's terrible. It's expensive enough to install the panels." (RP-26)
- "It was the administration charges that came out of the blue … 12.95 every month … could wipe out everything you make throughout the winter … it's a bit of a cheat … in other words they're ripping us off." (RP-25)
- "There are a lot of problems with the program. They're charging us a monthly fee for the

delivery, but it's 11.25 a month. In all of the forms and paperwork I've had to complete there was no mention of this most basic thing." (RP-14)

- "Specific issues is administrative charges, which are clawing back in excess of 25% of the credit I'm generating for generating power. That's a huge problem." (RP-17)
- "It seems to me that in the winter time … we'll have a net loss … and it seems to me a disincentive." (RP-22)

A second outcome noted by five participants was a willingness to use their homes as demonstration projects for promotion of the program for other interested parties. When mentioning such points, respondents were always positive and spoke of their willingness with a sense of pride. Respondents noted how their experiences have been publicized through media stories, both on the radio and in the newspaper, and that their homes had been the focus of special "green days" in their community. Two of the participants also noted that they posted a sign advertising their retailer on their lawns.

Thirdly, three respondents also explicitly noted that an increase in the payback rate would create a greater incentive for adoption.

4.3.3.2 The Impact of Word-of-Mouth and Social Influence

Towards the conclusion of their interviews, respondents were asked whether or not they would recommend the purchase of a solar PV system or the use of the RESOP to do so (Figure 3-3, questions 10 and 11). The purpose of such questions was to provide an overall impression of both the installation and RESOP processes, as well as to probe the relationship between consumer experiences and their influence on the decision of potential future adopters.

The question was designed to be closed-ended in terms of a yes-or-no answer, though open-ended with the intent of allowing description of why such would be the case. Participants

provided distinct yes and no answers, as opposed to something neutral, such as "maybe" or "I don't know."

Of the 21 respondents, 18 suggested that they would recommend a solar PV system, while three clearly stated that they would not (Table 4.9). Three respondents were not posed this question in light of interview time constraints.

Table 4.9 Sample responses to question 10 "Would you recommend purchasing a solar PV system?"

Recommendation	Sample Examples
Yes, I would recommend the purchase of a solar PV system.	"Would definitely." (RP-01) "If you really want to do it, then definitely go for it." (RP-09) "If you've got the money, go for it. This is what you can do to reduce the carbon footprint of our society." (RP-11) "I would tell them that we were very satisfied with this and we think it's a good thing to do both for the environment and as an investment in the future, that it's financially … economically viable." (RP-22) "Yes, definitely. Especially if it's a collaborative initiative." (RP-23) "If you can afford it and you're interested in doing it … we'd say yes." (RP-25) "My advice would certainly be to do it through an initiative happening in their area." (RP-26)
No, I would not recommend the purchase of a solar PV system.	"So, we put them up with the idea that we'd get other people going on them too, but now I can't tell anyone about it. Who are you gonna suggest you get that when … it's going to turn people off about doing anything about the environmental problems we have." (RP05) "No, but not because of the paperwork, but because of the [additional] cost of it." (RP-08) "I wish I had nothing to do with this. Why am I doing this?" (RP-10)

Similar to question 10, question 11 asked whether or not participants would recommend using the RESOP when purchasing a solar PV system. The reader should bear in mind that one alternative to the use of the RESOP would be participation in the Net-Metering Program.

Table 4.10 Examples of responses to question 11 "Would you recommend using the RESOP?"

Recommendation	Representative Examples
Yes, I would recommend participation in the RESOP.	"This seems to be working very well … They're paying me 42 cents per kilowatt hour." (RP-02) "I'd recommend it because it decreases your payback." (RP-07) "The RESOP program has a much better return." (RP-15)
Depends.	"Depends on how large the system is." (RP-06)
No, I would not recommend participation in the RESOP.	"If anyone were to ask me ahead of time I would say no, I wouldn't have done this." (RP-08) "It's not enough to announce programs. You gotta have people on the ground who are advocating for it." (RP-10) "I would never sign up for the Standard Offer Program. Ever. I wouldn't recommend it to anyone. It's too painful." (RP-14) "I wouldn't … I would tell them not to count on it." (RP-24)

Unlike question 10, alongside the distinct yes and no responses, one respondent noted that his/her recommendation would be dependent on the size of the system being installed. The difference noted by this participant was that certain sizes may make more sense to participate in the Net-Metering Program, where across an undefined threshold, the RESOP would become the better option.

Two respondents were not asked this question in light of time constraints during the interviews. Of the 21 respondents who did respond, only 16 suggested that they would advise a potential consumer to utilize the RESOP (Figure 4-12).

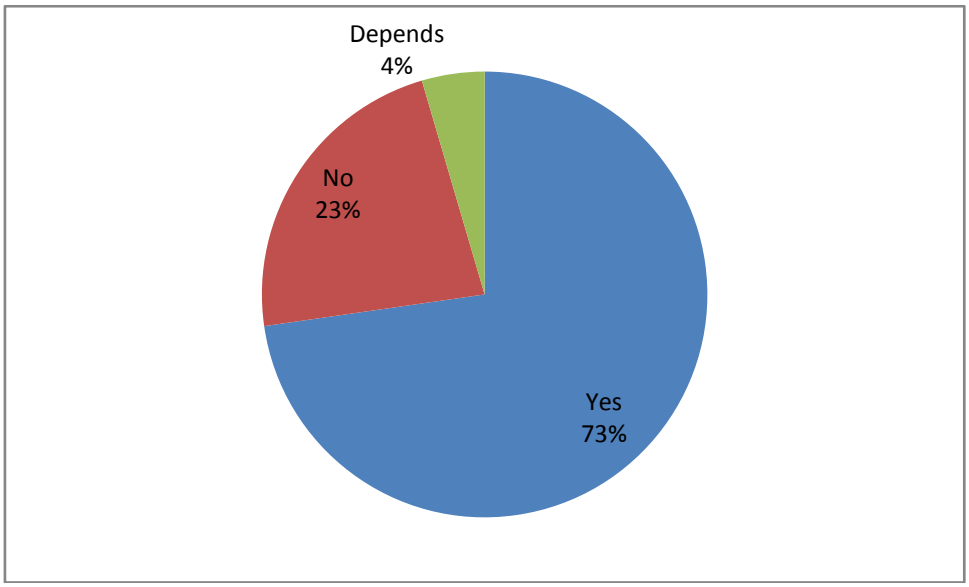


Figure 4-12 Frequency of responses to Q11 "Would you recommend using the RESOP?" (n=21)

4.4 Summary

In this chapter, the data collected during the nine preliminary and 24 primary interviews have been presented in a summarized format.

Results of the preliminary interview stage have served two purposes. First, in light of the exploratory nature of the preliminary interviews, results were used to inform the scope and design of the primary interview phase methods. Second, participant responses have provided insight to the central questions posed by this thesis (see section 1.2). The analysis of these data is presented in chapter 5, wherein linkages between participant responses and their implications with respect to the RESOP-integrated adoption process are made explicitly.

Primary interviews results comprise the bulk of the data collected for this thesis. Primary interviewees were able to provide information pertaining to all aspects of the RESOP-integrated adoption process, spanning each of the planning, execution, and operational phases. Since the data collected from the primary interviews are drawn from first-hand experiences with the RESOP, they provide the greatest descriptive and explanatory capacity. These data are the primary focus of analysis in chapter 5.

5 Research Findings

5.1 Introduction

This chapter discusses the findings of this research, which sought to identify and describe the factors that promote and inhibit the utilization of the RESOP for the adoption of a microgenerating, residential solar PV system. Findings have been drawn from the observations presented in chapter 4, as well as from other primary data collected during both interview stages, introduced here as necessary.

In chapter 4, results were presented primarily as structures, frequencies, and magnitudes.[10] In this chapter, those data are analyzed in order to extract more information and to enrich our understanding. Section 5.2 addresses the observations of the planning phase in the adoption process. Analysis across all data sets (i.e. the literature review, preliminary interviews, and primary interviews) identifies which factors are present in Ontario, and the prominence with which they have arisen in the decision-making processes of this study's sample. With respect to the execution phase of adoption, section 5.3 takes the experiences reported by participants and cross references them with the parties (i.e. retailers, Local Distribution Companies, Community-Based Co-operative Purchasing Groups) with whom participants interacted in order to provide further description. Finally, section 5.4 looks at the results of the operating phase, focusing on the recommendations made by participants with respect to solar PV system adoption and the use of the RESOP in order to understand how this sample's experiences may influence future adopters.

[10] According to Lofland and Lofland (1995) (cited in Babbie, 2007), structures describe different types or categories of variables, magnitudes describes the levels of a variable (referred to as prominence in chapter 4), and frequencies describe how often a variable presents.

5.2 Planning Phase

This section analyzes the data presented in section 4.3.2. Section 5.2.1 identifies which drivers and barriers are present in the case of Ontario. Those drivers and barriers identified in the primary interview stage that are most noteworthy are discussed in section 5.2.2. Two of the most prevalent influences on the consumer's decision to adopt a solar PV system, the Renewable Energy Standard Offer Program (RESOP) and Community-Based Co-operative Purchasing Groups (CBCPG), are discussed in section 5.2.3. Finally, section 5.2.4 addresses this study's results with respect to those present in the literature to draw further insights.

5.2.1 Driver and Barrier Structures: Scope and Presence

The identification of drivers of and barriers to the RESOP-integrated adoption of a solar PV system occurred in three stages: a literature review, preliminary interviews, and primary interviews. Each stage produced its own set of factors, some of which overlapped across the stages, others of which were unique to a given stage and approach (Table 5.1). Consulting all three sources of data, one is able to assess which drivers and barriers are present amongst this study's participants.

Table 5.1 Drivers and barriers identified across the Literature Review, Preliminary Interviews, and Primary Interviews

	Literature review	Preliminary interview observations	Primary interview observations
Monetary	Cost and payback period	Cost and payback	Cost and payback
		Financial assistance	
		Unexpected costs/monthly fee	Unexpected costs/monthly fee
			Money generation
			Investment
	Alternative energy sources and associated pricing		
	Economic support and job creation		Support the economy
Social	Consumer perception and value	Understanding of technology	
		Technological fascination	Technological fascination
		Previous experience	Previous experience
		Joy of generating	Joy of generating
		Lead by example	Lead by example
	Social Influence	Professional advice	
		Other consumer experiences	
			Education and awareness
			Familial culture
		Political leadership	Political leadership
		Political legitimization	
			Policy support
			Political statement
	Sustainability concerns	Sustainability concerns	Sustainability concerns
Institutional	Poorly articulated demand	Policy uncertainty	
	Presence and adequacy of laws, regulations, and policy tools	Program awareness	Presence of a program
		Program ramifications	
	Awareness and availability of program information	Administrative assistance/CBCPGs	Administrative assistance
	Administrative processes	Installation delays	
		Cooperation of LDC	Program administration
		Administrative requirements	
	Administrative capacity and institutional connectivity		
Technological	Technical feasibility	Technical configuration	Technical configuration
		Home ownership	
		Reliability	Reliability/maintenance
		Adequate roofing	
	Technological viability		Technological risk
			Backup power

Environmental	Natural capital and site suitability		Solar exposure

In chapter 2, five factor categories and 14 factors were identified within the literature. Twenty-four factors were identified in the preliminary interview stage, while 21 were identified as present by primary interview participants. Of the factors identified in both interview sets, no factor was so novel as to be unidentified, to some degree, elsewhere in the literature. This result suggests that the scope of drivers and barriers identified thus far in the literature has been adequate in describing the general system parameters of the adoption process; at least the Ontario experience investigated here has not challenged that. Conversely, results also demonstrate that only a subset of those factors identified within the literature will be present in a given case study, as is the case in Ontario. This suggests that one must take into account context specificity when attempting to identify which factors are present for any given case study.

Participants in the preliminary interview stage identified a number of factors which then later failed to be present amongst primary interview participants (e.g. professional advice, program awareness). While this could be perceived as undermining the expertise of key informants, preliminary interview responses given should not be entirely disregarded. It may be the case that those factors identified by preliminary participants exist within the greater population (i.e. adopters and non-adopters), but failed to be present in the sample obtained for the primary interviews. For example, the lack of understanding of the technological nature of solar PV systems was identified as a potential barrier, though it never arose within the primary interview set. There are two plausible explanations for this absence.

The first explanation is that the responses produced by participants, whether in the preliminary or primary stage, were inaccurate. Inaccuracy may have arisen for multiple reasons: because participants were unable to accurately reflect upon their own decision-making process, or that of others; because they desired to appear knowledgeable or to provide the interviewer with what they believed the interviewer wanted to hear; or because the identification or self awareness of drivers and barriers by the participants themselves might not be evident – for example, despite not having known much about solar PV technology, participants may not have considered this ignorance to be a barrier.

The second explanation for the absence of a factor in the primary interview stage is due to the differences in samples drawn. The primary interview sample may not have been sufficiently large to capture each of the factors present in the preliminary stage; the absence of factors in the final stage may have been a case of sampling error.

Alternatively, the range of participant experiences discussed by participants in each interview stage differed. Participants in the preliminary stage of research were asked to speak about their experience with *both adopters and non-adopters*, while primary participants, comprising only a subset of this population, the adopters, spoke of their own experience. Thus, while a factor identified by a preliminary interview participant may not have emerged within the primary interview data set, it may be present within the non-adopter population.

Primarily for these reasons, absence in the primary interview stage is inadequate in ruling out the presence of a factor in either the RESOP-participant or the greater Ontario population. Combining both the preliminary and primary interview data sets, 34 factors can be assumed potentially present in the RESOP-integrated adoption process in Ontario, 21 of which have been empirically demonstrated.

5.2.2 Driver and Barrier Frequency and Magnitude: Prominence

This thesis not only identified the presence or absence of drivers and barriers in the case of Ontario, it also sought to identify the prominence of those factors present. One is able to gauge the magnitude and prevalence of decision-making factors using three indicators: i) salience, ii) stated significance, and iii) identified catalysts.

The first indicator, salience, assumes that an unprompted answer implies that a response is important. Thus, when question 4 of the primary interview schedule was asked in its open-ended form "What would you suggest were the most significant factors affecting your decision?", the responses given, unprompted, have been assumed to play a greater role in the decision-making process.[11]

Table 4.4 reveals three prominent factors. First, concerns pertaining to sustainability were the most commonly identified factor by participants both overall (24) and in terms of being unprompted (22). All but one participant explicitly noted that a concern pertaining to a sustainable future was influential in their decision to adopt.

The most common barrier identified, both overall and unprompted, was the concern for the high cost and lengthy payback of the solar PV systems. Eleven responses were unprompted, while six were prompted. Three participants, however, found cost and payback to be neither a driver nor a barrier and one participant found the cost of the system to be a driver.

Thirdly, the reliability and low maintenance requirements of the technology itself presented as a considered driver in half (12) of the interviews. Eleven of these responses were prompted, suggesting that such a consideration, while relatively common across participants, was a minor influence within participants' own decision-making process.

[11] As noted in 4.3.1.1, however, an unprompted answer did not infer prominence from the perspective of every respondent. In only one case, a participant stated, without prompt, that money was not a significant factor for them.

While salience has been used as an indicator, one is also able to gauge prominence based on its explicit identification by participants. Figure 4-3 displayed the frequencies of stated prominence, demonstrating results similar to those of salience. Again, cost and payback and sustainability criteria were the only factors considered to be of any significance. One should also note the greater prevalence of sustainability concerns over those of cost and payback, both with respect to the individual categories, general and 'most' prominence, and in terms of cumulative noted prominence.

While the reliability and low maintenance requirements of the technology were identified by half of the participants as influential, in terms of prominence, only one participant suggested that this was a major factor influencing their decision. This is not unexpected, however, since it was identified that the majority of responses related to this factor were prompted, and thus most likely not prominent.

A third indicator measuring the prominence of a factor's influence was its role as a catalyst. Whereas results from the two previous indicators suggest that sustainability and monetary concerns have been the most prevalent and prominent factors, with respect to the catalyst, a third factor, the presence of a CBCPG, emerges in greater frequency than the next two most prevalent catalysts, financial assistance and personal values.

The catalyst most frequently identified by participants was the presence of a CBCPG. Nine of the 24 participants (38%) noted that it was the creation of a CBCPG that actually propelled them to act upon their thoughts and values. Aspects of the CBCPGs that incited a reaction by participants included the reduction in system price due to bulk purchase, previous research into the technology and the retailers, administrative support in completing any required

applications, the trusted leadership of a member in the community, and the value of community-based projects.

One explanation for the presence of CBCPGs as catalysts and not as a rationale-type factor may relate to methodological limitations. For example, the role of the CBCPG may have been inadequately prompted in question 4 (Figure 3-3) of the primary interviews, reducing or eliminating the opportunity for respondents to note the prominence of a CBCPG to their purchase.

A second explanation is in relation to the point at which participants realized the importance of elements of the adoption process. While participants did not consider the presence of a CBCPG to be of a large magnitude at the outset of their decision to adopt, upon completing the adoption process and reflecting upon their experiences, the importance of the role which the CBCPGs played had become apparent. For this reason, despite their prevalence as a catalyst, when asked about the original decision to adopt, we do not see a strong presence of the CBCPG as a factor. This finding suggests that CBCPGs were undervalued at the outset of these initial adoptions.

Three of the catalysts identified, financial inheritance, the RESOP, and the increase in income have been jointly characterized as financial assistance since their influence as a catalyst was to make the purchase of a solar PV system affordable. For one participant, financial inheritance and the RESOP were both considered to be the joint catalyst for their decision. Therefore, eight participants were ultimately motivated into action by monetary concerns. When amalgamated, financial assistance catalysts nearly equal CBCPGs in terms of prevalence.

Finally, six participants, five concerned with a sustainable future and one motivated to act upon their beliefs, were sufficiently motivated by their values to proceed to action.

Whereas the debate in the first two indicators was primarily between sustainability and monetary concerns, with a slight edge towards sustainability, analysis of the catalysts present suggests that the presence of a CBCPG, for the reasons previously cited, also plays a prominent role. No attempt has been made to amalgamate these three indicators into a single ranking, as the complexity of the decision-making process and the unique nature of each indicator and each decision would make any such attempt arbitrary.

Ultimately, within this sample, concerns pertaining to sustainability and money ruled the initial decision of participants. Upon reflection, however, the presence of a CBCPG has been shown to be the most frequently cited catalyst for the adoption of a solar PV system, although both sustainability and money remained influential as catalysts.

5.2.3 Roles of the Renewable Energy Standard Offer Program and Community-Based Co-operative Purchasing Groups

Of the 24 participants in the primary sample, ten participants purchased and installed their solar PV systems prior to the creation and implementation of the RESOP, demonstrating that the RESOP had no influence over their original decision. Of the remaining 14 participants, seven stated that they would have purchased a solar PV system had the RESOP not been present, while one participant suggested that they were unsure whether or not they would have purchased. The remaining six participants noted that they would not have purchased a solar PV system had the RESOP not been present, five of whom noted that the RESOP was the catalyst for their action. Therefore, the RESOP can only be said to have played a definitive role in influencing six consumers (25%) to adopt, with the potential of a seventh adopter.

With respect to the use of a CBCPG, of the 11 participants who utilized their services, nine identified their CBCPG as the catalyst for their adoption. Nine of ten CBCPG-associated

participants,[12] when asked whether or not they would have undertaken the adoption process in the absence of a CBCPG, responded that they would have not.

The use of a CBCPG implicitly meant that participants would also be utilizing the RESOP, as this was part of the adoption process presented by the CBCPGs. In theory, the incorporation of the RESOP in the CBCPG may have been masking the reason why so many participants were strong advocates for the use of a CBCPG. To clarify the relationship between the use of the RESOP and a CBCPG, question 6c was incorporated: "If [co-operative] had been in place but the RESOP payback was not present, do you believe you would have purchased solar PV panels?"

Results demonstrate that the presence of the RESOP is closely correlated with the presence of a CBCPG. Of the 11 participants who adopted through a CBCPG, nine stated that they would not have adopted in the absence of a CBCPG; seven of these nine noted that, not only did they require the presence of their CBCPG to adopt, but that the RESOP needed to be present as well. Stated otherwise, only two of ten participants would have purchased a solar PV system through a CBCPG in the absence of the RESOP.

It must also be acknowledged that the RESOP played an indirect role in inciting action. In the preliminary interview stage, respondent Pre-CBCPG1 noted that the RESOP was the catalyst for the creation of the CBCPG. Therefore, while it may have been the CBCPG, as opposed to the RESOP, that more frequently prompted consumers into action, the existence of some CBCPGs was predicated upon the presence of the RESOP.

[12] See section 4.3.2.1 for an explanation of why only ten participants were asked this question when 11 participants utilized a CBCPG.

5.2.4 Findings and the Literature

Four factors have emerged from this study's sample as being of prominence to the decision to adopt a solar PV system: i) sustainability, ii) money, iii) CBCPGs, and iv) the RESOP. As noted in chapter 2, monetary (e.g. Bradford, 2006; Faiers et al., 2006; Jacobsson et al., 2000) and institutional (e.g. del Rio et al., 2007) factors have been identified in the literature as two of the leading explanations for the hindrance of solar PV system diffusion. For this reason, it is unsurprising that money (i.e. high initial capital cost and lengthy payback periods) and institutional support (CBCPGs and the RESOP) were found to be of considerable prominence in the decision-making process of this study's sample participants. It is the prominence of social factors in the presence of such other considerations that is revealing and unique to this study. While each study referenced thus far fills a unique role within the literature and the greater understanding of drivers and barriers on a whole, no work has presented a case study that i) is from the perspective of the consumer, ii) where a wide range of factors have been considered and compared (with monetary, social, and institutional factors emerging as the predominant factors influencing the consumer decision), and iii) where a single social factor, concerns pertaining to sustainability, were sufficient in overcoming the presence of other barrier(s), resulting in the adoption of a solar PV system.

Concerns over sustainability have been found to be of importance in emerging research out of Sweden. Tengvard and Palm (2009), in studying household motivations for the adoption of residential solar PV systems, found that the most prominent factors for adoption were those that would be characterized under this thesis's coding process as being related to sustainability. Specifically, Tengvard and Palm's (2009) results identified five sustainability related criteria as motivating the decision to adopt: i) concern for the environment (identified in their paper as

being the most important), ii) producing one's own electricity as a way to act, iii) harmonization with one's lifestyle, iv) as a symbolic act, and v) independence and self-sufficiency. While this thesis's study sample restricts the generalization of its results, Tengvard and Palm's research findings support those present in this thesis - namely that there exists some set of the broader population who are most concerned with acting out of values for sustainability rather than out of any of the other factors considered.

5.3 Execution Phase

Section 4.3.2 presented data pertaining to the three steps of the execution phase of the RESOP-integrated adoption process. Results demonstrated a variety of experiences, ranging from positive to negative, across the stages of adoption. The installation process was the most positively experienced step of the three – producing the most positive experiences, and the least mixed and negative experiences – while connection to the grid was the most negative – demonstrating the greatest number of negative and mixed experiences.

For analytic purposes, it is of use to understand the range of experiences presented across participants within each stage in order to discover any causal relationships or correlations. Such an analysis may provide further depth to the data and a richer depiction of the experiences. Sections 5.3.1, 5.3.2, and 5.3.3 address each of the execution phase stage experiences, purchase and installation, the acquisition of an SOC, and connection to the grid, respectively.

5.3.1 Purchase and Installation

Of the 21 respondents willing to discuss their experience purchasing and installing their solar PV system, two participants (10%) expressed a negative experience, three participants (14%) expressed a mixed experience, and 16 participants (76%) expressed a positive experience.

Both negative and one of the three mixed experiences came from participants who used retailer Pre-R2. One participant, RP-05, was discouraged by what he/she perceived to be misinformation provided by the retailer. Upon installation, RP-05 was left to believe that he/she was connected to the grid and generating electricity that would be compensated by the RESOP; this was not the case. For the first three months of ownership, the participant's solar PV system was neither connected to the grid, nor registered under the RESOP. Participant RP-18, who voiced the second negative experience, encountered a number of complications and disappointments with retailer Pre-R2, including roofing damage and the feeling that he/she had been mislead with regards to the complexity and uncertainty of the adoption process.

The mixed experience by RP-13 was related to the length of time required for the retailer to install the panels. Other than the delay, however, RP-13 was satisfied with the installation process. The remaining three experiences with this retailer were positive.

Interaction with retailer Pre-R1 produced eight positive and one mixed experience. The respondent whose experience was mixed stated that his/her installation went fairly smoothly, though he/she expected a more knowledgeable retailer. At the outset of the installation, the retailer was unsure about how to install the panels on the type of roof that the participant had. The installation ended up requiring some minor home renovations for the system to be functional. Ultimately, the participant was not upset about the renovation required, so much as the inexperience of the retailer.

The remaining six interactions with retailers, consisting of one mixed and five positive experiences, demonstrated no repetition amongst retailers. The mixed result came from retailer R3. R3 was described by the respondent as having dealt primarily with off-grid connections in the past. While the respondent was generally pleased with the final installation, the different

issues associated with a grid-tied system posed a challenge for the installer during installation. Of the remaining five positive experiences, retailers were identified as being fairly small operations – two of the retailers were identified by name, while the remaining three were not identified.[13]

Due to the infancy of the adoption process, it was hypothesized that the negative experiences might be related to when the installations were performed. With respect to the six experiences with Pre-R2, the two negative experiences occurred during the first two installations. Similarly, the most negative experience (in this case, a mixed experience) with retailer Pre-R1 occurred during the first installation. Furthermore, across all participants, each of the relatively negative experiences occurred prior to the implementation of the RESOP. This trend, though only amongst six participants, suggests improvement by the retailers, in terms of his/her installation process, across time.

5.3.2 Acquisition of a SOC

The distribution of experiences when acquiring a SOC was slightly more skewed towards the negative in comparison to the purchase and installation process, though more positive than the process of connecting to the grid. Twelve respondents expressed a positive experience, while seven described a mixed impression, and five negative. As noted in section 0, there were three manners by which a consumer could have completed the RESOP application process to acquire a SOC (i.e. on one's own, with assistance, and not at all). When one cross tabulates these two variables, the result is Figure 5-1.

[13] During the primary interviews, respondents were presented with the opportunity to voluntarily identify their retailers. In certain cases, respondents were willing, while in others, respondents preferred to keep the retailer they used anonymous.

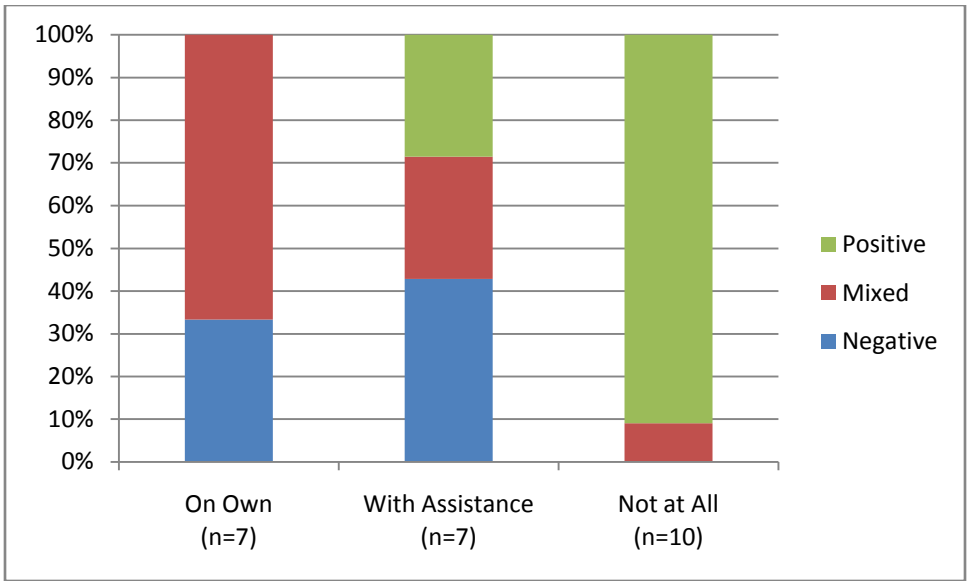


Figure 5-1 Relationship between the experience of acquiring an SOC and the degree to which participants completed the administrative process

Negative experiences when acquiring a SOC were isolated to those consumers who either completed the RESOP application entirely on their own, or with assistance. Positive experiences, on the other hand, were only experienced by those consumers who either had another party complete their application for them, or received some administrative assistance. Mixed experiences were found in all three categories. Using these indicators, it is evident that the less which one directly interacted with the RESOP, the more likely their experience was to be positive.

Every participant, with one exception, who contracted his/her installer or a Third Party Administrator (TPA) to complete the SOC process for them was content with the RESOP administrative process (the "not at all" category of Figure 5-1). The exception, a participant who used a TPA, was categorized as mixed because, despite predominantly positive comments, they noted mild frustration with the length of time which it took to acquire their contract. It was unclear, however, whether the lengthy processing time was due to a delay in the application by the TPA, or a processing delay by the OPA.

When receiving assistance with the RESOP process, experiences spanned all three categories. Four participants were assisted by Pre-R2, who provided its customers with a guide to complete the SOC process, which, while well-intentioned, was found to be inadequate by consumers; one consumer had a positive experience, one had a mixed experience, and two had negative experiences. The negative responses stemmed from the lack of support provided by the retailer and what they felt to be the cumbersome process required to complete the RESOP application process. Chronologically, a trend emerged across these four experiences, with negative experiences being reported by those participants who were the earliest to adopt, and the most positive experience being the most recent.

Of the six participants who completed the RESOP on their own, no experience was positive: four were mixed and two were negative (Table 5.2). Both participants frustrated by the RESOP process found the amount of paperwork and 'red tape' frustrating, with RP-14 describing it as a "very tedious, very bureaucratic … a very challenging process." Similarly, the four mixed experience participants found the application process to be cumbersome, though were less discouraged and more understanding. Further details are provided in Table 5.2.

Table 5.2 Mixed experience quotations of respondents who completed the RESOP application on their own

Respondent	Quote
RP-06	"It did take some time … the actual approval of the SOP was done quite quickly … that happened within a month"
RP-13	"It wasn't that it was bad, because [retailer] gave me a whole outline on what to do, what to fill out … so that's not that bad, but of course I got things wrong, and then they send things back to me. Everything's on a timeframe. That's what kinda bugged me. 'Here's your application back, you must have it back within 5 to 10 business days.' So then they send you a contract and it's like, 'we recommend you get a lawyer involved,' and I'm like 'this system's on the roof. It's set ready to go. Let's get this thing on and get producing.' That's the way I look at it, where it's funny how those guys are kinda like 'no, the paperwork and the paperwork and the paperwork'… a lot of paperwork."
RP-18	"Then there was a bunch of paperwork to accept me. Like I had to fill out a form online, which they then approved me and sent me some contract I had to sign and send back to them within two weeks. This was over the holidays … Then it was quite some time until [LDC] started paying me … but they did back date payment."
RP-21	"[The RESOP application] was fine. The one issue I phoned and followed up. I didn't realize there was a form I had to follow up, so when I phoned and checked on the status of my application, they were like 'oh you're missing an application' and I was like, 'ok, why wouldn't anyone calling me back and tell me a piece of my application was incomplete'."

5.3.3 Grid Connection

Of the three steps in the execution phase, grid connection proved to be the most challenging for consumers, with ten positive, seven mixed, and seven negative experiences. Again, experiences varied across Local Distribution Companies (LDC) (Figure 5-2).

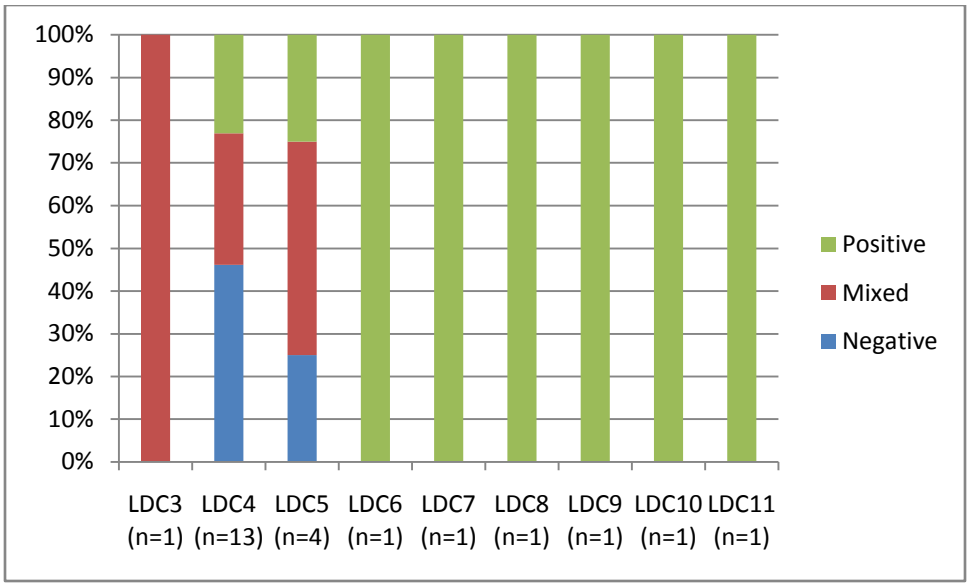


Figure 5-2 Consumer experiences across Local Distribution Companies

The seven negative experiences were in relation to only two LDCs, both of which had completed the most grid connections. Within the interview data, there is no explicit explanation for this relationship.

Based on the chronological trends demonstrated in the previous two stages, the dates of grid connection were analyzed for LDC4. Figure 5-3 depicts the 13 consumer experiences with LDC4, arranged in sequential order with respect to the time of grid connection.[14] Unlike previous chronologies, no pattern emerged amongst these experiences with respect to the date of grid connection. Experiences were evenly distributed from the first to the most recent connection.

[14] The data have been arranged with respect to sequential order, as opposed to the actual dates, to retain the anonymity of participants.

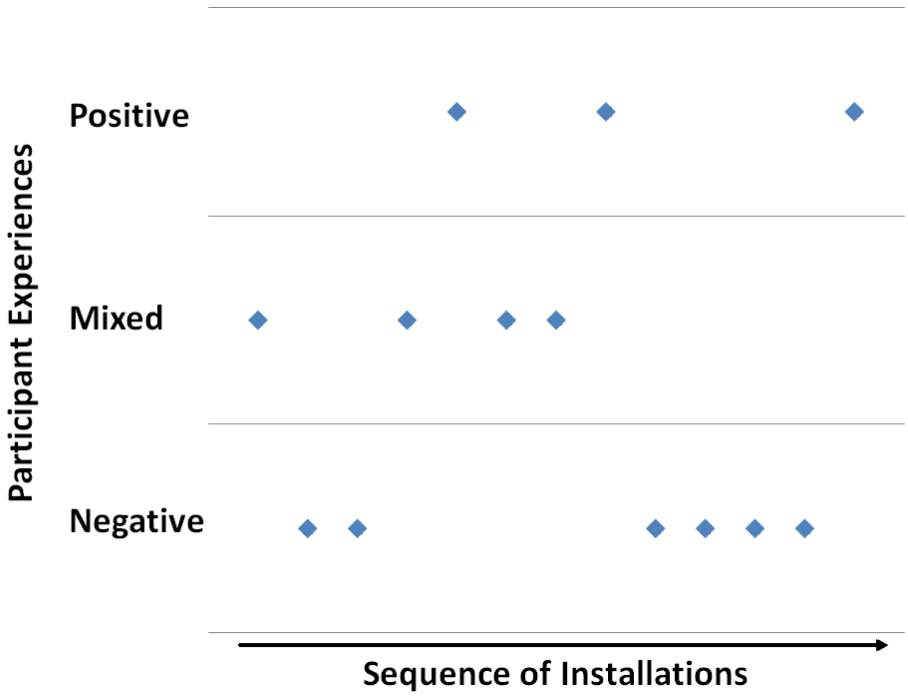


Figure 5-3 Participants grid connection experiences under LDC4 over time (n=13)

Another hypothesis was that, across all participants, the utilization of a CBCPG may have helped to facilitate the grid connection process, thus reducing the frequency of negative experiences by the consumer. This hypothesis appears to be false, as the experiences held by CBCPG participants were skewed towards the negative (Figure 5-4).

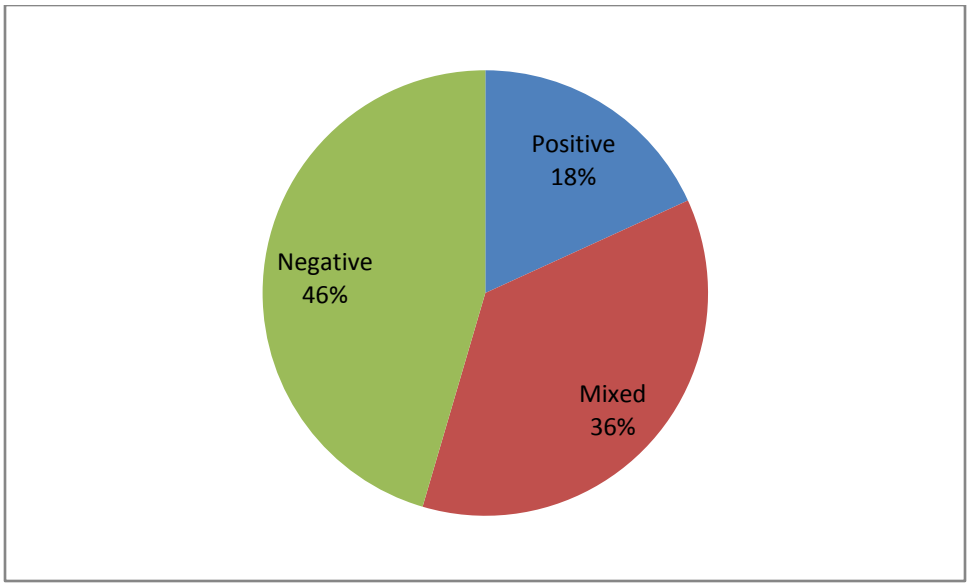


Figure 5-4 Distribution of grid connection experiences across CBCPG participants (n=11)

At this point, based on the data, it is challenging to provide a complete explanation, or even a clear correlation, with negative grid connection experiences.

5.4 Operation Phase

The results presented in chapter 4 with respect to the operation phase of adoption addressed two topics: i) participant recommendations pertaining to the purchase of solar PV systems and utilization of the RESOP, and ii) post-adoption experiences with the RESOP. Because consumers had little to say about the latter, and more information can thus be drawn from analysis of the former, the sole focus of this section is the results of section 4.3.3.2.

Towards the conclusion of the primary interview schedule, participants were asked to state whether or not they would recommend either the adoption of a solar PV system or the use of the RESOP to adopt a solar PV system. An analysis of participant responses serves two purposes. First, the responses to both questions can function as indicators, gauging the participants' concluding impression of the adoption of a solar PV system and the utilization of the RESOP. Secondly, by phrasing the question in terms of a recommendation, the analysis of

participant responses serves to inform the hypothesis that the experiences of adopters may affect the decision of potential adopters to adopt through social means (i.e. dialogue and a general social perception).

When asked whether they would advise a potential consumer to purchase a solar PV system, 18 of 21 individuals stated that they would advocate such a purchase. The three respondents who responded negatively stated that they would not recommend the adoption of a solar PV system because of the lack of affordability and the emergence of unexpected costs.

In comparison, when asked whether or not they would advise a household to utilize the RESOP for solar PV system adoption, only 16 of the 21 participants said they would. Of the five participants who stated they would not recommend the use of the RESOP, three were the same who did not recommend a PV system. In the case of the RESOP, the three participants were frustrated by the unexpected costs associated with the program, such as high meter costs and a monthly administration fee charged by their LDC. The remaining two participants (RP-14, RP-24) who would not recommended the use of the RESOP *did* recommend the purchase of a solar PV system. For participant RP-14, the negative recommendation is explained by the following statement:

> The solar panels are expensive, but there's no support for doing this at all, in my mind. The utility company's against it … it's pretty clear. I would never sign up for the Standard Offer Program. Ever. I wouldn't recommend it to anyone. The solar panels I would recommend … but not the Standard Offer Program. It's too painful. I've been thinking about disconnecting my power completely. I'm frustrated with it. Net-metering would have been a lot simpler; no contracts, no hassle, it would make a lot more sense than this contract. This contract has been a complete failure in my mind.

Participant RP-24's disdain for the RESOP did not come in the acquisition of the SOC, but in the grid connection process required under the RESOP. RP-24's response to question 11

was “I wouldn’t … [LDC]’s not very interested … and maybe it’s because they’re just too big of an organization.”

While 16 participants would advise the use of the RESOP, they did so primarily because of the improved payback. If a potential consumer were to probe further into the experience of RESOP participants, they would be exposed to the SOC acquisition experiences presented in the execution phase, where 21% of the sample population had negative experiences, and 29% had a mixed experience, the negative elements of which stemmed primarily from the cumbersome nature of the application itself and delays in the approval process.

It should also be noted that, in the execution phase, only 12 participants noted a positive experience, while 16 participants suggested that one should use the RESOP. While experiences may be negative, some element of the RESOP is sufficiently rewarding to merit the advocacy of the program by its current participants. While financial incentives are the obvious explanation, such advocacy might also be explained by the willingness of early adopters to act as “guinea pigs.” It was not uncommon for participants to make remarks similar to that of RP-13, who stated, “Like I say, I was the guinea pig.” Participants frequently noted their awareness that in the beginnings of any program or new process, challenges and uncertainties are bound to arise.

For this thesis, it has been hypothesized that word of mouth and social influence may affect the decision-making process of future adopters. None of the participants in this study’s sample, however, identified the recommendation of a previous adopter as influential to their own decision. As such, one may be tempted to conclude that these two factors are of no influence to the adoption process. Two alternative explanations are suggested.

First, this study’s sample was comprised primarily of the earliest of adopters in the province. Participants frequently noted that, when they began the adoption process, they were

the first in their community to adopt a grid-tied solar PV system. Given the relative scarcity of grid-tied solar PV systems in the province, it is not surprising that no participants would have been influenced by another's previous experience.

The second explanation pertains to the personal characteristics typically attributed to the earliest adopters of an innovation (Rogers, 2003). These people are typically champions of an innovation, and as such, are willing to endure the difficulties and challenges associated with the widespread diffusion of a new innovation. Rogers (2003) suggest that earlier adopters are typically willing to accept the occasional setback.

Ultimately, it remains challenging to assess the impact that social influence will have on future adopters. The data presented in this thesis are insufficient in any attempt to answer such a question, though such a finding provides direction for future study.

5.5 Summary

Analysis of the data has demonstrated that, while a plethora of factors are considered by participans when considering the purchase of a residentially mounted solar PV system in Ontario, the most prominent factors influencing such a decision are:

1. High initial capital costs and lengthy payback periods;
2. Concerns pertaining to the future sustainability of our societies; and
3. The presence of supporting institutions such as community-based co-operative purchasing groups and the RESOP.

It has also become apparent that different challenges emerge at different points of the adoption process. Those factors noted above were most influential during the initial decision process of the planning phase. Once in the execution phase of adoption, however, significance shifted to weigh more heavily on the institutional challenges encountered by consumers: flawed

installation processes due to a lack of experienced retailers, the lengthy and cumbersome application process required by the RESOP, and the overly bureaucratic and cumbersome grid connection process were encountered by almost every consumer in the adoption process; the emergence of CBCPGs appears to have minimized the negative experiences encountered by study participants during the execution phase. Furthermore, despite the myriad of challenges encountered by consumers throughout the execution phase, trends of improvement have been found within retailers and the RESOP application process. Finally, with the exception of continuing administrative fees charged by certain LDCs, once their solar PV system is operating and they are receiving payments from the OPA, consumers are content.

Interestingly, when recalling those factors considered during their original decision, only one respondent noted concern about, and for that matter, awareness of, potential administrative challenges (which would eventually arise) during the execution phase. The absence of concern regarding administrative challenges can be attributed to the fact that participants of this study were the earliest of adopters of grid-connected solar PV systems, thus having no previous experiences to draw upon.

The reader must remain aware of two caveats when interpreting the findings of this thesis. First, this sample cannot be said to be representative. The potential for the sample to be biased combined with evidence from Rogers (2003) that different classes of adopters possess different personality and interpersonal traits suggests that expanding the sampling frame beyond the current population of known early adopters may produce different results than those found in this thesis. For example, a different sample, while perhaps identifying the same prominent factors, may result in fewer cases of adoption. Alternatively, different factors may emerge or disappear

as being of prominence. That said, this study's sample does confirm the presence and prominence of those factors identified within some set of the population.

The second limitation which one must remain aware of is that understanding the human decision-making process is challenging, to say the least. While participants were able to identify what they believe to be the greatest factors influencing their decisions, there is the possibility that such identification is erroneous; participants may have been unable to accurately recall or assess their own decision-making process, or may have simply be responding untruthfully, whether or not doing so intentionally. It is plausible that respondent responses were reflexive, providing responses that were socially accepted. With that being said, it is assumed that the methods employed (section 3.3.1) reduced the inaccuracy of those responses provided.

Bearing both of these limitations in mind, the following chapter undertakes an interpretation of this thesis's findings, drawing conclusions with respect to the RESOP-integrated solar PV system adoption process, and suggesting future implications and paths of study.

6 Conclusions

6.1 Summary

With respect to the diffusion of residentially mounted solar PV systems in Ontario, the Renewable Energy Standard Offer Program has been found to have enabled six of this study sample's 24 participants to adopt who would otherwise have not. When one accounts for the RESOP's role in the creation of CBCPGs, however, the RESOP's influence becomes greater, as nine out of 10 participants would not have adopted in the absence of their respective CBCPG.

The supportive role of the RESOP, however, is solely of a financial nature. In both of the execution and operating phases of adoption, the RESOP application process and the grid connection requirements under it have resulted in a lengthy, cumbersome, and largely bureaucratic process. Furthermore, upon completion of these processes, consumers continue to be charged an administrative fee by their Local Distribution Company; this has led to varying degrees of frustration for consumers. In certain cases, extra costs produced from the grid connection process (e.g. expensive meters) and the cumbersome nature of the adoption process have led consumers to conclude that participation in the RESOP is not worth the reduced payback period it provides.

These challenges to the utilization of the RESOP did not emerge until participants had already made the decision to adopt a solar PV system; in other words, the barriers to the utilization of the RESOP did not lie in the *decision* to use it, but in the procedures required to participate in the program. Still, because of the relatively substantial increase in payback provided by the RESOP, participants were willing to complete the RESOP and grid connection processes in the presence of such challenges.

This sample of participants has demonstrated that, while the program is motivating and enabling some consumers to adopt who would otherwise not have, the number of contracts and generation capacity listed under the RESOP are misleading with respect to the influence of the RESOP. For example, while 1,617kW of electricity generation was in commercial operation as of December, 2008, one should not infer that such capacity is entirely the result of the creation of the RESOP. As demonstrated by this study's sample, some solar PV systems (42%) were already operating prior to the creation of the RESOP, while another seven of 14 participants stated that they would have adopted a solar PV system in the absence of the RESOP.

Another revealing finding of this thesis has been that, despite the presence of the most commonly identified barriers (e.g. costs and administrative challenges), sustainability related motivations have been sufficiently strong to overcome such barriers.[15] Each of the participants of this study's primary interview sample did, ultimately, adopt a solar PV system.

While sustainability related concerns were the predominant motivator, it must also be acknowledged that Community-Based Co-operative Purchasing Groups have been influential, enabling consumers to proceed from motivations to action. Benefits of adopting through a CBCPG have included: i) a reduction in system cost due to bulk purchase, ii) previous research into appropriate technologies and vendors, and iii) administrative support throughout the execution phase of adoption. While the results of this research do not disprove or even disagree with the significance of cost as a barrier, they do serve to point out that emphasis on the adequacy with which the barrier is being reduced may be misplaced, and that personal and social values may be driving the adoption of solar PV systems.

[15] In this sense, it may be more accurate to suggest that these barriers have only been challenges in the case of this research, wherein such a distinction would suggest that a barrier prohibits an action, as opposed to a challenge which simply inhibits.

6.2 Critical Themes

6.2.1 Institutional Capacity

Fuchs and Arentsen (2002) have noted that "the success of a technology depends on interactive learning between producers and consumers" (p. 527). In the context of this study, the successful diffusion of the technology can be argued to depend on a similar interactive learning process, one which is also inclusive of program administrators like the LDCs and the OPA. Results have demonstrated that, amongst this study's participants, producers (i.e. retailers) and the OPA have improved the installation and RESOP application processes; connection to the grid and interaction with LDCs, however, remains the greatest obstacle for solar PV system adopters and has shown no improvement (among the participants sampled herein).

Based on preliminary interviews, these institutional challenges appear to be largely associated with a lack of institutional capacity, an obstacle forewarned by Liberatore (1995), and can be explained by two circumstances. First, administration of the RESOP within LDCs is an additional responsibility placed on multiple departments and employees, all of whom already possess other responsibilities. As such, those employees responsible for the execution of the grid connection and billing process simply do not have the time within their daily duties to take care of such tasks in a timely manner.

Second, the RESOP is a relatively new program that provides a novel task for LDCs – the connection of microgenerating RETs to the grid. To do so, technical and engineering considerations and processes must be understood and developed, though minimal instruction or guidance was provided by any party to the Local Distribution Companies at the outset of the program. As a result, grid connection processes are undergoing their own growing pains, demonstrating an ad hoc learning process by each LDC. Furthermore, because the program is

new, it takes more of what already appears to be scarce time for administrators, only serving to further exacerbate the first point.

While primary interview respondents failed to explicitly acknowledge institutional support as a prominent factor in the planning phase of their adoption, there is evidence to suggest that consumers are either adverse to administrative requirements or simply lacking the time and effort to complete the steps of the initial planning process (e.g. researching their purchases and completing administrative forms). As noted in the chapter 3, those participants who utilized a CBCPG were willing to spend a supplemental $300 to have a third-party administrator take care of program administration for them. Participants paid for such a service *before* their awareness of the cumbersome nature of the execution phases processes, supporting both of the above claims. Furthermore, when describing the role of CBCPGs as catalysts, numerous participants noted that they may not have adopted otherwise because they simply did not have the time or the knowledge set to search out an appropriate retailer and the RESOP itself.

All stakeholders in this process would, no doubt, like to see all elements of the RESOP-integrated solar PV system adoption process improved. The question which then arises is: Who does the onus fall upon to improve the process? Is it the responsibility of the OPA to provide clear and simple rules for LDCs regarding metering configurations, administrative charges, and so forth, or should LDCs be putting in more effort to help their customers, who have essentially become their suppliers? These questions are beyond the scope of this research, but are of significance in both the current context as well as for future implementers of similar policies if they are to be efficient and successful in facilitating the diffusion of solar PV systems or other analogous RETs.

6.2.2 Future Adopters: Population Traits and Awareness

Two issues may differ in their effect between the participants of this study and future solar PV system adopters. When interpreting the results of this study, one should be cautious not to underestimate the significance of those barriers mentioned or to overestimate the role of the drivers present with relation to the greater population.

As noted, results of this thesis pertain only to a select group of participants, the early adopters. It has been demonstrated in the literature that such participants share similar character traits to one another, and that future adopter populations will possess different traits (Faiers et al., 2006; Rogers, 2003). For example, according to Truffer et al. (cited in Fuchs et al., 2002):

> In the case of green electricity, early adopters are likely to be members of the eco-niche. The benefits of switching to green electricity for this group are likely to be the highest, as they perceive environmental action to be necessary, environmental consciousness is part of their identity, and environmental actions may satisfy their need for participation. Given the relatively high value this group receives from choosing green electricity, the benefits of this choice will outweigh the costs at a relatively higher cost level. Spill-over from the eco-niche to other consumers, however, is likely to be limited, since the latter have different satisfiers for their needs and perceive the costs of green electricity differently as well. (p.534)

As such, there is strong reason to assume that future adopters will be less motivated by sustainability-related concerns, and more adverse to challenges of cost and administration. This hypothesis is also supported by comments generated throughout the primary interviews. When discussing the questions that are typically asked by interested parties, RP-13 noted that "they ask what the return on investment is." Similarly, RP-15 noted that "people've been asking the price …", while RP-16 stated that "anybody who's asked me about it, any of our neighbours or friends who've asked about it, have all been … they come at it with … the first things without knowing anything about … is the cost." This was commonplace amongst all primary interviews when responding to questions 11 and 12 (see Figure 3-3).

There is also reason to believe that a lack of awareness may inhibit future solar PV system diffusion. Retailers noted during the preliminary interview stage that many of their interactions with consumers were in the form of information provision and education, as opposed to the selling of the actual systems. If future policy tools are to be successful in facilitating the diffusion of solar PV systems, it is important that the general population becomes more aware and educated about the systems themselves as well as the supporting institutions. While an increased knowledge base will not guarantee improved diffusion rates (McKenzie-Mohr, 2000), it will support such an approach.

6.2.3 The Introduction of Ontario's Feed-In Tariff

In March, 2009, the month prior to the conclusion of this thesis, the Ontario Government announced, through its newly enacted *Green Energy Act*, the creation of a Feed-In Tariff program. The proposed new rate of compensation for the microgenerating solar PV systems will be $0.802/kWh (Ontario Power Authority, 2009). Such a rate is more in line with levels proposed by authors such as Jager-Waldau (2007), who suggests that "feed-in tariffs should be designed to potentially enable a pay-back of the initial investment within 10-12 yr'" (p.1427). Similarly, $0.802/kWh is comparable to the rate previously argued for by Brigham and Gipe (2007) in their feasibility analysis.

The feed-in tariff will, essentially, replace the RESOP, whether or not the province explicitly planned for this. While this higher rate of pay will certainly provide a greater impetus for the adoption of solar PV systems, many of the challenges and barriers identified within this thesis may continue to present in this new system, inhibiting or preventing the adoption of solar PV systems. As a result, as this program, or any one similar to it, moves forward, institutional and administrative challenges should be reduced, if not eliminated.

6.3 Recommendations

Having identified 34 drivers and barriers specific to the Ontario case, the following recommendations are proposed for the improvement of the RESOP-integrated adoption process.

Two drivers have been identified as prominent: sustainability-related concerns (e.g. climate change, the livelihood of future generations) and administrative assistance (e.g. community-based cooperative purchasing groups). A subset of the provincial populace has been found to be willing to purchase a solar PV system *primarily out of a concern* for sustainability-related issues, while CBCPGs have been found to support consumers and to not only facilitate the RESOP-integrated adoption process with respect to solar PV systems, but to move consumers from thought to action. Considering that the primary participants of this study chose to adopt a solar PV system and participate in the RESOP, it is apparent that the sum of drivers was of greater significance to their decision-making process than that of the barriers encountered. As such, future strategies developed by policy-makers, retailers, and others involved in the adoption of solar PV systems (e.g. CBCPGs, manufacturers, etc.), may be improved by promoting the identified drivers, as opposed to, or in conjunction with, the more traditional approach of reducing barriers.

The reduction and elimination of barriers is also necessary to improve the RESOP-integrated adoption process. The two barriers requiring the greatest attention in the case of Ontario are program administration and the high initial capital costs and lengthy payback periods. The administrative requirements and the processes required to meet them must be simplified and clarified. To achieve such improvements, it must be identified *whose responsibility it is* to develop and improve the administrative process. Furthermore, despite the $0.42/kWh offered by the RESOP, the financial burden continues to be of concern to consumers.

An increase in the rate of compensation is recommended, and may come to fruition with the proposed Feed-In Tariff rate of $0.802/kWh.

As noted in section 6.2.2, there is reason to believe that monetary and institutional challenges and barriers will become increasingly significant to future adopters; likewise, sustainability-related concerns may decrease as motivators. Bearing in mind this difference between adopter types, any strategy employed should be properly targeted to the population to which it is being applied. This case study has demonstrated that, when addressing the earliest of adopters, emphasis on drivers (e.g. the creation of CBCPGs or promotion of the contribution to sustainability) may be a more effective approach, whereas the reduction of monetary and institutional barriers may be more effective in garnering the participation of later adopters.

Finally, the forthcoming implementation of the Feed-In Tariff will present an opportunity to further study the relationship between financial incentives and the diffusion of solar PV systems. In particular, a comparison between this thesis' findings and the increased remuneration provided by the Feed-In Tariff may reveal further insight as to the influence of specific rates of compensation on the rate of solar PV system diffusion. Furthermore, as more people adopt solar PV systems, the type of consumers adopting will eventually transition from the early adopters to the early majority (Rogers, 2003), and so forth. This transition will present the opportunity to further describe the consumer types.

6.4 Final Comments

The RESOP has taken a step in the right direction in terms of supporting the uptake of renewable energy technologies within Ontario. Coupled with sustainability-related concerns by members of the provincial populace, solar PV system adoption has become a feasible process.

That being said, numerous financial and institutional challenges have presented throughout the process since its inception at the end of 2006. Some experiences with the RESOP have been so negative that, despite the vastly superior financial payback, the cumbersome administrative processes and hidden costs have deterred respondents from recommending the program. These challenges are troublesome with respect to policy design. Certainly, not every policy will be liked by all members of a population; however, it is one thing to say that the RESOP is insufficient in motivating potential consumers to purchase a PV system, and another to note that consumers have had such negative experiences that they are unwilling to recommend the use of the RESOP to future adopters. Given the expectation that financial considerations will weigh more heavily on the decision making of future adopters, and that these future adopters will be less willing to bear a cumbersome process, flawed processes and negative experiences may have a detrimental effect on the future adoption of solar PV systems.

The Renewable Energy Standard Offer Program and, in the future the Feed-In Tariff, demonstrate a desire of the province to promote and implement a greater degree of RET adoption within our current energy supply mix. The success of these programs will depend, to varying degrees, upon the institutions set up for their execution and administration. While some consumers will adopt because of strong sustainability values, moving beyond the early adopter types to the greater population will require a financial incentive that is palatable for potential consumers, and a process that is streamlined and 'user-friendly.' If these requirements can be met, there is hope that residentially-mounted solar PV systems will achieve greater diffusion and be able to contribute an energy supply mix that is sustainable.

References

Babbie, E. (2007). *The Practice of Social Research*. (11th ed.) Belmont: Thomson Wadsworth.

Bahaj, A. S. & James, P. A. B. (2007). Urban energy generation: The added value of photovoltaics in social housing. *Renewable and Sustainable Energy Reviews, 11,* 2121-2136.

Boyd, D. R. (2003). *Unnatural Law: Rethinking Canadian Environmental Law and Policy*. Vancouver: UBC Press.

Boyle, G. (2009). *Renewable Electricity and the Grid*. London: Earthscan.

Boyle, G., Everett, B., & Ramage, J. (2003). *Energy Systems and Sustainability: Power for a Sustainable Future*. Oxford: Oxford University Press.

Bradford, T. (2006). *Solar Revolution: The economic transformation of the global energy industry*. Cambridge: MIT Press.

Brigham, M. & Gipe, P. (2007). *Feasibility Analysis for a SolarShare Co-operative in the City of Toronto* Toronto: Toronto Renewable Energy Co-operative.

Brown, M. A. (2001). Market failures and barriers as a basis for clean energy policies. *Energy Policy, 29,* 1197-1207.

Cooke, R., Cripps, A., Irwin, A., & Kolokotroni, M. (2007). Alternative energy technologies in buildings: Stakeholder perceptions. *Renewable Energy, 32,* 2320-2333.

del Rio, P. (2007). Encouraging the implementation of small renewable electricity CDM projects: An economic analysis of different options. *Renewable and Sustainable Energy Reviews, 11*, 1361-1387.

del Rio, P. & Unruh, G. (2007). Overcoming the lock-out of renewable energy technologies in Spain: The cases of wind and solar electricity. *Renewable and Sustainable Energy Reviews, 11*, 1498-1513.

Dinica, V. (2006). Support systems for the diffusion of renewable energy technologies - an investor perspective. *Energy Policy, 34*, 461-480.

Dunn, K. (2000). Interviewing. In I.Hay (Ed.), *Qualitative Research Methods in Human Geography* (pp. 50-82). Melbourne: Oxford University Press.

Faiers, A., Cook, M., & Neame, C. (2007). Towards a contemporary approach for understanding consumer behaviour in the context of domestic energy use. *Energy Policy, 35*, 4381-4390.

Faiers, A. & Neame, C. (2006). Consumer attitudes towards domestic solar power systems. *Energy Policy, 34*, 1797-1806.

Faiers, A., Neame, C., & Cook, M. (2007). The adoption of domestic solar-power systems: Do consumers assess product attributes in a stepwise process? *Energy Policy, 35*, 3418-3423.

Fisher, B. S. & Nakicenovic, N. (2007). Issues related to mitigation in the long-term context. In B.Metz, O. Davidson, R. Dave, L. A. Meyer, & P. R. Bosch (Eds.), *Climate Change*

2007: Mitigation - Contribution of Working Group III to the Fourth Assessment Report on the Inter-governmental Panel on Climate Change (pp. 169-250). Cambrdige: Cambridge University Press.

Foxon, T. J., Gross, R., Chase, A., Howes, J., Arnall, A., & Anderson, D. (2005). UK innovation systems for new and renewable energy technologies: drivers, barriers and systems failures. *Energy Policy, 33,* 2123-2137.

Fuchs, D. A. & Arentsen, M. (2002). Green electricity in the market place: the policy challenge. *Energy Policy, 30,* 525-538.

Gibson, R. B., Hassan, S., Holtz, S., Tansey, J., & Whitelaw, G. (2005). *Sustainability Assessment: Criteria and Processes*. London: Earthscan Publications Ltd.

Haar, N. & Theyel, G. (2006). U.S. electric utilities and renewable energy: drivers for adoption. *International Journal of Green Energy, 3,* 271-281.

Halsnaes, K. & Shukla, P. (2007). Framing Issues. In B.Metz, O. Davidson, P. R. Bosch, R. Dave, & A. Meyer (Eds.), *Climate Change 2007: Mitigation - Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 117-167). Cambrdige: Cambridge University PRess.

Hawke, N. (2002). *Environmental Policy: Implementation and Enforcement*. Burlington: Ashgate Publishing Limited.

Independent Electricity System Operator (2008). *Supply Overview*. Retrieved February 15, 2009, from http://www.ieso.ca/imoweb/media/md_supply.asp

International Energy Agency (2007). *World Energy Outlook 2007: China and India insights edition executive summary*.

International Energy Agency (2008). *Trends in Photovoltaic Applications: Survey report of selected IEA countries between 1996 and 2007*.

International Energy Agency Renewable Energy Working (2002). *Renewable Energy...into the Mainstream*.

Jaccard, M. (2005). *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy*. New York: Cambridge University Press.

Jackson, T. & Oliver, M. (2000). The viability of solar photovoltaics. *Energy Policy, 28,* 983-988.

Jacobsson, S. & Bergek, A. (2004). Transforming the Energy Sector: The Evolution of Technological Systems in Renewable Energy Technology. *Industrial and Corporate Change, 13,* 815-849.

Jacobsson, S. & Johnson, A. (2000). The diffusion of renewable energy technology: an analytical framework and key issues for research. *Energy Policy, 28,* 625-640.

Jacobsson, S. & Lauber, V. (2006). The politics and policy of energy system transformation--explaining the German diffusion of renewable energy technology. *Energy Policy, 34,* 256-276.

Jaffe, A. B. & Stavins, R. N. (1994). The energy-efficiency gap. *Energy Policy*, *22,* 804-810.

Jager-Waldau, A. (2007). Photovoltaics and renewable energies in Europe. *Renewable and Sustainable Energy Reviews, 11,* 1414-1437.

Kaplan, A. (1999). From passitve to active about solar electricity: innovation decision process and photovoltaic interest generation. *Technovation, 19,* 467-481.

Liberatore, A. (1995). Arguments, Assumptions and the Choice of Policy Instruments. In B.Dente (Ed.), *Environmental Policy: In Search of New Instruments* (pp. 55-72). Norwell: Kluwer Academic Publishers.

Lofland, J. & Lofland, L. H. (1995). *Analyzing Social Settings: A Guide to Qualitative Observation and Analysis*. (3rd ed.) Belmont, CA: Wadsworth.

Lovins, A. B., Datta, E., Feiler, T., Rabago, K., Swisher, JN., & Lehman, A. (2002). *Small is profitable*. Boulder, CO: Rocky Mountain Institute.

Maldonado, P. & Marquez, M. (1996). Renewable energyes: an option for sustainable development. In.

Martinot, E. & McDoom, O. (1999). *Promoting Energy Efficiency and Renewable Energy: GEF Climate Change Projects and Impacts* Washington, DC.: Global Environmental Facility.

McKenzie-Mohr, D. (2000). Promoting Sustainable Behaviour: An Introduction to Community-Based Social Marketing. *Journal of Social Issues, 56,* 543-554.

Menanteau, P., Finon, D., & Lamy, M.-L. (2001). *Prices versus quantities: Environmental policies for promoting the development of renewable energy* France: Institut D'econome et de politique de l'energie.

Oliver, M. & Jackson, T. (1999). The market for solar photovoltaics. *Energy Policy, 27,* 371-385.

Ontario Ministry of Energy and Infrastructure (2008). *Net Metering*. Retrieved March 08, 2009, from http://www.mei.gov.on.ca/english/energy/renewable/?page=net-metering.

Ontario Power Authority. (2006). *Standard Offer Prgoram - Renewable Energy: For Small Electricity Generators - An Introductory Guide*. Toronto, Ontario Power Authority.

Ontario Power Authority (2008). *A Progress Report on Renewable Energy Standard Offer Program: December 2008*.

Ontario Power Authority (2009). FIT Price Schedule - Draft March 13, 2009. Retrieved March 22, 2009 from http://www.powerauthority.on.ca/fit/Storage/29/10116_FIT_Price_Schedule_-_Draft_March_13__2009.pdf.

Painuly, J. P. (2001). Barriers to renewable energy penetration; a framework for analysis. *Renewable Energy, 24,* 73-89.

Palys, T. & Atchison, C. (2008). *Research Decisions: Quantitative and Qualitative Perspectives*. (4th ed.) Toronto: Thomson Nelson.

Peters, R., Cobb, P., & Winfield, M. (2007). *Renewable is Doable: A Smarter Energy Plan for Ontario: Analysis of Resource Potential and Scenario Assumptions* (Rep. No. 1). The Pembina Institute.

Randolph, J. & Masters, G. M. (2008). *Energy for Sustainability: Technology, Planning, Policy*. Washington: Island Press.

Reddy, S. & Painuly, J. P. (2004). Diffusion of renewable energy technologies - barriers and stakeholders' perspectives. *Renewable Energy, 29,* 1431-1447.

REN21 (2008). *Renewables 2007 Global Status Report* Paris: REN21 Secretariat.

Rogers, E. M. (2003). *Diffusion of Innovations*. (Fifth ed.) New York: Free Press.

Rohdin, P., Thollander, P., & Solding, P. (2007). Barriers to and drivers for energy efficiency in the Swedish foundry industry. *Energy Policy, 35,* 672-677.

Sathaye, J. & Bouille, D. (2001). Barriers, Opportunities, and Market Potential of Technologies and Practices. In B.Metz, O. Davidson, R. Stewart, & J. Pan (Eds.), *Climate Change 2001: Mitigation, Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 345-398). Cambridge: Cambridge University Press.

Sherk, T. & Parker, P. (2008). *Community Solar Energy Through the Eyes of Green Early Adopters* Waterloo: University of Waterloo.

Sims, R. E. H., Schock, R. N., Adegbululgbe, A., Fenhann, J., Konstantinaviciute, I., Moomaw, W. et al. (2007). Energy Supply. In B.Metz, O. Davidson, P. R. Bosch, R. Dave, & L.

A. Meyer (Eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report on the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom and New Yorl, NY, USA: Cambridge University Press.

Singleton, R. A. & Straits, B. C. (2005). *Approaches to Social Research*. (4th ed.) New York: Oxford University Press.

Sudman, S., Bradburn, N. M., & Schwarz, N. (1996). *Thinking about Answers: The Application of Cognitive Processes to Survey Methodology.* San Francisco: Jossey-Bass.

Tengvard, M. & Palm, J. Small-scale production of electricity: part of sustainable living for households. *ECEEE Summer Study 2009 Conference Proceedings,* (in press).

Thayer, R. L. (1994). *Gray world, green heart: technology, nature, and the sustainable landscape*. New York: Wiley.

Toke, D. (2007). Renewable financial support systems and cost-effectiveness. *Journal of Cleaner Production, 15,* 280-287.

Unruh, G. (2000). Understanding carbon lock-in. *Energy Policy, 28,* 817-830.

Vachon, S. & Menz, F. C. (2006). The role of social, political, and economic interests in promoting state green electricity policies. *Environmental Science & Policy, 9,* 652-662.

Yin, R. (2003). *Case Study Research: Design and Methods*. (3rd ed.) (vols. 5) Thousand Oaks: Sage Publications, Inc.

Appendices

Appendix A: Recruitment Documents

Preliminary Interview Phase:

Recruitment Email

Dear (Insert Participants Name)

My name is Chris Adachi, and I am a graduate student at the University of Waterloo in the Department of Environment and Resource Studies. I received your contact information (insert information), and in light of your expertise in the field of solar photovoltaic systems, am contacting you to seek your participation in current research regarding the adoption process of such systems and the Renewable Energy Standard Offer Program. The focus of my research is on drivers and barriers to participation in the Renewable Energy Standard Offer Program (RESOP). My interests lie in understanding whether or not the RESOP is effectively promoting the diffusion of solar PV systems. I would appreciate the opportunity to speak with you about your experience on this topic.

An interview time can be arranged at your convenience. Your involvement in this research would be entirely voluntary and you may decline to respond to questions, if you wish. If you agree to participate, the interview should take no more than half an hour. All information you provided will be considered confidential and will be grouped with responses from other participants. You will not be identified by name in any thesis, report, or publication from this study. The data collected will be kept securely.

If, after receiving this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact Professor 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 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.

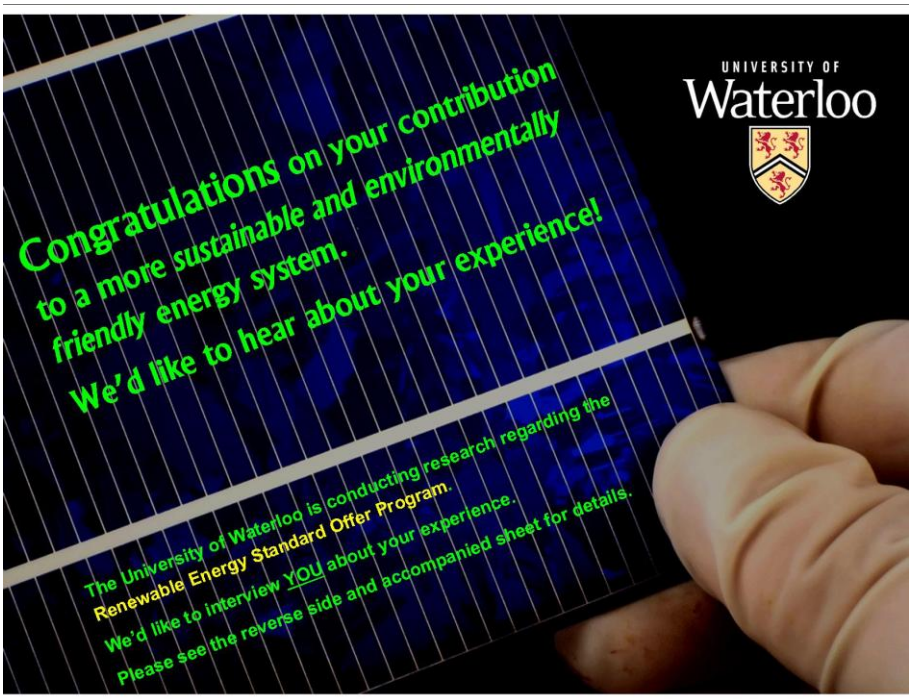
Thank you in advance for your interest in this project.

Yours sincerely,

Chris Adachi
University of Waterloo
Department of Environment and Resource Studies
519.505.4194
cwadachi@uwaterloo.ca

Primary Interview Phase

Recruitment Flyer and Cover Letter



UNIVERSITY OF Waterloo

Research is currently being conducted regarding the role of the Renewable Energy Standard Offer Program and Solar PV Systems. We would like to interview you.

Your participation would entail

- A **one-on-one interview**: interviews will last approximately 30 minutes and can take place at a time and location of your choosing. Interviews can take place in person or over the telephone.

If you are interested in participating, please contact Chris Adachi at:

cwadachi@uwaterloo.ca or **(519) 505-4194**

The researcher will be following this mail package up with a phone call to listed phone numbers between the dates of November 24, 2008 and December 5, 2008.

Further details are on the accompanying information sheet and consent form.

This study has been reviewed by, and received ethics clearance through the Office of Research Ethics, University of Waterloo

Dear November 13, 2008

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. Your contact information was ascertained from the Ontario Power Authority website and the listing of your Standard Offer Contract. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Recent concerns over the status of energy supply and the impacts of climate change have focused research on viable options for the future of energy supply and energy security. Renewable energy technologies, such as solar photovoltaic systems (solar panels), have emerged in recent decades as attractive and viable options for the provision of electricity. The purpose of this study is to investigate the adoption process of renewable energy technologies in society, with a particular focus on solar photovoltaic systems and the Renewable Energy Standard Offer Program (RESOP) in the province of Ontario.

This study will focus on the adoption of solar photovoltaic systems. When faced with the opportunity to adopt a cleaner technology, it is important to understand how consumers with unique values respond. People such as yourself provide a valuable knowledge base regarding consumer perspectives on solar panels and the RESOP, and as such, I would like to invite you to take part in this study. I believe that because you have executed a RESOP contract, you are well suited to speak to the various issues required to purchase and install a solar photovoltaic system and to participate in the RESOP.

Participation in this study is voluntary. A phone call will follow up this information package to determine whether or not you would like to participate in this research. Depending on your interest, participation will involve an interview of approximately 30 minutes in length to take place in a mutually agreed upon location or by telephone. 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 penalty by advising me. With your permission, the interview may be audio recorded to facilitate collection of information, and later transcribed for analysis. All information you provide is considered completely confidential. Your name will not appear in any report resulting from this study; however, with your permission anonymous quotations may be used. Data collected during this study will be retained for a one year period in a secured electronic format or within a locked office at the University of Waterloo, in the office of Dr. Ian Rowlands. Only researchers associated with this project will have access. 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) 505-4194 or by email at cwadachi@uwaterloo.ca. You can also contact my supervisor, Professor Ian Rowlands at (519)888-4567 ext. 32574 or email at irowland@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, ssykes@uwaterloo.ca.

I hope that the results of my study will be of benefit to people interested in purchasing a solar photovoltaic system and participating in the RESOP, to program administrators, and to the broader research community.

I very much look forward to speaking with you and thank you in advance for your assistance in this project.

Yours Sincerely,

Chris Adachi

CONSENT FORM

I have read the information presented in the information letter about a study being conducted by Chris Adachi of the Department of Environment and Resource Studies at the University of Waterloo under the supervision of Professor Ian Rowlands. 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 Dr. Susan Sykes, Director, Office of Research Ethics at 519-888-4567 ext. 36005 or ssykes@uwaterloo.ca.

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 from open-ended responses 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: _____

Appendix B: Expanded "Results" Data

Preliminary Interviews

Factors perceived to be influential in the consumer decision to purchase a solar PV system

Factor	Pre-R1	Pre-R2	Pre-LDC1	Pre-LDC2	Pre-CBCPG1	Pre-CBCPG2	Pre-TPA	Pre-P1	Pre-P2
Cost and Payback	B	B			B	B	B	B	B
Financial Assistance	D	D			D	D			D
Unexpected Costs				B				B	
Lead by Example						D		D	D
Political Leadership								D	
Technological Fascination					D				
Understanding of Technology	B	B	B						
Joy of generating		D							
Sustainability	D	D		D	D	D	D	D	D
Professional Advice			B						
Previous Experience					D		D		
CBCPG								D	
Installation Delays								B	
Adequate Roofing			B					N	
Home Ownership						N			
Reliability									D

Legend: **B**= Barrier
D= Driver
N= Neutral

Factors believed to be influential on the consumer decision to utilize the RESOP

Factor	Pre-R1	Pre-R2	Pre-LDC1	Pre-LDC2	Pre-CBCPG1	Pre-CBCPG2	Pre-TPA	Pre-RP03	Pre-P2
Unexpected Costs (i.e. Meter)				B	B	B			
Monthly Fee						B			
Other Consumer Experiences					B		B		
Political Legitimization						D			
Cooperation of Utility		B					B		D
Program Awareness	B		B			B	B		B
Administrative requirements	B	B	B	B		B	B	B	B
Program Ramifications			B		B				B
Policy Uncertainty	B							B	
Administrative Assistance		D							D
Technical configurations						B			

Legend: **B**= Barrier
D= Driver

Primary Interviews

Factor	RP-01	RP-02	RP-04	RP-05	RP-06	RP-07	RP-08	RP-09	RP-10	RP-11	RP-12	RP-13	RP-14	RP-15	RP-16	RP-17	RP-18	RP-20	RP-21	RP-22	RP-23	RP-24	RP-25	RP-26
Cost and Payback	*B*		**B**	**B**	*b*	*b*	**D**	**B**	**B**	**B**	**N**	**B**		**B**	**B**	**B**	*n*	**B**	*b*	**B**	*b*		N	*b*
Money Generation	*D*																							
Investment																						**D**		
Support the economy		**D**																						
Lead By Example	**D**			**D**						*d*	**D**					**D**		*d*	*d*					
Familial Culture	**D**																							
Previous Exp.		**D**																		**D**		**D**		
Sustainability	**D**	*d*	**D**	**D**	**D**	**D**	**D**	D	**D**	*d*	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	*d*	**D**	**D**
Joy of Generation						*d*	**D**																	
Political Leadership									*d*											*d*	*d*			
Policy Support								*d*								*d*								
Political Statement													*d*										*d*	
Presence program								**D**		**D**				**D**						*d*				**D**
Education Awareness					*d*											*d*		*d*	*d*					
Program Admin.								*b*																
Admin. Assistance																					*d*			
Reliability	*d*		*d*				*d*	*d*					**D**					*d*	*d*	*d*	*d*	*d*	*d*	*d*
Tech. Risk									**B**															
Backup Power		**D**						*d*									**D**					**D**		
Technical Config.					**D**					**N**														
Solar Exposure			*d*				**N**	**D**	**N**		**N**			**D**									**N**	

Legend:
B= Barrier, unprompted
b = Barrier, prompted
D= Driver, unprompted
d = Driver, prompted
N= Neutral, unprompted