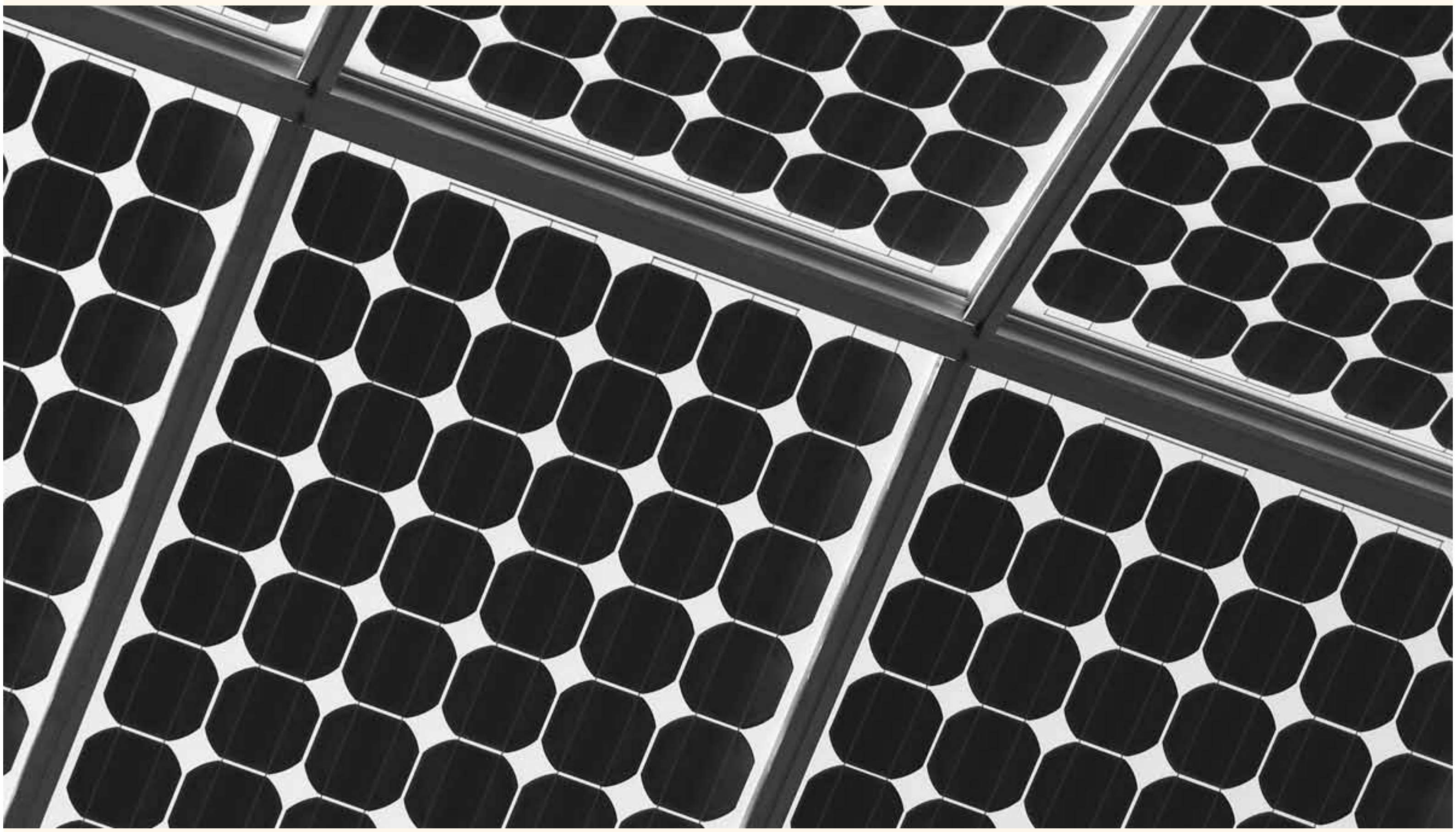
Rooftop Solar Program

Barriers & Opportunities with Rooftop Solar in the Pearson Eco-Business Zone



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This report was funded by:

This report was prepared by:

2010

Executive Summary

Rooftop solar is an important renewable energy source in Ontario and has been given a jump-start through the Government of Ontario's newly implemented feed-in-tariff ("FIT") program brought to life through the *Green Energy Act* (the "GEA"). This policy commitment has created the momentum for a great deal of interest in rooftop solar photovoltaic ("PV") electricity generation; however challenges towards widespread implementation remain. By commissioning this study, Partners in Project Green has taken a step towards promoting the implementation of rooftop solar in the Pearson Eco-Business Zone. This report identifies challenges to implementing rooftop solar based on research and interviews with market participants and other stakeholders. By uncovering real and perceived challenges, Partners in Project Green will be better equipped to implement programs that assist in overcoming these hurdles. Knowledge of these challenges will be shared with various stakeholders and is intended to aid future market development.

The challenges fall into four broad categories: (1) Economic Hurdles; (2) Legal and Policy Hurdles; (3) Institutional Knowledge/Capacity Hurdles; and (4) Technical Hurdles. The main challenges in each category are highlighted below.

1) **Economic Hurdles**

- Understanding, communicating and receiving management approval for the nature of the investment - lower-risk type of investment with longer paybacks of between 10-20 years;
- Sourcing financing – internal or external;
- Evaluating, assigning and determining the value of rooftop rights;
- Evaluating and addressing the cost of necessary site-specific evaluation and scarcity of real-world data;
- Evaluating and addressing the cost of solar PV equipment;
- Understanding constraints on system portability and future rooftop usage;
- Understanding and considering tax implications, such as property tax assessment and classification uncertainty, accelerated depreciation and capital cost allowance; and,
- Understanding and evaluating insurance developments and costs.

2) **Legal and Policy Hurdles**

- Understanding the implications of the new GEA and FIT program, eligibility, prices, domestic content rules, connectivity issues, how the program deals with environmental and municipal approvals;

- Recognizing that environmental attributes are retained by the Ontario Power Authority under the FIT and understanding how that may or may not impact a proponent's marketing claims about the project;
- Clarifying contractual issues such as equipment and installation agreements, operation and maintenance agreements and rooftop leases;
- Evaluating the implications of no right to solar access in Ontario (i.e. the risk that future development may change the amount of sunlight reaching the solar installation);
- Considering the implications of official plans, building permits, zoning by-laws and electrical inspection; and,
- Understanding incentives and potential constraints in federal law, including interaction (or lack thereof) with an emerging federal greenhouse gas offset system.

3) **Institutional Knowledge/Capacity Hurdles**

- Understanding the speed of market development and the influx of service providers, market players, integrators and interactions with government bodies;
- Building internal knowledge and seeking out external knowledge for the provision of services; and,
- Focusing on core competencies and finding the appropriate balance of integration into the new market.

4) **Technical Hurdles**

- Understanding installation constraints including structural issues relating to weight on roof, loading and slope considerations;
- Understanding grid connection and power conditioning issues;
- Picking the best PV technology for the site while also complying with FIT domestic content requirements;
- Properly accounting for all system losses during pre-feasibility and feasibility analysis to ensure proper expectations of system production and long-term monitoring to verify correct operation; and,
- Understanding and planning for operation and maintenance.

Recommendations focus on increased information and education to facilitate a better understanding of criteria and parameters and to increase comfort with the subject-matter, including:

- Education and communication (explaining FIT, training for installers and integrators);
- Legal information and templates (leasing templates, insurance information, contract information sessions);
- Identifying service providers (directory of providers, accreditation process to drive trust);
- Identifying sources of financing (e.g. banks, development funds);
- Policy and regulatory clarity (e.g. tax implications, approvals); and,
- Pilot projects (pooled resources can mitigate risk).

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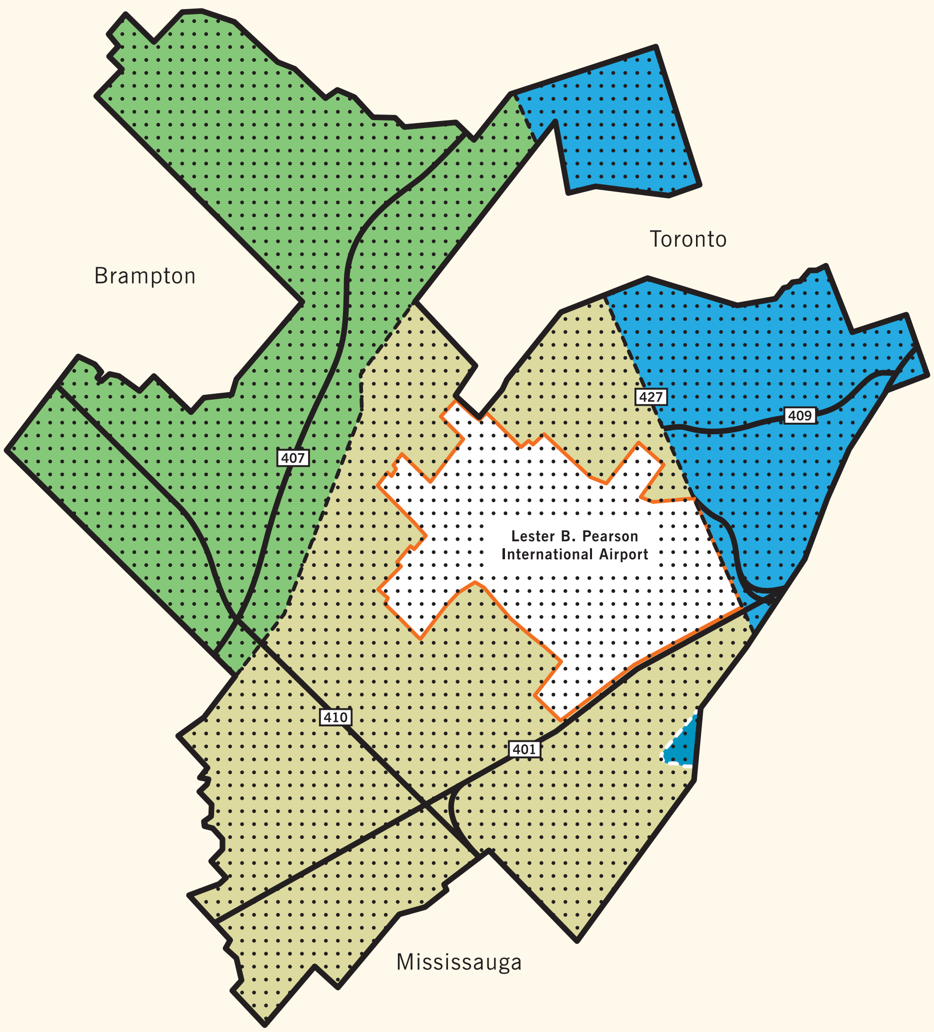

Pearson Eco - Business Zone

1. Introduction

Toronto and Region Conservation ("TRCA") has commissioned this research and development of this report in order to highlight the barriers to implementing rooftop solar in the Pearson Eco-Business Zone.

We are pleased to present this report to help drive action by landowners and facility managers in the Pearson Eco-Business Zone. Our report identifies barriers to the implementation of rooftop solar and examines them in light of the Partners in Project Green's goals. It has been prepared with a view to future steps that may encourage increased adoption of this technology in the Pearson Eco-Business Zone.

Partners in Project Green is an exciting collaborative initiative that aims to transform Canada's largest employment area into an internationally recognized eco-business zone. Through workshops, networking and publicly available resources, the initiative aims to encourage peer-to-peer learning in order to fully realize the Pearson Eco-Business Zone's potential and maximize its sustainability opportunities.

The Pearson Eco-Business Zone spans three municipalities, 12,000 hectares of industrial and commercial land and consumes approximately 5.8 million MWh of electricity resulting in 1.7 million tonnes of CO_2 emissions per year[1]. The size and diversity of the Pearson Eco-Business Zone make it an ideal location to benefit from the identification and exploitation of sustainability opportunities. Nevertheless, we appreciate that the path forward, especially with regards to the increased use of renewable power, may be complex.

Partners in Project Green aims to encourage the adoption of rooftop solar, as there is enormous potential for its development in the Pearson Eco-Business Zone. Globally, solar photovoltaic ("PV") energy is the fastest growing energy source with annual growth rates of approximately 30 per cent over the last 15 years.[2] In 2006, global investment in solar PV was US$20 billion with the U.S. and Germany leading the way.[3] The difference in installed capacity between the leaders and Canada is palpable; Canada only installed about 2 MW of PV capacity last year while world leader Germany added 600 MW.[4]

We believe the future is bright for rooftop solar. First, PV material prices have declined on average 4 per cent annually over the last 15 years[5], except for silicon shortages in 2005, and silicon prices experienced a significant decline from over US$400 per kilogram on the spot market prior to the recent economic crisis to under US$60 per kilogram subsequently.[6] Moreover, Ontario's newly enacted *Green Energy and Green Economy Act* has created significant incentives for solar electricity generation in the province. Most notably, the feed-in tariff ("FIT") program, a guaranteed pricing system for qualifying renewable generation, provides proponents with increased incentives and financial assurances. Predictions have been made that

1 Partners in Project Green Website: http://www.partnersinprojectgreen.com/files/partners_in_project_green_fact_sheet.pdf

2 "Fast Solar Energy Facts" Solar Buzz, online: http://www.solarbuzz.com/FastFactsIndustry.htm

3 Pembina Institute: http://pubs.pembina.org/reports/plugging-in-ontario-report.pdf

4 "Energy Source: Solar Energy" The Pembina Institute, online: http://re.pembina.org/sources/solar.

5 *Supra* note 2

6 Scott Nichol, President of 6N Silicon at a public seminar on February 24, 2010 at the MaRS Discovery District in Toronto

cost reductions will make PV cost competitive with grid electricity in many parts of the world by 2014.[7] Finally, the Canadian Solar Industries Association ("CanSIA") projects the technical potential for commercial buildings in Ontario to be over 1,000 MW by 2025. By considering these factors, this project will help facilitate the implementation of rooftop solar in the Pearson Eco-Business Zone and beyond.

As Canada's largest employment area, the Pearson Eco-Business Zone has a unique opportunity to be a national, and perhaps even global, leader in solar energy implementation. By identifying the challenges associated with implementation of rooftop solar and through further action on the recommendations presented in this report, Partners in Project Green can assist potential proponents to help the Pearson Eco-Business Zone realize its full leadership potential.

The report has been broken down into four main categories of challenges as follows:

- Economic Hurdles (Section 2)
- Legal and Policy Hurdles (Section 3)
- Institutional Knowledge/Capacity Hurdles (Section 4)
- Technical Hurdles (Section 5)

Finally, the report concludes with recommendations for actions that could help overcome these hurdles in an effective and realistic way.

7 Pembina Institute: http://pubs.pembina.org/reports/plugging-in-ontario-report.pdf

2. Economic Hurdles

2.1 Financial Options

Currently, there is a perception that a "gold-rush" mentality exists in the Ontario rooftop solar market with both technology providers and project integrators fervently marketing their services in the Pearson Eco-Business Zone to businesses in possession of enticing roof space. The opportunities are thanks, in large part, to the feed-in tariff program, which will be discussed further in Section 3 below. While high profile projects have been undertaken or are currently underway, many potential adopters we interviewed are currently exercising caution before making any significant commitments. This section will focus on financial questions facing Pearson Eco-Business Zone stakeholders.

An initial step for a business or organization in legal possession of roof space and interested in participating in the FIT program (hereinafter "project proponent") is to assess the suitability of its roof for hosting an installation (see Section 5 – Technical Hurdles). The next step is to calculate a project's return on investment ("ROI") or revenue potential in light of the available business and financial structures. Three common approaches are (i) a direct capital investment, (ii) a capital investment with a partner and (iii) a rooftop lease with a third party such as a project integrator or project developer (hereinafter "project developer"). The latter two approaches require the creation of a second landlord-tenant relationship - the "solar tenant."

Once a reasonable business case has been developed, the potential project proponent can compare the opportunity cost of undertaking a rooftop solar investment against its other potential investments. In some cases, this may result in competition for both available capital and available roof space. For instance, a business may discover that the Province of Ontario's incentives for solar hot water heating impact on both considerations.[8]

Below is a synopsis of common project ownership options including (a) a direct investment; (b) an investment with a partner or (c) a rooftop lease to a third party.

2.1.1 Direct Investment

A business could decide to directly fund its own rooftop PV system with either internally generated funds or with the use of debt financing. In such a scenario, once it is committed to becoming the project proponent, it would be responsible for project development decisions, incur all attendant costs, enter into a FIT contract with the OPA, take on the rights and obligations under that contract and collect the eventual revenue. The proponent would also be ultimately responsible for the electricity produced. Thus, it must establish an operation and maintenance program and monitor system progress.

Pearson Eco-Business Zone stakeholders raised the following concerns about funding their own projects.

2.1.1.1 Return on Investment

The long-term nature of the return on investment generally seen with PV projects is a challenge for many project proponents. The low-risk presented by the FIT program has proven to be an integral part of the pitch to sell PV projects to senior management, but interviewees indicated the corresponding low return is a cause for concern. One of the most optimistic scenarios presented by a project proponent, using renewable energy tax credits and accelerated amortization schedules, demonstrated a payback period of approximately 10 years. However, not all projects present such a favourable timeline, and a common refrain has been that a near 20-year commitment is required to ensure a favourable rate of return on PV projects. This presents a challenge for corporate decision-makers, who must answer to shareholders and/or a board of directors and explain decisions based on traditional business models, which focus on shorter timeframes.

While the FIT program has been designed to provide positive financial returns, actual returns, while positive may strike decision makers as too minimal to justify management attention and the attendant project risks associated with their implementation. At least one tenant has indicated that finding some of

8 In June 2007, the Province of Ontario announced a target of 100,000 solar water heater roofs for the province. A variety of provincial and federal incentives combine to make commercial solar water heating an attractive investment option for business. Several interviewees mentioned the benefit of solar thermal projects, however an examination of them is outside of the scope of this report. For more information see e.g. "Solar Water Heater Incentives" GoSolar, online: http://www.gosolarontario.ca/en/incentives_gs.asp

the project's value in goodwill, marketing or enhanced employee morale (i.e. working for a company that promotes green development) was helpful to more easily justify the investment.

Figure 1 below illustrates the rates of return and payback periods for a series of scenarios designed to illustrate what could be expected under certain market and policy contexts projected for the Greater Toronto Area. Included in the scenarios are total installed prices of $6 and $9 per watt and annual operation and maintenance costs equal to approximately 0.6 per cent of these installed costs.[9] These operation and maintenance costs also account for the lifetime of inverters, roughly 5-10 years. It is unlikely that inverter lifespans will dramatically increase beyond this range since market pressures tend to create lower-cost rather than longer-lasting inverters.[10]

Additionally, the scenarios examine the different possible tariff rates in ¢/kWh currently available under the FIT, which are adjusted for a 2.6 per cent annual inflation rate in this model. Finally, the class 43.2 accelerated capital cost allowance tax incentive of 50 per cent is included. The resulting rates of return vary between roughly 5 per cent and 18 per cent, while the payback periods range from 5 to 12 years depending on the installed costs and tariff rates employed in the simulation.

9 An approximation based on Sandia National Laboratories: http://www.sandia.gov/SAI/Reliabilitylifecycle.htm and PV Resources: http://www.pvresources.com/en/economics.php

10 NCI, 2006. A Review of PV Inverter Technology Cost and Performance Projections. National Renewable Energy Laboratory Subcontract Report NREL/SR-620-38771. http://www.nrel.gov/pv/pdfs/38771.pdf

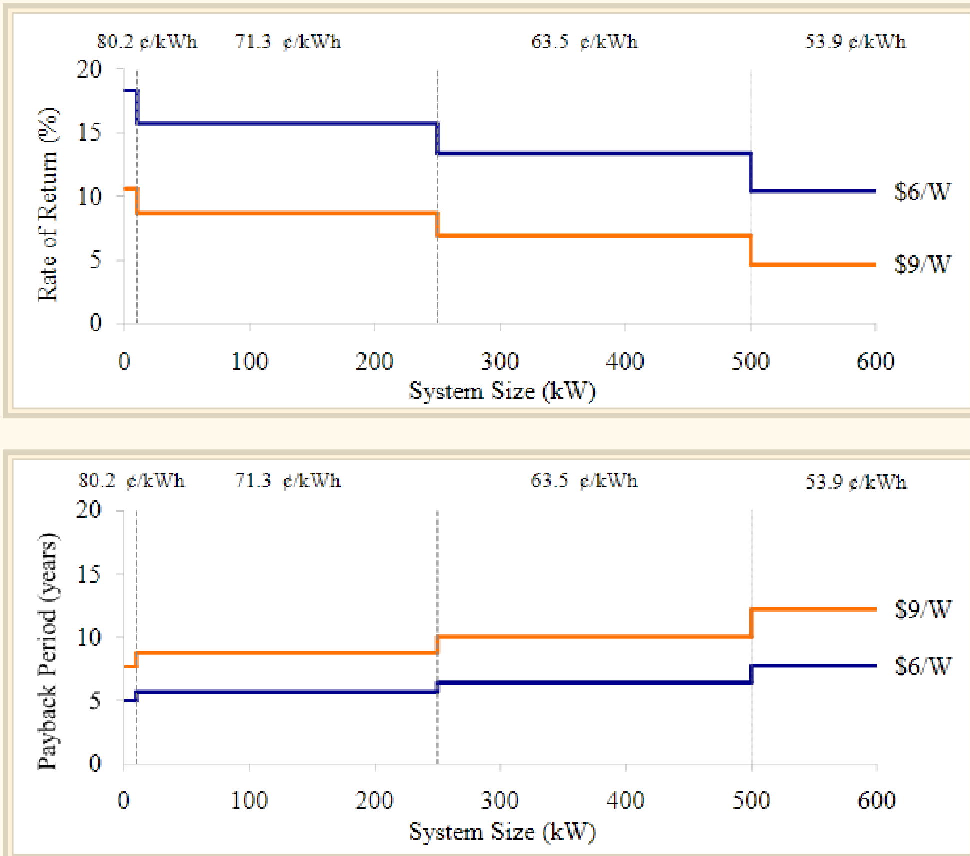

Figure 1: Rate of return and payback period versus system size and total installed cost using the FIT. For cell efficiency of 16 per cent, inverter efficiency 94 per cent, and miscellaneous losses of 11 per cent, also accounts for an additional 5 per cent losses due to shading. Includes south facing panels with a slope of 37°.

2.1.1.2 Real World Data

An effective site analysis is integral to determining the potential return of a rooftop PV system (as discussed in more detail in Section 5) and obtaining reliable data to use in that analysis is a challenge. Most projects based in the Pearson Eco-Business Zone should encounter little difficulty in grid proximity;[11] however, evaluating the solar quality of a roof is vital in virtually every case. Many solar PV arrays currently available on the market will have their overall generation reduced to the lowest common dominator if even one panel experiences shading. This will decrease the maximum possible return. Solar Pathfinder™[12] is one widely used tool employed by installers for evaluating proposed PV sites.

When incorporating various site analysis data for their roofs, organizations should be wary of solar resource estimates provided by third parties. While National Resources Canada has undertaken a Canada-wide

11 Discussion with Toronto Hydro staff member, 1 December 2009

12 Solar Pathfinder™ is a "non-electronic instrument…that accurately measures the shading of any site, allowing the user to see what could shade the system throughout the year." See Solar Pathfinder website at http://www.solarpathfinder.com/PF

review of solar irradiance across the country,[13] it is still important for individual sites to conduct their own research. The Horse Palace PV Pilot Project Report[14] highlighted the issue that data used in RETScreen[15] calculations defaults to historic weather data from local Environment Canada weather stations and may not fully account for local microclimactic conditions, nor changes in those conditions over the past two decades, thus failing to give an accurate estimate of future system performance. Moreover, this tool should only be used in a *pre-feasibility* study and not as a guarantor of a successful business model. Further analysis using more robust tools should be employed.

Another important consideration is that generated energy will ultimately produce less than a site's full potential due to imperfect conditions, system losses and unexpected situations. One general industry rule is that no reliable estimate should exceed 1200 kWh/kW/year. Reasonable estimates are more likely to range from 1000 to 1100 kWh/kW/year based on research conducted by organizations such as the Toronto Renewable Energy Co-op. Once a project proponent has gathered its resource information, acquired an understanding of the losses that will occur throughout the system and anticipated financial data, it can more effectively apply a financial analysis tool.

2.1.1.3 Senior Management Support

Interviews revealed that communicating the FIT value proposition to companies in the Pearson Eco-Business Zone is proving to be a challenge. While landlords are in the business of valuing the use of their properties, tenant businesses are typically more focused on their core competencies: tenant's typically invest scarce capital to improve their own operations and products. As discussed in Section 4, the institutional knowledge necessary to quickly and easily implement a FIT project is in short supply. In addition, there is the question of how well an aspiring solar power generator can manage the design, building and installation of a system that is well outside its traditional realm of expertise. Thus, presenting a favourable argument for a rooftop solar investment to senior management requires careful research and persuasive reasoning.

One large PV project cited support and advocacy from the company's president as integral to moving the project forward. This company viewed a solar PV project as an innovative way to energize both employees and stakeholders, while also demonstrating industry leadership. Businesses looking to project a green brand image have identified these types of opportunities as part of that strategy.

2.1.1.4 Sourcing PV Equipment

Domestic content requirements for solar PV projects and the lack of local expertise have created a dynamic market situation that Pearson Eco-Business Zone stakeholders have found difficult to stay fully informed on. The rapid increase in Ontario's PV equipment manufacturing capacity is a product of investment by local start-ups and foreign companies intrigued by the opportunities presented under the FIT. This includes

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13 See e.g. NRCan, "Photovoltaic potential and solar resource maps of Canada" Natural Resources Canada, online: https://glfc.cfsnet.nfis.org/mapserver/pv/index_e.php

14 Dianne Young, "Horse Palace Photovoltaic Pilot Project Findings Report" Exhibition Place (June 2009) at 13.

15 RETScreen is free software distributed by the Government of Canada designed to allow a project proponent "to analyse the technical and financial feasibility of renewable energy projects and then compare options to determine which package is best."

the resourceful but relatively inexperienced (in this field) Samsung Electronics, which is poised to enter the Ontario market following its groundbreaking deal with the provincial government.[16]

In addition to the opportunities created, as with other new industries, the novelty of Ontario's PV market creates a number of additional uncertainties that can discourage entry. First, the infancy of the industry could mean that supplier credit is not as readily available to project proponents as in more established supply chains, since new entrants are generally short on cash. Second, the serious push to meet the Province's mandated domestic content requirements (see Section 3.2.1.3) could decrease product and system quality, leading to higher future maintenance costs. Third, price competition will eventually emerge in the market, perhaps by sacrificing quality for affordability. Finally, project proponents are concerned that industry consolidation, which is predictable as an industry matures, could mean that suppliers will disappear, raising concerns about warranties and repair obligations for the duration of FIT contracts.

2.1.1.5 Securing Debt

Debt financing raises additional challenges for project proponents. Canadian banks are just starting to understand and quantify the risks associated with FIT projects. The CEO of SkyPower has publicly stated his company's reliance on European-based financing for solar projects in Ontario.[17] Recognizing the lack of local financial expertise in this field, the Toronto-based MaRS Discovery District played host to the *Green Energy Act* Finance Forum in January 2010,[18] which attracted the attendance of the Premier of Ontario. Even established clients may need to educate their banks about proposed projects and provide necessary financial guarantees based on other business assets.

Another avenue for project proponents is attempting to access debt financing through the various funds that have been created in order to promote the development of renewable energy projects through low-interest loans or grants. Eligibility for these programs may be limited, but should not be fully discounted by private sector actors. For instance, although the City of Toronto's Sustainable Energy Fund[19] requires that recipients operate in the municipal, academic, social and health (MASH) sectors, the Canadian Mortgage and Housing Corporation's Municipal Structure Lending Program[20] offers low-interest financing to a project so long as it is developed at least partly in conjunction with a municipality. While a full review of incentives is beyond the scope of this report, it is clear that increased research and information sharing in this respect could assist project proponents with financing challenges.

16 Government of Ontario, "Ontario Delivers $7 Billion Green Investment" Government of Ontario, online: <http://news.ontario.ca/mei/en/2010/01/backgrounder-20100121.html> ["These manufacturing facilities will produce wind turbine towers, wind blades, solar inverters and solar assembly in Ontario, creating more than 1,440 manufacturing and related jobs in the renewable energy industry. The local availability of these manufactured components will also help other renewable energy developers meet the Feed-In Tariff (FIT) domestic content requirements."]

17 Seminar on February 24, 2010 at the MaRS Centre, Toronto.

18 Conference presentations can be viewed at http://www.marsdd.com/greenenergyforum/resources.html

19 http://www.toronto.ca/energy/sef.htm

20 http://www.cmhc.ca/housingactionplan/hemubustco/muinleprfr.cfm

2.1.1.6 Ancillary Costs

Attempting to predict and quantify indirect and hidden costs relating to the installation and operation of a PV system is an additional challenge faced by project proponents attempting to ensure the most accurate payback period has been calculated. Over the life of an installation, FIT revenues may be reduced by local distribution company ("LDC") account fees (interim rates are currently under review by the Ontario Energy Board), equipment replacement (e.g. inverter), insurance premiums and operation and maintenance fees. One project developer has noted that any numbers being generated for the last variable are particularly "tight."

2.1.2 Investment with a Partner

A tenant and/or landlord could also opt to choose from a variety of hybrid project models in an attempt to share the development costs and benefits of a solar PV project. One obvious partner would be a project developer who can bring field expertise to the project. Should a completely new entity be created to take on the role of the solar tenant, it also offers an opportunity for landlords and tenants to work together on a project.

Another, less conventional structure available to Pearson Eco-Business Zone participants is a community renewable energy co-operative as defined under the *GEA*. Depending on a company's corporate social responsibility objectives, it may consider close collaboration with community stakeholders as an opportunity to enhance its brand and/or green credentials. This model could be another way for landlords and tenants to collaborate under the same corporate structure on a project.

At the other end of the spectrum are equipment-leasing products that have been developed to serve the emerging renewable energy generation market and rooftop solar in particular. At a minimum, a project proponent has the option of choosing between a capital lease (i.e. lease-to-own) and an operating lease with a purchase option. No doubt other permutations exist and it will require some research to determine the best option for any given project. Leases have been cited as providing proponents with a hedge against inflation, more secure cash flows and master leases for multiple locations.

2.1.2.7 Risk Allocation

One current challenge facing potential partnerships with a project developer is the allocation of risk, such as who bears the cost of underperforming systems. Pearson Eco-Business Zone participants expressed concern about the degradation rate of PV cells and unanticipated downtime, which could adversely affect business cases built on certain assumptions. If production does not meet its projected levels, which party will be responsible for meeting any difference?

2.1.3 Rooftop Lease

Under this scenario, a project developer would enter into a rooftop lease with a tenant or landlord and typically pay the other party a leasing fee. In return, the project developer would receive full control over the implementation of a "turnkey" rooftop PV project. In this case, the project developer would be responsible for project development decisions, incur all attendant costs, enter into a FIT contract with the OPA, take on the rights and obligations under that contract and collect the eventual FIT revenue.

Turnkey projects presumably offer tenants and landlords the ability to benefit from the FIT program without having to take on significant project risk. However, it is still unclear whether the market rates for rooftop leases being offered by project developers will adequately compensate lessors for the administrative and legal costs they will inevitably incur. The form of compensation is another open issue. Project developers could offer flat-fee or annuity-based payment options. The latter may even be contingent on system performance resulting in higher risk revenue.

2.1.3.8 Securing Financing

The general issue of financing for landlords and tenants hoping to directly finance PV projects are discussed above, but it is worth noting the specific challenges faced by project developers. While project developers may possess enthusiasm and more PV project installation and operation expertise than tenants or landlords, many are still only start-up companies with limited track records in Ontario. Financial institutions are wary of lending to businesses that lack an established record of at least four years. In addition, industry leaders have stated that Canadian banks are not inclined to provide commercial financing beyond seven-year time horizons.[21] This has created a situation in which some project developers are actually seeking financial assistance from potential project partners (i.e. landlords or tenants).

21 Kerry Adler, CEO of SkyPower at a public seminar on February 24, 2010 at the MaRS Discovery District in Toronto.

2.2 Rooftop Rights

In order to implement a rooftop solar PV project under the FIT program, the project proponent must possess a right to use the space on the proposed roof site. This is not a concern for owner-operated buildings; however, landlord-tenant relationships can present a more challenging situation. Whether a landlord or tenant, the aspiring project proponent will require a pre-existing right to the roof in its lease, or it must successfully negotiate one with its counterparty. In one case, an interviewee explained that as a tenant it approached its landlord to modify its upcoming lease. It was given relatively smooth approval for a right to redesign and use of its rooftop space. However, it is now fair to presume that landlords realize there is monetary value attached to their rooftops and will engage in more formal negotiations with tenants before signing away that value.

There is currently uncertainty regarding the value of rooftop space. Property managers are generally hired to lease out indoor space and most do not have extensive experience determining rooftop value. Early-moving property managers face the possibility of putting their job performance on the line if they make a serious valuation error. As such, landlords may be wary of making commitments before they have confidence in valuation procedures and/or more information or examples of successful rooftop rights negotiations. Fortunately, the market appears to be moving towards a consensus on rooftop value and once this information is widespread, it should provide a level of comfort to landlords.

As landlords and tenants engage in negotiations over rooftop rights, a number of issues could influence their positions. These are discussed below.

2.2.4 Project Justification

Both landlord and tenant project proponents face the issue of justifying a rooftop PV installation to their lease counterparty. Pearson Eco-Business Zone stakeholders have cited simply educating affected parties about the *GEA* and FIT program as a potential barrier. Landlords want assurances that a building tenant will have the financial resources and longevity to see a FIT project through to completion. A tenant may also need to convince a landlord that a FIT project will not impede the building's future leasing options (see Subsection 2.2.2).

Similarly, landlords face challenges justifying a project to their tenants. No doubt tenants will be most directly affected by a project's downsides. For instance, any issues that arise with regards to building structural integrity, panel maintenance/security or electrical components could hinder a tenant's full use and enjoyment of its facility. At the same time, the tenants are not entitled to receive any FIT revenue despite any inconvenience they might experience. From a landlord's perspective, this makes it difficult to determine if the return on a PV installation is worth the potential risk of alienated tenants. However, these challenges do not appear insurmountable. One benefit that could be promoted to building tenants is reduction or elimination of their sole responsibility for maintenance costs related to roof repair by securing these payments from a solar tenant. Landlords could also negotiate compensation agreements with tenants that could compensate for inconvenience or disruption that results from installation of a PV project. It should be noted that some property managers believe that mounting and operating a solar PV system will not be significantly different from other rooftop projects such as cellular communications equipment or rooftop signage.

2.2.5 Future Rooftop Usage

Landlords are concerned about locking their rooftop space into a fixed design for 20 years (the duration of a solar PV FIT contract). This is a serious concern in an industry where the lifespan of a typical rooftop is also 20 years, meaning that a roof could easily need refurbishment within the 20-year period of a FIT contract. In addition, the needs of future tenants (or even the future needs of a current tenant) are uncertain and a rooftop solar installation may limit a landlord's rental options. If the landlord is the project proponent, it could mitigate this challenge by opting to reserve space on the rooftop(s) from the PV project to save room for future development. On the other hand, if a building tenant or project developer attempts to secure rooftop rights, it could find itself facing landlords wary of allowing the solar tenant to lock a building into a 20-year commitment without some input into the design of the PV installation. Both of these approaches could reduce the maximum return on a proposed PV project by limiting its size and constraining its design.

One other consideration is emerging regulation targeting green roofing. Municipalities, such as Toronto, are implementing bylaws requiring green roofs on new developments. To date, local regulations have provided exemptions for rooftop renewable generation projects from any green roof obligations.

2.2.6 Lease Structure

Once the allocation of rooftop rights has been settled, interviewees explained there are challenges in managing both building tenant and solar tenant lease agreements. If the building tenant is also the solar tenant, then it will be necessary to ensure that the leases are co-terminus, or that the building lease is longer than the solar lease, as the OPA expects its counterparties to honour the full 20-year FIT commitment. This could prove a challenge for tenants negotiating with property managers whose practice includes lease periods that are significantly shorter than 20 years and for at least one Pearson Eco-Business Zone property manager no more than five. Other issues identified by Pearson Eco-Business Zone stakeholders in negotiating rooftop leases include:

- A need for financial covenants from the solar tenant;
- A commitment from the solar tenant to manage and pay for scheduled roof refurbishment;
- An articulation of obligations for project-related roof repairs;
- An articulated contingency plan if the rooftop lease cannot be fulfilled;
- The status of the solar installation in the event of a decision to redevelop the property;
- Fair and effective penalties and out-clauses for the parties; and,
- A clarification on the post-FIT status and removal of the PV equipment.

2.2.7 System Portability

The OPA requires that a project proponent lease its premises for the duration of the FIT contract. However, if a tenant's building lease is terminated, it will have an impact on its FIT rights and responsibilities. Assignment of a FIT contract to another party is contemplated within the FIT program but negotiations with and approval from the OPA are required. A tenant faces a difficult challenge if it attempts to move its solar PV system along with its operations to new premises. Thus, judging a proponent's long-term business viability could emerge as a project consideration for a landlord.

2.3 Other Considerations

2.3.8 Property Taxes

Pearson Eco-Business Zone participants have raised at least four property tax issues. First, building tenants currently pay property taxes and no consensus has yet emerged on what share a solar tenant should contribute. Second, if property value increases due to the presence of a PV system, a question arises of whether the organization that pays those taxes is also the one that is benefiting from the revenue being generated by the installation. If not, it appears the FIT program is inadvertently creating a fairness issue. Third, potential proponents are concerned about whether the installation of a PV system would change the classification of a property for tax purposes and discussions with the Municipal Property Assessment Corporation confirm this is possible. Finally, municipalities such as Peel Region currently do not levy property tax on some properties. A concern is that these properties will suddenly be required to pay property tax once a revenue generation project is installed at the property. Stakeholders have expressed the desire to see governments provide clarification for some or all of these issues. At a minimum, the entire industry expects the Province of Ontario to follow through on its expressed commitment in the 2009 budget to amend legislation to ensure that property tax assessments are not impacted by renewable generation facilities.[22]

2.3.9 Tax Credits/Depreciation and Incentives

Various tax credits and incentives could be used to offset the capital cost or otherwise incent project implementation. For instance, the Canadian Renewable and Energy Conservation Expense program provides for 100 per cent tax deduction on the intangible expenses incurred in setting up a PV system eligible under section 43.1 of the *Income Tax Act*. There is also the possibility of an accelerated capital cost allowance schedule for renewable energy equipment. Finally, the federal ecoENERGY for Renewable Power program could offer an additional revenue stream, although it is rapidly reaching its commitment limit.

2.3.10 Insurance

The insurance industry is still in the early stage of developing products and solutions for rooftop solar systems. There has been some cross-pollination from the wind energy experience and some lessons learned from other rooftop installations such as communications equipment and signage. Nevertheless, there remains market uncertainty in terms of underwriting rooftop PV projects. Some projects have managed to fit under a business' general corporate policy, while other proponents have put the issue of obtaining insurance on hold despite bringing their systems online. One interviewee's experience in the homeowner market suggests it may simply be a case of adding the installation value to the property and adjusting the premiums accordingly. From the insurance brokers' perspective, live issues include assurances from a structural engineer and how to treat the issue of business interruption.

2.3.11 Technology Development

As the market expands to meet the increasing global demand for PV panels, there is a significant opportunity for innovation in available technologies, panel performance and manufacturing processes. This will lead to lower production costs and a higher conversion of solar irradiance, the latter of which provides greater energy generation from a given PV installation. Industry participants foresee an appreciable reduction in PV prices over the next 2-4 years, causing some potential installers to wait before committing to a project. Project proponents prefer to make their 20-year long commitment with the best available technology.

22 Ministry of Finance, "Ontario Budget 2009: Chapter I; Confronting the Challenge: Building Ontario's Economic Future" Government of Ontario, online: <http://www.fin.gov.on.ca/en/budget/ontariobudgets/2009/chpt1.html#c1_green>. ["The government will make Ontario a champion of a green economy, with a sweeping group of initiatives that build on the province's strong record of protecting its natural resources. They include… proposed amendments to the Assessment Act and regulations under that Act to provide that the assessment of properties would not be affected due to energy-efficiency enhancements."]

There is a general fear of technology becoming obsolete. However, given that the degradation of the nameplate capacity of current PV panels is well understood,[23] there is greater certainty in using new technology even if it may ultimately prove to be surpassed in the near future.

2.3.12 OPA Performance Securities

The OPA has set out a schedule of milestones that must be met for each FIT project and this includes the payment of two performance securities. These securities are designed to ensure the potential proponents are serious about committing to the FIT program and are not merely taking time and attention away from other projects. Solar PV projects are subject to the highest FIT rate of all renewable energy projects and are calculated on a per kilowatt basis. The first performance security is due within 10 days of a contract offer and the second is due within 30 days of a notice to proceed. Both are returned once a project reaches commercial operation.[24]

2.3.13 Connection Costs

Before a project proponent begins the FIT application process with the OPA, it must contact its LDC to determine whether a connection can be made to the proposed site and what costs could be involved. An application form is a required part of the process. Any new construction required to connect a project to the existing grid will be the cost responsibility of the project proponent. The cost of upgrades that benefit the existing system will be shared between the LDC and the proponent. Allocation will vary depending on the type of upgrade required.

23 Nameplate capacity (the amount of electricity that a PV module is designed to produce) typically degrades after the first year and stabilizes at about 80 per cent of capacity thereafter.

24 Ontario Power Authority, "Feed-In Tariff Program: Program Overview" Ontario Power Authority (2009) at 11.

3. Legal and Policy Hurdles

Government policies and incentives are vital to facilitate the implementation of rooftop solar PV in any jurisdiction. This is particularly true in Ontario, where energy prices are relatively stable and modest, while the cost of PV is still quite high. Without facilitating policy, the implementation of rooftop solar would not often be economical. The policy and legislative change that spurred this study and the influx of rooftop solar in Ontario were largely brought about by the introduction and enactment of the *Green Energy and Green Economy Act* ("*GEGEA*") in 2009. This act amended 21 pieces of legislation and created the new *Green Energy Act*, which provides a guaranteed price for electricity generated by approved renewable energy projects through the FIT program. Rooftop solar benefits from this well-above market price guarantee. Therefore, a discussion of the provincial legal and policy challenges raised here will focus on working within the new FIT regime.

Of course, there are various other legal hurdles to address to ensure successful implementation of rooftop solar. These include rooftop leasing agreements, contractual agreements for the installation, operation and maintenance of the PV systems, liability, insurance concerns, municipal law and policy and the increasingly relevant topic of solar access rights.

3.1 Federal Law

Generally, the federal government does not have direct jurisdiction over energy generation in Canada. However, there are various federal government programs that may affect the implementation of rooftop solar in the Pearson Eco-Business Zone.[25] In particular, the federal ecoENERGY for Renewable Power program provides an incentive for renewable energy systems. However, the FIT program diminishes the value of this rebate. According to the FIT contract, 50 per cent of the ecoENERGY benefit must be remitted to the OPA. Additionally, the federal government has indicated that it is unlikely to renew funding to this program, leaving questions about access to federal incentives for renewable power.

The federal government has also announced its intention to create a climate change regime, which will include an offset system.[26] Most rooftop solar projects would be considered outside the scope of potential greenhouse gas ("GHG") reducing legislation and therefore, may be eligible (at face-value) to create offset credits. However, under the FIT program, the OPA retains any environmental attributes, which means that a project proponent will not be able to receive any value from the offset potential of its rooftop solar project.

The main challenge with respect to federal law is to follow and understand how the various federal programs interact with provincial, municipal and private law and policy in a way that may affect proponents.

3.2 Provincial Law

3.2.1 The Green Energy Act and the Feed-in-Tariff

Generally, the provinces have been given constitutional jurisdiction over energy generation in Canada. There are various pieces of legislation and bodies in Ontario that touch on the energy system, which may need to be considered in implementing rooftop solar here. Challenges such as a developing market, developing technical capabilities of workers, lack of education, awareness and understanding, and connectivity constraints are still present. These challenges may be presenting real or perceived barriers to the implementation of rooftop solar in the Pearson Eco-Business Zone.

Many of those we spoke with indicate that rooftop solar would not be economical in Ontario without the FIT program administered by the OPA, or some other form of government support. Therefore, an understanding of the challenges surrounding the FIT program is crucial. This discussion is divided into the following sections: the FIT contract, price, domestic content, connection issues, transmission capacity, renewable energy approvals, and environmental attributes. Related issues including leases, insurance, and landlord/tenant relationship will be addressed in Section 3.3.

3.2.1.1 FIT Contract with the OPA

Proponents must understand whether their project is eligible for a FIT contract, and what the implications are of becoming a party to that agreement. The eligibility requirements are not onerous, and are set out in

25 Not all are discussed here, for instance, federal tax considerations are dealt with under Section 2

26 The Offset System for Greenhouse Gases would allow entities not regulated by a cap on emissions to create credits corresponding to approved emissions reductions. It is contemplated that renewable energy may be eligible to generate offset credits under a future federal offset system. For more information please see: http://www.environment-canada.ca/creditscompensatoires-offsets/default.asp?lang=En&n=109DDFBA-1

the following table:

Requirements for Rooftop Solar Projects:
• Located in Ontario, at a location that project proponent has control over; • Use solar PV technology; • Connect to an eligible local distribution system, host facility or the IESO-controlled grid • Be separately metered for data collection and settlement purposes; • Have no existing OPA contract (note: transition provisions available in some cases); and • Meet the domestic content requirements as set out in Exhibit D of the FIT Contract.

Once the project proponent is satisfied that its solar PV project meets FIT eligibility requirements, it can then consider whether to apply for a FIT or microFIT contract as applicable. The two programs can be distinguished as follows:

FIT Program	microFIT Program
Small, medium and large renewable energy projects.	Very small renewable power projects suitable for homes and small business installations.
Generating electricity of >10 kW	Generating electricity of <10 kW.

This report assumes that Pearson Eco-Business Zone participants will be most interested in the FIT program and seeks to focus on concerns related to this program. The FIT program includes application fees ranging from $500 to $5000 as well as an application security charge of $20/kW for solar projects and $10/kW for all other projects. Applicants must also show that they have access rights to the facility (i.e. a lease or title for the duration of the FIT contract).

The domestic content requirement may be a particularly challenging aspect of the FIT eligibility requirements and will be dealt with below (Section 3.2.1.3).

Those who are awarded a FIT contract[27] must make the capital investments in the project and bear all the operating and maintenance costs. They must also ensure that the project is connected with an LDC

27 The contract has been revised as of Nov 19, 2009 and can be found at http://fit.powerauthority.on.ca/Page.asp?PageID=924&ContentID=10263

and be able to work on the Internet for the purposes of project registration, contract acceptance and communication.

Another challenge is keeping apprised of and understanding FIT program developments; for example, changes communicated by the OPA on November 19, 2009 indicate that only one rooftop solar PV facility shall be permitted on any single property. The communication states:

> *this means that more than one project can be located on the same property (for example, multiple rooftop projects on different building), provided the total capacity of the projects located on the property is reflected in a single application and all the projects share a common connection point*[28]

That is just one example of requirements that could change and must be understood in order to ensure a successful application. Other potential issues are connection assessments, connection costs and network upgrades are dealt with, requirements for commercial operation, and the suppliers reporting requirements. For many organizations venturing into electricity generation for the first time, the contract will pose a challenge and outside consulting or legal support will inevitably be required to ensure a full understanding and compliance with its terms. Additional detail about the particular elements of the FIT contract is outside of the scope of this report.

3.2.1.2 Price

The FIT program provides a guaranteed price for certain renewable electricity supplied to the grid. The guaranteed price is only paid for electricity actually delivered. The price received, coupled with the expected electricity output will determine whether a project is financially viable. Prices set for the initial period of the FIT program are set out in the table below:[29]

Feed-in Tariff Prices for Rooftop Solar in Ontario
Base Date: September 30, 2009

Size of Rooftop Solar System	Contract Price cents/kWh
$\leq$ 10 KW	80.2
> 10 $\leq$ 250 KW	71.3
> 250 $\leq$ 500KW	63.5
> 500 KW	53.9

It is anticipated that most rooftop solar projects contemplated in the Pearson Eco-Business Zone will receive 71.3 or 80.2 cents per kilowatt-hour over a 20-year contract. Understanding the details of the price

28 FIT Program Update – November 19, 2009. Found at: http://fit.powerauthority.on.ca/Storage/99/10831_Summary_of_FIT_Program_changes_November_19_2009_for_posting.pdf

29 Certain projects are eligible for a price adder if they meet requirements for aboriginal or community participation, this price adder is unlikely to be available for rooftop PV. More information can be found at: http://fit.powerauthority.on.ca/Page.asp?PageID=122&ContentID=10380&SiteNodeID=1103&BL_ExpandID=260

guarantee and how that price factors into the economic viability of the project seems to be a surmountable barrier. It is anticipated, but not yet confirmed, that the government will review and reduce tariff rates for future contracts.

3.2.1.3 Domestic Content

The FIT program requires that a certain proportion of the labour and materials that make up the contract facility be sourced domestically from within Ontario. The applicant must show the OPA (in a prescribed form) how it intends to meet the minimum required domestic content level, no later than six months before the milestone commercial operation date.

Generally, solar projects with a contract capacity greater than 10kW must show 50 per cent domestic content if the commercial operation date (COD) is prior to January 1, 2011. Projects over 10kW with a COD after that date must show 60 per cent domestic content. For solar projects of less than 10kW those numbers go down to 40 per cent prior to January 1, 2011 but jump to 60 per cent after that date. The OPA has also laid out how much of certain domestic activities can contribute to the domestic content total, referred to as the Qualifying Percentage. For instance, according to Exhibit D – Domestic Content[30] of the FIT contract, PV projects greater than 10kW utilizing crystalline silicon PV technology, which have *photovoltaic modules (i.e. panels), where the electrical connections between the solar cells have been made in Ontario, and the solar photovoltaic module materials have been encapsulated in Ontario* can use that component to qualify as 15 per cent domestic content. A facility will need multiple domestically sourced components (which could include labour) to reach the 40-60 per cent thresholds. The domestic content of a facility must be communicated through a Domestic Content Report.

Since most solar PV componentry is manufactured outside of Ontario there are concerns and challenges associated with this requirement. These include:

- Difficultly in quickly bringing proven technology into the Ontario marketplace;
- Inferior quality materials being rushed to market;
- lack of information sharing on how to "get around" the domestic content rule (many organizations explained their solutions to this challenge was the "value-added" they provide to projects; and,
- Some projects may not meet domestic content requirements, but hedge that the OPA will not strictly enforce this rule in the short term.

3.2.1.4 Connection and Transmission Capacity

Concerns over the availability of connection capacity have been raised. The OPA website states that "after the launch period, applications will be prioritized according to their estimated date of commercial

30 http://fit.powerauthority.on.ca/Storage/99/10810_FIT_Contract_Version_1.2_Exhibit_D_Domestic_Content.pdf

operation, with the earliest estimated commercial operation dates getting top priority for connection capacity." Therefore, there is an incentive to move quickly towards commercial operation to attain priority connection capacity. Many are concerned that this is a short-sighted policy which may lead to lower quality material flooding the market more quickly, and, coupled with the difficult-to-achieve domestic content rules, may pose a problem for rooftop solar projects in particular.

Distribution and transmission issues may be more of a perceived barrier with respect to rooftop solar and should not pose a real barrier in the Pearson Eco-Business Zone. The assumed capacity in the region, coupled with the small size of most projects dictates that distribution and transmission are unlikely to be a serious hurdle; however, the existence of these concerns should be acknowledged as a communications issue. For a further discussion see Section 5.1.

3.2.1.5 Renewable Energy Approvals

The Renewable Energy Approval (REA) integrates provincial review of the environmental issues and concerns that were previously addressed through the local land use planning process, the environmental assessment process and the environmental approvals process (such as Certificates of Approval and Permits to Take Water).[31]

Rooftop solar facilities of any size are exempt from the obligation to obtain an REA and all other certificates of approvals and permits issued by the Ministry of Energy. Facilities mounted on buildings, however, may require a municipal building permit. Thus, the REA should not be a barrier to rooftop solar, however, it may be perceived as a barrier for those who are not fully informed about FIT requirements.

3.2.1.6 Environmental Attributes

Environmental attributes are defined as the rights arising from the environmental impacts associated with generating renewable energy. They are also often referred to as offset credits or Renewable Energy Credits and may form another revenue stream associated with renewable energy projects. Projects that receive the FIT contract price must hand over these environmental attributes to the OPA and, therefore, they are not entitled to any of the economic value associated with them.

Renewable energy proponents who want to participate in the carbon market may have concerns over the OPA's ownership of environmental attributes generated under the FIT program, but the high price premium paid for electricity generated by rooftop solar under the FIT has mitigated much of the concerns associated with this issue. In addition to the economic value potentially associated with environmental attributes there are concerns over the "right" to make a claim in marketing or advertising materials or in corporate reporting documents that a project contributes to emissions reductions if these attributes are ceded to the OPA. In other words, it is arguable that proponents cannot make claims regarding the emissions reduction qualities of renewable energy projects, because the right to claim those "credits" has been acquired by the OPA. This issue is often referred to as the "double counting" problem and is a source

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31 Environmental Registry. EBR Registry Number 010-6516 *Proposed Ministry of Environment Regulations to Implement the Green Energy and Economy Act, 2008*. Found at: http://www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=MTA2NDQ5&statusId=MTYxMzcx&language=en

of frustration and concern for many market participants.

No one we spoke with in the course of our research mentioned offset credits as an important reason for her or his decision to implement rooftop solar. Although some industry participants discussed a desire to retain the environmental attributes, all agreed that it was preferable to obtain the FIT price and give up the right to claim any offset credits/environmental attributes. Once there is a more developed offset market in Ontario, this may become a more significant issue.

3.2.2 Compliance with Other Provincial Laws

The *GEA* largely eliminates the need for regulatory environmental and municipal approval prior to construction and operation of PV solar systems; however, other environmental laws may be relevant and pose real or perceived challenges. For instance, legislation regulating the handling of hazardous materials and waste may be applicable if solar panels are considered hazardous material. Used solar panels could be required to be treated as hazardous waste under provincial and federal environmental laws.

The Building Code may pose a challenge, as it does not require commercial/industrial roof structures to be able to withstand loads that include rooftop solar equipment. This will be discussed more fully in Section 5. According to some interviewees, buildings constructed to comply with the building code requirements for load in the last 10 years may not have the capacity to withstand heavy rooftop solar installations.

3.2.3 Compliance with Tax Laws and Taking Advantage of Tax Incentives

Tax laws and incentives have a role to play in the attractiveness of implementing rooftop solar. (This is also address in Section 2.) The challenge is understanding the myriad of rules that might apply or incentives that could be used to improve the financial viability of the project. Identifying all the potentially applicable tax laws and incentives is beyond the scope of this report; however, the following issues were raised by interviewees and should be noted:

- Renewable energy tax incentives,
- PST/HST rebates,
- Property tax reclassification in light of new revenue stream and
- Property tax increase due to assets of significant value attached to the property.

3.3 Private Law

Rooftop solar presents businesses with familiar legal relationships and issues in areas such as property, tort and contract law, but also raises at least one novel legal question related to solar access rights. The FIT contract should prove to be the cornerstone of most rooftop solar projects supported by related supplier and contractor agreements. All rooftop solar projects require some understanding and clarification of the rights and responsibilities (including leasing, supplier, operation and maintenance contracts) between the parties to the contract. Below is a synopsis of private law issues that are currently seen as outstanding by project proponents.

3.3.4 Rooftop Lease

Many current building leases are not explicit about rooftop use or access rights. Whether the project proponent is a tenant, landlord or project developer, securing the rights to the target rooftop will be one of the first steps of any project. Many of the issues that require addressing are often found in standard lease situations and therefore should not be challenging to negotiate and address in contracts. One analogous model with potential applicability has been the leasing of roof space to telecommunications companies for the installation of antennas, batteries and other equipment for cellular communications.

Questions have also been raised about the applicability of "green leases" in the context of rooftop solar installations. Green leases are designed "to incorporate ecologically sustainable development principles to ensure that the use and operation of a building minimizes the impact on the environment."[32] These leases typically address conservation, building material and sustainability initiatives and rarely, if ever, discuss energy generation. Thus, at present, green leases have very limited applicability to rooftop solar.

3.3.5 Equipment & Installation Agreement(s)

Project proponents will have to determine the best approach to buying and installing PV equipment. Property management companies with a large portfolio of properties might consider starting with pilot projects in order to whittle down the winning designer and/or installer in a competitive "design-build" bid process. Proponents with less roof space could simply obtain proposals from various installers before choosing one. Regardless of the approach, common issues apply.

One notable challenge is meeting time constrains within the FIT application process. It is important to verify that bidders for a project (or their subcontractors) will possess the capacity to punctually deliver components as required (or to negotiate suitable liquidated damages provisions

32 Borden Ladner Gervais LLP, "The Emergence of the Green Lease". *Commercial Real Estate Law Alert. December 2008.;* See also the Real Property Association of Canada definition. ["A lease that seeks to remove disincentives in a commercial lease to reduce energy, water and raw material consumption, increased recycling, as well as the use of sustainable materials in tenant improvements, and encourages sustainable practices by both the landlord and the tenant. A green lease works to ensure that tenants and landlords are required to adopt environmentally friendly practices."]

into supply agreements). Technology supply, given domestic content requirements and the fact that much of Ontario's PV manufacturing capacity is dedicated to previously committed projects, could also prove to be a bottleneck in the near-term.

Once equipment has been sourced, it is important to consider how it will be installed, because installation will inform the structure of the wiring sequence required for monitoring and grid connection. Thus, a thorough commissioning, verification and monitoring program should be put in place before construction in order to ensure a smoother installation process.

Finally, representations and warranties are important for any piece of PV equipment, but are particularly significant when considering newer but less-tested products. Potential project proponents have raised the long-term durability and specifications of newer systems as concerns. Solar companies are attempting to mitigate this risk by offering 20-25 year power warranties stating their systems will produce 80 per cent of a system's nameplate capacity; however, a key issue is whether the company providing those warranties will still be in business in 20 years to honour them for the duration of the warranty.

3.3.6 Operation & Maintenance Agreement

Rooftop solar installations will require monitoring, operation and maintenance. Project proponents need to determine whether they want to take on this responsibility or outsource it to a more experienced third-party.

A well-designed monitoring system will ensure that electricity generation is maximized from the PV system and promote prompt troubleshooting. Without a protocol to quickly alert appropriate parties to any issues, there is a risk that a project will not produce its maximum potential income. Project proponents should consider how they want to be notified of production issues, and they should get direct access to, and have training to understand, their project's data.

PV pilot projects, such as the Horse Palace at Toronto's Exhibition Place (see Appendix A), have identified the importance of regular visual inspections of the entire PV system as an integral complement to rigorous data monitoring. For instance, in the Horse Palace experience, one array cable became detached and resulted in an undetected reduction in the production rate that was wrongly attributed to adverse winter conditions. A project developer related another winter story about panels covered in snow that continued to register voltage but were not producing any power. Frequency and confirmation of visual inspections is an issue to consider under these agreements.[33]

3.3.7 Solar Access and "Right to Light"

Solar access over the period of the FIT Contract was raised as an issue by some stakeholders. Solar access has been defined as "the ability to have uninterrupted direct rays of sunlight fall onto one's property."[34] A

33 *Supra* note 15

34 Ronald M. Kruhlak, "A Legal Review of Access to Sunlight in Sunny Alberta" The Alberta Environmental Research Trust, 1981 at 5

"right to light" would be a legally enforceable right to access a natural and unobstructed flow of solar light. Businesses may be concerned about having uninterrupted solar access for the duration of the FIT Contract arising from future development on neighbouring properties which would block sunlight. Others have also identified this as a issue, for example, the UN International Sustainable Energy Organization has concluded, "the lack of such legal rights is a significant deterrent to investment in solar and wind energy."[35]

There is currently no "right to light" for Canadian property owners. In 1978, the Ontario Court of Appeal stated, "at common law, there is no natural right to lateral light."[36] Thus, the court confirmed that property owners enjoy an unrestrained right to build on their land even if their construction will cause shading on a neighbour's property. However, other common law jurisdictions (most notably the state of Wisconsin) have recognized a right for solar PV owners to access sunlight.[37] As PV systems become more common this may become a more significant issue.

The Ontario Municipal Board (OMB) has recognized a limited right to sunlight on this issue. However, it also predicated this recognition on the basis of local zoning bylaws that were at risk of being violated by a developer.[38] It remains to be seen whether the OMB would limit development without a breach of a by-law or similar legal obligation.

Solar developers can negotiate an agreement with neighbouring landowner(s). However, as this is a developing issue the fair market value associated with this right may be unknown and may not be determined until the market has more fully taken shape. It is clear that additional questions on this issue may need to be addressed in the future.

3.3.8 FIT Contract

FIT contract issues are discussed in more detail in Section 3.2.1.For the purposes of this section, it is just important to note that the FIT contract is unique in North America. While power purchase agreements are fairly common in the United States, the FIT contract has not yet been put to serious legal tests. With so many parties affected by a virtually identical document, future alterations or litigation could have a profound impact on the industry.

3.4 Municipal Law & Policy

As discussed in Section 3.2.1.5, the GEA has attempted to make the development of renewable energy projects as smooth a process as possible. In particular, the province has established the Renewable Energy Facilitation Office as a "one-window access point to assist renewable energy project proponents (developers, communities and municipalities) obtain information about bringing

35 International Sustainable Energy Organization, Energy Law and Sustainable Development (Geneva, n.d.), online: http://www.uniseo.org/legal.htm

36 *Earl Putnam Organization Ltd. v. MacDonald*, 91 D.L.R. (3d) 714, 8 C.P.C. 208, 1978 CarswellOnt 467, 21 O.R. (2d) 815 (Ont. C.A. Oct 12, 1978)

37 *Prah v. Maretti*, 321 N.W. 2d 182 (Wis. 1982)

38 *Portland Investments Inc. v. City of Toronto*, O.M.B.R. 1995 (30 December 2004)

their projects to life."[39] Rooftop solar projects are especially well positioned to take advantage of this streamlined approach because of their exemption from any obligation to obtain a Renewable Energy Approval or any other certificates of approval and permits issued by the Ministry of the Environment. However, there are some local issues that may still require a proponent's attention. A synopsis of the key concerns is provided below.

3.4.9 Official Plans

Municipal Official Plans may not have a major role to play in the approval process of a specific rooftop solar project, but they could influence the policy climate in which rooftop solar PV is implemented. Official Plans may serve an educational purpose to residents by outlining a municipality's objectives with respect to renewable energy projects. In addition, Official Plans could set the tone for the type of support a project proponent can expect to receive from the municipality's administrative functions (e.g. building inspections). Finally, it should be noted that the OMB has referenced Official Plan objectives in its decisions, which may prove instructive to future litigation involving solar PV projects.

3.4.10 Building Permits

Each municipality may have its own approach to building requirements. It may be wise to contact the relevant municipality early in a project life cycle. This early consultation is also recommended by the OPA to ensure all details are discovered. The Renewable Energy Facilitation Office may be able to offer some guidance, but should not be considered the last word on building permit requirements.

Single-building tenants or landlords should find it fairly easy to meet the requirements of their local municipality's building department. A more challenging situation occurs when a portfolio of projects is under consideration across multiple municipalities. It should not be taken for granted that each municipality will have the same requirements. This could cause a less uniform approach, increase costs and reduce the benefit of anticipated economies of scale for large project proponents.

3.4.11 Zoning By-laws

Municipal by-laws can act as both a sword and shield for the development of renewable energy projects in general and rooftop PV in particular. A by-law acts as a shield when it protects a PV system from the threat of neighbouring development. As mentioned earlier, the OMB has cited solar PV projects that relied on existing zoning by-laws for their installation as a contributing factor as to why it would not amend those by-laws to facilitate proposed neighbouring developments.

By-laws can also act as a sword by promoting the development of renewable energy projects. For example, the City of Toronto has recently passed a by-law clarifying that, subject to some minor qualifications, "the production of renewable energy…shall be permitted uses in all zones or districts of the City of Toronto."[40] Supportive by-laws may not provide solar access certainty, but they are a step in a favourable direction. Having stated this, it is still unclear whether a development that complies with all local zoning by-laws

39 http://www.mei.gov.on.ca/en/energy/renewable/index.php?page=refo_office

40 City of Toronto, By-law No. 218-2008

could be circumscribed simply by virtue of its shading a neighbouring PV installation.

Another by-law issue is the emergence of other "green" by-laws that have recently been proposed and passed by municipalities. Toronto, for example, has created a Green Roof By-law requiring that a given percentage of each new roof be set aside for green space.[41] The by-law will apply to all new commercial buildings constructed after January 31, 2010 and industrial buildings constructed after January 31, 2011. The challenge will be to determine how this and other by-laws impact rooftop solar PV installations.

3.4.12 Electrical Inspection

Before a PV project can be connected to the grid it must be inspected and approved by the Electrical Safety Authority (ESA). ESA approval is the final step in the FIT process, and the ESA is responsible for ensuring that Ontario Electrical Safety Code (OESC) requirements are met. Once a PV installation is complete and meets the OESC requirements, the ESA will send a connection authorization to the LDC.

4. Institutional Knowledge/ Capacity Hurdles

Time and time again in our interview process we heard concerns over the speed at which the rooftop solar PV market is developing, the lack of available "experts" in the field, and reluctance over diverting business assets into unknown territory. Property managers told us they had to worry about whether rooftop solar would negatively affect their tenant relationship(s), because, after all, they were in the business of getting and keeping tenants. Property owners told us they were not sure of the true value of their rooftops, and they were somewhat skeptical of the influx of project developers seeking to facilitate rooftop solar on their buildings. Others related the sentiment that "if it seems too good to be true, it probably is". We have classified all of these concerns and challenges as *capacity hurdles* and believe that they may be the most significant challenges, since education and changing entrenched corporate practices can take more time than resolving technical and financial issues and require multi-party support.

4.1 Internal Knowledge vs. Reliance on Service Providers

The significant cost and relative novelty of rooftop projects for many organizations means there are serious challenges in establishing in-house knowledge with respect to PV technology. In addition, there may be a lack of internal resources available to understand, commission and act upon opportunities to implement rooftop solar in the Pearson Eco-Business Zone.

Institutional knowledge is lacking for most building owners or potential project proponents. Some service providers have experience in integrating and implementing systems; however, there are a large number of new players in the market, leaving potential proponents to face many options with little internal experience to guide their decision-making.

41 City of Toronto By-law No. 583-2009

In the related field of energy efficiency and accredited buildings (such as LEED[42]), internal knowledge is increasing. Despite this, it appears that internal knowledge and capacity to implement rooftop solar is only being contemplated by the largest property management companies and market leaders. Even among market leaders, many seem to prefer outsourcing much of the implementation process. Potential proponents need reliable information on payback, expectations, electricity generation and general operational issues under the FIT program. To address the lack of internal capacity, potential proponents must decide whether to outsource, put resources into building internal capacity, or go forward with some combination of the two.

Information sharing has also emerged as a significant challenge. Although some organizations and service providers are arriving at solutions for various challenges, it appears that information sharing amongst participants in the Pearson Eco-Business Zone is lacking. This is largely attributable to competitive pressures and firms claiming solutions as a trade secret or "secret sauce." Not sharing these solutions exacerbates challenges to rooftop solar installation in the Pearson Eco-Business Zone and may lead organizations to duplicate efforts in the project development processes.

4.2 Market Development

Almost all interviewees referenced the influx of service providers, market players, integrators and those generally seeking to get involved in this bourgeoning sector as a potential challenge. How do project proponents pick the right service provider? How do they ensure they are getting reliable service when there are few providers who have experience working with solar generation in the province? How can they understand the numerous creative financing structures emerging? We have labeled this challenge *market development* because it encompasses the sentiment that novel financial issues, a lack of installation and operational experience and copious amounts of information need to be navigated. Obvious market leaders and best practices have yet to fully emerge in Ontario.

Service providers, including investment brokers, insurance brokers, real estate agents and lawyers are working to understand and develop roof and equipment leases in the context of FIT contracts. The market is also demonstrating creativity that could lead to some interesting and new arrangements (novel asset ownership structures, for example).

Manufacturers are figuring out procurement and domestic content rules. Some interviewees fear that the short timelines for getting into the FIT program, coupled with onerous domestic content regulations could lead to products being brought to market too quickly and sacrificing quality, while others think that domestic content rules could serve as an effective break on an over-heated market.

As there have only been limited large-scale rooftop solar installations in Ontario, installation capacity is thin and not many firms have experience with solar installations. CanSIA and others are working to address the lack of installation capacity. For instance, Durham College in Oshawa has created a Renewable Energy Technician course but it only began in Fall 2009 and will not graduate students until the Spring of 2011 at the earliest. A need for roofing experts, electricians, structural engineers and property managers to work

42 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council, provides a suite of standards for environmental sustainable construction.

together in partnership seems clear. The market will need to develop to address concerns expressed in the other sections of this report, and until it does, there will likely be significant challenges to widespread installation of rooftop solar in the Pearson Eco-Business Zone.

4.3 Focus on Core Competencies

Businesses know that they must stay at the top of their game with respect to their core competencies. Venturing outside of these core competencies may be counter productive. Just as a business does not undertake construction of its own buildings, its managers may not feel comfortable engaging in a new type of construction and operation of a renewable energy system.

Small and medium-sized businesses are especially challenged in this regard; they often have limited staff with a number of roles on the go, and dedicating staff time to the nuts and bolts of implementing rooftop solar may be a perceived or real barrier. As simple as this challenge may seem, much time was spent discussing it with interviewees and it appears to be a major hurdle.

5. Technical Hurdles

Photovoltaic electricity generation is a proven technology; nevertheless, issues related to its technical aspects pose challenges to ensuring that a quality product is installed and that, after installation, it is operated correctly. These challenges can be a perceived barrier to implementation but are mostly avoidable by appropriately considering and understanding the issues and solutions. We break the concept of technical hurdles down into two broad categories. The first are those that may be encountered during the installation phase. Second, we consider operational hurdles, concerns related ultimately to the performance of a rooftop solar PV system once it is operational.

5.1 Technical Hurdles during the Installation Phase

A primary technical impediment to the installation of rooftop solar can be constraints posed by the roof system itself. For instance, roofs of a certain age or construction may be less desirable for a solar installation and may require a significant refurbishment before such an installation is possible. Ideal conditions include roofs with 10-20 years remaining before significant maintenance or overhaul is required; if the roof lifetimes are shorter than this, then using ballasted systems that can be moved periodically, rather than fastened PV mounts is likely a better choice during installation. In terms of physical characteristics, flat rooftops with asphalt or comparable exterior surfacing are best for commercial/industrial rooftop solar installations. By far the most important issue to verify, however, is the roof's structural soundness. It is imperative to ensure that the roof will support the total weight of the PV system including racks and supports, the so-called "dead load," and to make sure to account for all existing loads on the exterior and interior of the roof as well as uplift loads due to wind blowing under the modules.

In accordance with the policies of a municipality's building code, the solar system and roof may need to pass inspection. Reductions in total system weight can be achieved by mounting the panels flat on the rooftop, although this will impact their performance as discussed in Section 5.2.

Complications with the rooftop that can occur during the installation of the rooftop system include problems with water leakage and proper fastening of the PV cells and their mounts. Water leakage can occur in any location where the building envelope must be pierced for either support or electrical considerations. In some cases, weighing down the system (ballasting) as opposed to direct fastening to the roof can avoid most of the need to penetrate roofing.

Other technical difficulties affecting the installation stage include complications due to connection with the distribution systems. Distribution systems are comprised of electricity lines under 50 kV and are operated by the LDCs from whom most customers acquire their electricity. The process for connection to the distribution system under the FIT program is illustrated in Figure 2. The proposed site must pass a transmission and a distribution availability test performed by the OPA and by the LDC respectively, which determines whether these systems can support the added production. If these tests fail, then the project enters an economic connection test where it is determined whether the necessary upgrades are economical. If upgrades are accepted or are already underway then the project is moved to the production line and will be accepted once the completion date of the required upgrades is known with certainty. If the upgrades are deemed to be uneconomical at the current time, the project is placed into the reserve until such time that the upgrades are economical and are approved. Fortunately, many projects are eligible for exemption from the connection approval process through the GEA, and can thus take advantage of a simplified application process. Exempt projects include systems of 250 kW or less connected to a 15 kV distribution line or projects of 500 kV or less connected to a 15 kV or greater line[43].

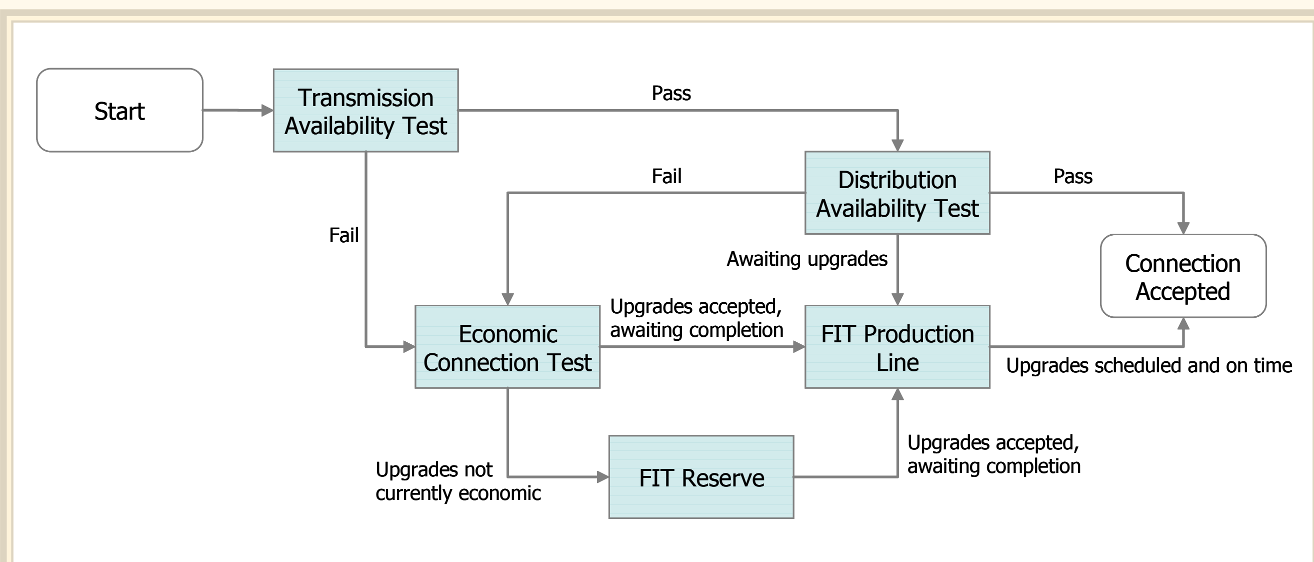

Figure 2: Connection approval process

43 OPA, 2009. Capacity Allocation Exempt Projects. http://fit.powerauthority.on.ca/Page.asp?PageID=751&SiteNodeID=1118

After the project is approved and built, it must successfully complete an electrical inspection by an approved Electrical Safety Authority electrician. A licensed installer should complete the installation and apply for the inspection as it can be difficult to ensure that correct procedures and design are followed in accordance with electrical standards. If a non-licensed party completes the installation it will cost $400 instead of $250[44].

5.2 Ensuring Quality Performance

Several design decisions and operational issues affect the performance or lifetime energy production of a rooftop solar PV system. In general, the design decisions require a tradeoff between cost and system output, which has a direct impact on revenue. Some operational decisions will see the same tradeoffs being made, while others will be required in every situation. The following sections will address some of the issues that must be considered related to quality performance.

44 ESA (Electrical Safety Authority), 2009. Electrical Safety Authority: Renewable Generation Safety. Accessed October 2009. <http://esasafe.com/GeneralPublic/sgi_002.php?s=24>

5.2.1 Design Decisions

5.2.1.1 Alignment Choice

A primary design issue is the correct alignment of the PV modules to maximize the power density of incident radiation. The alignment is set by the module's slope, measured from the horizontal and the module's azimuth[45], generally measured from due south as indicated in Figure 3. The choice of slope generally requires a trade-off between incident diffuse and incident direct radiation. The latter is maximized when it is perpendicular to the surface of the cell, since in other orientations the beam of radiation strikes the surface over a larger spread out area which results in a reduced power density. Collection of diffuse radiation is increased by lowering the slope of the PV modules so diffuse radiation from the surroundings can strike the cells.

The optimal choice of azimuth depends on the slope of the module, the geographical location and the mounting system used. For example, if the slope is zero then the azimuth is no longer a factor. If the system is installed in a northern location (above latitude of about 23°) the best practice is to set the azimuth to zero or directly south if the modules are mounted in a fixed position.

The entire set of techniques for setting the slope and azimuth includes fixed racks; racks whose slope can be changed periodically; azimuth trackers; and one and two axis trackers. The trackers follow the path of the sun along their degrees of freedom to optimize the solar incident radiation. As indicated in Figure 4 below the choice of alignment technique can have drastic implications on the annual output of a PV system. For instance, the percentage difference between the best and worst techniques, two axis tracking and fixed horizontal alignment respectively is nearly 30 per cent assuming energy used for the tracking systems is negligible, which may not be the

45 Azimuth is the angular measure in spherical coordinates, usually measured in degrees

case in all circumstances. As alluded to before however, this choice of technique can incur a higher capital and operating cost and the tracking systems are likely not feasible for a rooftop system.

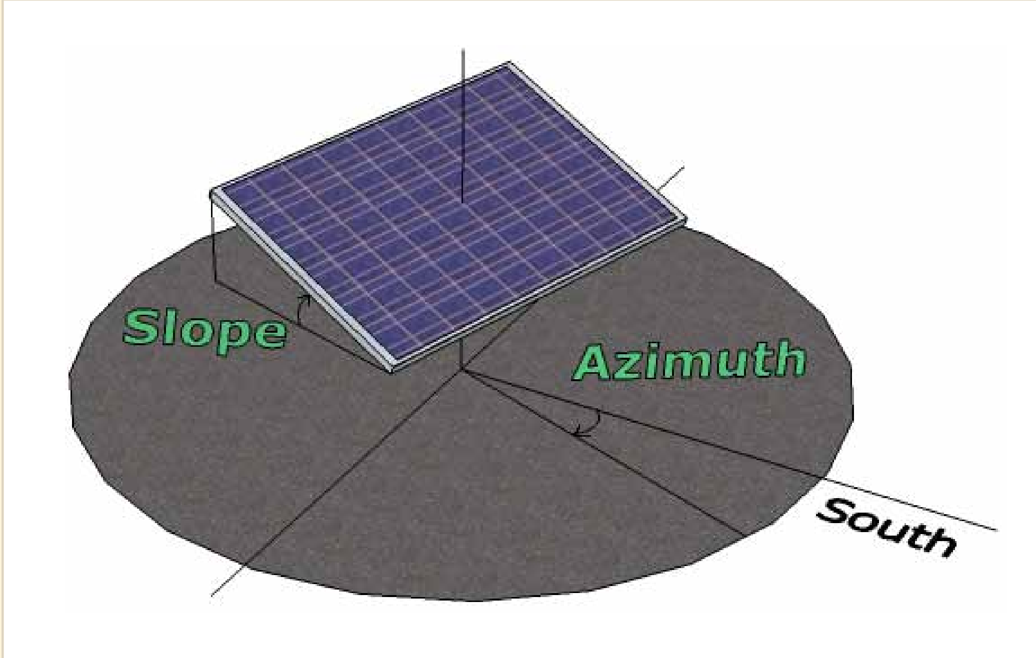

Figure 2: Photovoltaic Slope and Azimuth Schematic
The slope is measured from the horizontal and the azimuth is generally measured from South.

Also indicated in Figure 4 is the type of losses that can be expected. Typical losses will be in the range of 17 per cent and it is important to also consider that some shading will occur due to snow and other factors. Planning for a shading loss of around 5 per cent is appropriate in most cases where due diligence is conducted to ensure most sources of potential shading are avoided.

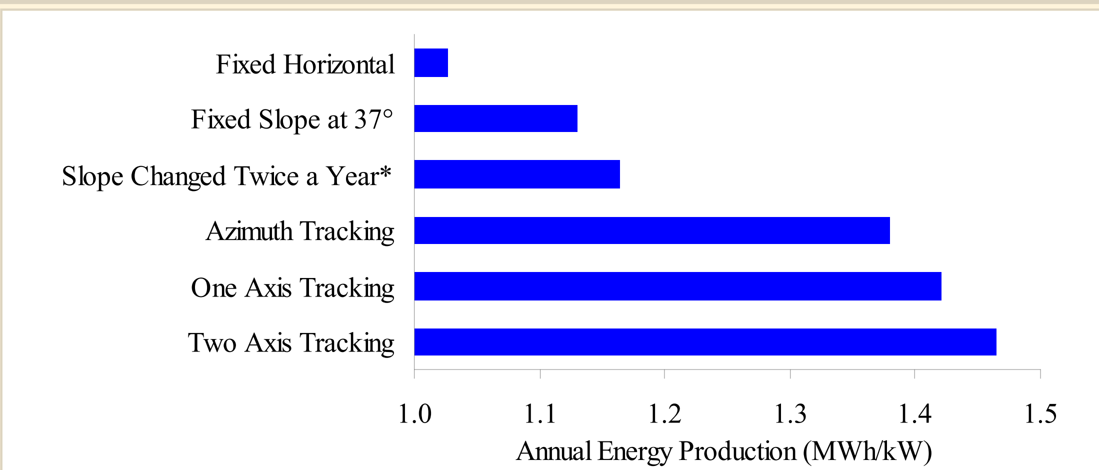

Figure 4: Annual PV energy production per kilowatt installed for various tracking systems
For cell efficiency of 16 per cent, inverter efficiency 94 per cent, and miscellaneous losses of 11 per cent for an overall efficiency of just over 13 per cent with an additional 5 per cent loss due to shading.
* Set to 28.7° for April through September and 58.7° otherwise

5.2.1.2 Mounting Arrangement and System Performance

When decisions regarding the alignment and subsequent mounting of cells are being made, careful attention should be paid to the spacing of the modules and the degree of coverage of the roof. In the case of spacing, it is important to leave enough space for movement of air around the modules to reduce overheating the cells in hot weather. As the temperature of PV cells increases, their efficiency decreases. The decrease in efficiency will vary with such factors as cell type, but could decrease by 0.3 per cent with each increase of 5°C. This can be a particular issue for horizontally mounted modules, since it is sometimes easiest to mount them on roof surfaces without any room for air flow.

To address the issue of overheating and to take advantage of unused heat, hybrid thermal-photovoltaic systems are available. These systems are available in two broad categories. The first includes a thermal collector mounted on the backside of PV cells to capture waste heat that can then be used for space or process heating in the building. The second hybrid type is a parabolic solar thermal collector, which reflects incoming solar radiation onto a collector positioned along the foci of the parabola to collect the thermal energy. PV cells can be installed on the outward facing side of the thermal collector. Both these system types can increase the overall efficiency of solar radiation collection.

Proper spacing is also important to facilitate maintenance activities. Additionally, when the modules are not horizontally aligned, it is important that there is adequate spacing between them such that they do not shade one another when the sun is low in the sky.

Finally, it is important when planning a rooftop solar system to keep in mind possible future uses for roof space. In some circumstances building tenants or operators may need to alter rooftop equipment, such as by adding an air conditioning system or upgrading other heating and ventilation components.

5.2.1.3 PV Technology Choice

Another design decision impacting performance is the choice of photovoltaic cell. As noted by CanSIA,[46] it is important for customers to be aware of 1) the meaning of a cells power rating and 2) its actual proven performance in the solar conditions where it is going to be installed. Performance can vary between cells types by 60 per cent[47] and can even vary between cells of the same power rating. CanSIA recommends that customers consult third party evaluation of any cells they are considering to ensure quality performance.

5.2.1.4 Power Conditioning System Choice

Performance is also influenced by the choice of inverter system. Inverters convert the direct current (DC) power generated by solar cells into alternating current (AC) power for use in a building or for distribution to the grid. In so doing, inverters must compute the optimal power output of the system by determining the maximum power point (MPP) where power is equal to the product of current and voltage. Figure 5 illustrates how the MPP can vary between cells of the same type, which means that inverters must select an average

46 CanSIA (Canadian Solar Industries Association), 2005. Performance Standards for Solar Electric Modules. Accessed October 2009. <http://www.cansia.ca/Content/Documents/Document.ashx?DocId=12239>

47 Williams, S.R., Gottschalg, R., Infield, D.G., 2004. PV Modules Real Operating Performance In The UK, A Temperate Maritime Climate. 19th European Photovoltaic Solar Energy Conference.

MPP. This cell variance and other factors including shading due to debris, leaves, snow and clouds can significantly increase the variation between MPPs of the different parts of a rooftop solar system and increase the losses resulting from selecting an average. Technologies such as distributed inverters or systems with power conditioning built into the modules are becoming available on the market and should be explored in the same way as cell types, through comparison of cost and benefits with the help of third party information.

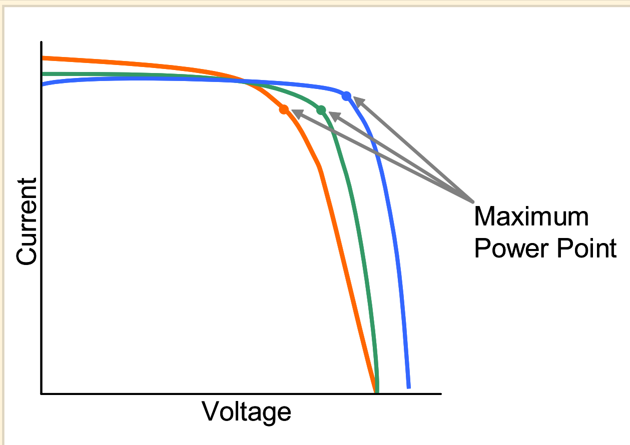

Figure 5: Max Power Point Variation

5.2.2 Operational Issues

Operational issues affecting rooftop PV performance include the planning and scheduling of proper maintenance and monitoring related to the durability of the system. Firstly, maintenance requires, at a minimum, proper removal of debris and snow from the system and periodic cleaning of the solar cells. Other more significant care and upkeep of rooftop PV systems is not required frequently. However, it is recommended that, in the event that no in-house staff with significant experience with these systems is available an external firm be used. Long-term maintenance contracts can be established with third party firms, or their services can be acquired on an as-needed basis.

Lastly, there is the issue of durability and degradation. In general, all materials used should be fit for the harsh climate that exists in Southern Ontario. It is important to plan for a certain degree of degradation, specifically in the cells themselves; as they age, their power output will decrease slightly. It is important to perform long-term monitoring of the rooftop PV system to ensure performance is not degrading faster than permitted by any agreed upon warranties.

6. Recommendations for Further Study and Action

The following are suggested recommendations for further study and action. They should not be considered comprehensive. Further work is suggested to identify the most appropriate actions to ensure challenges are overcome and the rooftop PV market in the Pearson Eco-Business Zone is developed.

Education and Communication

- Education and communication materials related to how the FIT program works, what government incentives are available, the nuts and bolts of market development
- Expand on programs to help train solar installers, integrators and project developers
- Provide opportunities to share information
- Education on structural requirements

Legal Information and Templates

- Leasing templates
- Insurance information
- Contract information sessions to discuss tenancy concerns and other legal issues

Identifying Service Providers

- Directory listing of service providers related to rooftop solar in particular, with rating/comment capability
- Creation or use of accreditation process for service providers, to drive trust and reliability

Policy and Regulatory Amendments

- Seek clarity on policy and/or regulation related to rooftop solar implementation such as:
    - Tax implications, especially property tax assessments
    - Other approvals (such as NAV Canada)

Pilot Projects

- Consider partnering/facilitating pilot projects in the Pearson Eco-Business Zone to:
    - Provide market development and serve as an experiential learning opportunity
    - Allow pooling of resources to mitigate risk

7. Summary and Conclusions

The level of opportunity to implement renewable energy generation in Ontario has reached an historic high. The FIT program, combined with falling costs associated with PV equipment, presents a unique economic climate for an investment in rooftop solar electricity generation. Moreover, the Pearson Eco-Business Zone is well positioned to take advantage of this opportunity, particularly with regards to solar power. The Pearson Eco-Business Zone boasts a significant portfolio of roof space in a geographically ideal location to exploit solar energy, parties with the resources to properly evaluate the risks and rewards of adopting rooftop solar project (such as property management companies), an established mandate under Partners in Project Green to collaborate on eco-business initiatives and relatively minimal grid connection issues. Nevertheless, as our research has revealed, most potential project proponents still find themselves questioning the value of a rooftop solar investment. Thus, TRCA finds itself in the position of being able to usefully address some of these issues on behalf of the Pearson
Eco-Business Zone.

Many of the concerns raised by businesses in the Pearson Eco-Business Zone can be distilled to one overarching issue: uncertainty. Rooftop solar may be analogous to some previous projects such as rooftop cellular communications equipment, but it has enough unique characteristics that parties are raising a variety of questions related to economic viability, legal complications, product quality and project developer soundness. Many of these questions have already been answered in the market, but that information has not necessarily found its way to businesses focused on addressing other issues more closely related to their core business priorities. Facilitating their access to this information will be important to assisting their internal decision-making process.

Fortunately for participants in the Pearson Eco-Business Zone, a number of projects have been undertaken locally and around the world from which lessons can be drawn. Thus, even though the FIT program is unique in Ontario, it does not present itself as a complete Pandora's Box to potential proponents. In addition, despite the fact that it presents a significant learning curve, proponents can take solace in knowing that the FIT program's goal is to provide a positive rate of return and to be accessible to even the smallest proponent. As the market matures, many of these issues should work themselves out.

If the Pearson Eco-Business Zone is to emerge as a leading area for rooftop solar implementation participants must move early and make progress. Partners in Project Green is an ideal vehicle to provide Pearson Eco-Business Zone participants with an opportunity to learn-by-doing and diffuse those lessons among a large group of progressive businesses. It may even be worthwhile for the Pearson Eco-Business Zone to engage in pilot projects of its own in order to share the risks and costs associated with early projects. As issues are resolved, the projects should provide encouragement for wider uptake of rooftop solar and give proponents the peace of mind they need to make their own investments.

Appendix A – Case Studies

Hershey Center

The Hershey Centre in Mississauga has a large open roof that faces south for maximum energy absorption. It is considered to be a state of the art facility. Its rooftop is now home to 144 photovoltaic panels. The system will produce 25 kW of electricity at peak output and is expected to produce 28 000 kWh/year. This power will be sold to the Ontario grid, generating $12 500 in revenue per year and will reduce emissions by 25 000 kg/year. The project is estimated to cost $300 000 and is jointly funded by the city of Mississauga and Enersource Mississauga, with each partner providing $150 000. Carmanah Solar Power Systems Group out of Victoria B.C. will design, project manage and install the solar power system. Carmanah has expertise in producing grid ties solar systems. They were also involved in the Horse Palace installation.

The system is made up of 144 Sharp 175 Watt solar modules and four SMA SB7000 inverters. The system also involves a Fat Spaniel Data Acquisition system, which features web based monitoring technology that will provide live content allowing the public to view power generation in real time. Maintenance costs are expected to be approximately $1000/year.

Exhibition Place Horse Palace

The Horse Palace installation was designed as a feasibility study to compare the performance of technology alternatives under otherwise common environmental and operating conditions. It is a pilot project intended to build capacity and aid in market development for large roof-mounted PV systems in Toronto and to gain experience with the Province of Ontario's then Renewable Energy Standard Offer Program. Simple payback for the project is expected to be 16.7 years taking into account grant support. Without grant support the project would see capital costs paid off in 30.5 years at a price of 42 cents per kWh. Payback would come in approximately 50 years if the system switched to net-metering at 12 cents per kWh after the 20 year Standard Offer contract ended. The Horse Palace Photovoltaic Pilot Project Findings Report (June, 2009) is available online at http://www.toronto.ca/taf/pdf/solarcity-horse-palace-june2009.pdf.

Some Lessons Learned

- Expected output is approximately 103, 275 kWh/y. However, in 2008 it only produced 96,724 kWh. Underperformance was attributed to energy production losses experienced in part of the array due to a problem caused by night-time power use by inverters.
- Obstructions such as flag poles, bill boards and exhaust fans were not properly taken into account.
- Panels were not installed at a true south facing position. Instead they were lined up with building structure and magnetic south. This accounted for only a 1 per cent decrease in expected output.
- Proximity to traffic lead to soiling of the solar array. Increased tilt is beneficial as it facilitates self-cleaning.

- Panels angled at 20 degrees were the best performers, but there was also a relatively strong performance from the flat panels, which take up less space, reduce roof loads and provide increased insulation for the building. They also do not have to be spaced as far apart because of self-shading issues.

FedEx distribution facility - Woodbridge, NJ

FedEx is installing a 2.4 mW solar array atop its distribution facility in Woodbridge NJ. This array will provide up to 30 per cent of the facilities energy needs, will cover 3.3 acres of rooftop space and will feature approximately 12,400 solar panels. It includes 5,769 photovoltaic panels and 306,378 solar cells. When completed, it should generate 2.6 million kilowatt hours of electricity annually.

The system is being built under a power purchase agreement (PPA) with BP Solar installing and operating the array and FedEx purchasing the power generated at an unspecified fixed rate. BP Solar's commercial projects team is focused on assisting corporations, such as FedEx Freight, to lower their energy costs while lessening the impact of their operations on the environment. The company offers a variety of financing options for its business customers including power purchase agreements, leasing and traditional purchase plans. FedEx would not reveal how much the installation would cost, but it is estimated to be approximately $7.2 million. The project also received a $2.5-million rebate from utility PG&E, through a state-mandated incentive program. It is unclear when a return on investment is expected, however, Mitch Jackson, director of environment for FedEx, said it would take more than three years.

Hydro One Brampton

Hydro One Brampton installed two solar installations to act as a working demonstration, one typical of a commercial installation (20 kW) and one typical of a residential installation (1.5 kW). The building is 154 000 square feet and is 16 years old. The cost of the installation was $220 000 with a simple payback of 24.5 years. Income from generation is approximately $8956/y.

Annual output is 21 325 kWh. The installation uses a ballast mounted non-roof penetrating racking system. The system uses 105 Sanyo 195Wp Solar modules configured in 3 separate solar arrays each connected to 3 SMA SunnyBoy SB7000 Inverters rated at 7 kW each.

Appendix B: Lessons from Germany

Germany provides solar PV project proponents in Ontario with both an understanding of the origins of the province's *Green Energy Act* and a sense of how Ontario could modify its feed-in-tariff (FIT) program. Germany enacted its first FIT program in 1991 with the passage of the Energy Feed-In Law (*Stromeinspeisungsgesetz*). Since then, the German program has been periodically amended to reflect the country's greater understanding of the FIT's benefits and challenges. The most significant change came in 2000 when Germany enacted the Renewable Energy Sources Act (*Erneuerbare-Energien-Gesetz* or EEG), which was most recently amended in 2009.

In the German experience, the solar industry did not especially benefit from the FIT program until an amendment to the EEG in 2004. This provided solar power with a big boost as the going rate for solar energy generated from household rooftops was raised to seven or eight times the market rate. This marked the beginning of a solar-age for Germany. In that year alone, 600 MW of solar PV systems were installed. Up until 2004, the combined number of all systems ever installed in the country was only 405 MW.[48]

Similarities to the *Green Energy Act*

Starting with the Feed-In Law, the guiding principles behind Germany's FIT were (i) an obligation that generators be guaranteed access to the electrical grid and (ii) guaranteed compensation to generators via a feed-in tariff. These concepts eventually came to form the backbone of Ontario's FIT program. Other similarities between the two programs include (i) a guaranteed payment period of 20 years, (ii) a tariff table indicating rates by technology and installation size whereby smaller systems receive higher rates while large industrial installations and utility-scale ground-mounted systems receive less; and (iii) an element of cost sharing between installation operators and grid operators for connecting and upgrading the grid to accommodate increased renewable energy generation and transmission.

Differences to the *Green Energy Act*

Given Germany's relatively extensive experience with feed-in-tariffs, it is understandable that its FIT program has since evolved from its most basic principles. However, it is worth highlighting some of the differences as they may provide signposts for how the Ontario program could evolve. Some of these differences relevant to solar PV include:

- *Tariff Degression*: The German FIT imposes an annual tariff degression (reduction) depending on solar PV market maturity and the existing cost reduction potential. This tariff degression is flexible and depends on actual market growth.[49]

- *New Category:* A rooftop solar PV category for 1,000 kW systems was created.

48 Marcus Maedl, "The German FIT for Renewable Energy - A Bargain!" 18 April 2008 RenewableEnergyWorld.com, online: <http://www.renewableenergyworld.com/rea/news/article/2008/04/the-german-fit-for-renewable-energy-a-bargain-52156>

49 Note that as of January 2010 is currently a political debate raging in Germany about this issue with pressure to increase the rate of degression

- *Façade Bonus:* A previously applicable supplemental bonus for façade systems of 5 cents/kWh was recently cancelled.
- *Personal Consumption:* Ratepayers with rooftop solar PV systems may opt to use the electricity generated for personal consumption and receive a reduced FIT payment plus bonus depending on the price of conventional electricity.
- *Market Choice:* Enables power producers to sell their electricity on the spot market. In order to gain experience on the conventional power market, producers can shift between the fixed FIT option and market sales on a monthly basis.
- *Remote Control:* Systems greater than 100 kW must have remote control capability.
- *Program Review:* Every two years, the German Parliament re-evaluates the EEG on the basis of a report that is prepared by the Ministries of Economics and Technology, in consultation with the Ministry of Environment and the Ministry of Agriculture.

Incidental Regulations

It should be noted that Germany's FIT program is a federal legal framework; whereas, the Ontario FIT is obviously a provincial construct. This means that the German government must rely on its states to create regulatory climates in which its FIT program can flourish. Conversely, Ontario has considerable control over other laws and regulations that may incidentally affect the success of its FIT program.

The most obvious examples of laws that can support or hinder a solar PV FIT program are zoning and building laws. In Germany, these laws are typically under the purview of more localized governments such as states (*Länder*) and municipalities. Local planning authorities are responsible for preparing regional and local development plans (*Bebauungsplane*), including areas designated for renewable energy projects. This primarily affects wind development, but also has an impact on biomass and PV projects. In the event there is no existing local development plan, general (for instance federal) planning law is applicable and provides privileges for renewable energy installations.

In terms of solar energy specifically, communities have the option of using their local development plans to establish obligations for the use of solar energy in designated areas. Communities have also been given the ability to more easily object to project developments, generally wind, outside of the designated areas in their local plans. In terms of building laws, small-scale PV installations are typically exempt from this process.

Implications for the *Green Energy Act*

Perhaps the most obvious implication for solar PV project proponents in Ontario is the concept of degression. There is currently nothing to suggest that Ontario FIT rates will decrease; however, it would be folly to assume these rates will remain unchanged. Even in Germany, which boasts a burgeoning solar industry, the Parliament has recently engaged in an intense debate about how their rates should decrease more rapidly. Industry leaders even volunteered to accelerate the decrease in order to mitigate any damage from a larger one being legislated by politicians. Thus, it may be tempting to wait for technology prices to continue to push down solar equipment prices while FIT rates remain unchanged in order to increase a project's return on investment. However, it is a state of affairs that may not continue unchanged.

Appendix C - List of Interviewees

Name	Organization
Scott McLorie	*Lennard Commercial Realty*
Tom Wasik	*Enersource*
Patty Hargraeves	*CanSIA*
Jen Aitchiscon	*Jones Brown Insurance*
Gordon Shields	*Net-Zero Energy Home Coalition*
Debbie Baxter	*Loyalty One*
Rob McMonagle	*City of Toronto, Solar Neighbourhoods*
Ken MacDonald	*GWL Realty Advisors Inc.*
George Vassallo	*Amp Solar, Roofing expert*
Deborah Seaton	*Helios Energy*
David Wawrychuk et al	*Orlando Corp.*
Jen Heneberry	*Ontario Co-operative Association*
Representative from Toronto Hydro (name unknown)	
Various attendees at Partners in Project Green meeting on November 20, 2009 and the Workshop held on February 10, 2010 also provided valuable input	

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