Small Scale, Big Impact: A Comprehensive Evaluation of Ontario's microFIT Program

A Major Paper submitted to the Faculty of Environmental Studies in partial fulfillment of the requirements for the degree of Master in Environmental Studies, York University, Toronto, Ontario, Canada

Dawn Strifler
July 31, 2012

_____	_____
Dawn Strifler	**Mark Winfield**
Student	Major Paper Supervisor

Acknowledgements

To my family, friends, and especially my partner, Ben, I offer my sincerest thanks for your unwavering support throughout this endeavour.

I would also like to thank Mark Winfield for his help in shaping my research question, his guidance through unfamiliar territory, and his enduring patience.

Finally, I would like to express the utmost gratitude to those who took the time to provide information, enhance my understanding of specialized subjects, and participate in interviews. Without you, a comprehensive evaluation of this important policy would not have been possible.

Foreword

This Major Research Paper (MRP) is the culmination of a course of study designed to provide a thorough understanding of the environmental policy and communication strategies which can encourage public support for and use of sustainable energy solutions. The subject of the MRP – Ontario's microFIT Program – aligns well with this educational program given that it is a policy that encourages homeowners and organizations to generate electricity from renewable resources. Although an evaluation of the microFIT Program could have encompassed all three components of my Area of Concentration, the scope of the paper necessitated a focus on only two – *Understanding Sustainable Energy Choices* and *Understanding Environmental Policy*.

The completion of this MRP was an effective strategy by which several learning objectives associated with these two components were achieved. With respect to the first component, *Understanding Sustainable Energy Choices*, my examination and analysis of the structure of, response to, and impact of the microFIT Program greatly enhanced my understanding of policy environments which encourage sustainable energy choices (Learning Objective 1.1). In particular, my knowledge of the multitude of factors which must be considered in the development of energy policy was enriched. My understanding of the technological capacity to incorporate renewable energy into the electricity grid was also enhanced (Learning Objective 1.2).

With regard to the second component of my Area of Concentration, *Understanding Environmental Policy*, the course of research undertaken to complete my MRP enhanced my understanding and practice of important policy research methods (Learning Objective 2.1). My examination of the factors and forces which influenced the microFIT Program's structure as well as the development of recommendations for policy change improved my understanding of and experience with policy creation (Learning Objective 2.2). Finally, my knowledge of and experience with important

policy evaluation methods and tools was enhanced throughout the production of this MRP (Learning Objective 2.3).

Abstract

A key component of Ontario's landmark Green Energy and Green Economy Act, 2009 is its feed-in tariff (FIT) for renewable energy. The FIT is divided into two streams: the FIT Program, through which the Ontario Power Authority (OPA) procures electricity produced by renewable energy generation systems with a nameplate capacity greater than 10 kilowatts, and the microFIT Program, through which the OPA purchases electricity from generation systems of 10 kilowatts or less. Despite its distinct differences from the FIT Program and the significant criticism it has received, the microFIT Program has been the subject of minimal independent research, and the policy has not been comprehensively evaluated. Moreover, little quantitative information about program outcomes has been released to the public by Ontario's energy institutions. With an aim to provide independent analysis suitable for comparison to the results of a formal program review conducted by the provincial government, this paper presents a comprehensive evaluation of the energy production, economic, social, and political impacts of the microFIT Program in an effort to determine whether the program can be justified from political and sustainability perspectives. More specifically, the paper

- examines the government's goals for the program and determines whether they have been met;
- investigates the full range of program benefits and detriments, and utilizes sustainability assessment criteria to evaluate whether the program can be considered sustainable; and
- assesses whether policy acceptance has been achieved among various stakeholder groups.

The evaluation establishes that all of the broadly defined goals set for the microFIT Program by the Ontario government have been met. However, the program has so far failed to advance sustainability because it may cause adverse effects and does not maximize sustainability gains. The program has also failed to achieve policy legitimacy among any stakeholder group directly impacted by

the program. The analysis suggests that program adjustments can help the microFIT Program achieve these goals, particularly measures to reduce costs and stabilize the solar PV industry. In addition, the paper argues that the program offers benefits to the province of Ontario which cannot be provided by other types of electricity generation or policies. It concludes that the microFIT Program deserves continued support and the commitment and resources needed to achieve policy success.

Table of contents

1. Introduction

1.1. Ontario's Green Energy and Green Economy Act, 2009

In early 2009, Ontario's government was facing problems in two of the most important aspects of society: the economy and the electricity system. The provincial economy was in a precarious state. A global recession had begun in late 2008, and Ontario, in the words of the Minister of Finance, had been "hard hit."[1] In addition, the province's agricultural communities were not prospering. Small and medium-sized family farms had been experiencing declining net operating income since 1995.[2] The average net operating income of family farms with revenues between 50,000 CAD and 99,999 CAD had been negative since 2003, while farms in lower revenue classes had been experiencing such conditions since at least 1995.

The province was also struggling with a shortfall in future electricity supply. This shortage was identified in 2004 and was attributed to aging infrastructure, project delays and the provincial government's commitment to eliminate coal-fired electricity generation.[3] The shortfall persisted throughout the decade, with the government asserting in its 2010 Long-Term Energy Plan that "15,000 MW [megawatts] will need to be renewed, replaced or added by 2030."[4] Moreover, the governing Liberal Party of Ontario was facing pressure to improve the environmental sustainability of the province's energy system. Some party members and political advisors had called for increased efforts to

---

[1] Ontario, Ministry of Finance, *2009 Ontario Economic Outlook and Fiscal Review* (Toronto: Queen's Printer for Ontario, 2008), 21-22, accessed January 13, 2012, http://www.fin.gov.on.ca/en/budget/fallstatement/2009/paper_all.pdf.

[2] Canada, Statistics Canada, "Summary Tabulation of the Canadian Farm Financial Database – Total Income of Farm Families (Unincorporated Sector)" (table), *Canadian Farm Financial Database* (database), 2010, last modified January 14, 2010, http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ESASaction=Pick1&ESASData=ESAS2008&Res-Ins=CFFD-BDFEAC/ESASPick&JS=1. Net operating income was calculated by selecting the following database variables: all years, total for all regions, total of farm types, all income classes under 249,999 CAD. Net operating income is adjusted for capital cost allowance and excludes off-farm income.

[3] Electricity Conservation and Supply Task Force, *Tough Choices: Addressing Ontario's Power Needs* (n.p.: Ontario Ministry of Energy, 2004), 25, accessed January 13, 2012, http://www.centreforenergy.com/documents/242.pdf.

[4] Ontario, Ministry of Energy and Infrastructure (MEI), *Ontario's Long-Term Energy Plan: Building Our Clean Energy Future* (Toronto: Queen's Printer for Ontario, 2010), 9, accessed January 13, 2012, http://www.mei.gov.on.ca/en/pdf/MEI_LTEP_en.pdf.

reduce the environmental impact of the electricity sector,[5] and the Green Energy Act Alliance – a coalition of environmental groups, industry associations and other stakeholders – was carrying out a strong advocacy campaign for green energy legislation.

Under the influence of these dynamics, the Green Energy and Green Economy Act, 2009 (GEGEA)[6] was introduced to the provincial legislature on February 23, 2009. Given Royal Assent later that spring, the Act comprised a comprehensive set of measures to reduce the environmental impact of Ontario's electricity system, including conservation programs, "smart grid" development, and a feed-in tariff (FIT) to promote electricity generation from renewable resources. The Act was praised for its innovative approach and programs,[7] but it also drew criticism, as will be seen below.

1.2. Ontario's feed-in tariff

Following the passage of the GEGEA, the Minister of Energy and Infrastructure assigned responsibility for developing and implementing the feed-in tariff to the Ontario Power Authority (OPA). The OPA officially began accepting applications for program participation on October 1, 2009. Through the program, the OPA purchases renewable electricity generated from qualifying, contracted projects at stipulated prices per kilowatt-hour (kWh) of electricity produced. Eligible renewable energy projects may generate electricity using solar energy, wind, water, biomass, biogas or landfill gas. Electricity supply from these projects is procured for a period of 20 or 40 years, depending on the renewable resource.

The program goals initially stated by the Minister were to increase generation of and investment in renewable energy, maintain sufficient electricity generation capacity, reduce emissions, and facilitate

[5] Rebecca MacWhirter, "Electricity Policy in Ontario: Sources of Instability and Implications for Ontario's Green Energy Act" (MES Major Research Paper, York University, 2010), 43.
[6] *Green Energy and Green Economy Act*, SO 2009, c12.
[7] Ontario, Ministry of Energy and Infrastructure (MEI), *Proposed Green Energy Act Attracts Industry-Wide Support* (Toronto: MEI, 2009), accessed January 14, 2012, http://www.cansia.ca/sites/default/files/ONT%20MEI%20gea-quotes.pdf.

new business and job opportunities, particularly in the manufacturing sector.[8] The Ministry later clarified that the key policy objectives of the program were to reduce the environmental footprint of the provincial electricity system and protect the health of citizens by supporting the elimination of coal-fired electricity generation, and to create jobs and investment opportunities.[9]

1.3. The microFIT Program

Ontario's feed-in tariff is applied to two separate categories of renewable electricity generation projects. These categories are differentiated by project nameplate capacity. Projects with a nameplate capacity greater than 10 kilowatts participate in the FIT Program, while projects of 10 kilowatts or less participate in the microFIT Program.

Aside from project capacity, the microFIT Program differs from the FIT Program in two important respects. First, while the goals of the FIT apply to both program categories, the microFIT Program is intended to achieve additional objectives. One such goal is to broaden the scope of stakeholders reaping the benefits – financial and otherwise – of renewable energy development.[10] Whereas FIT projects are most often commissioned by large renewable energy developers, medium to large businesses and organizations, and organized community groups, microFIT projects were intended to be developed by homeowners, small business owners, and other small organizations such as municipal governments, schools and faith institutions. Another unique objective of the microFIT Program is to stimulate rural economic development. Although this has not been cited as an official

[8] George Smitherman, *Directive to the CEO of the Ontario Power Authority* (Toronto: Ontario Ministry of Energy and Infrastructure, 2009), 1-2, accessed October 25, 2011, http://www.powerauthority.on.ca/sites/default/files/page/15420_FIT_ Directive_Sept_24_09.pdf. Intentions to simplify renewable energy development and procurement processes were also noted, however procedural matters are outside the scope of this paper.
[9] Ontario, Office of the Auditor General of Ontario, *2011 Annual Report* (Toronto: Queen's Printer for Ontario, 2011), 91-92, accessed January 14, 2012, http://www.auditor.on.ca/en/reports_en/en11/2011ar_en.pdf.
[10] Interview with a staff member of the Ontario government, April 5, 2012.

policy objective of the microFIT Program, program communications make a distinct appeal to farmers[11] which is absent from communications about the FIT Program. Government officials have also stated that micro-scale renewable electricity projects are expected to enhance the performance of the electricity grid.[12] The second difference between the FIT and microFIT Programs is the tariff rates. Electricity produced by microFIT projects is procured at higher prices than that produced by FIT projects. Prior to the program review, microFIT projects earned between 0.111 CAD per kWh and 0.802/kWh depending on project type, while FIT projects earned between 0.103 CAD/kWh and 0.713 CAD/kWh.[13]

1.4. Research purpose and questions

A scholarly examination of Ontario's microFIT Program was warranted for three reasons. First, there had been minimal academic research specific to Ontario's microFIT Program and no comprehensive evaluation of the policy. The majority of program commentary had been published by news media or private firms and is often anecdotal in nature. Moreover, little quantitative information about program outcomes had been released to the public by Ontario's energy institutions. Second, the government's first review of the FIT and microFIT Programs was launched by the Ministry of Energy and the OPA on October 31, 2011. The review and any resulting program alterations carried the potential to be coloured by two influences: the provincial government's recent loss of legislative majority and the criticism of various program elements. Finally, the distinct character of the microFIT Program necessitated its evaluation in isolation from the FIT Program.

[11] For example, see "Eligible Participant Schedule," Ontario Power Authority, accessed April 5, 2012, http://microfit.powerauthority.on.ca/eligible-participant-schedule; "FIT and microFIT Program," Ontario Ministry of Energy, accessed November 2, 2011, http://www.energy.gov.on.ca/en/fit-and-microfit-program/.
[12] Ontario, Legislative Assembly, Official Report of Debates (Hansard), 39th Parl, 1st Sess, (February 23, 2009) at 1320 (George Smitherman).
[13] Ontario Power Authority (OPA), *microFIT Price Schedule – Revised August 13, 2010* (Toronto: OPA, 2010), accessed January 14, 2012, http://microfit.powerauthority.on.ca/pdf/microFIT-Program-price-schedule.pdf; "FIT Price Schedule," Ontario Power Authority, accessed January 14, 2012, http://fit.powerauthority.on.ca/fit-price-schedule.

As such, the project sought to comprehensively evaluate the microFIT Program with the aim of determining whether the program can be justified from political and sustainability perspectives. More specifically, the research aimed to complete three tasks:

- understand government's goals for the program and determine whether they had been met;
- examine the full range of program benefits and detriments from energy production, economic, and social perspectives, and evaluate whether the program can be considered sustainable; and
- assess whether policy acceptance had been achieved among various stakeholder groups.

The research offers an independent analysis of the microFIT Program suitable for comparison with public review. This is important given that the program represents a significant public expenditure which affects electricity prices for all ratepayers in Ontario. Moreover, this paper helps fill the void of information and analysis on the microFIT Program, in both academic and public realms.

2. Methodology

2.1. Policy evaluation

A comprehensive policy evaluation necessitates the use of a variety of evaluative methodologies and criteria. The methods and criteria employed for this research are detailed below.

2.1.1. Program evaluation

The primary methodological framework of the research was that of program evaluation. This practice has been defined as "the systematic collection of information about the activities, characteristics, and results of programs to make judgments about the program, improve or further develop program effectiveness, inform decisions about future programming, and/or increase

understanding."[14] Leslie Pal links program evaluation directly with policy, noting that program evaluation attempts to determine "how successful a policy has been, whether it met its objectives, how far it fell short, and what might be done to improve its impact."[15]

Pal presents a number of principles for program evaluation in the context of policy. He asserts that evaluation is an empirical pursuit, but notes that some intangible costs and benefits of a program, such as cultural effects, may be difficult to quantify.[16] He also draws attention to the "attribution problem" – the difficulty encountered in attempting to distinguish the contribution of a program to a particular issue given that other factors may have affected that issue.[17] Additionally, Pal argues that the most critical requirement of program evaluation is the complete understanding of the goals of the policy since this informs inquiry and data collection.[18]

Pal also explores the typology of program evaluation. He characterizes impact evaluation as an attempt to assess the distinct effect of a program on an issue, while process (or implementation) evaluation is described as an examination of program delivery procedures and organizational performance.[19] A third type of program evaluation – efficiency evaluation – is defined as the utilization of cost-benefit or cost-effectiveness analysis to measure the value realized by a particular program. Additionally, Pal explains that program evaluation varies temporally. Formative evaluations are carried out in the midst of program implementation, while summative evaluations occur upon program completion. The evaluation presented here employs both impact and efficiency evaluation to determine whether the microFIT Program has achieved its goals and whether the policy can be justified. The evaluation is of a formative nature given that the microFIT Program is still in progress.

---

[14] Michael Patton, *Utilization-focused Evaluation*, 4th ed. (Thousand Oaks, CA: Sage Publications, 2008), 39.
[15] Leslie Pal, *Beyond Policy Analysis: Public Issue Management in Turbulent Times*, 4th ed. (Toronto: Nelson Education, 2010), 305.
[16] Ibid, 309 & 329.
[17] Ibid., 306.
[18] Ibid., 311.
[19] Pal, *Beyond Policy Analysis.*

2.1.2. Sustainability assessment

Sustainability is another perspective from which policies and programs may be evaluated. Sustainability assessment frameworks facilitate a more comprehensive critique of policies and programs than conventional evaluation methods. These frameworks integrate ecological, social and economic objectives at multiple scales with the intention of identifying approaches which maximize sustainability.[20] Recognizing that conflicts may occur among objectives, sustainability assessment frameworks may specify rules for conflict reconciliation, also referred to as trade-off rules.

The analysis of the microFIT Program was strongly guided by the sustainability assessment concept. The assessment criteria employed were defined specifically for the electricity sector by a team led by Mark Winfield and Robert Gibson.[21] These criteria are grounded in a generic set of sustainability requirements developed by Gibson et al.[22] The requirements established by Gibson et al. include socio-ecological system integrity, livelihood sufficiency and opportunity, intragenerational equity, intergenerational equity, resource maintenance and efficiency, socio-ecological civility and democratic governance, precaution and adaptation, and immediate and long-term integration.[23] The trade-off rules specified by Gibson et al. require the achievement of maximum benefit, justification by the trade-off proponent, the avoidance of significant adverse effects, no transfer of adverse effects to the future, clear justification and stakeholder participation.[24] For each of these sustainability requirement categories, Winfield et al. developed more precise criteria relevant to the electricity sector.[25] They also expanded the scope of the assessment framework by incorporating technological sustainability and added to the trade-off rules the question of whether trade-offs could feasibly be mitigated.

---

[20] Mark Winfield et al., "Implications of Sustainability Assessment for Electricity System Design: The Case of the Ontario Power Authority's Integrated Power System Plan," *Energy Policy* 38, no. 8 (2010), 4118, doi: 10.1016/j.enpol.2010.03.038.
[21] Ibid.
[22] Robert B. Gibson et al., *Sustainability Assessment: Criteria and Processes* (London: Earthscan, 2005).
[23] Winfield et al., "Implications of Sustainability Assessment," 4119.
[24] Ibid., 4119.
[25] Ibid., 4120-4122.

In consideration of the scope of study at hand, the sustainability criteria most likely to be impacted by the microFIT Program were the primary focus. These criteria were the minimization of negative impacts on biophysical systems and human health; cost-effectiveness; the efficiency of energy production and delivery; the minimization of vulnerability to grid upset; the promotion of conservation and efficiency; the creation of employment opportunities; the minimization of the risk of boom and bust effects; equitable distribution of benefits, costs and risks among electricity consumers and other stakeholders; the affordable provision of energy services; the facilitation of social learning; and the contribution to a "culture of conservation."[26]

2.1.3. Policy legitimacy

An additional approach to program evaluation is suggested by Jennifer Wallner, who argues that "[e]ven if a policy is implemented and achieves its objectives in an efficient and effective fashion, the policy can fail in terms of legitimacy."[27] The notion of legitimacy, which Wallner notes "rests upon the principles of justness and appropriateness,"[28] is often discussed in the context of the right to govern. However, its relevance to the success of individual policies has also been argued within the academic community. For example, Guy Peters asserts that a policy "is of little practical value if it cannot be justified to the public."[29] Stakeholders are typically unsupportive of policies which do not align with their objectives.[30] Achieving policy legitimacy is made particularly challenging for policymakers by the fact that it must be realized among a variety of stakeholders with differing interests.[31] If a policy is not

[26] Winfield et al., "Implications of Sustainability Assessment" 4120-4122.
[27] Jennifer Wallner, "Legitimacy and Public Policy: Seeing Beyond Effectiveness, Efficiency and Performance," *The Policy Studies Journal* 36, no. 3 (2008): 422, doi: 10.1111/j.1541-0072.2008.00275.x.
[28] Ibid., 423.
[29] B. Guy Peters, "Legitimating Policy Choices," in *American Public Policy: Promise and Performance*, 7th ed. (Washington, DC: CQ Press, 2007), chap. 4, http://common.books24x7.com.ezproxy.library.yorku.ca/toc.aspx?bookid=18266.
[30] Wallner, "Legitimacy and Public Policy," 423.
[31] Frank R. Baumgartner and Bryan D. Jones, *Agendas and Instability in American Politics,* 2nd ed. (Chicago: University of Chicago Press, 1993), quoted in Wallner, "Legitimacy and Public Policy," 423; Donald A. Schön and

supported, policymakers may be forced to defend it constantly[32] or, worse, may be incapable of achieving their objectives, potentially negatively affecting their government's legitimacy.[33]

Alexander George argues that policy legitimacy comprises two aspects. First, normative (or moral) legitimacy must be achieved, whereby a policy is perceived to be aligned with the values of stakeholders.[34] Wallner also asserts that policies should be congruent with stakeholder beliefs, but she notes that policies which seek to engender social change do not always gain consensus.[35] Second, cognitive legitimacy must be achieved, whereby stakeholders come to believe that the policymaker has the knowledge and the means to achieve a policy goal from design-objective, strategic and tactical perspectives. Given the arguments for the importance of the concept, the research included an evaluation of the degree of policy legitimacy achieved by the microFIT Program among the public, the private sector, provincial energy institutions and domestic and international governments.

2.2. Evaluative criteria

The set of evaluative criteria employed in the research was determined by a three-step process. First, the government's goals for the microFIT Program were identified. Second, the list of goals was reconciled with the relevant sustainability assessment criteria from the framework developed by Winfield et al. One of the criteria defined by the authors – the notion of building a "culture of conservation"[36] – was broadened to encompass not only the creation of a widespread positive attitude toward and habit of reducing energy use, but also the development of such a disposition toward and practice of utilizing sustainable energy resources. This broader criterion was defined as the creation of a

---

Martin Rein, *Frame Reflection: Toward the Resolution of Intractable Policy Controversies* (New York: Basic Books, 1994), quoted in Wallner, "Legitimacy and Public Policy," 423.

[32] Alexander L. George, "Domestic Constraints on Regime Change in U.S. Foreign Policy: The Need for Policy Legitimacy," in *Change in the International System,* ed. Ole R. Holsti, Randolph M. Siverson and Alexander L. George (Boulder, CO: Westview Press, 1980), 235.

[33] Wallner, "Legitimacy and Public Policy," 423.

[34] George, "Domestic Constraints on Regime Change," 235.

[35] Wallner, "Legitimacy and Public Policy," 439.

[36] Winfield et al., "Implications of Sustainability Assessment," 4121.

"culture of sustainability." This set of criteria was then categorized according to broad government goals for the microFIT Program. The criteria are listed in Table 1 below. Finally, the criterion of policy legitimacy was added. The resultant set of fourteen criteria formed the basis for the evaluation of the microFIT Program.

Table 1

Evaluative criteria for the microFIT Program

Electricity production impacts	**Economic impacts**	**Social impacts**
• Impact on the environment and human health • Cost-effectiveness • Efficiency of energy production and delivery • Impact on grid stability • Effect on energy conservation and efficiency	• Impact on employment opportunities • Effect on the provincial manufacturing sector • Risk of boom and bust effects	• Distribution of costs and benefits among electricity consumers and other stakeholders • Effect on rural economic development • Effect on electricity pricing • Contribution to social learning • Contribution to a "culture of sustainability"

2.3. Information gathering methods

The information on which the evaluation was based was collected from a wide variety of sources. Two essential sources of information were quantitative datasets and interviews. Quantitative data and analysis were provided by an Ontario-based solar PV installation company, a renewable energy consulting firm, and the Independent Electricity System Operator. Quantitative data was also provided by the OPA in response to a request for information pursuant to the Freedom of Information and Protection of Privacy Act, 1990. Interviews involved subject matter experts and individuals engaged in

the microFIT Program, and were typically conducted in order to obtain information not available from other sources. Interview participants are noted below.

In addition, the academic literature was reviewed and members of the academic community were engaged through personal communication. A variety of energy industry experts also contributed through personal communication as well as in formal interviews. Reports from the news media and from public opinion polling firms were consulted. Government legislation, documents, statements, press releases, and websites were explored, and a staff member of the Ontario government was interviewed. Interviews with representatives of provincial energy institutions, energy sector and environmental non-governmental organizations, and industry associations were important sources of information. Publications from these sources were also valuable. Finally, interviews with microFIT project proponents provided unique information.

3. Experience with feed-in tariffs for microgeneration

3.1. Overview of international microgeneration policies

In recent decades a number of national and sub-national governments have instituted policies which support renewable electricity microgeneration. The policies of leading jurisdictions are summarized here.

3.1.1. Germany

Widely regarded as the leader in renewable electricity development, Germany has implemented a succession of programs to support the development of renewable electricity generation since the early 1990s. In 1990, the German government passed the Electricity Feed-in Law, which supported renewable energy projects including microgeneration through a feed-in tariff. Tariffs were awarded for electricity produced using wind, solar energy, biomass, water, or landfill or sewage station gas and tariff rates were defined according to proportions of the electricity retail price. In 1991, the Thousand Roofs program was

implemented, adding a 70% investment subsidy for grid-connected residential rooftop solar PV projects with an installed capacity of between 1 and 5 kilowatts (kW). When the program ended in 1995, a total of 2,100 systems had been installed.[37] A new federal government whose platform included job creation[38] replaced the Electricity Feed-In Law with a more advanced FIT in the Renewable Energy Sources Act of 2000. This FIT offered support to a wider array of renewable energy sources, including geothermal energy, set payment levels based on cost of generation, and offered price differentiation within technology categories. By the end of 2009, the Renewable Energy Sources Act had resulted in the commissioning of 5,620 MW of renewable energy systems with installed capacities less than or equal to 30 kW.[39]

3.1.2. Spain

Spain's succession of renewable electricity policies, which began in 1980, has also offered financial support to microgeneration. However, in a constant struggle to balance renewable energy promotion, economic opportunities and costs,[40] the Spanish government has altered its renewable electricity support system numerous times.[41] For instance, the government has oscillated between systems which provide financial support based on a percentage of the electricity price or which set fixed

[37] Sven Teske and Volker U. Hoffmann, "A History of Support for Solar Photovoltaics in Germany," in *Renewable Energy Policy and Politics*, ed. Karl Mallon (London: Earthscan, 2006), 231.
[38] Volkmar Lauber and Lutz Mez, "Three Decades of Renewable Electricity Policies in Germany," *Energy & Environment* 15, no. 4 (2004): 607, http://www.swetswise.com.ezproxy.library.yorku.ca/ eAccess/viewFull text.do?articleID=152239456.
[39] Bundesnetzagentur, *Monitoring Report 2010* (Bonn: Bundesnetzagentur, 2010), accessed January 26, 2012, http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/ReportsPublications/2010/MonitoringReport2010pdf.pdf?__blob=publicationFile.
[40] Pablo del Río González, "Ten Years of Renewable Electricity Policies in Spain: An Analysis of Successive Feed-in Tariff Reforms," *Energy Policy* 36, no. 8 (2008), doi: 10.1016/j.enpol.2008.03.025; International Energy Agency (IEA), *Trends in Photovoltaic Applications: Survey report of selected IEA countries between 1992 and 2009* (n.p.: IEA, 2010), 16, accessed January 27, 2012, http://www.iea-pvps.org/index.php?id=92&eID=dam_frontend_push&docID=432.
[41] For overviews of Spanish renewable electricity policies, see del Río González, "Ten Years of Renewable Electricity Policies in Spain," and Rafael Cossent, Tomás Gómez, and Luis Olmos, "Large-scale Integration of Renewable and Distributed Generation of Electricity in Spain: Current Situation and Future Needs," *Energy Policy* 39, no. 12 (2011):8078-8087, doi: 10.1016/j.enpol.2011.09.069.

tariffs per kWh. When fixed tariffs have been paid, some policies have offered renewable electricity generators a choice between receiving a fixed tariff per kWh or a fixed premium in addition to the market electricity price.[42] The latter option has been subject to a cap-and-floor price system whereby the combination of the market electricity price and the premium for renewable energy cannot surpass a maximum price or fall below a minimum price.[43] Most recently, the government introduced an annual quota for solar PV development and limited the number of hours of production for which solar PV generators can receive a tariff.[44]

As a result of the changing nature of the support system, the Spanish solar PV market experienced a collapse in 2009. Prior to the collapse, approximately 2,700 MW of solar PV systems with a nameplate capacity less than 100 kW were present in Spain, but the proportion of small residential PV systems was low.[45] The 2012 announcement of a moratorium on incentives for new renewable energy projects has cast further uncertainty upon the future of Spanish microgeneration.

3.1.3. Japan

Japan's microgeneration sector has been dominated by solar PV – part of the country's response to the oil crises of the 1970s and a strategy for industrial development.[46] In 1992, Japan's electric power companies voluntarily introduced a program whereby excess electricity was purchased at the electricity market price. In 1994, the Japanese government introduced a program offering a 50% subsidy for the cost of installing a residential solar PV system. Despite a falling subsidy rate, these programs produced a

[42] del Río González, "Ten Years of Renewable Electricity Policies in Spain," 2926.
[43] Ibid.
[44] IEA, *Trends in Photovoltaic Applications 2009,* 16; International Energy Agency (IEA), *Trends in Photovoltaic Applications: Survey report of selected IEA countries between 1992 and 2010* (n.p.: IEA, 2011), 16, accessed January 24, 2012, http://www.iea-pvps.org/index.php?id=92&eID=dam_frontend_push&docID=899.
[45] Vicente Salas, *National Survey Report of PV Power Applications in Spain 2008* (n.p.: International Energy Agency, 2009), 10, accessed January 27, 2012, http://www.iea-pvps.org/index.php?id=93&eID=dam_frontend_push&docID=114; IEA, *Trends in Photovoltaic Applications 2009,* 16.
[46] Espen Moe, "Vested Interests, Energy Efficiency and Renewables in Japan," *Energy Policy* 40, no.1 (2012), 264, doi: 10.1016/j.enpol.2011.09.070.

steady increase in installed capacity.[47] Nevertheless, the subsidy expired in 2005, leading to stalled growth.[48] In January 2009, the subsidy program was reinstated, followed by an official policy to purchase excess electricity from residential systems with a nameplate capacity below 10 kW as well as non-residential systems. The success of these policies is evident in the 3,600 MW of solar PV which had been installed in Japan by the end of 2010.[49] Over 80% of this capacity is derived from residential systems, and the country has set a goal to install solar PV on 5.3 million homes by 2020. Promotion of other renewable energy sources has been minimal.[50] However, in August 2011, the government approved a FIT for electricity produced from wind, geothermal energy, biomass, solar energy and small- and medium-scale hydroelectric projects. This program targets non-residential sectors and is scheduled to begin in July 2012.

3.1.4. California

The State of California has implemented a variety of programs which have supported the development of renewable electricity microgeneration. The federal Public Utilities Regulatory Policy Act (PURPA) of 1978 obligated public utilities across the United States to purchase electricity produced from small renewable energy generators at a rate representative of the estimated avoided cost of conventional electricity purchased from the wholesale market.[51] This legislation inspired California's strong support of renewable energy. In 1996, the State introduced a net metering program which continues to support solar PV, wind, biogas and fuel cell generators with an installed capacity of less than 1 MW. To date, over 40,000 residential and non-residential participants have enrolled in this

[47] Izumi Kaizuka, *PV Status in Japan – Overcoming March 11th* (n.p.: International Energy Agency, 2011), accessed January 29, 2012, http://www.iea-pvps.org/index.php?id=3&eID=dam_frontend_push&docID=917.
[48] Japan Renewable Energy Policy Platform (JREPP), *Renewables Japan Status Report 2010* (n.p.: JREPP, 2010), 3, accessed January 29, 2012, http://www.re-policy.jp/jrepp/JSR2010SMR20101004E.pdf.
[49] Izumi Kaizuka, *PV Status in Japan*.
[50] JREPP, *Renewables Japan Status Report 2010,* 2.
[51] Eric Martinot, Ryan Wiser, and Jan Hamrin, *Renewable Energy Policies and Markets in the United States* (San Francisco: Centre for Resource Solutions, 2005), accessed January 29, 2012, http://martinot.info/Martinot_et_al_CRS.pdf.

program.[52] As of late 2009, net metering customers also became eligible to receive compensation for the excess electricity they produced.

Residential, commercial and institutional solar electric, wind and fuel cell projects under 30 kW have been supported by capital subsidies since 1998. Aspirations of industrial development are evident in the first iteration of this program – the Emerging Renewables Program – which was expected to induce industry expansion and efficiency.[53] A recently implemented version of this program focuses on solar PV, awarding a rebate for a relatively small portion of system costs based on system capacity and capacity procured statewide.[54] This program has been a success, supporting the installation of 506 MW of grid-connected solar PV projects from 2006 to early 2011.[55] Participants are also eligible for federal tax credits which apply to 10% to 30%of the cost of the system.

Alternatively, some small renewable energy projects may opt to participate in a feed-in tariff program included in the renewable portfolio standard to which California's investor-owned utilities, electric service providers, and community load aggregation programs are obligated. Under this program, a wide array of renewable energy projects with an installed capacity of less than 1.5 MW receive a tariff at a rate representative of the annual average cost of production for a combined-cycle natural gas fired baseload proxy plant. However, the proportion of micro-scale projects receiving the FIT is unclear.

3.1.5. Trends in international microgeneration policy

A number of trends can be noted among the above overviews of microgeneration policy. First, industrial development or job creation have frequently been cited as objectives of either

[52] "Net Energy Metering (NEM)," California Public Utilities Commission, accessed January 30, 2012, http://www.cpuc.ca.gov/PUC/energy/DistGen/netmetering.htm.
[53] Michal C. Moore et al., *Emerging Renewable Resources Account* (Sacramento, CA: California Energy Commission, 1998), 3, accessed January 30, 2012, http://www.energy.ca.gov/renewables/documents/archive/emerging_renewables/500-97-011V3-1st.PDF.
[54] "California Solar Initiative Rebates," California Public Utilities Commission, accessed June 20, 2012, http://www.gosolarcalifornia.org/csi/rebates.php.
[55] Damon Franz et al., *California Solar Initiative Annual Program Assessment* (San Francisco, CA: California Public Utilities Commission, 2011), 27, accessed January 30, 2012, http://www.cpuc.ca.gov/NR/rdonlyres/9BC1AC3A-020C-4E85-99F0-D6CF42D34B03/0/2011_APA_FINAL_PRINT.pdf.

microgeneration policies or of governments implementing such policies. With respect to policy choice, all reviewed jurisdictions have in recent years rewarded project owners according to the quantity of electricity generated by a project. Some jurisdictions have combined such a policy with a capital subsidy. The experiences of these jurisdictions indicate that the presence and consistency of policies to support micro-scale renewable electricity generation is critical to microgeneration development. If monetary support is not available or if policies change too frequently, significant microgeneration deployment will not occur. The development of microgeneration may also be affected by the level of monetary support. Although comparable estimates of program results were not found, it appears that programs which compensate microgeneration owners for a higher proportion of system costs are more popular. Simpler programs may also produce higher project deployment rates.

3.2. Outcomes of Ontario's microFIT Program

As of June 25, 2012, the microFIT Program had received nearly 50,000 applications and had executed over 13,000 contracts for a total of approximately 114 MW of installed capacity.[56] This degree of participation was beyond the OPA's expectations,[57] vastly so according to some.[58] The program is marked by a distinct preference for solar PV projects. Only 210 applications to the program proposed projects which use a renewable fuel other than solar energy, and only 1 bioenergy project and 7 wind energy projects have successfully executed contracts.[59]

The abundance of solar PV projects suggests that the program was designed to favour solar PV such projects. Employees of the OPA and the government have cited a number of reasons for such a program design. First, solar PV was thought to be the only technology in Ontario which, at that point in

[56] Ontario Power Authority (OPA), *Bi-weekly FIT and microFIT Report* (Toronto: OPA, 2012), microFIT Project Summary, accessed July 17, 2011, http://microfit.powerauthority.on.ca/sites/default/files/Bi-WeeklyReportJune 25-2012.pdf.
[57] Interview with a representative of the Ontario Power Authority, January 20, 2012. All interviews were conducted in confidentiality, and the names of interviewees are withheld by mutual agreement.
[58] Adonis Yatchew and Andy Basiliauskas, "Ontario Feed-In-Tariff Programs," *Energy Policy* 39, no.7 (2011): 3888, doi: 10.1016/j.enpol.2011.01.033.
[59] OPA, *Bi-weekly FIT and microFIT Report*, microFIT Project Summary.

time, was well-suited to a small scale of generation.[60] Although micro-scale wind turbines were available in Canada, the technology was thought to be immature in Ontario. Second, the technology and industry associated with solar PV was thought to have progressed to a point at which it was capable of significant growth,[61] suggesting suitability for an economic development policy. Third, solar PV technology was thought to be unobtrusive and unlikely to spark ire among surrounding neighbours and communities.[62] As such, the microFIT Program is dominated by rooftop and ground-mounted solar PV projects. For the purpose of this paper, the characteristics of electricity generation resulting from the microFIT Program will henceforth be equated with those of solar PV.

Within the solar PV energy source type, it is not possible to determine the precise ratio of rooftop to ground-mounted projects since early program applicants were not required to specify the solar PV project type.[63] Nonetheless, some trends may be extrapolated from the projects for which a project type was specified, which represent 85% of project applications prior to June 25, 2012.[64] Among contracted projects and those awarded a conditional offer of microFIT contract (hereafter referred to as a 'conditional offer'), a fairly even division between the project types is apparent. Yet, overall, a larger number of applications had been submitted for rooftop projects than for ground-mounted. This discrepancy is a result of the fact that many more applications for rooftop projects than ground-mounted projects were either awaiting an offer to connect to the grid or were rejected or withdrawn.

The average installed capacity of both proposed and contracted solar PV ground-mounted microFIT projects was approximately 9.8 kW.[65] The average installed capacity of proposed rooftop solar PV projects was nearly 1 kW lower than the capacity of ground-mounted projects, and the average

[60] Interview with an official from the Ontario Power Authority (OPA), January 20, 2012.
[61] Interview with a staff member of the Ontario government, April 5, 2012.
[62] Ibid.
[63] These applications are represented in the 'Solar PV' energy source type in the OPA's *Bi-Weekly FIT and microFIT Report*.
[64] OPA, *Bi-weekly FIT and microFIT Report,* microFIT Project Summary.
[65] Ibid.

capacity of rooftop projects with an executed contract was approximately 2 kW lower. The average installed capacity of proposed bioenergy projects was approximately 8.5 kW, while the single installed biomass project was 3.6 kW. Proposed hydroelectric projects were approximately 6.8 kW, while proposed wind energy projects were nearly 8 kW and projects with executed contracts were approximately 6 kW.

Aside from the data included in the Bi-Weekly FIT and microFIT Report – which, prior to November 2011, was even less detailed than the current format – very little information about the results of the microFIT Program has been released. This lack of transparency is not due to lack of information; the OPA has collected a range of information about microFIT projects through application forms and contracts.

4. Evaluation of the microFIT Program

4.1.1. Electricity production impacts

4.1.1.1. Impact on the environment and human health

As mentioned above, the policy objectives of Ontario's feed-in tariff include reducing the environmental and human health impacts of the province's electricity system. Although the environmental and human health impacts of renewable electricity generation are of a much smaller magnitude than those of conventional electricity generation, they must not be overlooked. Indeed, concern has been expressed regarding the lack of independent analysis of the effects of provincial renewable energy policies on greenhouse gas emissions.[66] As such, the environmental and human health impacts of each of the technologies supported by the microFIT Program deserve examination.

The environmental and human health impacts of solar PV derive almost exclusively from system manufacturing. The production process associated with some solar PV technologies may involve toxic

[66] Office of the Auditor General of Ontario, *2011 Annual Report*, 97.

and explosive gases as well as corrosive liquids.[67] For instance, cadmium is used as a semiconductor in cadmium telluride modules and is used to manufacture other technologies. However, alternative production processes have been developed which do not require harmful substances, and strict control methods minimize emissions of such substances.[68] Additionally, these technologies are relatively uncommon given that mono- and poly-crystalline silicon wafer technologies have dominated the market in recent years.[69] Silicon is not a toxic substance, although it does pose other risks to human health. The inhalation of silica dust produced by the solar PV manufacturing process can lead to lung diseases such as silicosis, emphysema or cancer.[70] As a risk among a variety of industries, control of occupational exposure to silica is mandated in Ontario.[71] However, exposures continue to occur in both developed and developing nations.[72]

The manufacture and installation of a solar PV system make a minor contribution to climate change since they produce greenhouse gas (GHG) emissions. The lifecycle GHG emissions of a solar PV system are between 30 and 80 grams of carbon dioxide equivalent per kilowatt-hour (gCO_2eq/kWh), which is approximately an order of magnitude lower than conventional fossil fuels, but is not necessarily lower than other renewable electricity technologies.[73] Since solar energy is the fuel used by solar PV systems, no emissions are created in the process of electricity production.

---

[67] David Arvizu et al., "Direct Solar Energy," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 51, accessed February 7, 2012, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

[68] Godfrey Boyle, "Solar Photovoltaics," in *Renewable Energy: Power for a Sustainable Future,* ed. Godfrey Boyle (Oxford: Oxford University Press, 2004), 95-96; Arvizu et al., "Direct Solar Energy," 51.

[69] Arvizu et al., "Direct Solar Energy," 23.

[70] Julia M. Gohlke, Sharon H. Hrynkow, and Christopher J. Portier, "Health, Economy, and Environment: Sustainable Energy Choices for a Nation" (editorial), *Environmental Health Perspectives* 16, no. 6 (2008): A236, doi:10.1289/ehp.11602; United States, Department of Health and Human Services, *Report on Carcinogens,* 12th ed. (n.p.: Department of Health and Human Services, 2011), 377, accessed June 11, 2012, http://ntp.niehs.nih.gov/ntp/roc/twelfth/roc12.pdf.

[71] O Reg 490/09, s 12.

[72] "Silicosis," World Health Organization, last modified May, 2000, http://www.who.int/peh/Occupational_health/OCHweb/OSHpages/OSHDocuments/Factsheets/Silicosis.htm.

[73] Arvizu et al., "Direct Solar Energy," 51; Stephen Larkin, Janet Ramage and Jonathan Scurlock, "Bioenergy," in *Renewable Energy: Power for a Sustainable Future,* ed. Godfrey Boyle (Oxford: Oxford University Press, 2004), 138.

Other environmental and human health impacts could manifest themselves during the installed lifetime of a solar PV system. Negative environmental impacts associated with land use change are unlikely to be caused by solar PV microFIT projects since their small size and frequent installation on rooftops will result in the occupation of a minimal amount of land. However, solar PV systems, particularly those mounted on the ground, may be visible to passersby and may be considered aesthetically displeasing.[74] It has also been claimed that electricity generation from solar PV and other intermittent renewable energy resources requires polluting fossil fuel generation to compensate for times of low resource.[75] To explore the validity of this claim in relation to microFIT projects, it is necessary to understand when solar PV produces electricity and the concurrent character of the electricity market. With respect to the temporal profile of solar PV generation, solar radiation was detected by a flat plate collector in Guelph, Ontario between the hours of approximately 6:00 a.m. and 7:00 p.m. on average over the course of a year.[76] As such, it can be expected that solar PV microFIT projects will produce electricity between these times.

Fluctuations in output from microFIT projects are balanced using regulation and load-following services at second-to-second and five-minute dispatch intervals.[77] In Ontario, second-to-second balancing is typically achieved using hydroelectric power, but can employ coal as well. Five-minute balancing utilizes load management and a wide variety of electricity generation resources including natural gas, coal, biomass, nuclear and water. In each case, the resource engaged is dependent upon which resource is 'on the margin' – the available resource with the lowest marginal cost at a given time.

The profile of marginal electricity resources in Ontario's five-minute market is suggested by the share of wholesale market prices set by various resources over the course of a month. Since microFIT

[74] Boyle, "Solar Photovoltaics," 95.
[75] Wayne Lilley, "Green Goals, Bigger Bills: How Ontario's Green Energy Act Got Politically Compromised – and Led to Soaring Electricity Costs," *Toronto Star,* November 27, 2010, ProQuest (814371230).
[76] Ian H. Rowlands, "Solar PV Electricity and Market Characteristics: Two Canadian Case-Studies," *Renewable Energy* 30, no. 6 (2005): 823, doi: 10.1016/j.renene.2004.08.001.
[77] Interview with an electricity sector expert, February 23, 2012.

projects are not capable of generating electricity overnight, only on-peak (8 a.m. to 11 p.m.) wholesale market prices were explored. Additionally, the months of April to September were concentrated upon since the preponderance of annual supply balancing is required during this period. This annual pattern occurs because most solar radiation received in Ontario arrives during these months,[78] and therefore the majority of annual electricity supply from solar PV systems – which requires balancing – is generated at this time. During the months of May to September 2010 and April 2011, the marginal resource was most often coal or natural gas.[79] The share of market prices set by coal-fired generation ranged from 20% to 49% depending on the month, while the share of prices set by natural gas-fired generation ranged from 38% to 49%. Hydroelectric generation set 14% to 34% of the market prices, while nuclear generation set 0% of prices in this period. Nuclear generation did, however, set 1% of prices in June 2009.

Two additional points must be noted. First, the future profile of marginal resources in Ontario will differ from that noted above due to the phase-out of coal-fired generation. Four of Ontario's coal-fired generating units were shut down in October 2010, in the midst of the Market Surveillance Panel's reporting period, and two more have been decommissioned since. Second, imported electricity may also set the five-minute market price, but these occurrences are not reported by the Market Surveillance Panel. Imported electricity may set the five-minute price once per hour and the resource must be purchased for the full hour.[80] Electricity may be imported from Quebec or Manitoba, where hydroelectric facilities produce the vast majority of electricity, or from the United States, where fossil fuel resources dominate the supply.

[78] Rowlands, "Solar PV Electricity and Market Characteristics," 817.
[79] Neil Campbell, Bill Rupert, and Roger Ware, *Monitoring Report on the IESO-Administered Electricity Markets for the Period from November 2010 to April 2011* (Toronto: Ontario Energy Board, 2011), 14, accessed March 6, 2012, http://www.ontarioenergyboard.ca/OEB/_Documents/MSP/MSP_Report_20111116.pdf.
[80] Employee of the Ontario Energy Board, e-mail message to author, March 11, 2012.

It is difficult to determine the share of fossil and hydroelectric resources utilized to balance variable microFIT generation without employing complex modelling software. Moreover, second-to-second balancing data must also be considered. Nonetheless, it is clear that variations in generation from solar microFIT projects – as well as those from wind-powered microFIT projects and any future hydroelectric microFIT projects which lack storage capacity – are not exclusively balanced by fossil fuels. While polluting fossil fuels are likely to be a significant source of balancing for microFIT generation, the task may also be accomplished using relatively benign hydroelectric power and load management. In the future, balancing services could increasingly be provided by biomass-fuelled generation as well as by blade pitch alteration among large wind projects or inverter shut-off among large solar PV projects.[81]

In addition, microFIT projects provide electricity which may otherwise have been supplied by fossil fuel-fired generators. Given that generation from current microFIT projects meets intermediate- and peak-demand needs rather than providing baseload supply, that the Ontario government plans to replace peaking coal-fired supply with natural gas and renewable energy,[82] and that Ontario regularly imports fossil fuel-fired power to meet peak demand, it is possible that microFIT projects have reduced the required quantity of new natural gas supply or electricity imports, along with their associated environmental and human health effects. However, it is also possible that microFIT projects are replacing larger solar PV systems which would have been procured through the feed-in tariff program.

Following their useful life, the material content of a PV system remains. If many PV modules are disposed in a single landfill, leached chemicals could enter water systems.[83] Fortunately, a large proportion of the material used in solar PV systems can be recycled, including the entirety of the glass

[81] Interview with an electricity sector expert, February 23, 2012.
[82] Ontario, MEI, *Ontario's Long-Term Energy Plan*, 33.
[83] Tetra Tech, Inc., *Potential Health and Environmental Impacts Associated with the Manufacture and Use of Photovoltaic Cells* (Palo Alto, CA: Electric Power Research Institute and California Energy Commission, 2003), accessed July 6, 2012, http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405.

and 60% to 99% of the semiconductor material, depending on the technology.[84] Some organizations have developed and implemented solar PV recycling processes, but not all technologies are supported. The small proportion of semiconductor material in amorphous silicon cells has caused little attention to be paid to the recycling of this technology, for example, despite its growing popularity.

A second type of renewable energy supported by the microFIT Program is wind energy. Scholarly evaluations of the environmental and human health impacts of wind energy generation have typically focused on systems of a larger scale than microgeneration. Studies of the lifecycle GHG footprint of onshore wind turbines have taken this approach and have produced values between nearly zero and approximately eighty gCO_2eq/kWh.[85] The lifecycle emissions of a micro-scale wind turbine can be expected to fall within this range, which is, once again, much lower than the emissions of conventional fossil fuels. Therefore, the replacement of fossil fuel-fired electricity with that produced from small-scale wind turbines could significantly reduce GHG emissions as well as other air pollutants. However, it is important to note that urban locations are generally less favourable for small-scale wind, potentially resulting in a negligible effect on overall GHG emissions.[86]

The American Wind Energy Association (AWEA) has conducted analysis specific to small-scale wind turbines and has summarized their environmental and health impacts.[87] Bird and bat collisions with wind turbines are possible, although AWEA notes that as of 2008 no studies had been completed with respect to collisions with small wind turbines. Additional environmental impacts relate to the human environment. The height and movement of small wind turbines has been perceived by some to be distracting and visually displeasing. A related impact of wind energy projects is that of the creation of

[84] N.C. McDonald and J.M. Pearce, "Producer Responsibility and Recycling Solar Photovoltaic Modules," *Energy Policy* 38, no. 11 (2010): 7043. doi:10.1016/j.enpol.2010.07.023.
[85] Ryan Wiser et al., "Wind Energy," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 48, accessed February 7, 2012, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.
[86] Ibid., 9.
[87] Ron Stimmel, *In the Public Interest: How and Why to Permit for Small Wind Systems* (Washington, DC: American Wind Energy Association, 2008), accessed February 7, 2012, http://www.awea.org/learnabout/smallwind/upload/InThePublicInterest.pdf.

moving shadows, but the height, blade size, and speed of small wind projects are likely to preclude this effect. The sound emitted by small wind turbines has also been a common concern, although advances in technology have reduced sound to near inaudibility outside of extreme weather events. It has also been noted that vertical-axis wind turbines produce less noise than horizontal-axis models.[88] Additionally, conclusive evidence of health impacts resulting from noise caused by wind energy technology has yet to be presented.[89] Overall, little research has been conducted regarding the human health impacts of micro-scale wind energy generation.[90] AWEA reports that ice is unlikely to be flung from small wind turbines since the weight of the ice slows the blades. 'Stray' voltage also is not a widespread issue as it is caused by poor electrical work.

Micro-scale hydroelectric power has a greater potential to negatively impact the natural environment than solar PV and wind turbines. Projects of this scale are often referred to as 'micro-hydropower' or 'micro-hydro' and typically operate in a 'run-of-river' fashion, whereby a portion of the water flow of a river or stream is used to produce electricity and no water is stored.[91] Some micro-hydro projects may employ a small dam if they involve water diversion from a river or stream.

According to the International Panel on Climate Change (IPCC), the lifecycle GHG emissions of run-of-river projects (which can have a nameplate capacity of many megawatts) are less than 20 gCO_2eq/kWh.[92] The IPCC also reports that run-of-river projects can improve water quality in some populated areas by increasing oxygen and reducing waste and water temperature. However, the IPCC also found some negative environmental impacts. Run-of-river systems which divert water can cause

[88] A.L.B. Heagle, G.F. Naterer, and K. Pope, "Small Wind Turbine Energy Policies for Residential and Small Business Usage in Ontario, Canada," *Energy Policy* 39, no.4 (2011), 1995, doi: 10.1016/j.enpol.2011.01.028.
[89] Wiser et al., "Wind Energy," 54.
[90] Heagle, Naterer, and Pope, "Small Wind Turbine Energy Policies."
[91] Canada, Natural Resources Canada (NRCan), *Micro-Hydropower Systems: A Buyer's Guide* (Ottawa: NRCan, 2004), 4, accessed February 11, 2012, http://canmetenergy.nrcan.gc.ca/sites/canmetenergy.nrcan.gc.ca/files/pdf/fichier/79276/buyersguidehydroeng.pdf.
[92] Arun Kumar et al., "Hydropower," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 45, accessed February 7, 2012, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

minor change to the flow of a river or stream, which could negatively impact fish populations.[93] The IPCC noted that fish and other aquatic animals may also be impacted by the use of a dam because their movement is impeded. Additionally, dam structures could reduce the amount of sediment carried by the water as well as increase sediment deposition, although Canada's geologic profile often precludes this. No negative human health effects were reported to be caused by this type of hydroelectric generation.

Finally, small-scale bioenergy projects, including those which are fueled by biomass, biogas and landfill gas, are associated with a number of environmental impacts. The emissions profile of bioenergy is difficult to determine because of the differences in technology, environmental conditions, methodology, feedstock – usually locally sourced wood, crop waste, animal manure or refuse[94] – and other factors. However, the IPCC asserts that lifecycle GHG emissions studies have found that bioenergy projects (of an unspecified installed capacity) emit only 16 to 74 gCO_2eq/kWh.[95] It should be noted that the supply chain for micro-scale bioenergy is unlikely to be energy-intensive given that the feedstock is often locally sourced. Additionally, bioenergy projects which combust animal waste- and landfill gas-derived methane for electricity production can reduce climate change effects by replacing methane molecules with carbon dioxide molecules, which are much less potent GHGs.[96]

If purpose-grown crops are used as a feedstock, carbon cycling must be considered. If the feedstock is not regrown at the same rate at which it is consumed for electricity, more GHGs may enter the atmosphere than are being sequestered through plant growth, increasing the GHG footprint of the electricity generation system. According to the IPCC, GHG emissions can also be impacted by changes in

[93] E.T. Helland-Hansen, T. Holtedahl, and O.A. Lye, *Environmental Effects Update* (Trondheim, Norway: Norwegian University of Science and Technology, 2005), quoted in Kumar et al., "Hydropower," 37.
[94] National Renewable Energy Laboratory, *Small Modular Biomass Systems* (Golden, CO: U.S. Department of Energy, 2002), accessed February 11, 2012, http://www.nrel.gov/docs/fy03osti/33257.pdf.
[95] Helena Chum et al., "Bioenergy," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 70, accessed February 7, 2012, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.
[96] Larkin et al., "Bioenergy," 139.

land management.[97] It was noted that such land use changes can be avoided by producing bioenergy using waste materials – those not used for any other purpose – although the IPCC cautioned that the harvesting of the waste material may shorten the time period over which carbon is stored in that material. Biomass projects which use forest materials have unique impacts on the environment. The IPCC noted that these projects can help reduce wildfires, lessening the release of carbon stocks and particulates and improving forest growth and soil carbon storage. However, the removal of plant matter can also cause soil and vegetation degradation.

The IPCC has reported estimates of the levels of air pollutants emitted per unit of electricity produced by bioenergy systems and other energy sources.[98] These estimates reveal that sulphur dioxide and particulate emissions from bioenergy projects are lower than those from most fossil fuel-fired sources, but higher than those from other renewable energy technologies as well as natural gas-fired generation. The estimates also show that some bioenergy projects may emit greater quantities of nitrous oxides than fossil fuel-fired plants, while all bioenergy projects emit more of the pollutant than other renewable energy systems. These pollutants are known to contribute to smog and acid rain and to negatively impact human health. Biomass electricity generation, especially that from animal waste and landfill gas feedstocks, may also emit heavy metals and organic compounds.[99]

In addition, polluting waste materials from bioenergy projects could enter water bodies,[100] although manure-based anaerobic digesters can, in contrast, help reduce water and land contamination

---

[97] Chum et al., "Bioenergy," 75.

[98] C. Bauer, *Life Cycle Assessment of Fossil and Biomass Power Generation Chains* (Villigen, Switzerland: Scherrer Institute, 2008) quoted in Jayant Sathaye et al., "Renewable Energy in the Context of Sustainable Development," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 44, accessed February 7, 2012, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf; P. Viebahn et al., *Final Report on Technical Data, Costs, and Life Cycle Inventories of Solar Thermal Power Plants* (Brussels: European Commission, 2008) quoted in Sathaye et al., "Renewable Energy," 44; Ecoinvent, *The Ecoinvent LCI Database, Data v2.2* (Duebendorf, Switzerland: Swiss Centre for Life Cycle Inventories, 2009) quoted in Sathaye et al., "Renewable Energy," 44.

[99] Larkin et al., "Bioenergy," 139.

[100] L.A. Martinelli and S. Filoso, "Polluting Effects of Brazil's Sugar-Ethanol Industry," *Nature* 445, no. 7126 (2007) quoted in Chum et al., "Bioenergy," 83; T.W. Simpson et al., "The New Gold Rush: Fueling Ethanol Production

resulting from manure disposal by reducing the pathogen content of manure.[101] Finally, the IPCC has noted contrasting impacts of bioenergy production on biodiversity. Changed forest practices could negatively impact species, while climate change mitigation derived from displacement of fossil fuels could reduce habitat loss.[102] Human health impacts cited by the IPCC include exposure to toxins in processing and exposure to polluting emissions and effluents.

4.1.2. Cost-effectiveness

4.1.2.1. Tariffs paid for electricity generated by microFIT projects

On September 24, 2009, the OPA released the initial set of tariffs offered for electricity procured from participants of the microFIT Program. The tariffs paid for electricity from the qualifying renewable energy sources are listed in Table 2 below. The only tariff rate tailored to projects of a capacity of 10 kW or less was that of solar PV. All other tariff rates applied to much larger projects as well, with the tariff

Table 2

Initial tariffs offered for electricity produced by microFIT projects

Renewable fuel	Tariff (CAD/kWh)
Solar PV	0.802
Wind	0.135
Waterpower	0.131
Biomass	0.138
Biogas	0.16
Landfill gas	0.111

for biogas applying to projects as large as 500 kW, the tariff for wind energy applying to onshore wind projects of any size, and all other rates applying to projects up to 10 MW in size. The price

---

While Protecting Water Quality," *Journal of Environmental Quality* 37, no. 2 (2008) quoted in Chum et al., "Bioenergy," 83.

[101] "Benefits," Canadian Federation of Agriculture, last modified February 19, 2008, http://www.farm-energy.ca/IReF/index.php?page=benefits-14.

[102] Chum et al., "Bioenergy," 84.

differentiation for solar PV projects is indicative of the microFIT Program's preference for this technology.

A variety of sources of project cost information were consulted in the process of developing the tariff rates for the microFIT and FIT Programs, but only information aligned with the renewable energy literature and industry observations was considered.[103] Following the release of draft program pricing, stakeholder feedback was also taken into account. The tariffs were intended to cover the capital cost of the renewable electricity system, operation and maintenance costs, connection costs, project financing costs, and a return on equity of 11%.[104] The majority of microFIT projects would be offered a 20-year contract for tariff payment, while hydroelectric projects would collect tariff payments over a 40-year term.

Additionally, all tariff rates, with the exception of that for solar PV, were to be adjusted annually in accordance with increases in the Consumer Price Index (CPI). Specifically, 20% of the tariff price was to be escalated in proportion to increases in the CPI. This escalation was intended to account for project costs which vary with inflation.[105] Over the course of a project contract, this change is noteworthy. Assuming a 1.6% annual inflation rate, a wind power project's tariff rate would rise from 0.135 CAD/kWh to approximately 0.15 CAD/kWh over the course of a contract.[106] This represents an increase of approximately 11%. However, greater increases could be observed since the assumed inflation rate of 1.6% is low relative to that experienced in Canada during the past sixty years.[107]

---

[103] Ontario Power Authority (OPA), "Proposed Feed-In Tariff Price Schedule" (presentation, Stakeholder Engagement Session 4, April 7, 2009), 34, accessed March 2, 2012, http://fit.powerauthority.on.ca/Storage/10147_FIT_ Stakeholder_Engagement_-_Session_4_FIT_Price_Schedule_FINAL_(HP).pdf.
[104] OPA, "Proposed Feed-In Tariff Price Schedule," 22-30.
[105] Ibid.," 32.
[106] Warren E. Mabee, Justine Mannion, and Tom Carpenter, "Comparing the Feed-In Tariff Incentives for Renewable Electricity in Ontario and Germany," *Energy Policy* 40 (2008), 486, doi: 10.1016/j.enpol.2011.10.052.
[107] Canada, Statistics Canada, *Consumer Price Index, Historical Summary (1992 to 2011)*, last modified January 20, 2012, http://www.statcan.gc.ca/pub/12-591-x/2009001/02-step-etape/ex/ex-data-donnees-eng.htm#a4; Canada, Statistics Canada, *Consumer Price Index, Historical Summary (1972 to 1991)*, last modified January 20, 2012, http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ46b-eng.htm; Statistics Canada, *Consumer*

The tariff rates for microFIT projects have drawn criticism throughout the program. Numerous energy industry commentators have criticized the relatively high tariffs paid, especially that for solar PV.[108] The tariff for microFIT solar PV projects even became an election issue, with the provincial Progressive Conservative (PC) Party vowing to cancel the microFIT Program upon election.[109] These criticisms were partially vindicated when, less than a year after program launch, the microFIT Program's designers asserted that excessive profits had been observed in the solar PV category. According to the OPA, ground-mounted solar PV projects were achieving approximately double the intended rate of return on equity.[110] Due to the unexpected level of participation in this stream of the program – a "large majority" of the 16,000 applications submitted to that point[111] – and a reduction in the cost of projects not utilizing solar tracking technology, the OPA announced a new price of 0.588 CAD/kWh on July 2, 2010. The new price was eventually set at 0.642 CAD/kWh following stakeholder consultation.

A team from the Office of the Auditor General of Ontario found a lack of documentation with respect to the determination of the tariff for electricity from ground-mounted solar PV microFIT projects and the initial development of the microFIT and FIT tariffs.[112] The team also identified a lack of independent scrutiny of the tariff prices, although it was noted that stakeholders were consulted in the process of setting the tariff paid for electricity from ground-mounted solar PV projects. Nevertheless, it is not clear which stakeholders were engaged in this process.

Price Index, Historical Summary (1952 to 1971), last modified January 20, 2012, http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ46c-eng.htm.

[108] Terence Corcoran, "Ontario's Iron-Fisted Energy Model," *National* Post, October 1, 2009, Factiva (FINP000020091001e5a10003t); Lilley, "Green Goals, Bigger Bills"; Jan Carr and Benjamin Dachis, "High Price for Green; Ontario Should Follow B.C. in Protecting Consumers," *National Post,* December 17, 2012, Factiva (FINP000020101217e6ch00040).

[109] Brian Shypula, "Hudak Would Pull Plug on microFIT," *Beacon Herald,* March 18, 2011, http://www.stratfordbeaconherald.com/ArticleDisplay.aspx?e=3033873&archive=true.

[110] "Rationale for New Ground-Mounted microFIT and FIT Program Price Category," Ontario Power Authority (OPA), last modified July 14, 2010, http://microfit.powerauthority.on.ca/rationale-new-ground-mounted-microfit-and-fit-program-price-category.

[111] "New Price Category Proposed for microFIT Ground-Mounted Solar PV Projects," Ontario Power Authority, last modified July 2, 2010, http://www.powerauthority.on.ca/news/new-price-category-proposed-microfit-ground-mounted-solar-pv-projects.

[112] Office of the Auditor General of Ontario, *2011 Annual Report*, 104-105.

4.1.2.2. Actual cost of solar PV microgeneration

It is clear that during the early stages of the microFIT Program the actual cost of developing a ground-mounted solar PV project was either miscalculated or dramatically reduced due to changes in technology costs or learning. A miscalculation is most likely given the OPA's admitted realization of a program "glitch,"[113] but a reduction in project costs is also probable given widespread agreement that the cost of a solar PV system has declined dramatically throughout the life of the program. In December 2011 it was reported that global prices for bulk purchases of solar PV panels had dropped by 70% since 2009.[114] In late 2011, auditors from the Office of the Auditor General noted that a study conducted by the OPA found that the cost of solar technologies in Ontario had declined by 50% since 2009, mainly due to reductions in solar PV component prices.[115] The Canadian Solar Industries Association (CanSIA) has estimated the reduction in solar panel prices for microFIT projects in particular. CanSIA estimates that the microFIT Program was designed according to a panel price of 4.5 CAD/watt-peak (Wp) and observes that, for a solar PV system with a nameplate capacity of 5 kW, this price dropped to an average of 2.21 CAD/Wp in 2011[116] — a reduction of more than 50%. CanSIA attributes much of this precipitous cost reduction to overcapacity in global solar cell production and local module production as well as to local manufacturing efficiency gains.

Conversely, the costs of other aspects of commissioning a microFIT project are reported to have remained steady or risen. CanSIA states that its members have indicated that the 'balance of system' (BOS) costs, including electronics, mounting, engineering, connection, permits, installation and profit, continue to amount to approximately 3.7 CAD/Wp. The organization provided little insight on the price

[113] "Rationale for New Ground-Mounted microFIT," OPA.
[114] "Solar Energy Cheaper Than You Might Think, Says Researcher," *Financial Post,* December 7, 2011, accessed January 31, 2012. http:// www.financialpost.com/news/Solar+energy+cheaper+than+might+think+says+ researcher/5826207/story.html.
[115] Office of the Auditor General of Ontario, *2011 Annual Report*, 107; employee of the Office of the Auditor General of Ontario, e-mail message to the author, January 31, 2012.
[116] Canadian Solar Industries Association (CanSIA), *Maximizing the Benefits of Early Success: Recommendations for the Sustainability of Ontario's Solar Energy Sector* (Ottawa: CanSIA, 2011), 48-50, accessed January 12, 2012, http://www.cansia.ca/sites/default/files/20111214_cansia_fit_review_submission_final.pdf.

dynamics of the various elements of the BOS, with the exception of the assertion that costs have arisen where municipalities have increased the documentation requirements for building permits. However, an executive from a residential-focused solar PV installation company noted that inverter costs have fallen slightly while labour costs have risen significantly.[117]

Excessive grid connection costs have also reportedly been charged to microFIT project owners by Hydro One and other local distribution companies (LDCs).[118] CanSIA has been informed of charges of up to 8,500 CAD and notes a general upward trend in connection costs, observing price increases from an initial range of 350 CAD to 500 CAD to a span of 1,500 CAD to 1,700 CAD more recently.[119] The Ontario Solar Network has offered a different expression of these costs, noting that in some cases connection fees now account for up to 20% of microFIT project costs.[120] However, an expert from one Ontario LDC noted that the average connection cost applied in his predominantly urban service territory has been approximately 600 CAD.[121] It is possible that connection charges are higher in mores sparsely populated rural areas with larger property sizes. Charges will also be higher if the local transformer must be upgraded to accommodate the new supply capacity.[122]

Overall, the price of a microFIT-scale solar PV system has declined significantly. The installed system price of such a project in Canada in 2010 was reported to be between 6.30 and 7.80 USD per watt.[123] A representative of another solar PV installation company noted that the cost of a small rooftop

---

[117] Richard Blackwell, "Price Dip Shakes Up Solar Panel Market," *Globe and Mail*, December 5, 2011, ProQuest (907914591).
[118] Green Energy Act Alliance (GEAA) and Shine Ontario Association, *Ontario Feed-In Tariff: 2011 Review* (Toronto: GEAA and Shine Ontario Association, 2011), 89, accessed January 9, 2012, http://environmentaldefence.ca/sites/default/files/report_files/FIT.Review_Updated.pdf.
[119] CanSIA, *Maximizing the Benefits of Early Success,* 48.
[120] FIT Review Coalition, *FIT 2.0 – Blueprint for Ontario's Solar PV Market* (Toronto: Ontario Solar Network, 2011), 8, accessed January 10, 2012, http://ontariosolarnetwork.org/Resources/Documents/FIT%202.0%20Blueprint%20for%20Ontario%27s%20Solar%20PV%20Market%20%20Ontario%20Solar%20Network%27s%20FIT%20Review%20Coalition%20-%20Submitted%202011.12.09.pdf.
[121] Interview with experts from a Local Distribution Company (LDC) in Ontario, February 15, 2012.
[122] Ibid.
[123] IEA, *Trends in Photovoltaic Applications 2010,* 30.

solar PV project had declined from 70,000 CAD to 50,000 CAD over the course of 2011.[124] Therefore, it is clear that all tariff rates for solar PV microFIT projects became significantly less cost-effective over the course of the program. In the case of ground-mounted systems, the 2010 tariff price reduction helped improve cost-effectiveness, although political pressure following the unscheduled price change may have resulted in a tariff that was still overly lucrative. While the originally proposed price adjustment was hotly contested,[125] ground-mounted solar PV systems have remained competitive, with several thousand applications submitted since the adjustment, albeit at a slower rate.[126]

The cost-effectiveness of the microFIT Program is reduced by four additional program features. The first two such features are related to the program objective of encouraging industry and job growth in Ontario. First, the domestic content requirements placed on solar PV projects increase project costs. These requirements stipulated that at least 40% of the components and labour used in solar PV microFIT projects completed in 2009 and 2010 were to be derived from Ontario, increasing to 60% for projects completed in 2011 or later.[127] Program critics and supporters alike have acknowledged that solar PV components produced in Ontario are more expensive than internationally produced components, with domestic module prices typically 10% to 15% greater than global market prices.[128] Increased domestic prices result from higher input prices (materials, labour, etc.) and lack of economies of scale, but also from the fact that suppliers may raise their prices in accordance with tariff rates.[129] Program designers may justify this premium for domestic components as the cost of attracting investment. However, there

[124] John Spears, "Review Clouds Outlook for Solar Firms: New Projects Grind to a Halt While Province Determines New Prices," *Toronto Star*, November 8, 2011, ProQuest (902586095).
[125] Tim Shufelt, "Ontario Solar Program in Disarray," *Financial Post*, July 7, 2010, Factiva (CWNS000020100707e67700d1i); Robert Benzie, "Liberals' Solar Shift Clouds MPPs' Mood: Quietly Slashing Subsidy for Rural Generators Sparks Caucus Fears," *Toronto Star,* July 9, 2010, ProQuest (603449592); Rob Ferguson, "Business Fights Solar Rate Cut; McGuinty Government's Price Drop 'Crippling and Quite Possibly Bankrupting' to Farmers," *Toronto Star*, July 13, 2012, Factiva (TOR0000020100713e67d0000l).
[126] Office of the Auditor General of Ontario, *2011 Annual Report*, 105.
[127] Smitherman, *Directive to the CEO*, 2.
[128] Office of the Auditor General of Ontario, *2011 Annual Report*, 105; Interview with a solar PV industry expert, February 17, 2012.
[129] Interview with solar PV industry expert, February 17, 2012.

is some disagreement about whether prices remain elevated. Stakeholders of Ontario's solar PV industry reportedly asserted that domestic component prices had declined to market parity by December 2011.[130] Second, the Ministry of Energy has admitted that it offered high tariff prices in order to rapidly attract investment during a period of economic downturn.[131]

Third, the rate of return on equity offered to all microFIT and FIT Program participants may be excessive. The team from the Office of the Auditor General, among others, has noted that the 11% after-tax rate of return is higher than that of programs in both Germany (between 5% and 7%) and Spain (between 7% and 10%).[132] Yet this comparison is not valid without context – the European renewable energy market is more advanced than Ontario's and therefore may require a lower rate of return to encourage participation. Ontarians may require a greater incentive to purchase a renewable energy system than citizens of other jurisdictions, but the Ontario government may also have further increased the assumed rate of return as part of its intentional inflation of the tariffs. Regardless, some stakeholder groups have advocated for reductions in the included return on equity. These recommendations will be discussed below.

Fourth, the microFIT Program's exclusion of companies that lease the roofs of buildings in order to develop solar PV projects (often referred to as 'commercial aggregators') eliminates an opportunity to develop microFIT projects more cost-effectively. Despite the fact that these companies incur additional costs by paying building owners a fee for the use of their roofs, they are able to commission projects at a lower cost by negotiating a lower price for project components purchased bulk.

Commercial aggregators were initially permitted to participate in the microFIT Program. However, this option was cancelled in August 2010 due to the low project costs incurred by these

[130] Keith Brooks, "Transmissions from a Solar Conference," *Blue Green Canada* (blog), December 7, 2011, http://bluegreencanada.ca/blog/transmissions-solar-conference.
[131] Office of the Auditor General of Ontario, *2011 Annual Report*, 105.
[132] Ibid., 104; Yatchew and Basiliauskas, "Ontario Feed-In-Tariff Programs," 3891-3892.

organizations relative to an individual developer.[133] The microFIT Advisory Panel was tasked with reviewing the program, and draft rules for a Commercial Feed-In Tariff (CFIT) Program were publicized in February 2011, with proposed prices of 0.713 CAD/kWh for rooftop projects and 0.443 CAD/kWh for ground-mounted projects, a similar application process to that of the microFIT Program, and changes to contract provisions which had been sought by commercial aggregators.[134] However, the program was never launched. According to the OPA, program complexity, broader policy issues (likely including the 2011 provincial election) and proximity to the biannual FIT Program review deemed evaluation under the scheduled program review more appropriate.[135] Nonetheless, the OPA reports that some companies have continued to operate as commercial aggregators by structuring their offerings such that building owners hold the microFIT contract with the OPA.

4.1.2.3. Suggested changes to solar PV tariffs

In October 2011, the first scheduled review of the FIT and microFIT Programs commenced. Publicly available submissions to the consultation process commonly recommended improving the cost-effectiveness of the microFIT Program by reducing the tariffs offered. For instance, the Green Energy Act Alliance (GEAA) and Shine Ontario suggested that rooftop and ground-mounted solar PV facilities with a nameplate capacity of 10 kW or less should receive 0.55 CAD/kWh and 0.44 CAD/kWh, respectively, over 25-year contract periods.[136] An extended contract period was recommended in order to distribute costs over a longer period of time, reducing the annual impact on ratepayers. For a contract period of 20 years, the groups recommended a tariff of 0.59 CAD/kWh for rooftop projects. A rate of return on equity of 9% was assumed. Tariff recommendations made by CanSIA for rooftop solar PV projects include rates of 0.65 CAD/kWh for projects with a nameplate capacity between 5 kW and 10 kW, and 0.695 CAD/kWh

[133] Interview with an official from the OPA, January 20, 2012.
[134] "New FIT Program Proposed for Commercial Aggregators," Ontario Power Authority, accessed April 1, 2012, http://microfit.powerauthority.on.ca/new-fit-program-proposed-commercial-aggregators.
[135] Interview with an official from the OPA, January 20, 2012.
[136] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 48.

for projects under 5 kW.[137] The group suggested a separate tariff category for rooftop projects under 5 kW due to the "greater likelihood of module shading and non-ideal tilt and azimuth angles," which reduce generation capacity.[138] This tariff category would reward projects that are clearly less cost-effective than others that provide very similar benefits. For ground-mounted microFIT projects, the group recommended a single tranche at a tariff of 0.594 CAD/kWh. CanSIA did not recommend any changes to the contract period, but in its tariff calculations it reduced the post-tax internal rate of return to between 8% and 10%.

In addition to immediate tariff reductions, stakeholders suggested several other measures to increase program cost-effectiveness. One such measure was the standardization and re-evaluation of costs for permitting and connection requirements.[139] More commonly recommended were changes to the program review process. These would help improve the management of prices and costs to ratepayers. As opposed to the original biannual review protocol, some stakeholders suggested that the program should be reviewed annually.[140] Others advocated more complex price degression strategies whereby tariffs are automatically reduced at specified points.[141] CanSIA recommended the annual review of microFIT tariffs for solar PV, with new prices applied at the granting of 200 MW of conditional offers within a calendar year or, if this volume is not achieved, at the turn of the year.[142] Another group recommended a similar two-pronged strategy for all solar PV FIT projects and included a suggested annual degression target of 9%.[143] This annual target would serve as a guide to inform the industry of the price trajectory, but actual project costs and appropriate tariff levels would be evaluated at the time

[137] CanSIA, *Maximizing the Benefits of Early Success,* 15.
[138] Ibid.*,* 46.
[139] Ibid.*,* 48.
[140] FIT Review Coalition, *FIT 2.0*, 3.
[141] Association of Municipalities of Ontario (AMO), *Feed-In-Tariff Program Review: AMO Written Submission to the Ministry of Energy and the Ontario Power Authority (OPA)* (Toronto: AMO, 2011), accessed January 9, 2012, http://www.amo.on.ca/AM/Template.cfm?Section=FIT_Review&Template=/CM/ContentDisplay.cfm&ContentID=163978.
[142] CanSIA, *Maximizing the Benefits of Early Success,* 16.
[143] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 45-46.

of degression. Other stakeholders suggested that the achievement of volume targets – based on project cost reductions, application volume, or installed capacity – should be the sole factor which dictates program review or price degression.[144]

Following the program review, Ontario's Ministry of Energy released recommended tariffs for all of the supported fuel categories. For rooftop and ground-mounted solar PV projects with a nameplate capacity of 10 kW or less, the Ministry recommended prices of 0.549 CAD/kWh and 0.445 CAD/kWh, respectively.[145] The Ministry did not recommend any adjustment to the contract period or create any new project size tranches for the solar PV fuel category. The government did, however, facilitate the participation of an additional solar PV technology by introducing domestic content compliance specifications for concentrated solar PV. The recentness of this action precludes its discussion here, but its effect on program costs should be evaluated independently.

The proposed tariffs are conservative relative to the suggested tariffs noted above (although they will be subject to a review process and therefore may be adjusted prior to program implementation). Given that the Ministry has not publicized its cost assumptions, it is difficult to determine if the government foresees lower costs than those proposed by renewable energy advocates or if it is offering a lower rate of return. If the latter scenario applies, this indicates an attempt to increase the program's cost-effectiveness.

The Ministry made recommendations regarding two additional cost management measures. First, it suggested that the tariffs awarded by the FIT and microFIT Programs undergo an annual review, with new tariffs announced each November and implemented at the turn of the year. Second, the Ministry recommended the abandonment of the CFIT Program in order to maintain individual and

---

[144] Ontario Sustainable Energy Association (OSEA), *Submission for the Review of Ontario's Feed-In Tariff Programs* (Toronto, OSEA, 2011), 5, accessed January 9, 2012, http://www.ontario-sea.org/Storage/64/5564_OSEA_ Submission _for_the_Review_of_Ontario%92s_Feed-in_Tariff_Programs.pdf.

[145] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program: Two-Year Review Report* (Toronto: Queen's Printer for Ontario, 2012), 27, accessed March 22, 2012, http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf.

community participation in and benefit from the microFIT Program.[146] This is somewhat puzzling given that the CFIT model would still allow project hosts to earn some revenue from the rental of their roof and would allow microFIT projects to be installed more cost-effectively. Surprisingly, the CFIT program received no comment in the publicly available stakeholder submissions reviewed, although, upon inquiry, one stakeholder expressed a lack of opposition to an appropriately priced and designed program.[147] This lack of pressure to implement the program is likely to have reduced its priority in the eyes of the government. As such, an opportunity to improve program cost-effectiveness has been lost.

4.1.2.4. Cost of other types of renewable electricity microgeneration

Other types of microgeneration projects are supported by the microFIT Program, although few projects have reached commercial operation. This is typically due to inadequate tariffs.[148] Nonetheless, some types of projects could be more cost-effective than solar PV. For example, micro-scale wind power projects could be a viable alternative to solar technology. Seven such projects had received executed microFIT contracts as of June 25, 2012,[149] although they are likely to have been undertaken as a result of moral rather than financial motives.[150] Multiple stakeholder groups have recommended the promotion of micro-scale wind projects.[151] One group has suggested that tariffs of 0.52 CAD/kWh and 0.42 CAD/kWh are appropriate for projects with respective nameplate capacities of less than 3 kW and between 3 kW and 10 kW.[152] A 2007 study suggested lower prices for micro-scale wind power, finding delivered electricity costs of 0.36 CAD/kWh and 0.17 CAD/kWh for a 2 kW and a 10 kW wind turbine,

[146] Interview with a staff member of the Ontario government, April 5, 2012.
[147] Interview with a representative of the Ontario Sustainable Energy Association (OSEA), February 8, 2012.
[148] Ibid.
[149] OPA, *Bi-weekly FIT and microFIT Report*, microFIT Project Summary.
[150] Interview with a representative of OSEA, February 8, 2012.
[151] OSEA, *Submission*, 7; GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 57.
[152] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 57.

respectively.[153] However, this study assumes that no equity is borrowed and no return on equity is offered. In addition, the study's assumed installed costs of between 4,500 CAD and 5,000 CAD may be low given that the Canadian Wind Energy Association (CanWEA) suggests an average total installed cost per kW of 7,170 CAD for wind projects with a nameplate capacity of 1 kW to 10 kW.[154] The ranges of assumptions underlying these estimates and those discussed below are summarized in Tables 3 and 4.

All of the tariff suggestions noted above are more cost-effective than those recommended for solar PV, although the application of the current tariff escalation could drive the higher tariffs above current solar PV tariffs. Regardless, the Ministry did not recommend any new project size tranches for wind projects and, in fact, recommended that the tariff offered for wind projects of all sizes be reduced from 0.135 CAD/kWh to 0.115 CAD/kWh. This will further discourage micro-scale wind power development. In addition, the microFIT Program's regulatory requirements for micro-scale wind projects with an installed capacity greater than 3 kW are more onerous than those for micro-scale solar PV.[155] This is likely to greatly reduce the desirability of wind-powered microFIT projects.

Hydroelectric power projects are less popular among microFIT project proponents, with only ten such projects having been proposed and none having progressed beyond the receipt of a conditional offer.[156] A 2004 report from Natural Resources Canada (NRCan) estimates that a micro-hydropower system with a nameplate capacity below 5 kW is likely to cost 2,500 CAD per kW or more, while projects between 5 kW and 100 kW would cost between 1,500 CAD and 2,500 CAD per kW.[157] The report also notes that the capacity factor of hydropower projects under 10 kW is approximately 50%. A website created in 2008 as part of a collaborative effort between NRCan, Agriculture Canada and various

[153] Alison Bailie et al., Economic Instruments for On-Site Renewable Energy Applications in the Residential/Farm Sector (Drayton Valley, AB: Pembina Institute, 2007), 17-19, accessed April 2, 2012, http://pubs.pembina.org/reports/Econ_Instru_Res_RE_03-07.pdf.
[154] Canadian Wind Energy Association (CanWEA), *2010 CanWEA Small Wind Market Survey: An Overview of Canada's Small Wind Manufacturing Sector* (Ottawa: CanWEA, 2010), 4, accessed April 1, 2012, http://www.canwea.ca/pdf/SmallWind/canwea-smallwindmarketsurvey-e-web.pdf.
[155] O Reg 359/09.
[156] OPA, *Bi-weekly FIT and microFIT Report*, microFIT Project Summary.
[157] Canada, NRCan, *Micro-Hydropower Systems,* 31.

agriculture and energy organizations adds detail to the estimates noted above, reporting that the cost of small-scale hydropower projects (under 250 kW) is between 2,000 CAD and 9,000 CAD per kW installed.[158] Operations and maintenance (O&M) requirements were also addressed by this website and were reported to be low.

The potential range of per kilowatt-hour costs of micro-hydropower projects can be calculated based on these installed cost estimates. Based on key assumptions of a 20-year contract (since an individual or organization is unlikely to occupy a property for 40 years) and no return on equity, a 5 kW system at a cost of 9,000 CAD per kW installed would require a tariff of 0.103 CAD/kWh, while a 5 or 10 kW system with an installed cost of 2,500 CAD per kW would require 0.029 CAD/kWh. Despite the exclusion of a variety of costs from this calculation, including those of debt financing, grid connection, and O&M, micro-hydropower projects are very likely to be more cost-effective than solar PV.

However, micro-hydro projects are limited to areas with a suitable water resource and are subject to a rigorous Class Environmental Assessment (EA). Typically completed over the course of 1 to 2 years,[159] the Class EA includes community notification and consultation, Aboriginal engagement, assessment and reporting of environmental effects, and post-implementation monitoring of project effects. Additional permits and approvals may also be required, potentially at both the provincial and federal levels. Moreover, regulatory delays and access to Crown land can be problematic for small-scale projects.[160] These factors are likely to limit the development of micro-hydro systems.

Between 15 and 22 projects had been proposed for each of the bioenergy categories as of June 25, 2012, but only one project – a biomass system with a nameplate capacity of 3.6 kW – had reached

[158] "Low Head and Ultra Low Head Hydro," Canadian Federation of Agriculture, last modified March 31, 2008, http://www.farm-energy.ca/IReF/index.php?page=low-head-and-ultra-low-head-hydro-ataglance.
[159] Ontario Waterpower Association (OWA), *A Citizen's Guide: Understanding the Class Environmental Assessment Process for Waterpower Projects* (Peterborough, ON: OWA, n.d.), accessed April 2, 2012, http://www.owa.ca/assets/files/classea/OWA%20Citizen's%20Guide.pdf.
[160] Employee of the Ontario Waterpower Association, e-mail message to the author, February 14, 2012.

commercial operation.[161] Only 7 biomass projects, 2 biogas projects and 1 landfill gas project had received a conditional offer. This is likely due to the high cost of such systems. A biogas system of this size requires expensive custom engineering and poured concrete.[162] Biogas systems also require costly substrate testing to ensure a viable biomass source as well as biomass handling and preprocessing systems and an expensive grid connection.[163] Micro-scale landfill gas projects involve considerable costs associated with gas cleaning, installation of piping systems, and regulatory approvals.[164]

Given these costs, there is widespread skepticism about the economic viability of such systems.[165] One expert estimated that the tariff required for a gasification system with a nameplate capacity of 10 kW or less is likely to be 0.35 CAD/kWh at minimum.[166] When the historic return on equity is added to this cost, this tariff rate is not dramatically lower than that for ground-mounted solar PV. Nonetheless, microFIT tariffs for bioenergy remain low. Following the program review, government suggestions for increases to bioenergy tariffs related only to the proportion of the tariff escalated in accordance with the CPI. The escalation percentage for bioenergy projects is proposed to be increased from 20% to 50%.[167]

The availability of appropriate technology for micro-scale biomass and biogas projects is also uncertain. Traditional combustion and steam turbines are not viable at the micro-scale, and Organic Rankine Cycle systems, which can be used in biomass combustion or gasification projects, are typically used in projects with an installed capacity of more than 50 kW.[168] A gasification system using solid

[161] OPA, *Bi-weekly FIT and microFIT Report*, microFIT Project Summary.
[162] Bioenergy expert, e-mail message to the author, February 24, 2012.
[163] Employee of a bioenergy company, e-mail message to the author, April 2, 2012; Bioenergy expert, e-mail message to the author, March 6, 2012.
[164] Bioenergy expert, e-mail message to the author, April 3, 2012.
[165] Bioenergy expert, e-mail message to the author, February 24, 2012.; employee of a bioenergy company, e-mail message to the author, April 2, 2012; bioenergy expert, e-mail message to the author, March 6, 2012.
[166] Bioenergy expert, e-mail message to the author, April 3, 2012.
[167] Ontario Power Authority (OPA), *FIT/mFIT Price Schedule (April 5, 2012)* (Toronto: OPA, 2012), accessed June 20, 2012, http://microfit.powerauthority.on.ca/sites/default/files/FIT%20and%20mFIT%20Price%20 Schedule%20 Version%202.0.pdf.
[168] Bioenergy expert, e-mail message to the author, March 2, 2012.

Table 3

Estimates of the installed cost and tariffs required for micro-scale wind generation

Source	Year estimate calculated	Installed capacity (kW)	Rotor diameter (m)	Wind speed (m/s)	Electricity delivered (kWh/year or kWh/m^2 of rotor swept area)	Contract length (years)	Return on equity (%)	Equity borrowed (%)	Discount rate (%)	Installed cost (CAD/kWh or CAD/ m^2 of rotor swept area)	Tariff estimate (CAD/ kWh)
1	2007	2	Unknown	5.5	2,240 kWh/year	20	0	0	5	5,000 CAD/kW	0.36
2	2011	<3	<5	5.5	450 kWh/m^2	20	9	60	6.9	1,750 CAD/m^2	0.52
1	2007	10	Unknown	5.5	21,500 kWh/year	20	0	0	5	4,500 CAD/kW	0.17
2	2011	<10	<10	5.5	500 kWh/m^2	20	9	60	6.9	1,600 CAD/m^2	0.42
3	2010	≤10	Unknown	-	-	-	-	-	-	2,300 CAD - 7,170 CAD/kW	-

Sources:

(1) Bailie et al., *Economic Instruments*, 17-19; (2) GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 57; Paul Gipe, "Feed-In Tariff Calculator Using Chabot PI Method" (unpublished data, 2011), received April 2, 2012; (3) CanWEA, *2010 CanWEA Small Wind*, 4.

Table 4

Estimates of the installed cost and tariffs required for micro-scale hydroelectric and bioenergy generation

Source	Year estimate calculated	Installed capacity (kW)	Capacity factor (%)	Contract length (years)	Return on equity (%)	Equity borrowed (%)	Discount rate (%)	Cost per installed kW (CAD)	Tariff estimate (CAD/kWh)
Hydroelectric									
1	2004	<5	-	-	-	-	-	≥2500	-
1	2004	5 – 100	50	20[a]	0	0	0	1,500 - 2,500	0.029[b]
2	2008	<250	50	20[a]	0	0	0	2,000 - 9,000	0.103[c]
Biomass gasification									
3	2012	≤10	Unknown	Unknown	0	100	Unknown	Unknown	≥0.35

Sources:

(1) Canada, NRCan, *Micro-Hydropower Systems,* 31; (2) "Low Head and Ultra Low Head Hydro," Canadian Federation of Agriculture; (3) Bioenergy expert, e-mail message to the author, April 3, 2012.

Notes:

a: Contract length assigned by author.
b: Tariff calculated by author. A cost per installed kW of 2,500 CAD and nameplate capacities of both 5 and 10 kW are assumed.
c: Tariff calculated by author. A cost per installed kW of 9,000 CAD and a nameplate capacity of 5 kW are assumed.

biomass and a modified internal combustion engine could be viable, as could a Stirling engine used in biomass combustion or gasification projects. However, such gasification systems as well as anaerobic digesters at this scale are currently prevalent in the developing world only.[169] In this context, labour is relatively inexpensive, reducing maintenance costs.[170]

There are two additional obstacles to the development of micro-scale bioenergy projects. First, micro-scale engines are not currently mass-produced. They are manufactured on a custom basis,[171] which is likely to be relatively costly. Second, the lifespan of small engines is reported to be short,[172] resulting in either a shorter period of tariff payment with higher annual tariffs or engine replacement and increased project costs. Ultimately, micro-scale electricity production is not a priority in the bioenergy sector since bioenergy projects benefit from significant economies of scale.[173] It is economically advantageous to build larger projects and to combine multiple sources of biomass feedstock. Once again, those pursuing bioenergy projects under the microFIT Program are likely to be doing so due to moral rather than financial motives.[174]

4.1.2.5. Cost of electricity purchased through alternative procurement channels

The magnitude of the tariffs offered by the microFIT Program can be assessed by comparing them to the cost of electricity purchased through other procurement channels. One alternative to supporting microFIT projects is the production of additional electricity from projects qualifying for the FIT Program. Generation from larger solar PV projects would match the supply profile of the current cohort of microFIT projects, and the current tariffs recommended – between 0.347 CAD/kWh and 0.548

[169] Employee of a bioenergy company, e-mail message to the author, April 2, 2012; Bioenergy expert, e-mail message to the author, March 2, 2012; Bioenergy expert, personal conversation, March 2, 2012.
[170] Bioenergy expert, personal conversation, March 23, 2012.
[171] Ibid.
[172] Bioenergy expert, e-mail message to the author, February 24, 2012..
[173] Bioenergy expert, personal conversation, March 23, 2012.
[174] Bioenergy expert, e-mail message to the author, March 2, 2012.

CAD/kWh depending on size and rooftop or ground-mounted positioning[175] – are more cost-effective. However, the differential between FIT and microFIT solar PV tariffs has decreased significantly following the review of the FIT, lessening the cost reduction provided by this alternative.

Past procurement programs in Ontario have also purchased renewable electricity at a lower cost. The Renewable Energy Supply (RES) program procured renewable electricity through three rounds of Request for Proposals (RFP) between June 2004 and August 2008. Supply was contracted from projects with nameplate capacities between approximately 2 MW and 200 MW at weighted average costs per kWh of 0.0951 CAD for wind projects, 0.0785 CAD for hydroelectric projects and 0.0823 CAD for bioenergy projects.[176]

In 2006, the Ontario government began purchasing electricity from renewable energy projects with a nameplate capacity of 10 MW or less through its first feed-in tariff – the Renewable Energy Standard Offer Program (RESOP). The program offered rates of 0.42 CAD/kWh to solar PV projects and 0.11 CAD to wind, hydroelectric or bioenergy projects before it was replaced by the FIT and microFIT Programs in 2009. Of the 305 RESOP contracts executed for solar PV projects, 240 were for projects with an installed capacity of 10 kW or less.[177] The quantity of RESOP contracts issued to micro-scale projects of other renewable fuel types is unclear. Very few wind projects under 500 kW were contracted and only 13 hydroelectric projects under 2 MW were developed. In the bioenergy category, only 8 landfill gas projects under 5 MW were commissioned; only 6 biogas projects under 5 MW were contracted, with unexpectedly low adoption by farmers; and no biomass projects under 2.5 MW were deployed. The

[175] OPA, *FIT/mFIT Price Schedule.*
[176] Employee of the Office of the Auditor General of Ontario, e-mail message to the author, January 31, 2012; Office of the Auditor General of Ontario, *2011 Annual Report*, 103.
[177] OPA, "Proposed Feed-In Tariff Price Schedule," 12.

program was criticized for low biogas and solar PV tariffs, an administration process which was difficult for homeowners, and a lack of participation from individual Ontarians.[178]

The cost of electricity generated by microFIT projects should also be compared to market electricity prices. In a study conducted between May 2002 and April 2004, average hourly solar radiation measured in Guelph, Ontario was found to rise as electricity market prices increased over the course of a day.[179] However, the highest price peak occurred at a time of negligible solar radiation. During the summer month of July, solar radiation was relatively high during the peak price period, and the two factors were statistically most closely correlated during this month as well as the month of August.

Nonetheless, electricity market prices in the study period were typically much lower than the price paid for generation from solar PV microFIT projects. The electricity price rose above 300 CAD per megawatt-hour (MWh), or 0.30 CAD/kWh – the highest price threshold considered – during only 6 hours in July and August of 2002 and 2003 combined. The first and third most expensive electricity price periods boasted market prices of 1,028.42 CAD/MWh and 889.13 CAD/MWh, or 1.03 CAD/kWh and 0.89 CAD/kWh, respectively. At these times, solar radiation availability was 85%. During the remaining peak price periods, with the exception of the period which occurred overnight, solar radiation availability was greater than 50%. Therefore, microFIT projects can occasionally be competitive with electricity market prices and, in general, can reduce the need to purchase electricity from the market during peak price periods.

Ontario's Independent Electricity System Operator (IESO) also imports electricity from Manitoba, Québec, and the United States on a regular basis. Although import market prices are most often lower than the prices paid for electricity from microFIT projects, they can be significantly higher. Between 2007 and 2011, imported electricity was purchased at a higher price than the proposed tariff

[178] Paul Gipe, *Renewables Without Limits: Moving Ontario to Advanced Renewable Tariffs by Updating Ontario's Groundbreaking Standard Offer Program* (Toronto: Ontario Sustainable Energy Association, 2007), 12-13 & 20, accessed April 3, 2012, http://www.ontario-sea.org/Storage/22/1375_RenewablesWithoutLimits.pdf.
[179] Rowlands, "Solar PV Electricity and Market Characteristics," 829.

for electricity from ground-mounted solar PV microFIT projects during 21 hours.[180] Prices at which electricity was purchased range from 0.45213 CAD/kWh on June 12, 2007 to 1.99999 CAD/kWh on February 18, 2009, and only three of these periods of high prices occurred outside daylight hours. This indicates that solar PV microFIT projects can often help reduce the need to purchase this expensive electricity.

In addition to purchasing electricity from wholesale markets, Ontario has procured much of its newest electricity supply through private contracts which specify price or revenue requirements. These contracts are not available to the public, but the OPA has provided estimates of the cost of new supply during stakeholder consultation processes. Given that generation from current microFIT projects does not provide baseload electricity supply and that the Ontario government plans to replace coal-fired supply with natural gas and renewable energy,[181] it is most appropriate to compare the cost of microFIT generation to the cost of electricity from a new simple-cycle natural gas plant.

The variable generation profile of microFIT projects makes precise estimation of the cost of comparable natural gas supply difficult to determine without employing modelling software. As such, published estimates of the cost of new natural gas supply must be relied upon. In 2007, the OPA submitted to the Ontario Energy Board (OEB) an estimate of the delivered cost of electricity generated by a newly built 340 MW simple-cycle natural gas plant that would run during only 88 peak demand hours per year.[182] This is similar to the York Energy Centre, for which the OPA awarded a 20-year contract in December 2008,[183] although the Centre is expected to operate for between 260 and 1,300

[180] Independent Electricity System Operator (IESO), "Import Scheduled Prices 2007-2011" (unpublished raw data, 2012), received April 2, 2012 from the IESO.
[181] Ontario, MEI, *Ontario's Long-Term Energy Plan*, 33.
[182] Ontario Power Authority, *EB-2006-0233 – Supplemental Settlement Proposal,* EB-2006-0233, Exhibit S-1-2, Issue 1, Item 1.6 (unpublished submission to the Ontario Energy Board, March 16, 2007), received March 14, 2012 from the Ontario Energy Board.
[183] Pristine Power Inc., "Pristine Power Announces Award of a 20 Year Contract to York Energy Centre," news release, December 11, 2008, http://www.vereseninc.com/upload/careers/12/01/7-ppx-08-12-11.pdf.

hours per year.[184] The OPA's estimate included capital, financing, fuel, O&M, and transmission and distribution costs, and resulted in an electricity price of between 1.19 CAD and 1.64 CAD per kWh, depending on the discount rate employed. Costs assumed in more recent estimates of the price of natural gas generation are fairly similar to those of the OPA. In the U.S. Energy Information Administration's (EIA) most recent Annual Energy Outlook, the assumed overnight capital cost of a 210MW Advanced Combustion Turbine facility was identical to the unit capital cost cited by the OPA, while the fixed O&M cost was lower, at 6.70 USD/kW (in 2010 dollars) compared to the OPA's 16 CAD/kW, and the variable O&M cost was higher, at 9.87 USD/MWh compared to the OPA's 3.5 CAD/MWh.[185]

It is important to note that the generation profile of microFIT projects is somewhat different than that of the OPA's model natural gas plant. Solar PV systems generate power during many more hours of the year and during both peak- and intermediate-demand periods. As mentioned above, Ontario receives solar radiation between the hours of approximately 6:00 a.m. and 7:00 p.m., on average. Depending on location within Ontario, approximately 1,800 to 2,000 hours of bright sunshine occur annually.[186] Therefore, a natural gas plant which provides the same supply profile as a cohort of microFIT projects would be expected to run for many more than 88 hours per year, albeit not necessarily at full capacity. Accordingly, the delivered cost of electricity from such a plant is likely to be

[184] "York Energy Centre (393.0 MW) – Northern York Region," Ontario Power Authority, accessed March 30, 2012, http://www.powerauthority.on.ca/clean-energy/york-energy-centre-393-mw-northern-york-region.
[185] United States, Energy Information Administration, *Updated Capital Cost Estimates for Electricity Generation Plants* (Washington, DC: U.S. Department of Energy, 2011), 7, accessed March 19, 2012, http://www.eia.gov/oiaf/beck_plantcosts/pdf/updatedplantcosts.pdf.
[186] Canada, Environment Canada, *Canadian Climate Normals or Averages 1971-2000* (database), last modified March 14, 2012, http://climate.weatheroffice.gc.ca/climate_normals/index_e.html?. Locations with 20 or more years of data observation and with the most recent observation made during the year 1990 or later were considered.

Table 5

The cost of electricity purchased through alternative procurement channels

Source	Year price applicable	Program	Technology types	Installed capacity (MW)	Capacity factor (%)	Contract length (years)	Return on equity (%)	Equity borrowed (%)	Discount rate (%)	Price (¢/kWh)
1	2012	FIT	Solar PV	>0.1	Unknown	20	Unknown	Unknown	Unknown	34.7 - 54.8
2	2004-2008	RES	Wind	≈2 - 200	Various	Unknown	Unknown	Unknown	Unknown	9.51[a]
2	2004-2008	RES	Hydroelectric	≈2 - 200	Various	Unknown	Unknown	Unknown	Unknown	7.85[a]
2	2004-2008	RES	Bioenergy	≈2 - 200	Various	Unknown	Unknown	Unknown	Unknown	8.23[a]
2	2006-2009	RESOP	Solar PV	≤10	Unknown	20	Unknown	Unknown	Unknown	42
2	2006-2009	RESOP	Wind, hydroelectric, bioenergy	≤10	Unknown	20	Unknown	Unknown	Unknown	11
3	2002-2003	Wholesale market, Ontario	Various	Various	Various	N/A	N/A	N/A	N/A	≥30 - 103[b]
4	2007-2011	Hourly electricity imports, Ontario	Various	Various	Various	N/A	N/A	N/A	N/A	45.2 - 199[c]
5	2007	-	Simple-cycle natural gas	340	1	20[d]	N/A	Unknown	6-11	119 - 164

Sources: (1) OPA, *FIT/mFIT Price Schedule*; (2) Office of the Auditor General of Ontario, *2011 Annual Report*, 103; (3) Rowlands, "Solar PV Electricity and Market Characteristics," 829; (4) IESO, "Import Scheduled Prices 2007-2011"; (5) Ontario Power Authority, *EB-2006-0233.*

a: Weighted average.
b: Hourly electricity prices during the 6 most expensive hours of procurement.
c: Hourly electricity prices during the 21 most expensive hours of procurement.
d: Accounting life.

lower than the estimates noted above. On the other hand, the price of natural gas is expected to be 8.7% higher than the OPA's assumed price by 2035,[187] increasing the cost of electricity generation from natural gas.

Two additional factors must be considered when comparing the cost of electricity from natural gas and solar PV. First, the aforementioned price estimates for electricity produced from natural gas do not consider the cost of externalities associated with fossil fuel combustion, such as the production of greenhouse gases and air pollutants. The inclusion of such costs would increase the unit cost of fossil fuel-fired electricity, reducing the cost differential between conventional generation and renewable microgeneration. Second, natural gas-fired electricity generation plants offer value because they provide significant supply flexibility. The electricity output of a natural gas plant can be reduced or increased in accordance with electricity demand – a characteristic termed dispatchability. In contrast, solar PV is typically considered only partially dispatchable. This will be elaborated upon below.

4.1.3. Efficiency of energy production and delivery

4.1.3.1. Solar PV

The efficiency with which microFIT projects produce and deliver electricity is relevant to program goals set by the government as well as program sustainability requirements. To date, the microFIT Program has achieved a fairly high degree of efficiency with respect to the amount of power produced by each microFIT project. As of June 25, 2012, the average nameplate capacities of ground-mounted and rooftop solar PV projects with executed contracts were 9.75 kW and 8.01 kW, respectively.[188] Indeed, some project owners "oversized" their system since, prior to the program review, the OPA permitted the facility's nameplate capacity to be determined by inverter capacity rather

[187] United States, Energy Information Administration, *AEO2012 Early Release Overview* (Washington, DC: U.S. Department of Energy, 2012), 5, accessed March 21, 2012, http://www.eia.gov/forecasts/aeo/er/pdf/0383er (2012).pdf.
[188] OPA, *Bi-weekly FIT and microFIT Report*, microFIT Project Summary.

than solar PV panel rating. With the knowledge that inverters are able to accommodate slightly more power than their rated capacity and that production from solar PV panels is reduced by dirt, degradation over time, and other factors, some project owners installed more than 10 kW of solar PV panels.[189]

However, the efficiency of electricity generation from microFIT projects is very low from the perspective of capacity factor. Micro-scale solar PV projects exhibit a capacity factor of only 13% to 19%.[190] As a result, multiple generating systems must be commissioned and operated in order to produce the same amount of power as other energy sources. Additional electricity generation capacity is required to produce electricity during periods of low insolation. In particular, solar radiation is significantly diminished in the winter,[191] reducing the capacity factor of solar PV systems to a very low level. Capacity factor is also reduced when solar radiation fluctuates, although fluctuations can be minimized through diversity of generator location and storage technologies.[192] The microFIT Program achieves diversity, and thus fluctuation reduction, because solar PV microFIT projects are dispersed across Ontario. This distributed nature also provides production efficiency when technical problems are encountered. Since electricity is produced by many dispersed systems rather than larger, more centralized generation plants, a supply outage in a particular plant results in minimal supply loss. The second fluctuation reduction strategy – the use of electricity storage technologies – is not yet common among microFIT projects.[193] This lack of electricity storage also limits system dispatchability. Without

[189] "FAQ's," WSE Technologies, accessed April 6, 2012, http://www.wsemicrofit.com/faq#oversize.
[190] Ontario Energy Board (OEB), *Bill Impact Model for Incremental Investments* (Toronto: OEB, 2010), EB-2010-0377, n.p., accessed March 14, 2012, http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/rec/306345/view/; "Rationale for New Ground-Mounted microFIT," OPA.
[191] Rowlands, "Solar PV Electricity and Market Characteristics," 824.
[192] Robert Passey et al., "The Potential Impacts of Grid-Connected Distributed Generation and How to Address Them: A Review of Technical and Non-Technical Factors," *Energy Policy* 39 (2011): 6283, doi:10.1016/j.enpol.2011.07.027.
[193] Interview with a staff member of the Ontario government, April 5, 2012.

electricity storage, solar PV can only be considered partially dispatchable because its output can only be reduced.[194]

The relationship between electricity supply from microFIT projects and electricity demand from Ontarians is also one of efficiency. On an annual basis, solar radiation is closely correlated with average daily electricity demand in Ontario, although it is not well-matched with the highest peak of the day.[195] Focusing on the months of April to September, changes in solar radiation and electricity demand match closely, especially in July and August. Furthermore, solar radiation is high during periods of the highest electricity demand. Therefore, microFIT projects can often be expected to increase power output as demand rises, reducing the need for other generators to increase their output to meet load requirements.[196]

The microFIT Program is also very efficient with respect to electricity delivery. Projects participating in the microFIT Program are typically situated in close proximity to electricity loads, particularly if they are located in urban areas. Where local electricity demand exceeds local electricity supply, microgeneration reduces the amount of power which must be supplied to that portion of the grid from elsewhere on the system, reducing grid congestion.[197] Moreover, a representative from one Ontario LDC stated that increased deployment of microFIT projects in the future could potentially reduce the need for investments to increase system capacity.[198] However, too few microFIT projects currently exist to create an appreciable impact on congestion.[199]

---

[194] Ralph Sims et al., "Integration of Renewable Energy Into Present and Future Energy Systems," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. by Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 26, accessed November 27, 2011, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.
[195] Rowlands, "Solar PV Electricity and Market Characteristics," 824.
[196] Advisor to Ontario's Independent Electricity System Operator, e-mail to the author, February 13, 2012.
[197] Interview with experts from an LDC in Ontario, February 15, 2012; Advisor to Ontario's Independent Electricity System Operator, e-mail to the author, January 29, 2012.
[198] Expert from a Local Distribution Company in Ontario, e-mail message to the author, March 29, 2012.
[199] Interview with experts from an LDC in Ontario, February 15, 2012.

Electricity lost during transmission and distribution is also minimized due to the proximity of microFIT projects to loads and the attendant reduction in transportation of energy over long distances.[200] In Ontario, approximately 9% of electricity is typically lost during transmission or transformation.[201] Although microFIT projects do have some impact in this regard, the notion that they do not yet have a substantial impact applies to transmission and distribution losses as well. The government's report on the results of the program review contains one measure which could enhance the electricity delivery efficiency of the microFIT Program. The report suggests that "self-consumption" models should be evaluated,[202] whereby buildings are able to consume the electricity produced by their microFIT project.

4.1.3.2. Other types of renewable electricity microgeneration

Two alternative types of renewable electricity microgeneration supported by the microFIT Program produce electricity more efficiently than solar PV. Micro-scale hydroelectric systems boast the highest capacity factor, at approximately 50%.[203] Bioenergy systems – most likely biogas-fired – are less efficient. A 10 kW biogas system using a combustion engine could achieve a capacity factor of between 30% and 35%.[204] However, some bioenergy systems are more dispatchable than solar PV. According to a bioenergy expert, gasification systems are capable of reducing output to only 40% of capacity.[205] Moreover, this expert noted that the electricity output of gasification as well as anaerobic digestion systems can be eliminated or maximized on command if gas storage facilities are installed. Micro-hydro systems do not typically include storage capacity, and therefore are not dispatchable.

---

[200] Arvizu et al., "Direct Solar Energy," 28; CanSIA, *Maximizing the Benefits of Early Success,* 6.
[201] Paul Gipe, Deborah Doncaster, and David MacLeod, *Powering Ontario Communities: Proposed Policy for Projects Up To 10 MW* (Toronto: Ontario Sustainable Energy Association, 2005), 51, accessed April 4, 2012, http://www.wind-works.org/FeedLaws/Canada/PoweringOntarioCommunities.pdf.
[202] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 18.
[203] NRCan, *Micro-Hydropower Systems,* 8.
[204] International Energy Agency, *Biomass for Power Generation and CHP* (n.p.: Organisation for Economic Co-operation and Development, 2007), 2, accessed February 24, 2012, http://www.iea.org/techno/essentials3.pdf.
[205] Bioenergy expert, e-mail message to the author, July 19, 2012.

The efficiency of micro-scale wind turbines is approximately equivalent to that of solar PV, with CanWEA employing a capacity factor of 20% in performance calculations.[206] However, the capacity factor of a wind turbine is dependent upon its location. In a UK modelling exercise, the maximum capacity factor of micro-scale wind turbines located in urban areas was found to be only 10%, while the value rose to between 15% and 20% in rural areas.[207]

Little information specific to micro-scale wind turbines was found when examining other generation characteristics. Without specifying a turbine size which may be affected, the North American Electric Reliability Corporation (NERC) has suggested that North American wind resources may be stronger in the spring and fall.[208] Therefore, the output of micro-scale wind turbines may vary less than that of solar PV over the course of a year. On the other hand, relatively low production during the winter and summer is unfavourable for Ontario given that electricity demands increase during these seasons due to the use of furnaces and air conditioners. Additionally, NERC has noted that daily wind energy generation can peak in the morning and evening. Since wind power is only partially dispatchable,[209] micro-scale wind energy generation may correlate poorly with sustained high demand on Ontario's electricity system throughout the day. Indeed, the IPCC has noted that "[i]n many cases, wind power output is uncorrelated or is weakly negatively correlated with periods of high electricity demand."[210] Of further concern is the fact that some electricity generation from small wind turbines occurs overnight.[211]

---

[206] "About the Technology," Canadian Wind Energy Association, accessed March 14, 2012, http://www.canwea.ca/swe/overview.php?id=47.
[207] Carbon Trust, *Small-Scale Wind Energy: Policy Insights and Practical Guidance* (London: Carbon Trust, 2008), 11, accessed April 6, 2012, http://www.wind-power-program.com/Library/Policy%20and%20planning%20documents/Carbon-Trust-Small-Scale-Wind-Report.pdf.
[208] North American Electric Reliability Corporation (NERC), *Special Report: Accommodating High Levels of Variable Generation* (Princeton, NJ: NERC, 2009), 15, accessed July 16, 2012, http://www.nerc.com/docs/pc/ivgtf/IVGTF_Report_041609.pdf.
[209] Sims et al., "Integration of Renewable Energy," 26.
[210] Wiser et al., "Wind Energy," 37.
[211] American Wind Energy Association (AWEA), *2010 U.S. Small Wind Turbine Market Report* (Washington, DC: AWEA, 2011), 30, accessed June 20, 2012, http://www.awea.org/_cs_upload/learnabout/smallwind/10860_1.pdf.

In recent years, Ontario has experienced excess supply conditions during the night, which can lead to inefficient generator operation, wasted resources, and the sale of electricity at very low prices.[212]

The delivery of electricity from alternate types of renewable microgeneration is not necessarily more efficient than the current supply profile of the microFIT Program. Bioenergy, hydroelectric and wind projects are likely to be located in rural areas, further away from major load centres. As such, they are less likely to aid grid congestion issues. On the other hand, rural projects may be more capable of reducing line losses since rural loads are likely to be located at a greater distance from generating stations.

4.1.4. Impact on grid stability

Electricity generation from the microFIT Program may reduce risks to the electricity grid in some respects, but is more likely to cause vulnerabilities. In urban areas where grid congestion is limiting the transmission of electricity supply, the local supply offered by microFIT projects could help meet the demand gap,[213] avoiding supply shortfalls. However, the effectiveness of this solution has been questioned given the small amount of power offered by microFIT projects.[214] Additionally, government expectations of high program participation in urban areas[215] have not come to fruition. This will be further examined below. Conversely, if microFIT generation is added in areas of the province which are experiencing an oversupply of electricity, grid congestion could be increased.[216]

---

[212] Independent Electricity System Operator (IESO), *The Ontario Reliability Outlook* (Toronto: IESO, 2009), 11, accessed June 20, 2012, http://www.ieso.ca/imoweb/pubs/marketReports/ORO_Report-Dec2009.pdf; Neil Campbell, Bill Rupert, and Roger Ware, *Monitoring Report on the IESO-Administered Electricity Markets for the Period from May 2011 to October 2011* (Toronto: Ontario Energy Board, 2012), accessed June 15, 2012, http://www.ontarioenergyboard.ca/OEB/_Documents/MSP/MSP_Report_20120427.pdf.
[213] Interview with a representative of OSEA, February 8, 2012.
[214] Interview with an electricity market expert, February 23, 2012.
[215] Ontario, Legislative Assembly, Official Report of Debates (Hansard), 39th Parl, 1st Sess, (February 23, 2009) at 1320 (George Smitherman).
[216] Interview with an electricity market expert, February 23, 2012.

The electricity generated by microFIT projects has so far been easily integrated into the provincial electricity system.[217] Solar PV generation is more erratic than other renewable energy resources over the course of a day, but its hours of production are predictable and the volume of electricity supplied by microFIT projects is currently small. As such, Ontario's IESO has not adopted any new practices to accommodate the generation, and changes are not expected to be necessary in the near future given the province's current renewable energy targets. If microFIT volumes increase beyond current expectations, the IESO may be compelled to re-evaluate its approach. This is a possibility given the government's recommendation to explore the possibility of the adoption of higher medium-term renewable energy targets.[218] If microFIT supply is increased exponentially, the IESO may be required to introduce visibility measures such as forecasting and real-time monitoring as well as dispatch control in order to maintain grid integrity. Such measures also add costs to the program, and these integration costs may eventually eclipse technical capacity as the limiting factor for microFIT development.[219]

The integration of electricity from other microgeneration sources is no less difficult than integration of solar PV.[220] Wind resources are less erratic over the course of a day, but vary more on a day-to-day basis. Micro-scale hydroelectric systems are unlikely to have storage capacity, resulting in variable electricity output and requiring the resources to be used when available.[221] Bioenergy systems may have storage capacity, enabling dispatchability, but most bioenergy resources must be used when they are produced.[222] When feedstock is available, bioenergy systems generate electricity constantly, but any fluctuation in feedstock supply introduces variability.[223] Yet the combination of these resources could help create a more reliable electricity supply in Ontario. Diversification of resources which may be

[217] Interview with an electricity market expert, February 23, 2012.
[218] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 13.
[219] Interview with a solar PV industry expert, February 17, 2012.
[220] Interview with an electricity market expert, February 23, 2012.
[221] Ibid.; Kumar et al., "Hydropower," 16.
[222] Interview with an electricity market expert, February 23, 2012.
[223] Sims et al., "Integration of Renewable Energy," 17.

available at different times helps to manage output variability and create a more constant electricity supply.[224]

The microFIT Program also impacts the infrastructure of Ontario's electricity system both positively and negatively. Solar PV microFIT projects may be capable of helping to correct technical problems on the electricity grid, but this is often dependent upon inverter characteristics. For example, inverters which operate in 'voltage-regulating' mode can help control voltage and correct power factor and harmonics.[225] However, inverters are not commonly configured as such. Regularly configured inverters may be able to provide frequency regulation, but this is only possible in cases where solar PV systems represent a significant proportion of generation on the grid.

The addition of microFIT projects to Ontario's electricity supply is more likely to cause technical problems on the electricity grid. These problems include voltage fluctuation, voltage imbalance, voltage rise, voltage controller malfunction, reverse power flow, poor power quality, frequency fluctuation, and unintentional islanding.[226] The microFIT Program is particularly vulnerable to such problems because of its domination by solar PV. This method of electricity generation displays a high degree of output variability, which reduces output predictability and thus the ability of system operators to ensure there is enough capacity on the system to meet demand.[227] Although a degree of load variability has historically been accommodated by the electricity system, output from renewable electricity generators can exhibit greater fluctuations than electricity demand.[228] Hydroelectric and bioenergy projects may be less likely to cause these electrical problems due to their lower variability.

---

[224] Amory B. Lovins, *Reinventing Fire: Bold Business Solutions for the New Energy Era* (White River Junction, VT: Chelsea Green Publishing, 2011), 193 & 196.
[225] Passey et al., "The Potential Impacts of Grid-Connected Distributed Generation."
[226] Ibid.; Institute of Electrical and Electronics Engineers (IEEE)*, IEEE Application Guide for IEEE Std 1547™, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems* (New York: IEEE, 2009), 12-80, doi: 10.1109/IEEESTD.2008.4816078.
[227] Advisor to Ontario's Independent Electricity System Operator, personal conversation, February 10, 2012.
[228] Ibid.

An expert from an Ontario LDC suggested that the current level of microFIT deployment is unlikely to adversely affect the provincial electricity grid providing that projects are evenly distributed and simple protection mechanisms are implemented.[229] The expert cautioned that if these principles are not followed and, for example, an excess of projects is located in an area, overvoltage or poor power quality may result. According to another expert, rural areas may be more vulnerable to negative grid impacts because fewer loads are served by a single feeder.[230] This smaller quantity of loads increases the likelihood that local generation will outstrip local demand, causing reverse power flow. If microFIT deployment increases, more serious technical problems may be encountered, particularly if LDCs continue to lack the capability to monitor microFIT project activity.[231]

In order to combat these issues, strict controls are currently placed upon microFIT capacity. Hydro One, which is responsible for the province's transmission assets and also provides distribution services in select areas, has required embedded LDCs to limit microFIT generation to between 7% and 10% of peak load on feeders, depending on feeder class.[232] This rule is conservative, virtually ensuring that microFIT projects do not adversely affect the grid.[233] Stakeholders have argued that these limitations should be increased to between 7% and 15% in accordance with more common interpretations of standards set by the Institute of Electrical and Electronics Engineers (IEEE) and the U.S. Federal Energy Regulatory Commission (FERC).[234] This rule relaxation would allow more microFIT projects to be accommodated. In its report on the FIT Review, the Ministry of Energy committed to

[229] Interview with experts from an LDC in Ontario, February 15, 2012.
[230] Advisor to Ontario's Independent Electricity System Operator, e-mail to the author, January 29, 2012.
[231] Interview with an expert from an LDC in Ontario, February 15, 2012; Advisor to Ontario's Independent Electricity System Operator, personal conversation, February 10, 2012.
[232] Brad Colden, "microFIT Screening & Reporting Requirements" (presentation, Hydro One Webinar, August 30, 2011), 7, accessed February 10, 2012, http://www.hydroone.com/IndustrialLDCs/Webinars/microFIT%20Screening%20and%20Reporting%20Requirements%20for%20Embedded%20LDCs.pdf.
[233] Advisor to Ontario's Independent Electricity System Operator, personal conversation, e-mail to the author, January 29, 2012.
[234] OSEA, *Submission*, 4; AMO, *Feed-In-Tariff Program Review*, 14-15; CanSIA, *Maximizing the Benefits of Early Success,* 11.

maintaining the rule while additional research is conducted.[235] Overall, the current level of microFIT project deployment is not expected to cause grid vulnerabilities if projects are implemented correctly. From a system operations perspective, the increased deployment of microFIT projects is never expected to undermine the reliability of the electricity system providing that appropriate management techniques are adopted.[236] However, it should be expected that microFIT generators will be directed to cease generation if the maintenance of system integrity is dependent on such action.

4.1.5. Effect on energy conservation and efficiency

Raphael Sauter and Jim Watson hypothesize that microgeneration owners' "new role as co-providers of energy in their own home may raise awareness of energy related issues and may therefore trigger behavioural changes in households' energy consumption pattern."[237] A variety of scholars, think tanks, and energy institutions have explored this relationship among homeowners, with varied results. Reviews of these studies report that some have found consumption reductions, while others are unable to identify a clear pattern and at least one has shown increased consumption in particular demographics.[238]

One study not mentioned in these reviews was completed for the California Public Utilities Commission (CPUC) in 2010.[239] The study explored the electricity consumption of over 1,000 residential participants in the general market stream of the California Solar Initiative, which offers capital subsidies or performance-based incentives to solar PV project proponents. This study differs from others in its use

[235] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 20.
[236] Interview with an electricity market expert, February 23, 2012.
[237] Raphael Sauter and Jim Watson, "Strategies for the Deployment of Microgeneration: Implications for Social Acceptance," *Energy Policy* 35 (2007): 2776, doi: 10.1016/j.enpol.2006.12.006.
[238] Ibid.; Noam Bergman and Nick Eyre, "What Role for Microgeneration in a Shift to a Low Carbon Domestic Energy Sector in the UK?" *Energy Efficiency* 4 (2011): 339-340, doi: 10.1007/s12053-011-9107-9; James Keirstead, "Behavioural Responses to Photovoltaic Systems in the UK Domestic Sector," *Energy Policy* 35 (2007), doi: 10.1016/j.enpol.2007.02.019.
[239] California Public Utilities Commission (CPUC), *California Solar Initiative Annual Program Assessment* (San Francisco: CPUC, 2010), accessed January 23, 2012, http://www.cpuc.ca.gov/NR/rdonlyres/CE1D2316-405C-4C94-A805-A68A1988D640/0/2010APA_final.pdf.

of billing data to observe electricity consumption prior to and following the installation of a solar PV system rather than self-reported information. The study reported that project owners were likely to reduce their consumption following installation, sometimes by more than 30%.[240] However, it is important to note that changes in weather and economic conditions as well as incomplete data may have had some effect on the results. In addition, the program requirement to undertake an energy efficiency audit may have influenced adoption of energy efficiency measures following system installation.

People who occupy buildings with microgeneration systems, but who are not responsible for system installation or purchase, can also be motivated by the systems to reduce electricity consumption. A frequently cited UK study found that many tenants of social housing units and schools which featured renewable energy microgeneration systems producing electricity, heat, or hot water were encouraged by the systems to practice energy conservation and efficiency.[241]

Among a very small sample of residential microFIT project owners in Ontario, most reported increased energy conservation or efficiency practices following the installation of their solar PV system.[242] Others noted that they had been very conscious of energy usage prior to installing their system and that the system had not influenced their behaviour.[243] The effect of microFIT projects on energy conservation and efficiency behaviours among building occupants (as opposed to system owners) was unclear. A representative of the Markham Energy Conservation Office was unsure whether City of Markham staff had changed their practices following the installation of a microFIT project, and an owner of a rental property which houses a microFIT project was similarly uncertain of the effect on his

[240] CPUC, *California Solar Initiative,* 7-35.
[241] Judith Dobbyn and Gillian Thomas, *Seeing the Light: The Impact of Micro-Generation on the Way We Use Energy* (London: Sustainable Consumption Roundtable, 2005), accessed February 27, 2012, http://www.sd-commission.org.uk/data/files/publications/Micro-generationreport.pdf.
[242] Interviews with microFIT project owners, February 19, 2012 and February 26, 2012.
[243] Interviews with microFIT project owners, February 8, 2012 and February 21, 2012.

tenants.[244] A pair of this homeowner's tenants stated that the solar PV system had not inspired them to take additional electricity conservation or efficiency measures.[245] Their lack of direct engagement with the system may contribute to the absence of new practices, but the fact that they do not receive an individual utility bill may also play a role.

Access to information about energy consumption can aid electricity demand reduction.[246] Promisingly, demand for electricity monitoring systems has been observed among owners of microgeneration systems, as has interest in side-by-side display of energy consumption and production data.[247] If microFIT project proponents were obligated to install these relatively inexpensive systems in order to receive a microFIT contract, electricity demand reductions among microFIT system owners could potentially be improved. Such a measure could also encourage electricity conservation and efficiency among Ontarians who are simply renting roof space to a commercial aggregator. Some have argued that these arrangements reduce project host engagement and thus may elicit minimal behaviour change.[248] However, ongoing communications may encourage behaviour change in these aggregation scenarios,[249] and mandatory energy monitoring devices would provide this service. One group of microFIT Program stakeholders proposed an alternative method of encouraging electricity conservation among program participants. This group suggested that the payment of an additional tariff for electricity exported to the grid would promote demand reduction,[250] but this is not currently advisable since it would increase program costs.

The reduction of electricity consumption as a result of interaction with microgeneration could help reduce the use of polluting electricity generation as well as stress on electricity systems. However,

[244] Interview with microFIT project owner, February 21, 2012.
[245] Interview with microFIT project owner, February 24, 2012.
[246] Bergman and Eyre, "What Role for Microgeneration," 339.
[247] Keirstead, "Behavioural Responses to Photovoltaic Systems," 4135.
[248] Bergman and Eyre, "What Role for Microgeneration," 347-348; Sauter and Watson, "Strategies for the Deployment of Microgeneration," 2777.
[249] Sauter and Watson, "Strategies for the Deployment of Microgeneration," 2777.
[250] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 58.

Noam Bergman and Nick Eyre believe that this combination of measures can have a more important effect on society. These scholars assert that "[m]icrogeneration, with clear information and appropriate feedback and metering, has the potential to catalyse change by increasing energy literacy and empowering people to seriously engage in energy debates."[251] These broader impacts will be discussed below.

4.2. Economic impacts

Economic development is one of the central goals of the microFIT Program, yet the goal itself and the government's efforts related to it have been criticized. It is difficult to assess the validity of program criticisms or the economic impacts of the microFIT Program, in general, given that the government has not published information about the employment and revenue resulting specifically from the program. As such, the following sections provide insight on the character of the program's economic outcomes and convey the critiques and problems which have arisen.

4.2.1. Impact on employment opportunities

Skepticism about the employment creation potential of the GEGEA and its feed-in tariff has been evident since the GEGEA was first introduced in 2009. At this point, Ontario's government claimed that the Act and its feed-in tariff would create 50,000 direct and indirect jobs in the following three years,[252] but Ontario's PC Party questioned the government's assertion based on analysis the Party had commissioned.[253] This doubtfulness was vindicated when, in early 2012, the government stated that the GEGEA had created only 20,000 jobs.[254] However, the government noted that the GEGEA was still anticipated to generate 50,000 jobs. Quantitative employment creation goals specific to the microFIT

[251] Bergman and Eyre, "What Role for Microgeneration," 336.
[252] Ontario, Legislative Assembly, Official Report of Debates (Hansard), 39th Parl, 1st Sess, (February 23, 2009) at 1320 (George Smitherman).
[253] Jim Coyle, "Tories Try to Cut Through 'Green' Fog," *Toronto Star*, May 1, 2009, ProQuest (1693860871).
[254] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 4.

Program have never been articulated, and the government did not specify the proportion of new jobs which were attributable to the microFIT Program. Yet it is important to understand the program's contribution to employment opportunities. Since the microFIT Program has thus far been dominated by solar PV projects, the following analysis will focus on that renewable energy technology.

A variety of industries and professions are drawn upon to develop a micro-scale solar PV project. Engineers and technicians are required for materials processing, product assembly, installation, and O&M, while construction workers are required for project installation and decommissioning. Solar assessment and design experts are required for project development, and business managers and financial analysts are required in all industries involved in the deployment of a microFIT project. Jobs may also be created in the materials recycling industry.

Employment in the renewable energy sector is difficult to evaluate because National Occupational Classification (NOC) and North American Industry Classification System (NAICS) codes specific to this industry have not yet been created or exist at a level of aggregation too high to enable analysis of the renewable energy industry.[255] This lack of information is viewed to be problematic, with some Ontario stakeholders calling for an inventory of jobs in Ontario's solar power industry such that industrial development policy can be adequately informed.[256] Until such information is available, employment must be approximated based on information gathered directly from industry members and economic modeling.

A renewable energy consulting firm has estimated the number of jobs created by the development of solar PV microFIT projects using a combination of these methods.[257] The Jobs and Economic Development Impact (JEDI) model – an input-output model developed by the National Renewable Energy Laboratory – was utilized, along with proprietary research and economic figures from

[255] Interview with a solar PV industry expert, January 31, 2012.
[256] FIT Review Coalition, *FIT 2.0*, 8.
[257] ClearSky Advisors Inc., *Data Requests Regarding the microFIT Program* (unpublished data, 2012), received March 15, 2012 from Clearsky Advisors Inc.

Statistics Canada, to calculate the number of job-years of employment (JYE) created by the microFIT Program. One JYE was assumed to represent 40 hours of employment per week for 52 weeks. The quantity of JYE created in the various industries involved in project deployment was estimated, as was JYE stimulated in different phases of project development. The calculations also account for the transition in domestic content requirements between 2010 and 2011. It is possible that project proponents are sourcing a higher percentage of locally produced project components than is required under the domestic content rules, but such information is not publicly available. If higher levels of domestic content are being utilized, more employment may have been created than estimated by this model.

According to this model, 583.87 direct and indirect JYE were created by the microFIT Program in 2010 and 3,120.33 direct and indirect JYE were created in 2011. The construction industry was estimated to have provided 738.12 direct and indirect JYE in 2011, while the manufacturing sector was responsible for 610.70 direct and indirect JYE – approximately 20% of all JYE. The majority of employment resulted from the project commissioning phase of microFIT project development, accounting for 2,174.76 direct and indirect JYE in 2011, compared to 945.56 direct and indirect JYE in the operations and maintenance phase. Overall, direct employment in 2011 accounted for 2,064.66 JYE, or 26.37 JYE for every MW_{AC} of solar PV microFIT projects developed, while indirect employment represented 1,055.67 JYE, or 13.48 JYE/MW_{AC}. Including both direct and indirect employment, 25.72 JYE/MW_{AC} and 39.85 JYE/MW_{AC} are estimated to have been created in 2010 and 2011, respectively. By the end of 2018, cumulative microFIT solar PV development is expected to have reached 430.8 MW and to have created 19.27 direct JYE/MW_{AC} and 9.74 indirect JYE/MW_{AC} for a total of 12,498.68 JYE.

Other studies of the employment impacts of investment in micro-scale solar PV generation have reached similar conclusions. A 2001 study by the Renewable Energy Policy Project (REPP) found that the development of solar PV projects with an installed capacity of 2 kW on residences in the U.S. would

create 35.5 direct JYE/MW, where 1 JYE represents 40 hours of work per week for 49 weeks.[258] It was noted that labour intensity was expected to decline due to automation in manufacturing, more reliable systems, and increased standardization of retail offers for PV systems. In a 2008 evaluation of the extension of U.S. federal tax credits for solar energy, Navigant Consulting, Inc. built upon the work of REPP to project that residential development of solar PV projects with an installed capacity of 3.5 kW would result in approximately 28 direct JYE/MW_{DC} in 2010, where 1 JYE represents 40 hours of work per week for 49 weeks.[259] The proportion of domestic content assumed in this evaluation is not specified and indirect jobs are calculated in a more aggregated manner than in the analysis of the microFIT Program. This calculation employs a single multiplier value which predicts significantly more indirect JYE than are associated with the microFIT Program.

Employment opportunities could be affected by the microFIT Program in two additional respects. First, the ability of distributed generation to relieve electricity system constraints in urban areas could stimulate employment growth. New distributed electricity generation provides additional electricity supply in transmission-constrained areas, and therefore could enable the construction of new electricity-consuming commercial buildings which house employment opportunities.[260] While these jobs may otherwise have been created in an alternative region of Ontario, resulting in no net job growth in the province, it is also possible that they could have been created elsewhere in Canada or North America. This is particularly relevant to major urban areas where regional offices of multinational organizations are commonly located. Second, it has been argued that the additional electricity costs

[258] Virinder Singh and Jeffrey Fehrs, *The Work That Goes Into Renewable Energy* (Washington, DC: Renewable Energy Policy Project, 2001), 12, accessed April 10, 2012, http://www.repp.org/articles/static/1/binaries/LABOR_FINAL_REV.pdf.
[259] Lisa Frantzis, Jay Paidipati, Matt Stanberry, and Daniel Tomlinson, *Economic Impacts of Extending Federal Solar Tax Credits* (Washington, DC: Solar Energy Research and Education Foundation, 2008), 22, accessed April 10, 2012, http://www.seia.org/galleries/pdf/Navigant%20Consulting%20Report%209.15.08.pdf.
[260] Fernando Carou and Rob McMonagle, "Economic Benefits of Local Generation: Rethinking How We Power Our Communities" (presentation, Connections Energy Symposium, Toronto, ON, December 8, 2011), 40, received March 12, 2012 from the Association of Municipalities of Ontario.

created by the feed-in tariff will in fact cause job losses in other sectors.[261] This could occur if increased electricity costs prompt businesses to reduce staff. It is difficult to evaluate this dynamic in Ontario given the myriad influences on business decisions, and therefore is outside the scope of this research. However, job losses are reported to have resulted from renewable energy programs in other jurisdictions,[262] indicating that Ontario-focused research is warranted. This investigation is particularly important since, as noted by some commentators,[263] such employment losses call into question the core concept of combining electricity procurement and economic development policies.

The geographic distribution of employment created by the microFIT Program is very important given that all electricity consumers in Ontario are accountable for program costs and thus should be privy to program benefits. Comprehensive information about the distribution of companies involved in Ontario's solar PV industry is not available for all industry segments, nor is it specific to companies with microgeneration products or services. However, general trends can be discerned from maps which catalogue the locations of solar module manufacturers and suppliers, inverter manufacturers, and mounting and tracking system manufacturers, the vast majority of which have entered Ontario or begun producing such components since the passage of the GEGEA.[264]

First, companies in Ontario's solar PV manufacturing industry are not spread evenly throughout the province. Only four companies of the dozens listed are located in 'Northern Ontario'[265] – a vast area

[261] Don Butler, "Ex-Power Authority Boss Chides FIT Program," *Ottawa Citizen*, September 21, 2011, Factiva (OTCT000020110921e79l00020); Maria Babbage, "Liberals on Attack Over Tory Plans to Gut Ontario's Green Energy Plans," *Canadian Press,* May 11, 2011, Factiva (CPR0000020110512e75b000ad); Office of the Auditor General of Ontario, *2011 Annual Report*, 117.
[262] Office of the Auditor General of Ontario, *2011 Annual Report*, 118.
[263] Lilley, "Green Goals, Bigger Bills"; Butler, "Ex-Power Authority Boss."
[264] Ontario, Ministry of Economic Development and Innovation (MEDI), *Inverter, Mount & Tracker Mfrs* (Toronto: Queen's Printer for Ontario, 2012), received March 19, 2012 from MEDI; Ontario, Ministry of Economic Development and Innovation (MEDI), *Photovoltaic Module Manufacturers and Suppliers in Ontario* (Toronto: Queen's Printer for Ontario, 2011), received March 19, 2012 from MEDI.
[265] Ontario, Ministry of Northern Development, Mines and Forestry (MNDMF), *Northern Ontario: A Profile* (Sudbury, ON: MNDMF, 2011), 1, accessed April 12, 2012, http://www.mndm.gov.on.ca/northern_development/documents/northern_ontario_e.pdf. 'Northern Ontario' is defined according to the definition adopted by Ontario's Ministry of Northern Development, Mines and Forestry.

which would benefit greatly from economic development. In fact, most companies in Ontario's solar PV manufacturing industry are concentrated in southwestern Ontario. Second, most manufacturing companies are located in urban centres rather than rural areas. Given these trends, it is probable that the employment opportunities created by the manufacturing of microFIT-scale products is unevenly distributed throughout the province. Companies that design and install microFIT projects are more likely to be spread across the province given the widespread participation in the program. A survey of the distribution of jobs associated with the microFIT Program, including all industries involved in the program, must be conducted in order to gain an understanding of the impacts of the program.

4.2.1.1. Quality of employment opportunities

The quality of jobs created by the microFIT Program must also be considered when evaluating the program's economic impact. The quality of a job is characterized by factors such as the period of employment, the quantity of hours worked per week, and the wages earned. Once again, due to the lack of assigned NOC and NAICS codes, it is difficult to determine the character of jobs in the renewable energy industry. Therefore, employment quality must be assessed using previously published findings.

The period of employment typical of jobs in various industries of Ontario's renewable energy sector has been broadly speculated upon. Construction jobs are expected to provide employment for a maximum of three years, while manufacturing, operations, maintenance, and engineering jobs are characterized as long-term.[266] According to these assumptions, most JYE resulting from the microFIT Program are created in industries characterized by longer-term jobs. In the modeling exercise noted above, the construction industry was estimated to provide less than one-third of direct and indirect JYE related to the microFIT Program in 2011. The full-time or part-time status of jobs created by investment in renewable energy is not commonly evaluated and therefore cannot be estimated for the microFIT

[266] Office of the Auditor General of Ontario, *2011 Annual Report*, 117.

Program. Nonetheless, this is an important measure of the microFIT Program's economic impact and should be evaluated elsewhere.

A 2009 study examined the wages paid across many industries for occupations that would be expected to be involved in solar power development in Ontario.[267] Five of the most common of occupations involved in the solar power industry – electrical or electronics engineer, construction manager, financial auditor or accountant, electrician, and electricity engineering technologist or technician – were paid over 20 CAD per hour in 2007, resulting in annual compensation of between 46,382 CAD and 69,362 CAD. These earnings are higher than Ontario's 2010 personal income per capita of 37,803 CAD.[268] The other 7 solar industry occupations examined earned lower annual wages than the current provincial per capita income, although wages may have increased with inflation since 2007. The lowest wage paid among the most common jobs in the solar industry was 15.54 CAD, representing annual earnings of 32,327 CAD. As such, the solar PV industry can be expected to offer average to high wages. Based on the available information, the microFIT Program is likely to offer jobs of fairly high quality.

4.2.1.2. Employment opportunities created by other types of renewable electricity microgeneration

The promotion of other types of renewable electricity microgeneration would also create employment opportunities in Ontario. Indeed, it has been noted that the manufacture of wind turbines is well-suited to Ontario's economy given its experience with steel production.[269] However, the job

[267] Robert Pollin and Heidi Garrett-Peltier, *Building the Green Economy: Employment Effects of Green Energy Investments for Ontario* (Toronto: Green Energy Act Alliance, 2009), 21, accessed April 12, 2012, http://www.greenenergyact.ca/Storage/25/1722_PERI_ON_Green_Jobs_Report.pdf. A particular type of solar energy technology was not specified.
[268] Ontario, Ministry of Finance, "Ontario Fact Sheet April 2012," accessed April 12, 2012, http://www.fin.gov.on.ca/en/economy/ecupdates/factsheet.html.
[269] José Etcheverry et al., *Smart Generation: Powering Ontario with Renewable Energy* (Toronto: David Suzuki Foundation, 2004), 20, accessed February 14, 2012, http://www.davidsuzuki.org/publications/downloads/2004/Smart_Generation_full_report.pdf.

creation potential of small wind energy development is uncertain. In a 2010 report, CanWEA asserted that a survey it distributed to Canada's small wind industry (which includes turbines of an installed capacity of up to 300 kW) found that 50 jobs were created for each MW of small wind capacity.[270] However, it is not apparent whether this estimate considers capacity installed in Canada or total manufactured capacity. CanWEA also suggested that if adequate feed-in tariffs are implemented in Canada (the price per kWh is not provided), 1,800 MW of small wind projects could be installed by 2025, creating a total of 17,900 jobs, with 5,300 located in Ontario. This results in a national average of only 10 jobs per MW. The inclusion and proportion of direct, indirect, and induced jobs is unclear, as are the length of jobs and the proportion of full-time and part-time jobs. Slightly lower levels of job creation have been projected in the UK, where the development by 2021 of between 1,000 and 2,200 MW of wind projects with a capacity of 100 kW or less is expected to produce between 8,300 and 14,200 direct and indirect JYE,[271] or between 6.45 and 8.3 JYE/MW.

Credible estimates of employment creation associated with micro-scale electricity generation projects utilizing water or biomass were not found during the literature review. As such, estimates related to larger projects will be drawn upon. First, the development of 7,250 MW of run-of-river hydroelectric projects in Canada by 2020 has been estimated to create 11.52 JYE/MW.[272] However, it should be noted that run-of-river hydroelectric projects can have a nameplate capacity of many megawatts. Second, the commissioning of 2,079 MW of bioenergy projects of an unspecified scale over 10 years has been found to create 1,547 direct and indirect jobs in Ontario,[273] resulting in less than 1 job per MW. Given that the development of renewable energy at a micro-scale results in the commissioning

[270] CanWEA, *2010 CanWEA Small Wind Market Survey*, 2.
[271] RenewableUK, *Working for a Green Britain: Vol 2* (London: RenewableUK, 2011), 15, accessed April 11, 2012, http://www.bwea.com/pdf/publications/Working_for_Green_Britain_V2.pdf.
[272] Pembina Institute, *Canadian Renewable Electricity Development: Employment Impacts* (n.p.: Clean Air Renewable Energy Coalition, 2004), accessed April 10, 2012, http://www.cleanairrenewableenergycoalition.com/documents/Employment-Predictions.pdf.
[273] Pollin and Garrett-Peltier, *Building the Green Economy*, 12.

of many small projects rather than relatively few large projects which attain economies of scale, it is possible that an increased number of jobs will be created in both of these technology categories. This effect is apparent in projections of employment created in 2018 as a result of microFIT and FIT solar PV deployment. While microFIT projects are expected to create 29.01 JYE/MW_{AC}, larger projects qualifying for the FIT Program are expected to create 21.32 JYE/MW_{AC} or less.[274]

A typology of jobs associated with these alternative microgeneration technologies was not provided in any of the literature reviewed, and given that the character of generation systems used to harness these resources changes significantly with scale, it is inappropriate to make quantitative extrapolations from projects of a larger scale. However, general trends with respect to employment characteristics can be noted. First, a large share of labour required by technologies which do not rely on fuel inputs derives from the manufacturing and construction processes, while feedstock production is responsible for the largest share of labour among technologies which depend on fuel inputs.[275] Second, the profile of wages earned in the most common occupations in the wind industry is generally similar to that of the solar power industry, while wages earned in the hydroelectric industry are likely to be slightly higher and those earned in the bioenergy industry are considerably lower.[276] Wages paid to develop and operate bioenergy projects are relatively low due to the involvement of non-technical occupations such as agricultural and feedstock management.

4.2.2. Effects on the provincial manufacturing sector

With the goal of inducing growth in Ontario's manufacturing sector, both the FIT and microFIT Programs require project proponents to source a defined proportion of domestically produced content for solar PV projects, as detailed above. These requirements are likely to have been an impetus for the

[274] ClearSky Advisors Inc., *Data Requests.*
[275] Hugo Lucas and Rabia Ferroukhl, *Renewable Energy Jobs: Status, Prospects and Policies* (Abu Dhabi: International Renewable Energy Agency, 2011), 10, accessed January 23, 2012, http://www.irena.org/DocumentDownloads/Publications/RenewableEnergyJobs.pdf.
[276] Pollin and Garrett-Peltier, *Building the Green Economy*, 19-21.

investment of 1.07 billion CAD in Ontario's solar PV sector in 2009 and a further 3.99 billion CAD in 2010.[277] CanSIA has reported that over 35 manufacturing companies increased production of solar PV components or entered Ontario's solar PV market following the passage of the GEGEA.[278] CanSIA expected that at least 23 of these companies would manufacture modules and at least 12 would manufacture inverters. At least 13 module manufacturers and 7 inverter manufacturers were predicted to establish facilities in Ontario, while at least 10 module producers and 5 inverter producers were expected to contract their production to third-party Ontario-based manufacturers. At least 2 module manufacturers were expected to use Ontario-refined silicon. The government has estimated that the feed-in tariff has created nearly 2,000 direct manufacturing jobs to date.[279]

The impact of the microFIT Program on economic development in Ontario's manufacturing sector has not been publicized to date. As such, economic modeling based on information collected from industry and government must again be employed. This analysis was also completed by the previously noted energy consulting group, who accounted only for spending in Ontario; any export revenues are excluded.[280] Based on annual installed capacity and assumed installation and O&M costs of 7.05 CAD/W_{AC} and 0.012 CAD/W_{AC}, respectively, the microFIT Program is estimated to have generated over 62 million CAD in revenue in 2010. Assuming installation costs of 6.96 CAD/W_{AC} and unchanged O&M costs, revenues rose to over 247.5 million CAD in 2011. However, it should be noted that annual O&M costs assumed by the consulting group are between 40% and 87% lower than those reported by CanSIA.[281] As such, these revenue estimates could be low. Focusing on economic development in the manufacturing sector, over 28 million CAD and 134 million CAD of the total revenue was estimated to

[277] Ontario, Ministry of Economic Development and Innovation, "Ontario Leads in Next Generation Solar Technologies," last modified December 22, 2011, http://www.ontariocanada.com/ontcan/1medt/en/cleantech_solar_en.jsp.
[278] CanSIA, *Maximizing the Benefits of Early Success,* 4.
[279] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 6.
[280] ClearSky Advisors Inc., *Data Requests.*
[281] CanSIA, *Maximizing the Benefits of Early Success,* 47.

have been received by this sector in 2010 and 2011, respectively. In 2011, the manufacturing sector received over half of annual revenue from the microFIT Program.

In addition to providing a new source of revenue, the microFIT Program has had other important effects on Ontario's manufacturing sector. The program has prompted increases in industry capacity including skills development and the acquisition of specialized equipment.[282] It is also thought to play a valuable role in maintaining continuous demand for domestic products.

Yet Ontario's solar PV industry has experienced a number of challenges. While the current market for solar PV modules has become very competitive, contributing to price reductions,[283] there may in fact be too many solar PV companies in Ontario.[284] One industry expert has noted that this overcapacity was prompted by the initial design of Ontario's feed-in tariff, which permitted rapid and almost unlimited development of solar PV projects.[285] This expert suggested that a slower increase in solar PV deployment would have been a more appropriate strategy for industrial development. As a result of this overcapacity, detrimental activities have occurred within Ontario's solar PV industry. According to anecdotal evidence, some companies have 'dumped' product at very low prices.[286] Overcapacity could also result in reduced product quality as manufacturers attempt to reduce prices to attract sales.[287] In addition, unstable solar PV markets in other countries may enhance overcapacity by driving more companies to enter Ontario's market.[288]

Some companies may have reduced their capacity due to uncertainty about the microFIT and FIT Programs, potentially to the point where demand may exceed supply.[289] On the other hand, uncertainty

[282] CanSIA, *Maximizing the Benefits of Early Success,* 20.
[283] Justin Malecki, "What the Flux?!," *ClearSky Advisors Inc.*, last modified December 22, 2011, http://www.clearskyadvisors.com/1243/what-the-flux/.
[284] Interviews with solar PV industry experts, January 31, 2012 and February 17, 2012.
[285] Interview with a solar PV industry expert, January 31, 2012.
[286] Ibid.
[287] Ibid.
[288] Ibid.
[289] Interview with a solar PV industry expert, February 17, 2012.

has simultaneously reduced demand for microFIT systems.[290] Program uncertainty has been created by program changes, project connection and application processing problems, the provincial election, and the program review.[291] As mentioned above, a significant reduction in the tariff offered for ground-mounted solar PV projects was announced in July 2010. The reduced rate was expected to result in cancelled projects, potentially leading to job losses.[292] The fact that the change was announced at an unscheduled point in time is likely to have created anxiety among those considering participation in the program. Prospective participants may have begun to question the notion that the time and resources expended on a project would guarantee successful deployment. This anxiety may have been bolstered by the initial indication that project proponents who had submitted an application, but had not yet received a conditional offer, would receive the new lower price.[293] This protocol was eventually reversed, but it is likely that uncertainty remained.

The feeling of unease among prospective project proponents would have escalated to members of the solar PV industry since their market could have been jeopardized if demand waned. Program stakeholders also deemed the lack of external consultation prior to the announcement of the program adjustment problematic.[294] Furthermore, at least one member of the solar PV industry expressed concern that the sudden change could provoke perceptions of risk among the financial institutions that support industry members and project proponents.[295] This anxiety within the sector manifested in detrimental activity, with at least one manufacturing company reported to have reconsidered locating a facility in Ontario.[296]

---

[290] Interview with a solar PV industry expert, January 31, 2012.
[291] Interviews with solar PV industry experts, January 31, 2012 and February 17, 2012.
[292] Shufelt, "Ontario Solar Program in Disarray."
[293] "Alliance Submission to Ontario Power Authority on Proposed Ground-Mounted Solar microFIT Tariff Rate," Green Energy Act Alliance, last modified July 27, 2010, http://www.greenenergyact.ca/Page.asp?PageID=122&ContentID=1435&SiteNodeID=238.
[294] Ibid.
[295] Karen Howlett, "Green Firms Fume Over Ontario's Rule Changes," *Globe & Mail*, August 3, 2010, Factiva (GLOB000020100803e6830001l).
[296] Ibid.

A second source of uncertainty derives from grid capacity constraints. Following a rule change on February 9, 2011, LDCs were required to evaluate the feasibility of connecting microFIT projects to the grid prior to connection.[297] They had previously been obligated to connect all projects. Soon after this rule change, Hydro One informed approximately 1,000 Ontarians who had received a conditional offer and, in some cases, had already invested in generation equipment that their projects could not be connected at that time.[298] This set of rejections was attributed to the inability to upgrade grid infrastructure at pace with the unexpectedly heavy connection demands.[299] Constrained projects were subsequently given the option to relocate the project, reassign the project to another applicant, or combine the project with another.[300] In addition to project rejections, there is anecdotal evidence of inconsistent communication regarding grid capacity. Individual Hydro One employees have purportedly expressed differing opinions on grid capacity for particular projects within a short span of time or differing opinions on capacity have been expressed among multiple employees.[301]

Additional uncertainty was created by delays in program application processing[302] as well as by the 2011 provincial election.[303] As noted above, the PC Party vowed to cancel the feed-in tariff. Finally, the suspension of microFIT Program activities during the program review and the retroactive application of the new rules and prices to applications submitted prior to the announcement of the review caused disruption and uncertainty.[304] The absence of a new tariff schedule hampered marketing efforts by solar

[297] "Rule Change for New microFIT Applications," Ontario Power Authority, accessed May 1, 2012, http://microfit.powerauthority.on.ca/rule-change-new-microfit-applications.
[298] John Spears, "Ontario Solar Projects Put On Hold," *Toronto Star*, February 11, 2011, http://www.thestar.com/business/article/937782--ontario-solar-projects-put-on-hold.
[299] Brian Cross, "Dreams Fade for Solar Investors," *Windsor Star*, February 2, 2011, ProQuest (853362751).
[300] "Relocation Options for Constrained microFIT Projects," Ontario Power Authority, last modified April 5, 2012, http://microfit.powerauthority.on.ca/relocation-options-constrained-microfit-projects.
[301] Interview with an electricity sector expert, March 12, 2012.
[302] Renata D'Aliesio, "Solar Power's Stuttering Steps," *Globe and Mail*, December 7, 2011, ProQuest (908745899).
[303] Interview with a solar PV industry expert, February 17, 2012.
[304] CanSIA, *Maximizing the Benefits of Early Success,* 21; interview with solar PV industry expert, February 17, 2012.

PV installers, and many consumers were unwilling to commit to installing solar PV systems until new tariffs were announced.[305]

Aside from creating market instability, program uncertainty may have had other impacts on the manufacturing sector. Learning processes and product cost reductions may have been stymied among manufacturers operating in Ontario.[306] Some companies may have simply dismissed involvement in Ontario's market. A further source of trepidation within the sector was the reduction of tariff prices. There was concern that if prices were set too low, project proponents would pressure manufacturers to reduce their prices in order to obtain the rate of return offered earlier in the program, inciting a 'race to the bottom'.[307]

In the medium term, the sustainability of the solar PV manufacturing industry may be threatened by three factors. First, the aforementioned restrictions placed by Hydro One upon LDCs regarding feeder capacity occupied by microFIT projects may limit market growth.[308] Projects which were denied a connection prior to 2012 have been estimated to represent 400 million CAD of investment.[309] This figure does seem high given the previously noted program revenue estimates and the fact that many fewer requests to connect were denied than granted. Second, the Ministry of Energy's Long-Term Energy Plan, a document which describes the development of Ontario's electricity system until 2030, implies that all growth in renewable electricity generation will be completed by 2018.[310] It has been argued that the shortness of the term over which renewable energy supply is expected to be developed in Ontario is problematic for market development.[311]

---

[305] CanSIA, *Maximizing the Benefits of Early Success,* 21; D'Aliesio, "Solar Power's Stuttering Steps."
[306] Mabee, Mannion, and Carpenter, "Comparing the Feed-In Tariff Incentives," 487.
[307] Monica Wolfson, "Green Act Changes Spark Fear," *The Windsor Star,* November 2, 2011, ProQuest (902206843).
[308] CanSIA, *Maximizing the Benefits of Early Success,* 11.
[309] Marion Fraser, *Getting It Right - Not Quite – Ontario's Green Energy Act* (Toronto: Ontario Sustainable Energy Association, 2011), 15, accessed April 6, 2012, http://www.ontario-sea.org/Storage/62/5441_Getting_it_Right_-_Not_Quite_-_Ontarios_Green_Energy_Act_GCEC11-121.pdf.
[310] Ontario, Ministry of Energy and Infrastructure, *Ontario's Long-Term Energy Plan*, 31-32.
[311] Interview with a solar PV industry expert, January 31, 2012.

Third, trade-related complaints could result in the removal of domestic content requirements, forcing local companies to compete with global manufacturers which offer lower prices.[312] In September 2010, Japan filed with the World Trade Organization (WTO) a request for consultation with Canada, citing a number of infractions including less favourable treatment of imported equipment, subsidization and protectionism.[313] The United States and European Union subsequently requested to join the consultation and several other countries have reserved their third-party rights in panel proceedings. Moreover, in 2011, a U.S. renewable energy company threatened to file formal action against the domestic content requirements under the North American Free Trade Agreement (NAFTA).[314] If these complaints are successful and domestic content requirements are removed, the share of Ontario's market held by local manufacturers is likely to shrink.

To help insulate itself from this instability, one strategy that is beginning to be adopted within Ontario's solar PV industry is the development of export markets. Some of Ontario's manufacturers have reported the export of products to the U.S. and Europe,[315] although this strategy may be less common among Ontario-based solar PV companies since they are less experienced and less recognized than subsidiaries of international companies.[316] The microFIT Program has played a role in export sales by helping at least one company to secure export contracts.[317] The program also encourages the development of a manufacturing base for microgeneration components, which can subsequently export such products. However, it is unclear whether microgeneration products are currently the subject of export contracts. The suite of solar PV system components manufactured by some companies reported

[312] Malecki, "What the Flux?!."
[313] "Canada – Certain Measures Affecting the Renewable Energy Generation Sector," World Trade Organization, Dispute DS412, accessed April 15, 2012, http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds412_e.htm.
[314] Mesa Power Group, "Mesa Power Group Files Legal Action Against Canadian Government for NAFTA Infractions," news release, July 14, 2011, http://www.mesapowergroup.com/index.php/news.
[315] CanSIA, *Maximizing the Benefits of Early Success,* 18.
[316] Interview with a solar PV industry expert, January 31, 2012.
[317] Samco Solar, "Contract Manufacturer Samco Solar Announces New Ontario Facility," news release, May 17, 2012, http://www.cansia.ca/sites/default/files/press_release_samco_solar_may_17th_2011.pdf.

to be exporting such products includes components for microgeneration systems, but it is not clear whether these microgeneration components are the products which are being exported abroad.

In addition to helping the solar PV sector weather volatility in the domestic market, the development of export markets offers other benefits. The revenue received from the export of renewable energy products can help offset the cost of creating employment opportunities in Ontario's renewable energy sector and can help create additional employment opportunities in the province.[318] Exports could also help maintain domestic employment as local project development decreases – a pattern which has been predicted for Germany.[319] In addition, entry into export markets will help the solar PV industry achieve long-term sustainability, a condition which the small size of Ontario's market precludes.[320] Noting its importance for long-term growth, Ontario's Ministry of Energy has encouraged the development of export markets and has proposed the creation of a clean energy institute, export strategy and task force.[321] Some stakeholders have also proposed the development of an export credit to incent export production.[322] Nevertheless, instability in the domestic market could cause companies to cease operations or leave Ontario, resulting in the loss of export opportunities.[323]

4.2.3. Risk of boom and bust effects

A feed-in tariff is intended to provide security, stability and visibility for investors.[324] This has been manifested through the unexpected popularity of the microFIT Program, which can certainly be considered a market boom. Yet the industry has also faced several challenges. As noted, the industry

[318] Mabee, Mannion, and Carpenter, "Comparing the Feed-In Tariff Incentives," 481; ClearSky Advisors Inc., *Economic Impacts of the Solar PV Sector in Ontario 2008-2018* (Toronto: Canadian Solar Industries Association, 2011), 19, accessed January 12, 2012, http://www.cansia.ca/sites/default/files/economic_impacts_of_the_solar_photovoltaic_sector_in_ontario_2008-2018_july_26_0.pdf.
[319] Ulrike Lehr et al., "Renewable Energy and Employment in Germany," *Energy Policy* 39 (2008), doi: 10.1016/j.enpol.2007.09.004.
[320] Interview with a representative of OSEA, February 8, 2012.
[321] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 18.
[322] OSEA, *Submission*, 9.
[323] CanSIA, *Maximizing the Benefits of Early Success*, 18.
[324] Mabee, Mannion, and Carpenter, "Comparing the Feed-In Tariff Incentives," 481.

serving microFIT projects has experienced instability, primarily due to retroactive changes to rules and prices.[325] Long, but variable timeframes for conditional offer issuance also made it difficult for installation companies to maintain a steady workflow.[326] Additional delays were experienced at the grid connection phase due to both the Electrical Safety Authority and Hydro One.[327] Prior to August 2011, Hydro One exceeded the timeframe to issue either an offer to connect or a rejection notice for nearly 30% of applications, and processing times for overdue offers or rejections spanned a range from 16 days to over 200 days.[328] Hydro One also failed to comply with the mandated timeline to connect microgeneration projects to the grid.[329] These delays purportedly resulted from overwhelming demand to connect, an inconsistent flow of application approvals, strict connection timelines and the belief held by Hydro One field staff that the required processing timelines were longer than those mandated.[330] Despite the fact that the breach of mandated agency timelines forced some project proponents to reapply to the program due to conditional offer expiry, there were no repercussions for such breaches.[331]

It is important to note that Hydro One has received many more requests than other LDCs – 28,552 as of December 9, 2011 compared to 17,172 for all other LDCs.[332] However, it has been argued that Hydro One should have expected such a volume of requests based on past experience.[333] Nonetheless, the agency has been credited with improving processing times in 2011.

---

[325] CanSIA, *Maximizing the Benefits of Early Success*, 21.
[326] Ibid., 21; interview with an industry expert, February 17, 2012.
[327] Interview with a representative of OSEA, February 8, 2012.
[328] Fraser, *Getting It Right,* 10.
[329] Hydro One Networks Inc., *EB-2011-0118 – Hydro One Networks' Request for Exemption from Section 6.2.6 & 6.2.7 of the Distribution System Code – Hydro One Networks' Application* (Toronto: Ontario Energy Board, 2011), 13, EB-2011-0118, accessed July 18, 2012, http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/rec/266550/view/.
[330] Fraser, *Getting It Right,* 10.
[331] Interview with a representative of OSEA, February 8, 2012.
[332] Ryan Boudreau, "F.I.T. Connection Review" (presentation, Ontario Feed-In Tariff Forum, Toronto, ON, April 3, 2012), http://www.amiando.com/eventResources/g/z/HkejhLl01KstYp/06_Ryan_B.ppt.
[333] Fraser, *Getting It Right*.

Despite these challenges, bust effects have not been widely experienced, but they are a distinct possibility.[334] For instance, in late 2011, Canadian Solar operated only one of three production lines at its new module manufacturing plant in Guelph, Ontario and was forced to lay off a portion of the plant's employees.[335] In the same timeframe, some managers of solar PV design and installation companies laid off employees and began searching for other employment, sometimes due to the complete disappearance of demand. [336] Other companies reduced shifts or reduced the number of shifts assigned to each employee.[337] Accordingly, some companies are expected to leave Ontario's solar PV market, particularly local companies which may not have experience with these program challenges and thus may not have considered them in business planning.[338]

Cost appropriateness and predictability as well as transparency have been cited as key characteristics of successful renewable energy deployment and the achievement of attendant goals, including economic growth.[339] During the review of the feed-in tariff, local stakeholders suggested program improvements which could help the FIT and microFIT Programs develop these characteristics. Stakeholder recommendations regarding cost appropriateness of the microFIT Program have been addressed above. Increased price predictability was another typical theme among available commentary. The development of a clear and predictable degression scheme was commonly recommended in order to inspire confidence among all industry stakeholders.[340] The avoidance of retroactive rule and price changes was also recommended, as was the rapid completion of program

[334] Interviews with solar PV industry experts, January 31, 2012 and February 17, 2012.
[335] Renata D'Aliesio, "Solar Industry Seeks Its Place in the Sun," *Globe & Mail*, October 17, 2011, ProQuest (898500720); "Workers Issued Layoff Notices at Canadian Solar Plant in Guelph," *Guelph Mercury*, November 3, 2011, http://www.guelphmercury.com/news/local/article/619320--workers-issued-layoff-notices-at-canadian-solar-plant-in-guelph.
[336] D'Aliesio, "Solar Power's Stuttering Steps"; Spears, "Review Clouds Outlook for Solar Firms."
[337] Interview with a solar PV industry expert, January 31, 2012.
[338] Interview with a solar PV industry expert, February 17, 2012.
[339] Catherine Mitchell et al., "Policy, Financing and Implementation," in *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al. (Cambridge, UK: Cambridge University Press, 2011), 70-71, accessed February 7, 2012, http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.
[340] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 44; AMO, *Feed-In-Tariff Program Review*, 14; FIT Review Coalition, *FIT 2.0*, 5; CanSIA, *Maximizing the Benefits of Early Success,* 20.

reviews.[341] In addition, enhanced consistency, transparency, and public accessibility has been recommended with respect to grid connection capacity,[342] as has the relaxation of Hydro One's rules on acceptable microFIT project capacity.[343] Industry representatives and other stakeholders also encouraged the implementation of measures to improve market predictability. The adoption of annual capacity development targets was emphasized as a means of sustaining market growth, investment, and job creation, with one group recommending annual development of 200 MW of micro-scale solar PV.[344] Long-term targets were also recommended in order to help maintain construction and manufacturing jobs and develop export competitiveness.[345]

A draft version of the revised microFIT Program rules[346] introduces some mechanisms to stabilize prices and markets, but falls short of the standards proposed by stakeholders. First, the renewable electricity tariffs will now be reviewed annually rather than bi-annually. According to the Ministry of Energy's Two-Year Review Report and April 2012 directive to the OPA, new prices will be published each November and will take effect at the beginning of the following calendar year.[347] However, this schedule is not included in the draft program rules, perhaps allowing for deviations. If such a schedule is adhered to, the predictability of pricing adjustments will be improved, although the level of predictability of a defined degression rate is not offered. Program stability will also be improved if, as expected[348], program activities are not suspended during annual reviews.

---

[341] CanSIA, *Maximizing the Benefits of Early Success,* 21.
[342] OSEA, *Submission*, 6; interview with an electricity sector expert, March 12, 2012.
[343] CanSIA, *Maximizing the Benefits of Early Success,* 11.
[344] FIT Review Coalition, *FIT 2.0*, 5; GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 22; CanSIA, *Maximizing the Benefits of Early Success,* 6.
[345] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff,* 22-23.
[346] Ontario Power Authority (OPA), *microFIT Rules: Version 2.0* (Toronto: OPA, 2012), accessed April 5, 2012, http://microfit.powerauthority.on.ca/sites/default/files/microFIT%20Rules%20Version%202.0.1.pdf.
[347] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 13; Chris Bentley, *Directive to the OPA re: Feed-in Tariff Program Review* (Toronto: Ministry of Energy and Infrastructure, 2012), 4, accessed May 17, 2012, http://www.powerauthority.on.ca/sites/default/files/page/FIT-ReviewApril-2012.pdf.
[348] Interview with a staff member of the Ontario government, April 5, 2012.

Second, Annual Procurement Limits were introduced for microFIT projects. If the volume of applications pending connection requests is reported publicly and frequently, market advancement will be predictable. However, program uncertainty could be introduced if transparency is inadequate. A system similar to or more advanced than the current bi-weekly reporting must be maintained. Once reached, these limits are also likely to create periods of reduced demand, perhaps making the maintenance of steady workloads difficult. Of further concern is the possibility of low procurement limits. Future procurement volumes have not yet been announced, but low capacity volumes may hinder solar PV industry development. In addition, Hydro One's limitations on microFIT project capacity on the distribution system were maintained,[349] providing an additional restriction to solar PV industry development.

The combination of program review schedules, application processing timelines and the fact that the contract price will be assigned at the time of application approval notice issuance may create significant periods of reduced demand. The report issued following the program review illustrates that the total time between application submission and application approval notice could be five months or more.[350] If project proponents are faced with the possibility of receiving a lower tariff than anticipated because they receive the application approval notice following the November price change, they may refrain from submitting their application until the new tariffs are announced. If a proponent in such a situation decided to submit his or her application, but was unhappy with the new tariff, he or she may decide to cancel the project. Both of these scenarios could create gaps in demand for solar PV products and services.

In addition, the draft rules do not increase confidence in application review timelines. It is noted in the Two-Year Review Report that the OPA will review microFIT applications within sixty days of

[349] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program,* 20.
[350] Ibid.*,* 24.

receipt.[351] However, this timeline is not stipulated in the draft rules, potentially allowing for deviations and causing uncertainty among those considering projects. The frequency at which conditional offers – now referred to as Application Approval Notices – will be issued is not addressed in any program documentation released thus far. As such, the inconsistent issuance of notices could continue to disrupt workflow.

Moreover, the draft rules for the revised microFIT Program do not address the delays in connection application processing. The draft rules state that an applicant must obtain an offer to connect within ninety days of the completion of the OPA's application review or the application will be terminated.[352] This increases pressure on LDCs to issue an offer or refusal to connect in a timely fashion since the project proponent will be significantly inconvenienced if the deadline is not met. However, the publication of this timeframe may also reduce pressure on LDCs to issue connection offers to indirectly connected projects within the fifteen-day timeline mandated in the Distribution System Code.[353] Additionally, between May and August 2011, Hydro One continued to issue some offers and refusals to connect after more than sixty days.[354] If this practice is sustained under the revised program, Hydro One will infringe upon the thirty-day offer acceptance period mandated for the applicant,[355] perhaps rushing the applicant's decision.

4.3. Social impacts

4.3.1. Distribution of costs and benefits among electricity consumers and other stakeholders

An additional purpose of the microFIT Program is to broaden the profile of stakeholders participating in renewable energy development in Ontario. Feed-in tariffs have been found to achieve

[351] Ibid.
[352] OPA, *microFIT Rules*, 3.
[353] Ontario Energy Board, *Distribution System Code* (Toronto: Ontario Energy Board, 2011), section 6.2.6, accessed April 29, 2012, http://www.ontarioenergyboard.ca/OEB/_Documents/Regulatory/Distribution_System_Code.pdf.
[354] Hydro One Networks Inc. (HONI), *CDM Exemption: Hydro One Networks' Undertaking Responses* (Toronto: HONI, 2011), EB-2011-0118, 3-4, accessed April 29, 2012, http://www.hydroone.com/RegulatoryAffairs/Documents/EB-2011-0118/HONI_UndertakingsMega_20110812.pdf.
[355] OEB, *Distribution System Code*, section 6.2.6.

this due to their creation of a stable investment environment.[356] This type of policy can also encourage participation over a broader geographic area due to its relative lack of preference for the development of the strongest energy resources.[357] Additionally, the scale of projects promoted by the microFIT Program enables participation across a greater variety of locations because, as CanSIA notes, microgeneration projects may be situated on a wider array of sites than larger systems.[358]

The Ontario government stated in March 2012 that "almost 12,000 families, farmers, community groups and small businesses are participating in the microFIT Program."[359] However, at no point in the course of the microFIT Program had the government or the OPA released comprehensive information about microFIT Program participants, such as participation by proponent type or geographic distribution of projects. As such, stakeholders have had difficulty evaluating program participation, prompting calls for the publication of such information.[360]

It continues to be difficult at best to explore the participation of specific proponent types. In particular, information about the quantity of individual or aboriginal participants as well as participants from renewable energy cooperatives, faith-based organizations, local distribution companies, educational institutions and hospitals was not found during the course of the research. However, some information has been released with respect to other proponent types. As of August 2011, over 200 microFIT projects were owned by municipalities across Ontario.[361] In a document published one month later, the Liberal Party stated that over 20,000 farmers had applied to the microFIT Program with nearly

---

[356] Ian H. Rowlands, "Envisaging Feed-In Tariffs for Solar Photovoltaic Electricity: European Lessons for Canada," *Renewable and Sustainable Energy Reviews*, 9 (2005): 58, doi:10.1016/j.rser.2004.01.010; Thomas Faber et al., *Review Report on Promotion Strategies for Electricity from Renewable Energy Sources in EU Countries*, ed. Reinhard Haas (Vienna: Institute of Energy Economics, Vienna University of Technology, 2001), 25, accessed May 15, 2012, http://download.nachhaltigwirtschaften.at/pdf/haas_promotion_res.pdf.

[357] Rowlands, "Envisaging Feed-In Tariffs for Solar Photovoltaic Electricity," 58.

[358] CanSIA, *Maximizing the Benefits of Early Success,* 20.

[359] Ontario, Ministry of Energy, *Ontario's Feed-In Tariff Program*, 5.

[360] OSEA, *Submission*, 6.

[361] Colin Andersen, "Long Term Electricity Planning – What Communities Need to Know" (speech, 2011 Association of Municipalities of Ontario Annual Conference, London, ON, August 22, 2011), 15, accessed May 13, 2012, http://www.powerauthority.on.ca/sites/default/files/news/Colin%20Andersen%20-%20AMO%20Conference%20August%202011%20-%20Speech_0.pdf.

11,000 having already connected their systems.[362] According to these estimates, farmers represented approximately half of all microFIT applicants, and are likely to have held a majority of executed contracts.[363] Therefore, farmers appear to be overrepresented among microFIT Program participants.

Although small businesses are reported to be participating in the program, it is not possible for many of them to do so because they often do not own their property.[364] Moreover, small businesses are not specifically recognized as an Eligible Participant of the program because it is difficult to create a legal definition of a business which would permit small businesses, but exclude larger companies which are likely to be capable of developing a microFIT project at a lower cost.[365] The requirement that a project proponent must own the property which hosts the project was also a barrier for several other Eligible Participant groups. Therefore, the revised Eligible Participant Schedule permits Aboriginal communities, schools, hospitals, long-term care facilities, municipalities and social housing organizations to situate microFIT projects on leased buildings.[366] The revised program has also recognized the eligibility of farm co-operatives to participate.

Individuals or organizations participating in the microFIT Program incur both benefits and costs. The benefits of the microFIT Program are significant, with the primary benefit deriving from net financial gain from tariff payments. However, particular segments of society may be more likely to participate in the program and thus reap this benefit. Given the significant capital investments required to commission a microFIT project and the fact that financing options are limited for some Ontarians,[367] it is likely that a disproportionate amount of relatively wealthy proponents are participating in the microFIT Program.

---

[362] Ontario Liberal Party, *The Ontario Liberal Plan for Rural Ontario* (Toronto: Ontario Liberal Party, 2011), 10, accessed May 15, 2012, http://www.ontarioliberal.ca/OurPlan/pdf/ruralnorthern/rural_platform_mini.pdf.
[363] Ontario Power Authority, "Bi-Weekly microFIT Program Reports," September 2, 2011. Accessed March 2, 2012. http://microfit.powerauthority.on.ca/bi-weekly-microfit-program-reports.
[364] Interview with an official from the Ontario Power Authority, January 20, 2012.
[365] Interview with an official from the Ontario Power Authority, January 20, 2012.
[366] Ontario Power Authority, *microFIT Eligible Participant Schedule* (Toronto: OPA, 2012), accessed May 14, 2012, http://microfit.powerauthority.on.ca/sites/default/files/microFIT%20Eligible%20Participant%20Schedule%20Version%202.0.pdf.
[367] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 69.

A number of measures could enable the participation of Ontarians with lower levels of disposable income. First, the OPA could publicize additional financial incentives available to microFIT Program participants. For example, the federal capital cost allowance for clean energy generation equipment offers tax benefits for businesses, but awareness of the incentive has been found to be low.[368] Second, low- or zero-interest loans could help increase the diversity of participants. A program offering low-interest loans to homeowners commissioning renewable energy projects was contemplated during the development of the GEGEA,[369] but the program was not implemented. Early discussions regarding the GEGEA also included consideration of a third measure which could enable wider broader program participation. The notion of "supporting the bulk purchase" of renewable energy technologies was contemplated as a method of helping co-operative groups gain access to competitive pricing,[370] but it could also lessen costs for individuals developing microFIT projects and could reduce the total cost of the program. Finally, the launch of a CFIT program would remove financial barriers to participation for many Ontarians because they would not be required to purchase a renewable energy system.

Although microFIT project owners can receive great benefit from their renewable energy systems, they also assume significant risks and liabilities because they hold sole title to their systems. First, they must devote a significant amount of capital to the development of the project. Second, technical problems and unanticipated project costs are borne by project owners. Warranties are available for some system components, but other issues could reduce or eliminate expected profit. Public assumption of these risks represents a significant benefit for Ontario's government and energy agencies. Rather than bearing the risks of microgeneration, as they do with many other types of

---

[368] Émanuèle Lapierre-Fortin, *Implementing Bill 150: Reflections from the* Field (Guelph, ON: Workforce Planning Board of Waterloo Wellington Dufferin, 2011), 10, accessed May 15, 2012, http://workgreen.ca/system/files/Implementing%20Bill%20150%20-%20Reflections%20from%20the%20Field.pdf.

[369] Ontario, Legislative Assembly, Official Report of Debates (Hansard), 39th Parl, 1st Sess, (March 2, 2009) at 1640 (Laurel C. Broten).

[370] Tyler Hamilton, "Ontario Aims to Set Continental Standard with Green Energy Act," *Clean Break* (blog), February 22, 2009, http://www.cleanbreak.ca/2009/02/22/ontario-aims-to-set-continental-standard-with-green-energy-act/.

electricity supply, these organizations are able to externalize them and avoid responsibility for any potential problems. Although it would not transfer any risk to provincial energy institutions, a CFIT program would help improve the distribution of risk associated with microgeneration. This type of program would place responsibility for capital outlay, technical problems, and unanticipated costs on corporations rather than on individuals and organizations with little technical or financial capacity.

With the exception of those employed in the booming solar PV industry, those who do not participate in the microFIT Program are unlikely to gain any financial benefit from the program. However, other program benefits and costs are shared by all Ontarians, regardless of program participation. These include the environmental benefits of the program and the cost of the program, which is passed to electricity consumers through increased electricity prices. This will be discussed in detail below.

The program may also place a cost upon Ontarians whose property is in close proximity to a microFIT project or who view such projects. For instance, one project developer erected a large number of microFIT projects on a subdivided lot in a residential area, prompting concerns about aesthetics, property values and proximity to homeowners' property lines.[371] Aesthetic complaints have also been directed toward the City of Markham's solar PV project, with some citizens preferring that the system be less visible.[372] Other Ontarians have expressed concerns about groundwater contamination resulting from ground-mounted solar PV projects.[373]

Some of these program costs will be reduced by a measure included in the draft rules for the revised microFIT Program. This measure bans ground-mounted solar PV projects and wind projects of an installed capacity of 3 kW or less from residential property or land that abuts residential property,

[371] Sharon Hill, "Solar Panels Unwelcome Neighbour; 44 Units Planned for Subdivision," *Windsor Star*, June 11, 2011, Factiva (WINSTR0020110611e76b00013).
[372] Interview with a representative of the Markham Energy Conservation Office, February 22, 2012.
[373] Interview with a representative of OSEA, February 8, 2012.

excluding agricultural land where residential use is ancillary.[374] In addition, such projects may no longer be located on commercial or industrial land which does not serve an alternative primary purpose. This rule could negatively affect some owners of large residential properties where such projects would be appropriate. Therefore, the benefits of the microFIT Program are currently inequitably shared among Ontarians and microFIT project owners, while risk is inequitably placed upon project owners and costs are relatively evenly shared.

The evaluation of the geographic distribution of microFIT Program participants (and beneficiaries) was made possible by the OPA's 2012 release of a set of program data. This new information specified the number and average nameplate capacity of microFIT projects of each renewable fuel type in communities, towns, cities and regions of Ontario.[375] The data represented all microFIT projects with executed contracts as of March 13, 2012. The following analysis is derived from this information.

Renewable energy systems have been erected across the province of Ontario as a result of the microFIT Program.[376] High numbers of projects have been developed in the southern regions of the province,[377] with the cities of Ottawa and Chatham-Kent and the counties of Middlesex, Essex and Simcoe each hosting approximately 475 to 575 projects. The Region of Waterloo and the counties of Bruce, Leeds and Grenville, and Hastings also host high numbers of projects, but the method of data aggregation employed by the OPA does not permit precise calculation of the quantities of projects.[378]

---

[374] OPA, *microFIT Rules*, 5.

[375] Ontario Power Authority (OPA), *microFIT Connections by City/Region (March 13, 2012)* (unpublished data obtained from the OPA in response to Freedom of Information and Protection of Privacy Act Request 2012-012, 2012), received May 28, 2012.

[376] See data and maps in Appendix A.

[377] Ontario, MNDMF, *Northern Ontario: A Profile*. Southern Ontario excludes all communities in the province's ten northernmost territorial districts, as defined by the Ontario Ministry of Northern Development, Mines and Forestry.

[378] In its reporting of the number, capacity, and type of microFIT projects in cities and regions across Ontario, the Ontario Power Authority occasionally combined all or part of multiple counties and districts into one reporting region. For example, one reporting region included "East Haldimand County, northwest Niagara Region, and most of rural Hamilton." In these cases, the author divided the quantity of microFIT projects in the reporting region by

The OPA's aggregation technique also prevented the evaluation of the popularity of different types of microgeneration systems among different regions.

In some cases, high regional participation is likely to be related to city, county or district population size. For example, the City of Ottawa's share of microFIT projects is slightly lower than its share of Ontario's population,[379] while the shares of projects and population in the region of Waterloo are approximately equal. The other areas mentioned above all host high shares of microFIT projects relative to their share of population. Although it is not a leader with respect to total number of projects developed, Prince Edward County hosts the highest share of microFIT projects by population. Among the areas with the lowest shares of projects relative to population size are all regions and cities in the Greater Toronto Area as well as Greater Sudbury and the City of Hamilton. At a broader scale, concentrations of microFIT projects appear in the extreme southwestern and eastern areas of the province, while very few microFIT projects exist in northern districts. Therefore, when analysed at the regional level, it is clear that the development of microFIT projects is uneven.

This regional disparity in microFIT project development could result from any of a number of factors. For instance, differences in regional demographics or psychographics could account for some differences in program participation. The presence in a region of a strong renewable energy advocate or a renewable energy project development company with robust marketing could also result in greater participation. In order to reduce the effect of these factors and the regional differences in program participation, the government or OPA should undertake province-wide marketing activities.

A regional disparity does not appear when the distribution of microFIT projects is evaluated according to location in northern or southern regions of the province. A large majority of microFIT

---

the number of counties and districts represented in that region and assigned an equal number of microFIT projects to each represented county or district.

[379] Canada, Statistics Canada, "Ontario Census Divisions – Annual Population Estimates at July 1" (table), *Annual Demographic Estimates: Subprovincial Areas,* Statistics Canada Catalogue no. 91-214-X (Ottawa, ON: Statistics Canada, 2012), accessed May 31, 2012, http://www.statcan.gc.ca/pub/91-214-x/2010000/t043-eng.pdf.

projects – 10,687, or 91.4% – were commissioned in southern regions of Ontario, while 1,005 projects, or 8.6%, were commissioned in northern regions. These figures align with Ontario's population distribution, where 93.99% of Ontarians live in southern regions and 6.01% live in northern regions. In northern regions of the province, rooftop PV systems are slightly more popular than ground-mounted systems, accounting for 45% and 37% of microFIT projects, respectively. The reverse is evident in southern Ontario, where rooftop systems account for approximately 34% of projects and ground-mounted systems represent over 40%. However, these trends are not definitive given that nearly 3,000 solar PV microFIT projects have not been classified as rooftop or ground-mounted.

Regardless of region, ground-mounted projects appear to have a higher nameplate capacity than rooftop or unclassified solar PV projects, averaging nearly 10 kW, 8 kW and 7.5 kW, respectively. However, caution must again be exercised because averages were not calculated from the capacities of individual projects, but from the average nameplate capacities of projects in particular areas. Employing the same method, it was found that the average nameplate capacity of each type of solar PV project appears to be slightly higher in northern regions. Projects involving more progressive technologies had thus far been confined to southern Ontario, where 2 landfill gas projects with an average capacity of 7 kW[380] and 7 wind projects averaging 6.22 kW were commissioned.

4.3.2. Effect on rural economic development

Rural economic development is a goal unique to the microFIT stream of Ontario's feed-in tariff, and the newly released program information permitted evaluation of the achievement of this goal with respect to project deployment. A variety of methods have been devised in order to classify urban and

[380] The quantity of landfill gas projects with executed contracts reported by the OPA in *microFIT Connections by City/Region (March 13, 2012)* does not match the quantity reported in the OPA's contemporaneous *Bi-weekly FIT and microFIT Reports*. Clarification could not be obtained prior to publication.

rural areas in Canada and Ontario.[381] The Rural Economic Development (RED) Program operated by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has defined rural Ontario as

> all of Ontario with the exception of the Greater Toronto Area (GTA) and eight large urban areas. These large urban areas are the cities of Hamilton, Ottawa, Greater Sudbury, Thunder Bay, London and Windsor, and the regions of Waterloo and Niagara. However, communities and lower tier municipalities with a population of less than 100,000 in the GTA or in the eight large urban areas will be considered rural.[382]

In practice, program staff classify communities and lower tier municipalities within the large urban areas according to population density and other criteria.[383] This definition has been adopted for the purpose of this analysis given the common economic development goals of the RED and microFIT Programs. However, the definition has been modified as follows:

- Communities with a population under 100,000 within the 9 large urban areas were classified as urban if 50% or more of the land area contained urban development patterns;
- Cities with a population of 100,000 or more located outside the 9 large urban areas were classified according to the above rule.

According to this definition of urban and rural Ontario, 2,631 microFIT projects, or 22.5% of projects, have been commissioned in urban areas, while 9,061 projects, or 77.5%, have been erected in rural areas. It is difficult to compare these figures to the populations of these areas because Statistics Canada defines rural areas as "areas with fewer than 1,000 inhabitants and a population density below 400 people per square kilometre"[384] – a much narrower definition than that employed here. According to Statistics Canada, 14.1% of Ontarians live in rural areas. Given this very low proportion, it is likely that most definitions of rural areas would produce a smaller population than that of urban areas. As such, it

---

[381] See, for example, Valerie du Plessis, Roland Beshiri, Ray D. Bollman, and Heather Clemenson, *Definitions of "Rural"*, Statistics Canada Catalogue no. 21-601-MIE (Ottawa, ON: Statistics Canada, 2002), Agriculture and Rural Working Paper Series, no. 61, received May 24, 2012 from the Ontario Ministry of Agriculture, Food and Rural Affairs.

[382] Ontario, Ministry of Agriculture, Food and Rural Affairs (OMAFRA), *Rural Economic Development Program (RED): Program Guidelines* (Guelph, ON: OMAFRA, 2011), 3, accessed May 31, 2012, http://www.omafra.gov.on.ca/english/rural/red/live/docs/redguidelinesform.pdf.

[383] Employee of Ontario's Ministry of Agriculture, Food and Rural Affairs, e-mail message to author, May 24, 2012.

[384] Canada, Statistics Canada, "Canada's Rural Population Since 1851," last modified May, 2012, http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-310-x/98-310-x2011003_2-eng.cfm.

is probable that rural microFIT projects are overrepresented, with the share of projects located in rural areas exceeding the share of population.

In urban areas, the share of rooftop solar PV projects far exceeds the share of ground-mounted projects. Excluding unclassified projects, rooftop solar PV projects account for approximately 64.3% of microFIT projects, while ground-mounted projects account for only 8.7%. This is in stark contrast to the character of rural solar PV projects, where 26.8% are placed on a rooftop compared to 49.3% mounted on the ground. The average nameplate capacity of ground-mounted projects approaches 10 kW regardless of location, while rural rooftop projects are markedly larger than urban projects, with average capacities of 8.4 kW and 6.8 kW, respectively. Unclassified solar PV projects and wind projects also have higher capacities in rural areas. These rural solar PV projects have an average capacity of 7.91 kW compared to 5.68 in urban areas, and rural wind systems have a capacity of 10 kW compared to 3.7 kW for urban systems. Both landfill gas projects are located in urban areas, and all projects which do not utilize solar PV are located in the GTA.

On an individual basis, rural and urban microFIT Program participants may not gain equal benefit from the program. The microFIT Program supports multiple types of solar PV systems within the categories of rooftop and ground-mounted. Rooftop systems can be designed for flat or slanted roofs, and ground-mounted systems can be designed to track the sun's elevation and azimuth or to remain fixed. Different types of systems are appropriate for different types of buildings and properties. For example, most urban roof spaces cannot accommodate the area of solar panels required for a PV system with an installed capacity of 10 kW, whereas a roof on a barn is likely to be large enough to do so. Similarly, an urban property is unlikely to be capable of comfortably hosting a 10 kW ground-mounted solar PV system, while a rural property is likely to be larger and thus able to do so. These differences in proponent capacity are reflected in the program participation data, as noted above. These distinctions, as well as the differing levels of investment required for each system type, could result in

varying levels of profit and return on investment (ROI) for different proponent types. As such, it is important to compare the financial profiles of different types of projects.

To obtain a complete picture of profit trends, it is necessary to comprehensively survey Ontario's solar PV installation industry – an investigation exceeding the scope of this paper. Instead, general trends were discerned by comparing a single solar PV installation company's cost estimates for representative projects.[385] Given that microFIT tariffs and technology costs have changed over time, a temporal comparison of project costs was also completed. The representative urban project was rooftop system with a nameplate capacity of 5 kW, while representative rural projects were a 10 kW fixed ground-mounted system, a 10 kW dual-axis tracking ground-mounted systems, and a 10 kW rooftop system. Estimates were also generated for a 10 kW system installed on a flat roof, representing a project installed on a commercial or public building. All microFIT solar PV projects involve a variety of costs, including equipment, engineering, installation, maintenance, financing costs, sales taxes, income taxes, connection charges, and administrative costs. Many of these costs are highly project-specific, and, as such, are excluded from the estimates. Only equipment, engineering, installation and maintenance costs were considered by the installation company. However, it can be assumed that financing costs and tax payments will be higher for larger projects and that connection charges and administrative costs will be relatively similar for most projects.

As mentioned above, rural ground-mounted microFIT projects were very lucrative prior to the 2010 tariff change – this is reflected in the estimates. Following the tariff change, the ROI for these systems was lower than that of an urban system, although rural rooftop systems continued to offer a similar ROI to urban systems. In the third quarter of 2011, prior to the program review, the ROI for rural rooftop systems was slightly higher than that for urban systems, while both remained higher than that for rural ground-mounted systems. The new tariff regime currently offers rural ground-mounted

[385] Dynamic Solar Tech Inc., *MicroFIT Costs, Revenues* (unpublished data, 2012), received May 7, 2012 from Dynamic Solar Tech Inc. See Appendix B for representative project descriptions and assumptions.

systems with tracking technology a significantly lower ROI than other systems, while fixed ground-mounted systems earn a similar ROI to urban systems. A rural rooftop system continues to secure a higher ROI.

Therefore, rural microFIT proponents appear to have been able to earn a more favourable ROI than urban proponents at numerous points in the program, although recent prices appear to favour only those rural residents who own a barn or other large building, or whose house boasts a large quantity of roof space. In fact, tariffs have consistently favoured both rural and urban residents with large roof spaces. This trend has also been noted elsewhere.[386] Since larger houses typically belong to wealthier people, the microFIT Program again appears to give preference to this demographic.

In addition, according to the available estimates, rural projects of all types have consistently earned a higher profit than urban projects. However, more capital must be invested in rural projects – and a more significant risk assumed – and the profit discrepancy has been significantly reduced by the new tariff regime. Overall, the favourability of rural projects is evidenced by the overrepresentation of program participants located in rural areas. It should also be noted that a commercial or public project installed on a building with a flat roof has consistently offered a relatively high ROI and profit, very similar to that of a rural rooftop project.

While rural communities appear to be financially favoured by the microFIT Program, they may have been disproportionately impacted by program challenges. A member of Ontario's PC Party claimed that the 2010 tariff reduction for ground-mounted solar PV microFIT projects imposed a disadvantage upon rural communities.[387] This is not entirely accurate since, as noted above, larger projects more appropriate for rural areas could still earn a higher profit than urban projects. It has also been reported

[386] CanSIA, *Maximizing the Benefits of Early Success,* 21.
[387] Canadian Press, "Cut in Rate Paid for Solar Power Will Hurt Rural Ontario, Critics Say," July 15, 2010, Factiva (CPR0000020100716e67g000av).

that Hydro One's February 2011 rejection of approximately 1,000 connection requests mostly affected rural areas.[388]

Along with increasing a farmer's income, the financial benefits offered by microFIT projects can cause indirect positive impacts. The revenue stream offered by microFIT projects can help farmers meet financial commitments critical to maintaining their farms.[389] There is also anecdotal evidence of perceived improvement in farmers' financial profiles, enabling access to more favourable loans for other purposes.[390] The microFIT Program is likely to have improved the broader rural economy as well. One group of experts has noted that renewable energy product and service providers may begin operating in rural communities as a result of a renewable energy support policy, possibly creating employment opportunities and income.[391] Similar effects could be caused by renewable energy manufacturing companies, but rural Ontario has not yet benefited from significant manufacturing development. The experts also asserted that local economies could be bolstered by increased local spending resulting from the revenue generated from renewable energy projects. Moreover, renewable energy generation could help stabilize rural economies in the long term by combating climate change and its associated extreme weather events, which can be detrimental to agriculture.

Adjustments proposed for the microFIT Program during or following the program review will have both positive and negative consequences for rural economic development. One stakeholder group suggested that rooftop solar PV projects of a nameplate capacity of 30 kW or less should qualify for the microFIT tariff such that farmers could develop larger solar PV projects on barn rooftops.[392] This measure is not advisable given that it would increase program costs, and was not included in the draft

[388] Spears, "Review Clouds Outlook for Solar Firms."
[389] Kristi Anderson, Arne Jungjohann, and Tim Weis, *Harvesting Clean Energy on Ontario Farms: A Transatlantic Comparison* (Washington, DC: Heinrich Böll Stiftung, 2011), 50, accessed May 15, 2012, http://pubs.pembina.org/reports/harvesting-energy-ontario-june-24-final.pdf.
[390] Interview with microFIT project owners, February 19, 2012.
[391] Anderson, Jungjohann, and Weis, *Harvesting Clean Energy on Ontario Farms*, 49.
[392] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 48.

tariff schedule released following the program review. The government did, however, choose to encourage increased participation from the rural community by including farm co-operatives in the revised Eligible Participant Schedule.

Rural economic development could be negatively affected by the promotion of urban microFIT projects. CanSIA recommended the creation of a distinct tranche for rooftop solar PV projects with an installed capacity of 5 kW or less in order to encourage greater participation among Ontarians with smaller rooftops.[393] Projects of this size are more likely to be commissioned by urban Ontarians. Given the implementation of Annual Procurement Limits, greater deployment of urban projects may eliminate opportunities for rural project development. Rural participation could also be hindered by the government's proposed rule regarding the maximum distance between a project and connection point. Rural proponents are likely to have larger properties, and therefore the distance between the project and connection point could be greater than that of other projects, perhaps resulting in unfavourable project siting or project infeasibility. This should be considered in rule development.

4.3.3. Effect on electricity pricing

The electricity supply procured by the microFIT Program and other renewable energy programs will inevitably add costs to the bills of all electricity consumers in Ontario. A variety of estimates of these costs have been published. During legislative debate regarding the GEGEA, the government stated that all measures implemented under the Act would raise energy costs by a total of 1% per year.[394] In its 2010 Long-Term Energy Plan, the government noted that residential electricity prices were expected to increase by 7.9% each year for five years, with 56% of this increase attributable to investment in new renewable energy generation.[395] The Plan does not specify whether generation other than that procured

[393] CanSIA, *Maximizing the Benefits of Early Success,* 15.
[394] Ontario, Legislative Assembly, Official Report of Debates (Hansard), 39th Parl, 1st Sess, (February 23, 2009) at 1010 (George Smitherman).
[395] Ontario, Ministry of Energy and Infrastructure, *Ontario's Long-Term Energy Plan*, 59.

by the FIT and microFIT Programs was considered in the calculations, but it is likely that the projection includes generation contracted by the RES and RESOP programs which had not yet reached commercial operation. A study which is confirmed to have included renewable energy procured outside the FIT and microFIT Programs was conducted by the Ontario Energy Board (OEB).[396] This investigation projected a 46% increase in residential electricity costs between 2009 and 2014, with renewable energy contracts accounting for more than half of the costs.[397]

To date, these projections have not proven accurate. An April 2012 report by the OEB illustrates that the total Global Adjustment (GA) – a category of electricity charges which includes the cost of electricity supply procured outside wholesale markets – has risen from a monthly average of approximately 100 million CAD between 2006 and 2008 to approximately 400 million CAD per month from 2009 to October 2011.[398] While GA costs associated with Ontario's renewable energy programs have increased from a negligible amount at the beginning of 2009 to approximately 50 million CAD, GA costs associated with the province's nuclear energy supply have risen from under 100 million CAD prior to 2009 to approximately 200 million CAD between 2009 and October 2011. GA costs associated with other supply sources have also increased. Therefore, renewable energy has so far been responsible for a much smaller proportion of increases in electricity costs than projected. In fact, the OEB attributes only 6% of all GA costs since February 2006 to renewable energy.

A quantification of the additional electricity costs derived specifically from the microFIT Program has yet to be published. As such, an estimation of such costs is offered here. To calculate the annual cost of the program to consumers, all executed microFIT contracts as of March 2, 2012 were considered, with capacity factors of 19% for ground-mounted solar PV projects,[399] 13% for rooftop and unclassified

[396] Employee of the Office of the Auditor General of Ontario, e-mail message to the author, March 13, 2012.
[397] Office of the Auditor General of Ontario, *2011 Annual Report*, 95.
[398] Campbell, Rupert, and Ware, *Monitoring Report,* 59.
[399] "Rationale for New Ground-Mounted microFIT," Ontario Power Authority. In an interview on January 20, 2012, an Ontario Power Authority official stated that ground-mounted solar PV microFIT projects located in rural areas

solar PV projects, and 20% for wind energy projects.[400] Tariff payments of 0.642 CAD/kWh for electricity from ground-mounted solar PV, 0.802 CAD/kWh for rooftop and unclassified solar PV, and 0.135 CAD/kWh for wind were assumed. It should be noted that an unknown proportion of ground-mounted solar PV projects received conditional offers or executed contracts prior to the 2010 tariff change, and thus receive a tariff of 0.802 CAD/kWh. Therefore, total costs may be slightly underestimated. Additionally, some costs associated with transmission and distribution upgrades required to implement microFIT generation may be excluded, although the tariff rates were designed to account for project connection costs.[401]

Given these assumptions, it is estimated that 136,345 MWh of electricity will be provided annually by these microFIT projects at a cost of 97,245,728 CAD. When the annual cost of the program is spread over 143.2 billion kWh – Ontario's forecasted electricity demand for 2012[402] – the additional cost per kWh of electricity is 0.0007 CAD. If this cost is applied to the electricity bills of various Ontario electricity consumers, the annual costs listed in Table 6 result.

For most electricity consumers, the annual cost of the microFIT Program is currently minor. Additional costs can be significant for large consumers, although these consumers incur a smaller proportion of the costs of the microFIT Program than other consumers because they are responsible for a smaller proportion of the Global Adjustment.[403] This is not considered in the above estimates. As additional microFIT projects are contracted costs placed on electricity consumers will increase, but the rate of increase is likely to slow due to declining tariffs and the proposed procurement limits.

---

typically utilize tracking technology. Given that the vast majority of ground-mounted solar PV microFIT projects are located in rural areas, the use of this technology is assumed here.

[400] Ontario Energy Board, *Bill Impact Model*; "About the Technology," CanWEA, accessed March 14, 2012, http://www.canwea.ca/swe/overview.php?id=47.

[401] Ontario Power Authority, "Proposed Feed-In Tariff Price Schedule," 22.

[402] Independent Electricity System Operator, *18-Month Outlook: From December 2011 to May 2013* (Toronto: IESO, 2011), 3, accessed March 14, 2012, http://www.ieso.ca/imoweb/pubs/marketReports/18MonthOutlook_2011nov.pdf.

[403] Campbell, Rupert, and Ware, *Monitoring Report*, ii.

Table 6

Annual cost of the microFIT Program to various electricity consumers

Electricity customer class	Annual electricity usage (kWh)	Annual cost of microFIT Program (CAD)
Residential	9,600	7.66
General service under 50 kW	34,368[a]	27.43
General service over 50 kW	496,671[a]	396.38
Large user	1,248,300,000[b]	957,910.48

Sources:

a: Ontario Energy Board (OEB), *2010 Yearbook of Electricity Distributors* (Toronto: OEB, 2011), Statistics by Customer Class, accessed May 13, 2012, http://www.ontarioenergyboard.ca/OEB/_ Documents/RRR/2010_ electricity_yearbook_excel.xls
b: Interview with an electricity sector expert, April 25, 2012.

Notes:

a: The annual electricity usage of 'General Service under 50 kW' customers represents the average annual electricity usage of all such customers in Ontario. The annual electricity usage of 'General Service over 50 kW' customers was calculated by averaging usage data from utilities which do not serve 'Large User' or 'Sub Transmission' customers.
b: Approximate annual electricity usage of a single large consumer in Ontario.

4.3.4. Contribution to social learning

Winfield et al. list facilitation of social learning as a criterion for sustainable energy planning.[404] Social learning has been defined as "a process of social change in which people learn from each other in ways that can benefit wider social-ecological systems."[405] The concept involves three principles: altered understanding, social interaction between actors, and proliferation beyond the individual to wider social units.

The microFIT Program has the potential to achieve social learning. Energy experts have noted that small-scale renewable energy systems can promote enhanced knowledge and acceptance of

[404] Winfield et al., "Implications of Sustainability Assessment," 4121.
[405] Mark S. Reed et al., "What is Social Learning?," *Ecology and Society* 15*,* no. 4 (2010): n.p., http://www.ecology andsociety.org/vol15/iss4/.

renewable energy as well as increase awareness of energy sustainability.[406] These effects are facilitated by the ability of small-scale projects to "reduce the spatial and psychological 'distance' between electricity generation and the electricity user,"[407] and by the visibility of microgeneration, particularly solar and wind technologies.[408] Although renewable energy visibility and its associated positive effects are not restricted to small-scale projects,[409] it is likely that microgeneration projects are visible to more Ontarians than their large-scale counterparts. For example, large-scale wind energy projects have, to date, been developed only in regions of Ontario with strong wind resources. When renewable energy systems are widely dispersed, as microgeneration systems are, many people can be motivated to converse about renewable energy and energy systems, and broad support for renewable energy can be created.[410] Ontario's few large ground-mounted solar PV projects share wind energy's concentration problem, and solar PV systems mounted on commercial roof spaces may not be visible to the public. Moreover, large bioenergy facilities are unlikely to be identifiable to the public. These factors further limit the opportunity for many Ontarians to view large-scale renewable energy systems.

In addition, large-scale renewable energy projects are likely to be owned by corporations, limiting opportunities for the public to inquire about projects beyond any educational materials, websites or displays produced by the project owners. Conversely, all members of a small sample of homeowners who had installed solar PV microFIT projects noted that family, friends and neighbours had

[406] Gordon Walker et al., "Harnessing Community Energies: Explaining and Evaluating Community-Based Localism in Renewable Energy Policy in the UK," *Global Environmental Politics* 7, no. 2 (2007): 72, http://muse.jhu.edu/journals/gep/summary/v007/7.2walker.html; Jennifer C. Rogers et al., "Social Impacts of Community Renewable Energy Projects: Findings from a Woodfuel Case Study," *Energy Policy* 42 (2012): 239, doi: 10.1016/j.enpol.2011.11.081; Patrick Devine-Wright, "Energy Citizenship: Psychological Aspects of Evolution in Sustainable Energy Technologies," in *Governing Technology for Sustainability*, ed. Joseph Murphy (London: Earthscan, 2007), 72.
[407] Hannah Devine-Wright and Patrick Devine-Wright, "Representing the Demand Side: 'Deficit' Beliefs About Domestic Electricity Users," in *ECEEE 2005 Summer Study Proceedings, Panel 6: Dynamics of Consumption* (Stockholm: European Council for an Energy Efficient Economy): 1343, accessed February 26, 2012, http://www.eceee.org/conference_proceedings/eceee/2005c/Panel_6/6163devine_wright/paper.
[408] Bergman and Eyre, "What Role for Microgeneration," 348.
[409] Roger Peters and Tim Weis, *Feeding the Grid Renewably: Using Feed-In Tariffs to Capitalize on Renewable Energy* (Drayton Valley, AB: Pembina Institute, 2008), accessed February 27, 2012, pubs.pembina.org/reports/FITariffs_Primer.pdf.
[410] Rowlands, "Envisaging Feed-In Tariffs for Solar Photovoltaic Electricity," 59.

conversed with them about their project.[411] Some of these curious people inquired about solar energy, while others asked more detailed questions about cost, technology and installation. Project owners in both urban and rural areas also noted that passersby had stopped to ask about their project.[412] Tenants of one project owner reported that they had inquired about the project following its installation and were then able to answer select project-related questions posed by passersby, family and friends.[413] Learning on the part of social units, which Reed et al. define as institutions, organizations and communities of practice,[414] was not demonstrated by those who own a microFIT project or occupy a building which hosts one. However, their experiences clearly indicate the extension of learning beyond the individual.

Two of the interviewed homeowners have facilitated additional social learning opportunities through their active involvement in environmental initiatives. One homeowner who often speaks publicly about environmental sustainability intentionally mentions his ownership of a microFIT project in his presentations.[415] He stated that people often ask him about his project and its development. Another homeowner has spoken publicly about his environmentally friendly home and microFIT project, and also advertises and hosts annual public tours of his home, typically drawing approximately one hundred participants.[416] He answers many questions about his microFIT project during these tours, and some participants have contacted him afterward with additional questions. This homeowner has also opened his home to his architect's clients and to groups from educational institutions, providing a practical example to supplement theoretical learning. Interestingly, this homeowner credits a tour of a home with microgeneration and other environmentally friendly features as an impetus for the development of his sustainable home.

[411] Interviews with microFIT project owners, February 8, 19, 21, & 26, 2012
[412] Interviews with microFIT project owners, February 21, 2012 and February 26, 2012.
[413] Interview with tenants of a house with a microFIT project, February 24, 2012.
[414] Reed et al., "What is Social Learning?."
[415] Interview with microFIT project owner, February 21, 2012.
[416] Interview with microFIT project owner, February 8, 2012.

Organizations which have installed microFIT projects have also endeavoured to encourage social learning. The City of Markham has developed and promoted a publicly accessible website that reports the energy production, environmental impact and revenue of the highly visible microFIT project located on the roof of its Civic Centre. The website is also displayed at a kiosk in the lobby of the Civic Centre, enabling Town employees and the public to learn about the project. Town employees have proactively introduced groups to the kiosk and the project during public events, and school or community groups could independently use the website and kiosk for educational activities, although a Town employee was not aware of such use.[417] This employee reported that City of Markham staff, citizens, businesses and politicians had all inquired about various aspects of the project, and noted that while community and staff interest were strong following installation, only staff continued to express interest. Furthermore, the representative asserted that City staff had responded to requests for information from other municipalities, helping them to learn about Markham's project and experience with the program.

One interviewee who helps facilitate microFIT projects for faith institutions noted that these institutions promote their renewable energy systems while they are being developed and when they are completed.[418] He explained that the faith groups discuss their projects in community announcements and at information events they host, and also hold celebration events when projects are completed. He was not certain that these initiatives typically continue following project completion, but he noted that Ministers have discussed the projects during worship services, that congregations have access to websites which track their projects' energy supply, and that the institutions learn about each other's initiatives through congregation green teams.

[417] Interview with a representative of the Markham Energy Conservation Office, February 22, 2012.
[418] Interview with microFIT project owner, February 21, 2012.

4.3.5. Contribution to a "culture of sustainability"

Winfield et al. identify an energy program's ability to build a "culture of conservation" as a criterion for program sustainability since such activity can help improve the capacity for energy system governance.[419] A culture of conservation comprises a positive public attitude toward reducing energy consumption and an effort to do so in practice.[420] An institutional framework which enables this action must also exist. While renewable microgeneration can encourage a culture of conservation, as noted above, it may also be capable of encouraging positive attitudes toward renewable energy and eagerness to reduce the impact of energy use through the employment of renewable and lower-impact energy sources. As such, microgeneration may be able to contribute to the creation of a broader "culture of sustainability."

Other scholars have made similar arguments about renewable energy microgeneration. Gordon Walker et al. have speculated that mere exposure to community-based renewable energy projects (a category which includes microFIT projects[421]) could promote positive attitudes toward renewable energy.[422] Patrick Devine-Wright adds that microgeneration systems can raise consumers' awareness of energy use and can potentially lead to senses of personal responsibility for the effects of energy consumption and confidence in one's ability to reduce such effects.[423] He also suggests that these sensibilities may be difficult to achieve in a removed, centralized energy system.

Noam Bergman and Nick Eyre agree that microgeneration can enhance awareness of and engagement in energy systems and add that the technology could spur broad transformation in society's relationship with energy, potentially helping to reduce the sector's environmental impact.[424] Devine-

[419] Winfield et al., "Implications of Sustainability Assessment," 4121.
[420] Chief Energy Conservation Officer, *Ontario – A New Era in Electricity Conservation* (Toronto: Ontario Power Authority, 2006), 4, accessed March 16, 2012, http://www.ontla.on.ca/library/repository/ser/257270/2006.pdf.
[421] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 69.
[422] Walker et al., "Harnessing Community Energies," 79.
[423] Devine-Wright, "Energy Citizenship," 71.
[424] Bergman and Eyre, "What Role for Microgeneration," 341.

Wright characterizes this transformed paradigm as one of 'energy citizenship,' where consumers play an active role in the development of the energy system and take responsibility for the consequences of energy use, as opposed to the more common characterization of energy consumers as lacking knowledge of energy issues and motivation to participate in energy decisions.

The ability of microgeneration to encourage positive attitudes toward renewable energy has been observed in a UK study. Among a small sample of tenants of social housing units which featured renewable energy systems, most had little awareness of energy use and its associated issues prior to moving into their homes, but had since become proud advocates of renewable energy.[425] Clear changes in attitude toward renewable energy among staff and students of schools with renewable electricity systems were not reported by the study. However, it was noted that some teachers and students displayed a positive attitude toward renewable energy as well as pride in their school's system.

In Ontario, microgeneration is likely to have positively affected some citizens' perceptions of renewable energy. Some Ontarians who have commissioned microgeneration systems independently or with the support of previous procurement programs have noted that their children have grown up with such systems and now see them as a normal part of life.[426] It is conceivable that a similar effect will occur as a result of the microFIT Program. Many other Ontarians who do not own a microFIT project have observed them on houses and other buildings around the province and have taken the opportunity to inquire about them. While these people may not be as closely engaged with the systems as the social housing tenants interviewed in the UK study, these Ontarians' experiences could encourage a similar change in attitude toward renewable energy. Indeed, some of Ontario's microgeneration system owners have noted that experience with their system has elicited from their friends and neighbours expressions of a positive attitude toward and keen interest in renewable energy.[427] While the adoption of this

[425] Dobbyn and Thomas, *Seeing the Light,* 31-32.
[426] Interviews with microFIT project owners, February 8, 2012 and February 19, 2012.
[427] Interviews with microFIT project owners, February 8, 2012 and February 21, 2012.

attitude cannot be directly attributed to the microgeneration projects with which these people interacted, the projects may have bolstered positive attitudes toward renewable energy. This ability of microFIT projects to build support for renewable electricity has also been noted by renewable energy advocates in Ontario.[428]

In addition, some homeowners participating in the microFIT Program attributed the commissioning of other microFIT projects to experience with their own.[429] A member of Ontario's renewable energy industry has also observed this effect.[430] A representative of the City of Markham added that at least one other municipality had undertaken a microFIT project following discussions with City staff,[431] although the project was in the evaluation stage at the time of writing.[432] This secondary project development exemplifies the microFIT Program's ability to inspire people to employ renewable energy – a key characteristic of a culture of sustainability.

Aside from inspiring people to produce electricity from renewable energy, microgeneration can encourage the use of renewable or lower-impact energy for other energy-consuming activities. The previously noted UK study observed that microgeneration owners and occupants of buildings with microgeneration began recognizing and adjusting other energy-consuming activities.[433] For example, homeowners with solar PV systems contemplated installing a solar thermal water heater.

This effect has occurred among some microFIT project owners as well. The installation of their systems encouraged these individuals to embark upon initiatives such as the electrification of a boat motor, the addition of a solar panel to an electric boat motor, the purchase of a plug-in electric vehicle, and the exploration of household energy self-sufficiency through solar water heating and other

[428] FIT Review Coalition, *FIT 2.0*.
[429] Interviews with microFIT project owners, February 8, 2012 and February 19, 2012.
[430] Shelley White, "It's Not Easy Being Green," *Globe and Mail,* November 29, 2011, ProQuest (906333534).
[431] Interview with a representative of the Markham Energy Conservation Office, February 22, 2012.
[432] Town of Aurora, *General Committee Meeting Report* (Aurora, ON: Town of Aurora, 2012), February 7, 2012, 7, accessed March 8, 2012, http://www.town.aurora.on.ca/app/wa/mediaEntry?mediaEntryId=59522.
[433] Dobbyn and Thomas, *Seeing the Light,* 35 & 55.

measures.[434] Similar encouragement occurred at the City of Markham, where the installation of a microFIT project helped the staff become comfortable with the technology, costs and risks associated with the technology, and instilled confidence to pursue additional renewable energy projects.[435] The City may, in fact, direct the revenue earned from its project toward future energy conservation and renewable energy activities. The microFIT Program may also stimulate a greater appreciation for the nature of the electricity system. For example, one homeowner noted that he had become more conscious of the relationship between electricity supply and demand.[436]

The self-directed, grassroots nature of these changes in attitude and behaviour is important. Encouraging the public to engage with and act on energy issues has been a challenge for governments,[437] so the microFIT Program could be playing a vital role in inducing a culture of sustainability. The awareness of and engagement in energy issues which appear to be promoted by the microFIT Program help prepare the public to make wiser decisions regarding their own energy use and to participate in the ongoing development of provincial energy systems. However, as noted above, a cultural shift can only take place if change among the public is accompanied by change among institutions. The reaction of the province's energy institutions to the microFIT Program will be explored in the next section.

4.4. Policy legitimacy

As noted above, a policy is unlikely to achieve success if it is not considered legitimate by stakeholders. Therefore, the microFIT Program must achieve legitimacy among a variety of stakeholders, including the public, the private sector, provincial energy agencies and utilities, and all levels of government involved.

[434] Interviews with microFIT project owners, February 8, 19 & 26, 2012.
[435] Interview with a representative of the Markham Energy Conservation Office, February 22, 2012.
[436] Interview with microFIT project owner, February 21, 2012.
[437] Bergman and Eyre, "What Role for Microgeneration," 349.

4.4.1. Public

Public opinion about a particular issue is commonly assessed using an opinion poll administered to a representative segment of the population. None of the polls found in the course of research focused specifically on the microFIT Program, therefore more general polls about renewable energy and the GEGEA were examined. Particular attention was paid to questions which were likely to reflect opinions about the microFIT Program, but perceptions of the microFIT Program might also affect opinions of the GEGEA as a whole.

Prior to the passage of the GEGEA, public support for the Act and interest in installing a rooftop solar PV system were both reported to be fairly strong. According to a public opinion poll conducted in early 2009, 62% of Ontarians strongly supported the GEGEA, while 25% of respondents stated that they "somewhat support" the Act.[438] Support was relatively consistent across the province, although strong support for the Act was slightly lower outside the Greater Toronto Area. When asked how likely they would be to invest in a rooftop solar PV system, 26% said they would be very likely to invest, while 33% said they would be somewhat likely to do so.

As of June 25, 2012, the microFIT Program had received nearly 50,000 applications from a population of millions, failing to match stated interest. This is no surprise given that program challenges have negatively affected demand, as previously noted. These challenges have also created negative public opinion about the program,[439] and inappropriate siting of microFIT projects has caused sporadic social friction.[440] Furthermore, criticism of the microFIT Program has appeared in the news media throughout the life of the program, perhaps promoting negative opinions among Ontarians not engaged

[438] Pollara, *Green Energy Act, 2009 Survey* (Toronto: Green Energy Act Alliance, 2009), 8, accessed April 23, 2012, http://www.greenenergyact.ca/Storage/25/1707_GEA_Summary_Report.pdf.
[439] For example, see Rob Ferguson, "Controversy Flares Over Solar Subsidy Flip-Flop," *Toronto* Star, July 22, 2010, ProQuest (633510266); John Goddard, "Province Has a Plan for Stranded Solar Projects," *Toronto Star*, August 2, 2011, ProQuest (884398778).
[440] Interview with a representative of OSEA, February 8, 2012.

with the program. Nonetheless, in the context of program participation, officials and others closely involved with the microFIT program have consistently described the program as highly successful.[441]

Approximately two years after the GEGEA was enacted, several polls were conducted regarding the Act and renewable energy. Only one poll focused on solar energy, although it did not specify the size of the system. This March 2011 poll found that 57% of respondents strongly supported the generation of electricity in Ontario using solar energy, while 32% somewhat supported such generation. Support declined slightly with age and rural location. When asked about the installation of solar PV in their community, 71% of respondents expressed strong support for rooftop systems, while 22% expressed some support.[442] Support was significantly lower for systems situated on agricultural land, with only 28% strongly supporting the notion and 36% expressing some support. However, these statistics may reflect opinions about erecting large solar PV projects on agricultural land since project scale was not specified.

Opinions about the costs associated with solar electricity generation were mixed. Nearly half of respondents strongly supported financial incentives for companies and individuals generating solar electricity, while 33% of respondents somewhat supported such incentives. Support for solar PV declined significantly when higher electricity costs were considered. Only 18% of respondents strongly supported investment in solar energy if it resulted in higher electricity costs and only 36% somewhat supported such investment. It should be noted that many of these opinions were not influenced by current policies since 49% of survey respondents claimed they were not at all familiar with government policies for electricity generation from solar energy.

However, given that fairly little differentiation was found when respondents were asked about the impact of various electricity supply sources and system components on energy prices, Ontarians

[441] Tyler Hamilton, "Green Power to the People; Plan to Boost Renewable Projects at the Local Level Has Beaten All Expectations Since its October Launch," *Toronto Star*, December 16, 2009, ProQuest (TOR0000020091216e5cg00016); Cross, "Dreams Fade for Solar Investors."
[442] The Gandalf Group, *Opinion of Renewable Energy Policy and Solar Power: CanSIA Survey of Ontario* (unpublished report, 2011), 17, received April 19, 2012 from the Canadian Solar Industries Association.

appear to understand that other electricity sources will also be costly. For instance, 68% of respondents thought solar energy would increase electricity costs, while 77% and 64% held the same opinion regarding imported electricity and natural gas, respectively. With respect to the magnitude of price impacts, 53% of respondents believed electricity imports would have a significant effect on prices, while 34% and 23% believed the same about solar energy and natural gas, respectively. Moreover, similar proportions of respondents expected solar energy and natural gas to cause a moderate price increase. Ultimately, 51% of respondents believed that replacing coal-fired generation with electricity derived from solar energy would benefit the economy, while only 29% believed such a change would have a negative impact.

A poll conducted in August 2011 produced similar results. On a scale of costliness, respondents ranked wind and solar generation nearly equally with energy efficiency and generation from coal or natural gas.[443] Nuclear energy was thought to be more expensive. Results were relatively similar across provincial regions and other demographic groups, though older respondents thought wind and solar energy were slightly more expensive while natural gas-fired generation was less expensive. The perceived cost of wind and solar energy rose with education and income level while perceived cost of nuclear power dropped. When responses were categorized according to political preference, it was found that those voting for the PC Party believed that fossil fuel-fired generation was less expensive than wind and solar energy. Conversely, those voting for the New Democratic Party (NDP) thought wind and solar power were less expensive than fossil fuel-fired generation.

Polls conducted in July, August and October of 2011 evaluated Ontarians' support for renewable energy from a broader perspective. The polls indicated that between two-thirds and three-quarters of

[443] Vision Critical, *Party Energy Proposals Poll* (Toronto: Environmental Defence, 2011), accessed April 27, 2012, http://environmentaldefence.ca/sites/default/files/report_files/PARTY%20ENERGY%20PROPOSALS%20POLL.xls.

Ontarians supported "green" energy initiatives.[444] Therefore, support for environmentally sustainable energy appears to have declined slightly over the course of the implementation of the Act, though it is still strong. Indeed, one poll found that 46% of Ontarians believed that the GEGEA should be "expanded."[445] Support was consistently found to be particularly strong in Toronto, with mixed results in southwest Ontario.[446] Respondents from northern Ontario displayed relatively high support for green energy initiatives, while only about 60% of respondents from central Ontario held such an opinion.[447] Mixed results were also observed among those in the eastern part of the province and in the area surrounding Toronto.

Once again, support for green energy initiatives was found to decline with age,[448] although one survey showed that support was also lower among those under 34 years of age.[449] Support was found to be much higher among respondents voting for the Ontario Liberal Party and the NDP compared to those voting for the PC Party, although a majority or near-majority of PC voters were supportive of green energy initiatives.[450] Polls which evaluated support among income groups found a high level of support among all groups with no consistent patterns of reduced or elevated support for particular groups.[451]

---

[444] Oraclepoll Research Limited (ORL), *July 2011 Ontario Omnibus Survey Report* (Toronto: Ontario Sustainable Energy Association, 2011), 5, accessed April 18, 2012, http://www.ontario-sea.org/Storage/60/5146_Ontario_Omnibus_Report_Green_Energy.pdf; Paul Seccaspina, *Green Energy & Perceptions of Wind in Ontario for Friends of Wind Ontario* (Montréal, QC: Oraclepoll Research Limited, 2011), accessed April 19, 2012, http://www.oraclepoll.com/uploads/Friends_of_Wind_Sept7_11am_ver2222222.ppt; Leger Marketing, *Ontario Electoral Poll* (Toronto: Leger Marketing, 2011), 10, accessed April 19, 2012, http://www.legermarketing.com/admin/upload/publi_pdf/Ontario_Electoral_Poll_14oct2011.pdf; Vision Critical, *Party Energy Proposals.*

[445] Leger Marketing, *Ontario Electoral Poll,* 10.

[446] ORL, *July 2011 Ontario Omnibus Survey, 6;* Seccaspina, *Green Energy*; Vision Critical, *Party Energy Proposals*.

[447] ORL, *July 2011 Ontario Omnibus Survey, 6*; Vision Critical, *Party Energy Proposals.*

[448] ORL, *July 2011 Ontario Omnibus Survey, 6;* Seccaspina, *Green Energy.*

[449] Vision Critical, *Party Energy Proposals.*

[450] ORL, *July 2011 Ontario Omnibus Survey, 6;* Seccaspina, *Green Energy*; Leger Marketing, *Ontario Electoral Poll,* 10; Vision Critical, *Party Energy Proposals.*

[451] ORL, *July 2011 Ontario Omnibus Survey, 6*; Vision Critical, *Party Energy Proposals.*

Finally, a single poll evaluated support for green energy initiatives on the basis of education level, finding higher levels of support among those with a university education.[452]

One poll queried respondents regarding the economic impacts of green initiatives. Half of the respondents thought the "green economy" would create jobs in Ontario in the near future, with a majority of those voting for the Liberal and NDP parties holding this belief and only 24% of those aligned with the PC Party doing so.[453] A nearly identical result was found with respect to the belief that the GEGEA would have a positive impact on the economy. Overall, it appears that broad support for solar energy and its economic benefits remains in Ontario, suggesting that the normative component of policy legitimacy is strong. However, the public may lack the belief that the Liberal government understands how to achieve greater deployment of renewable energy. Significant concern about increased electricity costs is evident, although there may be an understanding among the public that many energy options involve substantial costs.

A number of measures have been suggested which may improve public support for the microFIT Program. Tariff degression has been recommended in order to increase cost control for ratepayers while maintaining adequate prices for domestic solar PV products and services. This mechanism was not included in the revised version of the microFIT Program, but similar goals are intended to be achieved by the proposed annual tariff review. Program costs could also be reduced by decreasing the return on equity offered, while the cancellation of the CFIT Program represents a missed opportunity to improve cost-effectiveness. In addition, the launch of a public relations campaign, which would include an explanation of the minor cost of the microFIT Program in the context of electricity costs, has been recommended.[454] Increased public awareness of Ontario's solar policies may also be required to

[452] Vision Critical, *Party Energy Proposals.*
[453] Leger Marketing, *Ontario Electoral Poll*, 11.
[454] FIT Review Coalition, *FIT 2.0*, 3.

maintain growth in the solar PV market,[455] the benefits of which are favourable to Ontarians. Therefore, a public awareness campaign could affect multiple influences on perceived policy legitimacy. Finally, the proposed restrictions on ground-mounted solar PV projects and wind projects of an installed capacity of 3 kW or less will help reduce public opposition to the program.

Given the government's goal of involving farmers in the microFIT Program and the popularity of the program among this segment of the population, policy legitimacy among farmers must be evaluated. The majority of farmers in Ontario are members of either the Ontario Federation of Agriculture (OFA), the National Farmers Union - Ontario (NFU-O), or the Christian Farmers Federation of Ontario (CFFO). As such, commentary on the microFIT Program issued by these organizations can serve as a proxy for the opinions of farmers. The OFA is the largest general farm organization with more than 38,000 members.[456] The organization helped advocate for the GEGEA as a member of the Green Energy Act Alliance, but has since changed its perspective. The OFA heavily criticized the tariff adjustment for ground-mounted solar PV microFIT projects and the retroactive application of the new price, claiming that the move had "shaken the confidence of rural Ontario."[457]

In its submission to program review committee, the organization stated that microFIT projects were being erected in areas which did not require new supply and that it was very concerned about the cost of the program relative to that of imported power or natural gas-fired electricity.[458] The OFA did not call for the cancellation of the program, but it suggested that the feed-in tariff program will not be accepted without considerable changes. This is in fact a compromised position. As an organization, the

[455] "Solar in Ontario: 2011 Preview," ClearSky Advisors Inc., accessed January 24, 2012, http://www.renewableenergyworld.com/rea/news/article/2011/01/solar-in-ontario-2011-preview.
[456] "Become a Member," Ontario Federation of Agriculture, accessed April 19, 2012, http://www.ofa.on.ca/become-member/default.aspx.
[457] Paul Wettlaufer, "Government Can't Rewrite the Deal," *Ontario Federation of Agriculture*, last modified July 9, 2010, http://legacy.ofa.on.ca/index.php?p=238&a=2279.
[458] Ontario Federation of Agriculture (OFA), *The Green Energy Feed in Tariff Review: Recommendations of the Ontario Federation of Agriculture* (Guelph, ON: OFA, 2011), accessed April 19, 2012, http://ofa.on.ca/issues/submission/Green-Energy-Feed-in-Tariff-Review.

OFA believes that solar PV is a poor choice for electricity generation.[459] However, it has been estimated that approximately 7,000 OFA members have commissioned microFIT projects or have received conditional offers. These members are very supportive of the program, whereas those who were unable to obtain a contract or who are simply paying for the program as electricity consumers are not in favour of the program.

From this perspective, the OFA made several recommendations for the microFIT Program,[460] most of which were not adopted. The proposed tariffs for solar PV remain higher than the OFA's recommendations and do not appear to favour projects suitable for urban areas, where new electricity supply is more likely to be required. The tariffs for all other technologies are lower than suggested and it is unclear whether the assumed return on equity has been reduced. The OFA's membership is likely to be pleased that annual procurement limits have been proposed, but disappointed that dispatchability requirements have not been introduced. Overall, the OFA and its members are unlikely to be satisfied with the state of the program.

In contrast, the NFU-O has consistently supported the microFIT Program. The organization prefers Ontario's renewable energy projects to be owned by farmers and the public rather than corporations and considers the microFIT Program to be an important opportunity to achieve this type of development.[461] Indeed, it has noted significant program interest and acceptance in rural areas.[462] The NFU-O has also expressed support for the domestic content requirements, suggesting that manufacturing jobs should be created in rural communities and even advocating for enhanced

[459] Employee of the Ontario Federation of Agriculture, telephone conversation with the author, May 3, 2012.
[460] OFA, *The Green Energy Feed in Tariff Review*.
[461] National Farmers Union - Ontario (NFU-O), *June 2010 Statement on Renewable Energy and the Ontario Green Energy Act* (Guelph, ON: NFU-O, 2010), accessed June 7, 2012, http://nfuontario.ca/upload/files/userfiles/NFU%20Renewable%20Energy%20Statement,%20June%202010(1).pdf; Ann Slater, *re: FIT Review* (unpublished letter, National Farmers Union – Ontario [NFU-O], 2011), received April 26, 2012 from the NFU-O.
[462] Slater, *re: FIT Review*.

requirements.[463] However, the organization raised concerns about the program in June 2010, noting that the provincial electricity system was developed in order to provide benefit to Ontarians through at-cost electricity and that the procurement of high-cost renewable electricity was contravening this intent. The NFU-O also requested enhanced informational assistance for farmers evaluating microFIT projects and aid in accessing funding.

In response to the call for stakeholder consultation during the program review, the NFU-O recommended a number of program adjustments and called for increased deployment of microFIT projects.[464] Some the organization's suggestions were adopted. While microFIT tariff rates remain higher than those for large-scale projects, as advocated by the NFU-O, the rate for rooftop solar PV microFIT projects remains more than 20% higher than that for ground-mounted projects, representing urban-rural inequity according to the NFU-O. The organization also suggested that microFIT projects be given priority access to grid capacity in order to prevent the project delays and rejections which are negatively affecting program support. This was not granted by the Ontario government, but project delays may be improved by some of the measures previously noted. In addition, the NFU-O's concerns about program costs may be somewhat alleviated by the proposed reduction in tariff rates and the increased frequency of program review. Yet the organization's goals for rural job creation remain unfulfilled as most solar PV manufacturing jobs are located in urban centres. The NFU-O is also likely to be disappointed with the proposed annual procurement limits. NFU-O commentary released following the program review did not include any references to the microFIT Program,[465] but it is unlikely that the organization is entirely satisfied with the program.

[463] NFU-O, *June 2010 Statement.*
[464] Slater, *re: FIT Review*.
[465] National Farmers Union - Ontario, "NFU Response to FIT Review Report," news release, March 26, 2012, http://www.nfuontario.ca/upload/files/NFU_FIT_review.pdf.

Finally, the CFFO does not appear to have a strong opinion about the microFIT Program. Like the OFA, the CFFO criticized the change in price for ground-mounted solar PV microFIT projects.[466] The organization was particularly concerned about the lack of transparency with respect to the adjustment, noting that confidence in the program would be negatively affected. However, the CFFO stated that it would support the new tariff if retroactive application was eliminated – an approach eventually taken by the government. In the context of the program review, the CFFO advocated for sharply reduced tariffs for microFIT projects with the aim of achieving global competitiveness.[467] The proposed tariff rates are likely to have satisfied this request. On the other hand, the CFFO recommended improvements to regulations impeding the development of micro-scale biomass- and biogas-based cogeneration systems, but these were not addressed in the program review report.

If the OFA's commentary is representative of the opinion of the majority of Ontario's farmers, neither normative nor cognitive policy legitimacy appear to have been fully achieved. However, it is clear that negative opinions are not unanimous among the farming community and that program adjustment, not cancellation, is desired by the majority.

Non-profit environmental groups are also important public stakeholders of the microFIT Program. The Green Energy Act Alliance (GEAA) – a coalition which includes 7 prominent environmental groups – has suggested a number of revisions to the microFIT Program, as previously noted. Although the government has implemented measures designed to achieve many of the goals advocated by the GEAA, the aggressiveness of the measures does not match that proposed by the GEAA. Moreover, the government's approach to the program sometimes directly opposes that of the GEAA. For example, the GEAA proposed procurement targets, while the government implemented procurement limits.

---

[466] Henry Stevens, *RE: The New Price Category Proposed for Microfit Ground-Mounted Solar PV Projects* (Guelph, ON: Christian Farmers Federation of Ontario, 2010), n.p., accessed April 20, 2012, http://www.christianfarmers.org/uploadpics/The%20New%20Price%20Category%20Proposed%20for%20Microfit%20Ground-mounted%20Solar%20PV%20Projects.pdf.

[467] Lorne Small, *CFFO Submission on Microfit Programming* (Guelph, ON: Christian Farmers Federation of Ontario, 2011), n.p., accessed April 20, 2012, http://www.christianfarmers.org/images/microfit.pdf.

Additionally, the previously noted paper which criticized Hydro One for delays in the issuance of offers to connect microFIT projects as well as for the capacity limitations placed on microFIT projects was written by a board member of the Ontario Sustainable Energy Association (OSEA) – a member of the GEAA – and published on OSEA's website.[468] As mentioned above, the problems identified in this paper have not been fully resolved. Despite the fact that the revised microFIT Program does not include many of the recommendations suggested by these groups, most issued statements of support[469] for the revised feed-in tariff policy as a whole and none issued negative statements about the policy or the microFIT Program. As such, the microFIT Program has achieved normative legitimacy among many of Ontario's prominent environmental organizations, but perhaps has not achieved cognitive legitimacy.

4.4.2. Private sector

In order to evaluate the achievement of policy legitimacy in the private sector, the perspectives of the renewable energy industry and of businesses which purchase electricity must be considered. Policy legitimacy among the renewable energy industry will be evaluated first. A number of solar PV companies as well as Solar Ontario – an industry association for the solar energy sector – endorsed the GEAA's submission to the program review committee. As mentioned above, a number of the recommendations made by the GEAA were not adopted, and even those which were adopted may not have been implemented in an ideal manner. For example, Canadian Solar has stated that the proposed

[468] Fraser, *Getting It Right*.

[469] Environmental Defence, "Springtime for Renewable Energy in Ontario: Environmental Defence Welcomes Improvements to Ontario's Feed-In Tariff Program, North America's Leading Renewable Energy Policy," news release, March 22, 2012, http://www.newswire.ca/en/story/942343/springtime-for-renewable-energy-in-ontario-environmental-defence-welcomes-improvements-to-ontario-s-feed-in-tariff-program-north-america-s-leading-ren; Pembina Institute, "Pembina Reacts to Ontario's Feed-In Tariff Review," news release, March 22, 2012, http://www.pembina.org/media-release/2326; WWF Canada, "WWF Applauds Changes to Ontario Green Energy Plan," news release, March 22, 2012, http://m.wwf.ca/newsroom/?10601/WWF-applauds-changes-to-Ontario-Green-Energy-Plan; Ontario Sustainable Energy Association, "OSEA Welcomes FIT Review Decision," news release, March 20, 2012, http://www.ontario-sea.org/Page.asp?PageID=122&ContentID=3667&SiteNodeID=272&BL_ ExpandID=.

tariff rates for solar PV are "not great rates, but we can operate with them."[470] Neither Solar Ontario nor the individual solar energy companies that endorsed the GEAA's report have released statements in reaction to the proposed changes to the microFIT and FIT Programs, but it is likely that they are somewhat disappointed with the adjustments related to the microFIT Program.

The major industry association representing the solar energy sector is the Canadian Solar Industries Association. As noted throughout this paper, CanSIA has identified a number of problems with the microFIT Program as well as solutions, but these have been largely unheeded by the Ontario government. While also likely to be underwhelmed by the proposed changes to the program, CanSIA has publicly stated its support, but has warned that procedural adjustments proposed for the microFIT Program must be implemented correctly.[471] The Ontario Solar Network is also likely to be dissatisfied with the proposed revisions to the microFIT Program given that few of its recommendations were adopted. The release of further details regarding some measures proposed for the microFIT Program (for example, the annual procurement limits) may also affect the opinions of these organizations. Therefore, while normative policy legitimacy has been achieved among the solar PV industry, cognitive policy legitimacy appears to be somewhat weak.

The microFIT Program also impacts businesses outside the solar energy industry. Small businesses are noted program participants, earning revenue by commissioning their own projects, although it is unclear how many are involved. It is much more likely that a small business is affected by the microFIT Program by incurring the electricity costs associated with the program. Although it did not focus specifically on the microFIT Program, a 2011 survey of approximately 1,100 businesses and organizations in Ontario helps to illustrate the business community's perspective on renewable

[470] Susan Nelson, "Canadian Solar Sees Sustainable Future in Lower-Priced Market," *SNL Energy Power Week Canada*, April 23, 2012, ProQuest (1009771211).
[471] Canadian Solar Industries Association, "CanSIA Welcomes FIT Announcement Signaling Ongoing Commitment to Renewable Energy," news release, March 22, 2012, http://www.cansia.ca/news-media-archive/news-release-cansia-welcomes-fit-announcement-signaling-ongoing-commitment.

energy.[472] When asked which issues government should focus on, the survey found that "sustainable and affordable energy supply" was the fourth most popular issue, although it is not clear whether sustainability or affordability was more important to these businesses.[473] The support and promotion of green energy was, however, identified as the top initiative which would increase the sustainability, competitiveness and reliability of Ontario's energy system. These businesses also viewed the green energy and clean technology sector as the most important sector for economic competitiveness in Ontario.

In its submission to the program review committee, the Ontario Chamber of Commerce (OCC) expressed support for the feed-in tariff and the economic development it induced.[474] Yet while the organization conferred importance upon low-emission energy, it also noted the advantage offered by a diversified supply as well as growing concern about the reliability and cost of energy. Furthermore, the OCC noted that energy security and economic growth must be pursued, and recommended increased use of demand response.

Maintaining competitiveness, in part through cost containment, is also a key objective for large businesses. As such, it could be expected that large businesses would oppose the microFIT Program because it increased electricity costs. However, according to an electricity sector expert, the costs associated with investments in transmission and distribution infrastructure and the upgrade of the province's nuclear energy fleet are of more concern to large businesses.[475] On the other hand, this expert noted that it is important to consider that the microFIT Program added yet another expense to a growing list of charges paid by electricity consumers. If the program was introduced at a time when

[472] Ontario Chamber of Commerce (OCC), *2011 Pre-Election Business Survey Results* (Toronto: OCC, 2011), accessed April 19, 2012, http://www.occ.on.ca/assets/OCC-2011-Pre-Election-Business-Survey-Report.pdf.
[473] Ibid., 3.
[474] Len Crispino, *RE: OCC Submission on Feed-In Tariff (FIT) Program Two Year Review* (Toronto: Ontario Chamber of Commerce, 2011), accessed April 19, 2012, http://occ.on.ca/assets/Ontario-Chamber-of-Commerce-FIT-2-Year-Review-Submission-December-2011.pdf.
[475] Interview with an electricity sector expert, April 25, 2012.

these other costs were nearing unacceptability, significant opposition might result. Since this scenario does not exist at present, the additional costs resulting from the program can be considered a minor irritant to large businesses – not likely to be appreciated, but not a priority and not heavily opposed.

While the normative legitimacy of the microFIT Program is not currently challenged by businesses outside the solar energy industry, cognitive policy legitimacy is tenuous. The private sector is likely to welcome reduced microFIT tariffs and other cost-minimizing measures as well as the implementation of annual procurement limits, but concern about cost could become problematic in the future as more projects are commissioned and total program costs continue to rise.

4.4.3. Energy agencies and utilities

Due to their close relationship to the provincial government, Ontario's energy agencies, including the OPA, Hydro One, the IESO, and the OEB, have limited abilities to publicly critique government policies. However, the impact of a policy on these organizations, and their actions with respect to the policy, can help illustrate whether policy legitimacy has been achieved. According to anecdotal accounts of the early stages of the FIT and microFIT Programs, OPA staff who designed the programs slowly began to support increased deployment of renewable energy as a result of their responsibility for achieving program goals.[476] OPA staff also believe that the microFIT application process functions well, but frustration ensues when system glitches or policy changes affect a large volume of applications.[477] In addition, the OPA has had negative experiences with the microFIT Program when program design flaws or application processing delays have forced the organization to publicly admit such inadequacies.[478]

[476] MacWhirter, *Electricity Policy in Ontario*, 66.
[477] Interview with an official from the Ontario Power Authority, January 20, 2012.
[478] For example, see "Rationale for New Ground-Mounted microFIT," OPA, or "Applications for microFIT Solar PV Projects – Update," Ontario Power Authority, accessed April 30, 2012, http://microfit.powerauthority.on.ca/applications-microfit-solar-pv-projects-update.

In addition, OPA resources have been drawn upon to manage program matters outside the typical application process, such as the feed-in tariff review and the administration of projects stalled by grid capacity constraints, including those rejected en masse by Hydro One. The OPA has also been subject to blame for the ceasing of program activity during the program review, with the government noting that OPA staff resources were divided between application processing and program review.[479] As such, it is unlikely that the OPA perceives the microFIT Program to be either normatively or cognitively legitimate.

Hydro One has experienced a series of challenges related to the microFIT Program. The organization's concern about the effect of microgeneration projects on the integrity of the electricity grid led it to implement capacity limitations which have been criticized by a variety of stakeholders. The management of grid connection requests has also been difficult for Hydro One, causing the organization to apply for an exemption from the mandated request processing and grid connection timelines.[480] Moreover, the organization has rejected many connection requests, which, in the eyes of consumers, reflects poorly on the organization. This may be particularly frustrating for Hydro One since the OPA had long been aware that distribution system capacity was limited.[481] On the other hand, if Hydro One connects too many microFIT projects, causing grid operations to be negatively affected, it is likely to receive complaints from its distribution customers.[482] Therefore, Hydro One may be pleased that it is able to reject projects which it believes will jeopardize its infrastructure.

The cost of the microFIT Program has also caused anxiety among Hydro One employees. Concern has been expressed regarding the cost of grid upgrades required to connect some microFIT

[479] Spears, "Review Clouds Outlook for Solar Firms."
[480] Hydro One Networks Inc., *EB-2011-0118*.
[481] Office of the Auditor General of Ontario, *2011 Annual Report*, 115.
[482] Advisor to Ontario's Independent Electricity System Operator, personal conversation, February 10, 2012.

projects,[483] perhaps leading to the Ministry of Energy's proposal to limit the distance between a project and its grid connection point. Hydro One has also reportedly been anxious about reimbursement for expenses related to the feed-in tariff program.[484] In addition, Hydro One's approach to some of its responsibilities under the microFIT Program suggests that the organization is not motivated to encourage smooth program operation and, therefore, that it has little interest in the program. For instance, it has been suggested that if agencies like Hydro One were interested in maximizing microFIT project connection, they would standardize connection charges.[485] Moreover, Hydro One's communication and consultation with project proponents and program stakeholders has reportedly been poor.[486] Therefore, on the basis of these challenges and implications, it can be expected that neither normative nor cognitive policy legitimacy have been achieved at Hydro One.

Ontario's other LDCs also play a substantial role in the microFIT Program, but they have experienced many fewer challenges. Connection request management does not appear to be a major problem for other LDCs as none have applied to the OEB for exemption from request processing or connection timelines. One area of concern for LDCs is the technical implications of distributed generation.[487] However, as noted previously, a representative from one LDC stated that technically sound project implementation precludes technical problems at the current level of deployment. [488] In fact, he noted that experiences with the microFIT Program have benefitted his organization by enhancing staff knowledge in advance of future deployment increases.

Costs associated with the microFIT Program are a more prominent concern for LDCs. Like Hydro One, some LDCs are concerned about reimbursement of costs associated with microFIT projects. Anxiety

[483] Ayesha Sabouba, "Distribution Issues" (presentation, Solar Ontario 2011, Windsor, ON, May 11, 2011), http://www.cansia.ca/sites/default/files/bing_young.pdf.
[484] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 90.
[485] Interview with a representative of OSEA, February 8, 2012.
[486] AMO, *Feed-In-Tariff Program Review*, 14-15.
[487] Electricity Distributors Association (EDA), *Electricity is the Answer: The EDA's Road Map for Delivering Ontario's Electric Future* (Vaughan, ON: EDA, 2011), 17, accessed April 21, 2012, http://www.eda-on.ca/eda/edaweb.nsf/0/E044A815BFD1F92E852579480058AB3C/$FILE/Sector%20Review_final.pdf.
[488] Interview with experts from an LDC in Ontario, February 15, 2012.

has also been noted regarding the costs of any upstream impacts of microFIT projects.[489] Furthermore, LDCs are worried that they will be pressured to maintain current rates despite the additional costs associated with renewable energy development and the need to replace aging infrastructure.[490] In order to avoid further cost increases, some LDCs may choose to forego infrastructure investments, introducing a risk of component failure, which may result in customer complaints and even higher costs.[491] Increases in regulatory burden are also challenging for LDCs.[492] The microFIT Program has contributed to such increases because LDCs must consider and plan for microgeneration as part of their obligation to file plans for infrastructure upgrades to assist the development of renewable energy generation.[493] This burden negatively impacts administrative resources,[494] perhaps resulting in additional costs.

On the other hand, the microFIT Program has opened a new revenue source for LDCs since they are eligible to participate in the program. For example, one LDC has leased roof space from a social housing organization and has erected eleven microFIT systems as a social and revenue-generating initiative.[495] However, some LDCs may have more capacity and willingness to embark on such projects than others.[496] An additional benefit offered to LDCs by the microFIT Program is the enjoyment employees derive from involvement in new and innovative activities.[497] In sum, normative policy legitimacy appears to be relatively strong among LDCs, while cognitive policy legitimacy is likely to be weaker.

The IESO and OEB are much less involved in the microFIT Program. The IESO currently has no concern regarding the integration of microFIT projects into the electricity system, but, in anticipation of

[489] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 90; EDA, *Electricity is the Answer*, 17.
[490] EDA, *Electricity is the Answer*, 18; employee of the Electricity Distributors Association, e-mail to the author, April 23, 2012.
[491] Employee of the Electricity Distributors Association, e-mail to the author, April 23, 2012.
[492] EDA, *Electricity is the Answer*, 17.
[493] *Ontario Energy Board Act*, SO 1998, c 15, Schedule B, s 70(2.1), s 2(i).
[494] EDA, *Electricity is the Answer*, 10.
[495] Interview with experts from an LDC in Ontario, February 15, 2012.
[496] Employee of the Electricity Distributors Association, e-mail to the author, April 23, 2012.
[497] Interview with experts from an LDC in Ontario, February 15, 2012.

future complications, it has been granted authority to set rules to aid supply management.[498] The OEB is more engaged with the microFIT Program than the IESO. The program has imposed some additional tasks on the OEB, including the creation of new regulations, the provision of additional information, and the evaluation and approval of LDC plans for grid upgrades to accommodate renewable energy. Yet some responsibilities typically held by the OEB have also been foregone. In particular, despite the agency's mandate to "protect the interests of consumers with respect to prices,"[499] the agency has not reviewed the feed-in tariff because its procurement oversight responsibilities are only exercised in the context of an Integrated Power System Plan, which is not yet available in Ontario.[500] Nevertheless, the OEB has criticized the FIT and microFIT Programs, stating that procurement limitations must be utilized to contain costs and encourage efficiency.[501] As such, the IESO's perceptions of normative and cognitive policy legitimacy seem strong, while those of the OEB are likely to be weaker.

4.4.4. Governments

Finally, all levels of government to which the microFIT Program is relevant must perceive the policy to be legitimate. In fact, political commitment has been identified as one of the primary requirements for a successful feed-in tariff in Ontario.[502] By continuing the microFIT Program following the program review, the provincial government has shown commitment to the program. However, program support is not unanimous among the provincial political parties or even within the governing Liberal Party. Following the announcement of the reduced tariff for ground-mounted solar PV microFIT projects, journalists reported that elected members of the Liberal Party, especially those in rural areas, had received many calls from discontented Ontarians.[503] These journalists also noted that some officials

[498] Interview with an electricity market expert, February 23, 2012.
[499] *Ontario Energy Board Act*, s 1(1), s 1.
[500] Office of the Auditor General of Ontario, *2011 Annual Report*, 101.
[501] Ibid., 107.
[502] GEAA and Shine Ontario Association, *Ontario Feed-In Tariff*, 96.
[503] Benzie, "Liberals' Solar Shift Clouds MPPs' Mood"; Ferguson, "Business Fights Solar Rate Cut."

had requested that the rule be reconsidered, and that some worried the measure would impact the upcoming election.

The 2011 provincial election saw the Liberal Party lose several seats in the Legislative Assembly, but maintain the highest proportion of seats, narrowly missing a majority. Opinions differ on the impact of the feed-in tariff on the outcome of the election. The notion that renewable energy policy negatively affected the Liberal Party[504] has been countered with the assertions that there is little evidence of such an effect and that the GEGEA may have drawn young voters to the party.[505]

The other major political parties in Ontario hold differing opinions of the microFIT Program. As mentioned previously, the PC Party called for the cancellation of the entire feed-in tariff policy during election campaigning in 2011. The party has maintained this position since the election.[506] The NDP's election platform advocated continuation of the feed-in tariff policy, and the party's energy critic responded to the program review results by urging the Liberal government to make a stronger commitment to renewable energy.[507] However, in its response to the provincial budget, the NDP proposed to review the electricity sector in order to reduce costs.[508]

The Green Party of Ontario (GPO) specifically addressed microgeneration in its election platform, supporting the technology and its local benefits.[509] The party also clearly stated its support for the feed-in tariff policy. Yet the GPO's submission to the FIT review committee expressed concern about a variety

---

[504] Adam Radwanski, "Smitherman Unexpectedly Plugs Back In To the Green-Energy Debate," *Globe & Mail*, December 27, 2011, ProQuest (912711609).
[505] Mark S. Winfield, *Blue-Green Province: The Environment and the Political Economy of Ontario* (Vancouver: UBC Press, 2012), 200.
[506] Ontario Progressive Conservative Party, "Affordable Energy Now: Hudak," news release, March 22, 2012, http://www.ontariopc.com/news/affordable-energy-now-hudak/.
[507] "New Democrats Will Help Households Make Affordable Green Choices: Horwath," New Democratic Party of Ontario, last modified August 11, 2011, http://ontariondp.com/en/green-choices; Canadian Press, "Ontario to Cut Rates Paid for Wind, Solar Power," *CBC News*, March 22, 2011, http://www.cbc.ca/news/canada/toronto/story/2012/03/22/ontario-wind-solar-electricity-rates.html.
[508] New Democratic Party of Ontario, "Ontario's Budget Must Address Jobs Crisis: Horwath," news release, April 10, 2012, http://ontariondp.com/en/ontarios-budget-must-address-jobs-crisis-horwath.
[509] Green Party of Ontario (GPO), *Green Party of Ontario Energy Strategy 2011* (Toronto: GPO, 2011), 8, accessed July 24, 2012, http://www.gpo.ca/sites/gpo.ca/files/attachments/gpo_issues_paper_energy.pdf.

of program elements which apply to microFIT projects,[510] and only two of these areas of concern were addressed by the government. The party's calls for a renewable energy development schedule have been heeded to some degree with the adoption of annual capacity targets. In addition, stalled project development during program review periods may be eliminated according to the indication that program activities will not be halted during future reviews. Other actions suggested by the GPO were not taken, including the restoration of municipal authority over renewable energy projects, the articulation of a long-term schedule for capacity development, the adoption of a degression scheme, and the improvement of the microFIT application process. Moreover, the transparency of grid connection capacity for micro-scale projects was not addressed in the report on the FIT review and the feeder capacity limitations on microFIT projects were not relaxed. Therefore, both normative and cognitive policy legitimacy are relatively fragile among the provincial political parties.

Municipal governments are very important stakeholders of the microFIT Program given that microFIT projects are erected in their communities. However, municipal governments have little direct involvement with these projects since the majority of their planning authority over renewable energy project development was removed by the GEGEA. Project developers are still required to obtain a municipal building permit, but the municipality does not have any authority to manage project siting. Opinion on this measure is divided, with some municipal governments desiring more control over renewable energy project siting and others content to relinquish responsibility since they lack the resources to effectively oversee project development.[511]

Municipal governments have expressed more concern about some types of projects than others. They are generally comfortable with rooftop solar PV microFIT projects given that they are not visually

[510] "Feed-In Tariff Review: Green Party Submission," Green Party of Ontario, last modified January 16, 2012, http://www.gpo.ca/statement/feed-tariff-review-green-party-submission.
[511] AMO, *Feed-In-Tariff Program Review*, 4.

intrusive and are clearly the responsibility of the property owner.[512] Governments are less comfortable with ground-mounted solar PV projects and micro-scale wind projects. Ground-mounted solar PV projects are of concern to municipalities because developers have not always followed best practices with respect to siting. This has caused a variety of problems. In addition to the previously noted example of a developer prompting public ire by commissioning several projects in a residential area, ground-mounted projects have been erected on main streets adjacent to commercial areas, which can negatively affect heritage or commercial development initiatives and can hinder municipal efforts to meet mandated employment density targets. Other projects have been placed close to a curved road, causing safety concerns due to impaired driver sight lines. In rural areas, a poorly sited project could damage a drainage system and flood a nearby property, perhaps exposing the municipality to liability for damages. An additional monetary concern arises when a residential lot is subdivided such that multiple ground-mounted projects can be erected. In this scenario, a municipality would receive much less property tax than if the land had hosted a residence. In order to combat some of these issues, the Association of Municipalities of Ontario (AMO) has proposed a ban on the placement of ground-mounted solar PV projects in areas zoned for residential or employment purposes.[513]

Municipal governments are also wary of micro-scale wind power projects. They do not consider experience with this technology to be robust and there is concern that project proponents may not have adequate technical expertise to install and manage such projects, raising safety concerns.[514] As a result of this large range of siting problems, there is desire among municipalities to review the program's approach to project approvals.[515] Public outreach regarding the trade-offs involved in renewable energy development may also help alleviate some of these problems, but this activity has been lacking.[516]

[512] Interview with a municipal sector expert, March 12, 2012.
[513] AMO, *Feed-In-Tariff Program Review*, 9.
[514] Interview with a municipal sector expert, March 12, 2012.
[515] AMO, *Feed-In-Tariff Program Review*, 8.
[516] Interview with a municipal sector expert, March 12, 2012.

Municipal governments' negative experiences with the microFIT Program are countered by their ability to derive benefit from the microFIT Program by commissioning their own projects. Many municipalities have developed microFIT projects with the aim of generating revenue, attracting solar PV manufacturing companies, or meeting environmental objectives.[517] Given this participation, criticisms of the microFIT Program articulated by the municipal sector reflect the interests of both citizen and municipal project proponents.[518] AMO has called for longer periods of notice prior to tariff and rule changes and has opposed retroactive application of such changes.[519] It has also criticized Ontario's energy institutions for program disruptions caused by rule changes and grid connection problems, as well as for delays in providing information regarding project relocation. Concerns related to the latter issue were two-fold: municipal projects had been stalled and relocation of citizens' projects carried the risk of prompting some of the aforementioned siting issues.[520] In addition, AMO echoed calls for degression mechanisms, improvements to project connection timelines, and relaxation of restrictions on microFIT capacity on the grid.

While some of the program challenges identified by the municipal sector were addressed by program adjustments proposed following the program review, most concerns were not. AMO's response to the program review report communicated a lack of contentment with respect to the proposed adjustments to the microFIT and FIT Programs, although a positive tone was maintained throughout the commentary.[521] As such, normative policy legitimacy seems fairly strong among municipalities, while cognitive legitimacy is somewhat weaker.

---

[517] Ibid.
[518] Ibid.
[519] AMO, *Feed-In-Tariff Program Review*, 7.
[520] Ibid.; interview with a municipal sector expert, March 12, 2012.
[521] Association of Municipalities of Ontario, "Ontario's Latest Energy Reforms Reflect Municipal Concerns," news release, March 22, 2012, http://www.amo.on.ca/AM/Template.cfm?Section=News_Releases&Template=/CM/HTMLDisplay.cfm&ContentID=165203.

The Canadian federal government and other national governments have become involved with the microFIT Program as a result of the aforementioned challenges related to WTO and NAFTA rules. In its defense against the WTO challenge, Canada's federal government, led by the Conservative Party of Canada, could have chosen to present a weak case in favour of the domestic content requirements of the microFIT and FIT Programs in order to support the position of the provincial PC Party.[522] Instead, the government submitted to the WTO a strong argument that the feed-in tariff could be considered a means of government procurement and thus was permissible under the General Agreement on Tariffs and Trade, 1994 (GATT).[523] The employment opportunities created by the program as well as the program's alignment with the government's desire for leadership in the green energy sector[524] may have motivated the government to take this position. Yet the government's position is not firm. In negotiations for a Comprehensive Enhanced Trade Agreement (CETA) with the European Union, the government took an opposing standpoint, agreeing to forbid domestic preference in provincial procurement.[525]

International opposition to Ontario's feed-in tariff has persisted. Although the NAFTA dispute has not progressed, pressure at the WTO has continued, despite the European Parliament's suggestion in the context of 2011 CETA negotiations that the European Commission should abandon its challenge to the GEGEA.[526] However, many international governments do not oppose small-scale renewable energy generation on a normative basis. According to a report by the United Nations Environment Program, the

[522] Andrew Lord and James Kelsall, "Ontario Domestic Content Rules Facing WTO and NAFTA Challenges," *Environmental, Energy and Resources Law* (blog), August 10, 2011, http://www.davis.ca/en/entry/environmental-energy-and-resources-law/Ontario-domestic-content-rules-facing-WTO-and-NAFTA-challenges/.
[523] Canada, Foreign Affairs and International Trade Canada, *Canada – Certain Measures Affecting the Renewable Energy Generation Sector* (Ottawa: Foreign Affairs and International Trade Canada, 2011), WTO Doc. WT/DS412, accessed May 2, 2012, http://canadians.org/trade/documents/WTO/DS412-submission.pdf.
[524] Lord and Kelsall, "Ontario Domestic Content Rules."
[525] Linda Diebel, "Canada-Europe Trade Deal Prohibits Provinces, Municipalities from Favouring Local Bidders on Contracts," *Toronto Star*, February 24, 2012, http://www.thestar.com/news/canada/politics/article/1136423--canada-europe-trade-deal-prohibits-provinces-municipalities-from-favouring-local-bidders-on-contracts.
[526] European Parliament, *European Parliament Resolution of 8 June 2011 on EU-Canada Trade Relations,* 2011, P7_TA(2011)0257, http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2011-0257+0+DOC+XML+V0//EN.

top 10 countries investing in renewable energy generation systems with an installed capacity of less than 1 MW spent between 0.7 and 24 billion USD on such generation in 2011.[527] The report also noted that systems of 20 kW or less accounted for 25% of all PV capacity installed in 2011. Moreover, national governments participating in the Clean Energy Ministerial (CEM) – a forum for ministers responsible for energy efficiency and renewable energy technologies – have made international commitments to small-scale renewable energy generation. In April 2012, twenty governments involved in the CEM launched an initiative to foster knowledge and technical tools to, among other goals, support the commissioning of "clean distributed generation" projects, as distinct from large centralized projects.[528] Therefore, normative policy legitimacy appears to have been achieved among international governments and the Canadian federal government, while cognitive policy legitimacy is lacking among all parties.

5. Analysis and recommendations

This research has sought to evaluate the microFIT Program's achievement of the government's policy goals, its advancement of sustainability, and its attainment of policy legitimacy. These elements are addressed in turn.

5.1. Achievement of the government's goals

It is difficult to justify a policy that does not achieve the goals it was designed to attain. The results of the microFIT Program must be evaluated against the Ontario government's goals for both the feed-in tariff program as a whole and the microFIT Program in particular in order to understand whether the policy has achieved its objectives. The first objective of the feed-in tariff was to increase renewable electricity generation in the province. The microFIT Program has done so, surpassing the expectations

[527] United Nations Environment Program, Frankfurt School-UNEP Collaborating Centre for Climate & Sustainable Energy Finance, and Bloomberg New Energy Finance, *Global Trends in Renewable Energy Investment 2012* (Frankfurt, Germany: Frankfurt School of Finance and Management, 2012), 51, accessed July 17, 2012, http://fs-unep-centre.org/sites/default/files/media/globaltrendsreport2012_3.pdf.
[528] Clean Energy Ministerial (CEM), *Summary of CEM Accomplishments* (n.p.: CEM, 2012), 4, accessed July 19, 2012, http://www.cleanenergyministerial.org/pdfs/CEM-ACCOMPLISHMENTS.pdf.

for project deployment and greatly increasing investments in micro-scale generation relative to that achieved by the previous Renewable Energy Standard Offer Program. Another policy goal was to maintain ample provincial electricity generation capacity. The volume of microgeneration capacity procured – equivalent to that of a small natural gas plant – has enabled the microFIT Program to make a meaningful contribution to the province's generation capacity, particularly given that Ontario's coal-fired generation was intended to be replaced in part by renewable electricity generation. Ontario's microFIT projects have also provided generation capacity at many times of peak electricity demand.

The government's goals of reducing GHG and air pollutant emissions may have been served by the microFIT Program. If new generation or imported electricity fueled by fossil fuels would otherwise have provided the quantity of electricity supplied by microFIT projects, the microFIT Program will reduce emissions. In this scenario, the related program objectives of reducing the environmental impact of the province's electricity system and protecting the health of Ontarians would also have been achieved. If the program instead replaced another type of renewable energy generation, the program may not have reduced emissions or impacts on the environment or human health.

The microFIT Program has facilitated new business and job opportunities in Ontario. It has created thousands of job-years of employment and contributed to new business development in the manufacturing and service sectors. Significant growth has been experienced in Ontario's solar PV manufacturing sector as a result of sales in the domestic market and, increasingly, in international markets. The microFIT Program has also increased industry capacity by stimulating the acquisition of specialized skills and equipment. However, there may be too many solar PV manufacturing companies present in Ontario. Market growth and development have also been hindered by program uncertainties, including program changes, project connection and application processing challenges, the provincial election and the first program review. Trade disputes could still undermine the local market, although the development of export demand could provide a stabilizing force.

Goals specific to the microFIT Program have been achieved. First, the microFIT Program engaged a broad array of non-corporate stakeholders in renewable electricity development in Ontario, including homeowners, farmers, municipalities, community groups and LDCs. Second, rural economic development was stimulated. This was achieved primarily by the deployment of thousands of microFIT projects by homeowners and organizations located in rural Ontario. Rural project owners also appear to have reaped greater financial benefit from the program than urban project owners at various points throughout the program. The solar PV manufacturing industry has contributed little to rural economies since most solar PV manufacturing companies are not located in rural areas. Finally, microFIT projects may have effected small improvements in the performance of the electricity grid since minimal electricity is lost in transmission from microFIT projects to loads. In addition, the supply from microFIT projects may reduce the amount of electricity which must be transmitted across the grid, reducing grid congestion. However, future increases in microFIT project deployment could cause technical problems with grid components as well as challenges at the system operations level.

5.2. Program sustainability

5.2.1. Satisfaction of sustainability criteria developed by Winfield et al.

The environmental, technical, economic, and social sustainability of an electricity policy can be assessed utilizing criteria developed by Winfield et al. This type of evaluation provides a more nuanced examination of the achievements of the microFIT Program than an assessment conducted according to the broad program goals set by the Ontario government. If the microFIT Program satisfies the pertinent criteria by Winfield et al., it can be considered to contribute to sustainable electricity policy.

The first criterion relevant to the microFIT Program is the minimization of negative impacts on biophysical systems and human health. The microFIT Program has had a minimal negative impact on the environment and human health given that lifecycle emissions of solar PV are low, control methods limit exposure to harmful substances used in the solar PV manufacturing process, and much of the material

used in solar PV panels can be recycled. These impacts are lower than many other types of electricity generation, but increased use of micro-scale wind energy systems in rural areas as well as micro-hydro which does not utilize damming infrastructure could further reduce the impact of the program. Although fossil fuel-fired generation is often used to balance electricity supply from microFIT projects at times of low solar radiation, electricity from microFIT projects may replace supply that otherwise would have been derived from fossil fuels.

The second criterion – cost-effectiveness – has not been met by the microFIT Program. The program has experienced cost inefficiencies since its inception as a result of program design flaws, solar PV component cost reductions, the government's desire to attract economic development, domestic content rules, and the exclusion of companies that erect multiple projects on leased roof space. The program review did not address all of these inefficiencies. In addition, the tariffs offered for electricity produced by microFIT projects are more expensive than the prices paid for electricity procured through other channels. They are costlier than the electricity currently purchased from larger renewable energy projects involved in Ontario's FIT Program and are seldom competitive with market prices for wholesale and imported electricity. Although the tariffs awarded by the microFIT Program could be competitive with the cost of new simple-cycle natural gas supply, the relative value of supply from microFIT projects is reduced because microgeneration cannot offer equivalent supply flexibility.

Despite the low capacity factor of solar PV systems and the need to utilize alternative electricity generation at times of low solar radiation, the microFIT Program displays relatively high levels of efficiency with respect to energy supply and delivery – the third sustainability criterion. The average microFIT project approaches the maximum nameplate capacity permitted by the microFIT Program or a typical roof space, and generation from microFIT projects is well-matched to Ontario's daily electricity demand profile. Moreover, the microFIT Program may reduce transmission losses and grid congestion.

These characteristics are unlikely to be improved upon by other types of microgeneration, although some large-scale renewable energy technologies could offer comparable benefits.

The fourth sustainability criterion is the minimization of vulnerability to grid upset. Although future increases in the deployment of microFIT projects could negatively affect grid infrastructure and system operations, the current deployment rate and the restrictions imposed on deployment prevent the program from adversely affecting the grid. As such, the microFIT Program has satisfied the criterion. The fifth criterion suggests that an electricity policy should promote conservation and efficiency. Owners of microFIT projects reported increased energy conservation and efficiency practices following the installation of their projects. However, it is unclear whether such an effect has occurred among Ontarians who occupy buildings with microFIT projects, but do not hold any ownership stake in the projects. Nonetheless, the microFIT Program has clearly promoted conservation and efficiency and has therefore fulfilled the criterion.

Based on the available information, the sixth criterion – the creation of employment opportunities – appears to have been satisfied by the microFIT Program. As mentioned above, the program is estimated to have created significant new employment in the solar PV industry, although employment opportunities are not distributed evenly throughout the province as most manufacturers are located in urban areas. The solar PV sector offers many long-term employment opportunities as well as average to high wages, indicating that the employment created by the microFIT Program is of fairly high quality. Due to a lack of available information and differences in reporting methodologies, it is difficult to utilize existing research to assess whether increased deployment of other types of microgeneration could improve the employment opportunities offered by the microFIT Program. It is also unclear whether enhanced job quality could be offered by other micro-scale technologies, although minimal improvements are suggested by the comparison of wages associated with other renewable

electricity technology sectors. However, job losses due to increased electricity costs resulting from the microFIT Program must also be considered and quantified.

On the other hand, the microFIT Program continues to pose a risk of boom and bust dynamics, failing to satisfy the seventh sustainability criterion. The high level of participation in the microFIT Program has certainly caused a boom in Ontario's solar PV industry. Subsequent bust effects have not yet been widely experienced, although some companies have reduced shifts or laid off employees. This employment loss, as well as the broader risk of bust effects, results from the market instability created by the aforementioned sources of program uncertainty and from the variability of timelines for conditional offer issuance and connection approval. Some adjustments made following the program review, such as the annual review of tariffs, will improve market predictability, but others, such as Annual Procurement Limits and new rules for contract price assignment, may cause gaps in the flow of business. Delays in application and connection request processing are also likely to remain, causing market uncertainty. Therefore, bust effects continue to be a distinct possibility.

The equitable distribution of a policy's benefits, costs and risks is the eighth sustainability criterion with relevance to the microFIT Program. Currently, the benefits, costs and risks of the microFIT Program are not distributed equitably. Among all Ontarians, microFIT Program participants benefit disproportionately from the program compared to non-participants. Ownership of – and therefore benefit from – microFIT projects is also distributed unevenly among Ontario's cities, counties, regions and districts, and between urban and rural communities. Rural communities host a large proportion of microFIT projects relative to their population, and farmers are overrepresented among project owners. Additionally, rural project owners appear have reaped greater financial benefits than urban project owners at various points throughout the program. Relatively wealthy Ontarians may also be disproportionately participating in and benefiting from the microFIT Program.

The cost of the microFIT Program is borne by all electricity consumers in proportion to their electricity usage, resulting in the equitable distribution of monetary program costs. However, some Ontarians may also incur a cost as a result of aesthetic or property value changes. Finally, risk is placed upon project owners by Ontario's government and energy institutions. These organizations have externalized risks such that any technical problems or unanticipated costs must be managed by project owners, who have considerably less technical and financial capacity.

A closely related sustainability criterion – the affordable provision of energy services – is satisfied by the microFIT Program. To date, the microFIT Program has imposed a minimal increase in electricity costs on most consumers, ranging from less than ten dollars for residential consumers to hundreds of dollars for larger commercial customers. The high annual costs paid by Ontario's largest electricity consumers are somewhat offset by their payment of a lower proportion of the Global Adjustment – and therefore cost of the microFIT Program – compared to other customer classes. As such, the microFIT Program does not jeopardize the affordability of electricity in Ontario.

The tenth criterion for sustainable energy planning is the facilitation of social learning. Solar PV microFIT projects are placed on or near thousands of buildings which are occupied and viewed by many Ontarians. This proximity and visibility to the public, combined with project owners' passion for renewable energy, has prompted a variety of interactions between project owners and other individuals and has enhanced understanding of renewable energy. As such, two of the three elements of social learning have undoubtedly occurred among Ontarians. It is not clear whether knowledge has proliferated to wider social units, but it has certainly travelled beyond the individual. Therefore, the microFIT Program can be deemed to have facilitated social learning with respect to renewable energy.

Finally, the microFIT Program has helped build a culture of sustainability, satisfying the eleventh sustainability criterion. Although this research cannot attest as to whether exposure to microFIT projects has produced positive attitudes toward renewable energy among Ontarians, it does suggest that such

attitudes have at least been bolstered. In addition, it is clear that microFIT projects have encouraged Ontarians to adopt renewable or low-impact energy sources. Some individuals and organizations have reportedly made the decision to commission a microFIT project following experience with another individual or organization's system. Even more promisingly, microFIT project owners commonly noted that their experience with their project had encouraged them to adopt renewable or lower-impact energy in other aspects of their lives.

5.2.2. Trade-offs

As noted above and summarized in Table 7 below, three sustainability criteria – cost-effectiveness, minimization of risk of boom and bust effects, and equitable distribution of benefits, costs and risks – have not been met by the microFIT Program. As such, their eligibility to be considered acceptable trade-offs must be evaluated in order to determine program sustainability.

The first requirement of an acceptable trade-off is the achievement of maximum net gains towards sustainability. At this point in time, it is virtually impossible to support widespread deployment of micro-scale renewable electricity generation without incurring higher costs than would be required by other types of generation. However, if microgeneration is not supported and these higher costs not incurred, it will be very difficult to achieve some of the other sustainability criteria satisfied by the microFIT Program, particularly the degrees of social learning and creation of a culture of sustainability.

Similarly, widespread engagement in renewable energy development is difficult to achieve without the deployment of generation systems suitable for placement on or near a home or building. Individuals and organizations require an incentive to expend their resources and time on the development of renewable energy projects. Since a massive, unacceptable cost would be incurred if every homeowner and organization in Ontario were paid an incentive to develop a microFIT project, deployment of microgeneration must be limited to a portion of the population. This limited deployment results in inequitable distribution of the benefits and costs the microFIT Program. In addition, this type

of electricity generation exposes project owners to risk. Since only a part of Ontario's population will own a microFIT project, some Ontarians will assume risk while others will not. Therefore, reduced cost-effectiveness and inequitable distribution of benefits, costs and risks are necessary trade-offs for program deployment and the achievement of sustainability gains. However, net gains are currently

Table 7

Summary of the microFIT Program's satisfaction of Winfield et al.'s sustainability assessment criteria

Sustainability assessment criteria	**Criterion satisfied?**
Minimization of impacts on biophysical systems and human health	Yes
Cost-effectiveness	No
Efficiency of energy production, delivery and use	Yes
Minimization of vulnerability to grid upset	Yes
Promotion of conservation and efficiencies	Yes
Creation of employment opportunities	Yes
Minimization of risk of boom and bust effects	No
Equitable distribution of benefits, costs and risks among stakeholders	No
Affordable provision of energy services	Yes
Facilitation of social learning	Yes
Creation of a culture of sustainability	Yes

not being maximized since cost-effectiveness and the distribution of costs, benefits and risks can be improved through program adjustments. These adjustments will be discussed in detail below.

Another trade-off rule stipulates that trade-offs cannot create significant adverse effects. Neither of the above trade-offs cause significant adverse effects on Ontarians, but the program's distinct risk of boom and bust dynamics may have such an effect on some. While the employment opportunities created in the solar PV industry have contributed to the microFIT Program's progress toward sustainability, the unstable nature of the program has also resulted in job losses within the industry, adversely affecting the livelihood of some Ontarians. This instability could cause solar PV companies to choose to halt or relocate operations, which would result in significant job losses. Since boom and bust

effects are not a prerequisite for gains among other sustainability criteria, and since the microFIT Program can be delivered with reduced boom and bust effects, it cannot be argued that this trade-off maximizes gains toward sustainability. As such, the current risk of boom and bust effects cannot be considered an acceptable trade-off for microFIT deployment.

The Ontario government's failure to explicitly or openly explain the trade-offs inherent in the microFIT Program has violated two important rules for trade-off acceptability. While the government has publicly discussed the environmental and economic benefits of the feed-in tariff, it has not communicated the cost-effectiveness and equity trade-offs or their justifications to the public. In order for Ontarians to make sound decisions about the acceptability of the microFIT Program, they must understand these trade-offs.

Since the microFIT Program has failed to satisfy three sustainability criteria and these failures cannot be considered acceptable trade-offs, the current form of the microFIT Program cannot be considered sustainable. However, the implementation of a variety of measures can help the program achieve maximum net gains and, thus, sustainability. These are discussed in detail below.

5.3. Policy legitimacy

The microFIT Program has not yet achieved policy legitimacy among Ontario's public, private sector, or energy agencies and utilities, nor has it done so among affected governments. Normative legitimacy has been achieved among most stakeholder segments, with many stakeholders appearing to be aligned with or unopposed to the idea of increasing renewable energy supply with microgeneration. The public is somewhat divided since normative legitimacy has been achieved among the general public and among environmental non-profit organizations, but is lacking within the farming community. A division of opinion is also apparent among Ontario's energy institutions, with the OPA and Hydro One likely to be lacking support. Yet normative legitimacy is strong among Ontario's business community, as well as among most levels of government. Conversely, the microFIT Program has not achieved cognitive

legitimacy among any of the stakeholder groups which are currently directly impacted by the program. Some of these stakeholders are unwilling to accept the program's failure to meet sustainability criteria noted above. However, a number of program changes may help improve cognitive legitimacy as well as normative legitimacy. These are explored below.

If policy legitimacy cannot be improved, the microFIT Program will continue to be at considerable risk. Stakeholders will be unwilling to devote the attention and resources necessary to enable the program to achieve its full potential, the government's defense of the program will deplete resources and therefore support, and the program will continue to be unstable, risking dissolution or market collapse.

5.4. Recommendations for program adjustment

5.4.1. Reduce program costs

Cost is a key source of criticism of the microFIT Program. As a result, measures which could help reduce program cost should be implemented or at least evaluated. If they have not already done so, program administrators should reduce the rate of return on equity assumed in the calculation of microFIT tariffs. This is unlikely to meet criticism as it has been called for by a variety of program stakeholders.

Recommendation

1. ***Unless such action was already taken following the program review, reduce the rate of return on equity assumed in the calculation of microFIT tariffs.***

In addition, some stakeholders have suggested that solar PV microFIT tariffs should be subject to a volume-based degression, whereby tariffs are reduced when stipulated project cost, application volume or installed capacity thresholds are reached. Program administrators should evaluate whether such a mechanism could help reduce program costs. If a volume-based degression mechanism is

deemed to be capable of reducing costs and is implemented, it must be accompanied by ongoing communication regarding progress toward the threshold.

Recommendation

2. Evaluate the ability of a volume-based degression mechanism to reduce program costs.

Program administrators should also implement a Commercial Feed-In Tariff (CFIT) Program to facilitate the participation of companies which lease roof space for the purpose of installing solar PV microgeneration systems. The ability of these companies to purchase system components in bulk reduces the cost of individual microFIT projects while still distributing the financial benefits of renewable energy beyond renewable energy development companies. Financial benefits are shared because a roof rental fee is paid to the building owners. Such a program would also remove financial and temporal barriers to participation, permitting a more diverse group of Ontarians to become involved in the microFIT Program, and would reduce the risk placed on building owners. If project proponents preferred not to enter a profit-sharing arrangement, they would still have the opportunity to develop their own microFIT project.

Recommendation

3. Implement a Commercial Feed-In Tariff Program.

Furthermore, the cost of electricity grid upgrades required to connect microFIT projects should be minimized. Projects with high connection costs should continue to be discouraged by including only moderate connection costs in tariff calculations. The new rule stipulating a maximum distance between a project and connection point could also help achieve this goal. In order to avoid the squandering of time and capital by project proponents and installation companies and the creation of negative attitudes toward the program, project proponents should be encouraged to consult their LDC about connection capacity and costs even earlier than is currently recommended by the OPA – this should be one of the first steps in the exploration of a microFIT project.

Recommendations

4. ***Discourage projects with high connection costs.***
5. ***Encourage project proponents to consult their LDC about connection capacity very early in the project development process.***

Another controversial aspect of program costs is the indirect costs incurred by LDCs. LDCs should be permitted to increase their electricity rates in accordance with increased administrative and technical costs resulting from the microFIT Program. LDCs should not be forced to allow their assets to degrade in order to sustain a particular electricity rate. Grid integrity must not be jeopardized since policy legitimacy could be negatively affected in turn.

Recommendation

6. ***Permit LDCs to increase their electricity rates in accordance with costs resulting from the microFIT Program.***

Additionally, program administrators should conduct a full cost comparison of electricity from micro-scale renewable energy generation and other types of electricity supply such that the cost of microgeneration can be evaluated fairly. Such a comparison should consider expenses related to capital, fuel (at present and in the future), operations and maintenance, and transmission and distribution, as well as costs such as energy security risks, subsidies provided, and externalities including environmental and social damage. Program administrators should release their findings and methodology to the public and should communicate the results to Ontarians.

Recommendation

7. ***Program administrators should conduct a full cost comparison of electricity from micro-scale renewable energy generation and other types of electricity supply. This comparison should be released to the public and communicated to Ontarians.***

5.4.2. Explore opportunities to broaden the program's scope

The diversity of the microFIT Program's proponents and supported renewable fuels could potentially be broadened. Increased diversity could be achieved with respect to program participants if program administrators worked to reduce financial barriers to participation. Program administrators should publicize other financial incentives available to participants and consider offering low- or zero-interest loans. A CFIT Program would also reduce proponent costs, as noted above.

Recommendations

8. ***The Ministry of Energy and OPA should provide information on other financial incentives available to microFIT project proponents.***
9. ***The Ministry of Energy should consider offering low- or zero-interest loans to microFIT project proponents.***

Program administrators could also encourage enhanced geographic diversity of microFIT Program participants. An increase in the share of feeder capacity which is permitted to be occupied by microFIT projects should be considered. This would allow more Ontarians to participate in the microFIT Program. However, microFIT capacity should not be increased at the expense of grid integrity since a reduction in the quality of electricity service could compromise policy legitimacy. Hydro One should continue to study the feasibility of increasing capacity limits and should communicate results with program stakeholders.

A second measure which would enhance geographic diversity is the creation of a tranche for rooftop solar PV projects with an installed capacity of 5 kW or less. This will encourage more residents of urban areas to participate in the microFIT Program. The creation of dual tranches will also permit the equalization of ROI for rooftop solar PV projects of different sizes, perhaps allowing for further tariff reductions for projects above 5 kW. This could occur if the current tariff is set relatively high such that smaller projects remain feasible. Overall, this measure is unlikely to have a significant effect on program costs. Given that annual project deployment is likely to be restricted, this measure would not result in

additional project development. The new tranche would simply increase the share of urban projects relative to rural projects.

Program administrators must also be cognizant of measures which might exclude some Ontarians. Specifically, the proposal to limit the maximum distance between a project and connection point could prevent some rural Ontarians from participating in the microFIT Program. The magnitude of this effect should be considered.

Recommendations

10. ***Hydro One should continue to study the feasibility of increasing the share of feeder capacity which may be occupied by microFIT projects. Research should be shared with program stakeholders.***
11. ***The share of feeder capacity that may be occupied by microFIT projects should be increased to the extent feasible.***
12. ***Create a separate tariff tranche for rooftop solar PV projects with an installed capacity of 5 kW or less.***
13. ***Evaluate the impact on rural microFIT project proponents of the proposed limitation on the distance between a project and its grid connection point.***

A strong case for including other renewable energy resources in the microFIT Program does not currently exist. The development of micro-hydro generation is likely to be more cost-effective than solar PV generation, but projects could be subject to both provincial and federal approvals, and the systems have the potential to disrupt aquatic ecosystems. Additionally, opportunities to deploy micro-hydro systems are limited since few Ontarians have access to the water resources required to develop such projects. A lack of system deployment opportunities is also a significant challenge for biomass-fuelled microgeneration because micro-scale equipment is not widely available. Furthermore, the promotion of micro-scale hydroelectric and bioenergy systems is not compelling from an employment perspective. Although difficult to characterize, the employment opportunities associated with these technologies do not appear to offer advantages over solar PV. As such, it is not currently advisable to actively promote the development of micro-scale hydroelectric or bioenergy projects.

The alternative resource which is most feasible for microgeneration is wind energy. It is essentially cost-competitive with solar PV and is capable of creating a considerable number of jobs. However, wind turbines will produce a small amount of electricity overnight – currently a time at which Ontario does not require additional power – and they are considered a safety concern among municipalities. As such, a tariff for micro-scale wind power should be implemented such that experience can be gained and industry built, but only a small volume of capacity should be procured so as to avoid negative impacts.

Recommendations

14. ***Tariffs for micro-scale bioenergy and hydroelectric projects should not be created at present.***
15. ***A tariff should be developed for micro-scale wind projects, but only a small volume of capacity should be procured.***

5.4.3. Improve program visibility, transparency, and continuity

In order to improve program visibility for the solar PV industry and market, program administrators should, on an ongoing basis, articulate to stakeholders their expectations with respect to annual tariff adjustments. This will help prevent project development activities from being impeded by market uncertainty about project viability. The utmost transparency must also be provided with respect to grid connection capacity. This will prevent time and resources from being squandered or misallocated due to infeasible projects and will reduce market uncertainty about project practicality. The retroactive application of tariff or rule changes must be avoided for the same reasons.

Stakeholders must also be continually informed about progress towards the Annual Procurement Limit (APL) such that resources are not expended on projects which will not qualify for a particular year's procurement quota. Additionally, measures should be taken to reduce the creation of boom and bust effects as a result of the APL. Attempts should be made to avoid the rapid fulfillment of the APL and to instead maintain a continuous flow of issued application approval notices and project

development over the course of a year. For example, based on historic rates of project completion, a specified quantity of applications could be accepted each quarter such that the APL would be achieved after four quarters. The APL also cannot be set too low or significant overcapacity in Ontario's solar PV manufacturing and installation industries will occur, causing many companies to cease operations or leave the province. Additionally, future APLs as well as a long-term outlook on microgeneration development in Ontario should be publicized in order to improve the renewable energy industry's understanding of Ontario's market.

Recommendation

16. Ontario's Ministry of Energy, energy agencies, and LDCs should improve program visibility, transparency, and continuity by

- ***informing program stakeholders of their expectations with respect to annual tariff reductions;***
- ***publicizing grid connection capacity at all times and updating capacity estimates on a near-real time basis;***
- ***avoiding the retroactive application of tariff and rule changes;***
- ***continually informing program stakeholders of progress toward the Annual Procurement Limit;***
- ***adopting measures which promote continuous project development throughout a given year;***
- ***setting the Annual Procurement Limit at a level which does not cause an excessive capacity reduction in Ontario's solar PV industry;***
- ***publishing future Annual Procurement Limits; and***
- ***publishing long-term goals for microgeneration development.***

The annual review of the microFIT tariffs must not be a source of market uncertainty. The annual review schedule should be included in the microFIT Rules in order to maximize stakeholder confidence in market development and the viability of projects. Program activities must continue throughout periods of program review so as not to create lulls in market demand, and therefore adequate resources must be made available to staff both tasks. The OPA must also reduce project delays

by processing applications promptly and continually releasing conditional offers as they are processed. This will increase the predictability of project development timelines and facilitate business planning. For the same reasons, Hydro One must endeavour to achieve the connection timelines mandated in the Distribution Code rather than the ninety-day period allotted in the new microFIT rules.

Recommendation

17. Ontario's Ministry of Energy and energy agencies should strive to avoid the disruption and delay of program and project activities by

- ***adhering to the annual schedule for tariff review;***
- ***including the annual tariff review schedule in the microFIT Rules;***
- ***maintaining program activity during periods of tariff review;***
- ***providing ample resources for simultaneous program review and processing of microFIT applications;***
- ***processing program applications promptly;***
- ***releasing conditional offers as they are processed rather than in batches; and***
- ***continuing to endeavour to achieve the connection timelines mandated in the Distribution Code.***

The stabilization of the solar PV industry must be the priority of microFIT Program administrators. Continued instability could cause an industry collapse, which would undermine the employment gains achieved – a key program goal and an important element of public tolerance of increased electricity costs. Industry stabilization should take precedence over maximizing renewable electricity microgeneration for two reasons. First, the microFIT Program does not produce a significant amount of electricity, and therefore is not essential to grid operations or environmental objectives. Second, an increased rate of microFIT project deployment is likely to stress cost concerns and technical capacity, which could potentially create negative attitudes toward renewable energy among Ontarians.

Recommendation

18. Stabilizing Ontario's solar PV industry should be the priority of program administrators.

5.4.4. Improve information and education regarding micro-scale renewable energy

In order to gain a comprehensive understanding of the impact of the microFIT Program, the quantity, quality and public availability of information about both the solar PV industry and the outcomes of the microFIT Program must be improved. The industry and occupational classification systems currently used in Canada include activities related to renewable energy within broader categories of classification. As such, information specific to the renewable energy industry cannot be retrieved. These systems should be enhanced such that information related to renewable energy industries is classified separately, with distinct categories assigned to each type of renewable energy. This will help improve broad knowledge of activities in renewable energy industries.

In addition, more specific studies will be required to ascertain data related to microgeneration. The government should thoroughly analyse the employment opportunities and revenue created by each industry associated with the microFIT Program and release the results publicly. The analysis must include an examination of the distribution of employment opportunities created by the microFIT Program, as well as a characterization of typical contract periods, weekly hours worked, and wages earned. The analysis should also include an evaluation of the jobs lost due to increased electricity costs resulting from the microFIT Program.

The OPA should publish comprehensive information about microFIT projects, owners, and proponents on a regular and ongoing basis. Available information should include the city or town in which projects at the application, application approval notice, and executed contract stages are located, as well as the number of projects undertaken by each proponent type. This measure will increase program transparency and will facilitate independent program evaluation. Additionally, the program's ability to encourage energy conservation, social learning and a culture of sustainability should be studied comprehensively by program stakeholders or members of the academic community.

Recommendations

19. ***Industry and occupational classification systems currently used in Canada should separately classify information related to renewable energy industries and should assign a distinct category to each type of renewable energy.***
20. ***The government should analyse the employment opportunities and revenue created by each industry associated with the microFIT Program. The results should be released to the public.***
21. ***The OPA should publish comprehensive information about microFIT projects and their owners and proponents on a regular and ongoing basis.***
22. ***The microFIT Program's ability to encourage energy conservation, social learning and a culture of sustainability should be studied comprehensively.***

While this information will enhance the knowledge of those engaged in the renewable energy sector, efforts should also be made to enhance all Ontarians' knowledge of renewable energy and the microFIT Program. Social learning and the creation of a culture of sustainability could be enhanced by encouraging further community engagement with microFIT projects. For example, the OPA could provide project owners with signs which draw attention to their microFIT projects and encourage passersby to stop and ask questions. This would also help raise awareness of the microFIT Program, although a province-wide marketing and public relations campaign is also necessary to raise awareness of the microFIT Program and the benefits and costs of micro-scale renewable energy.

Program administrators should provide resources on renewable energy product quality and encourage proponents to ask renewable energy installation companies for testimonials and references. This will help reduce the technological and monetary risks placed on microFIT project owners. Finally, project proponents should be required as a condition of the receipt of a microFIT contract to install an electricity monitoring system or prove that one has previously been installed in the building. This measure aims to capitalize on the increased awareness of electricity use which follows installation of a microgeneration system in order to encourage reductions in electricity consumption. A monitor which displays electricity consumption and production side-by-side should not be required as this may encourage project owners to use electricity at times of peak demand.

Recommendations

23. ***The Ministry of Energy and the OPA should encourage community engagement with microFIT projects.***
24. ***The OPA should launch a province-wide marketing and public relations campaign to raise awareness of the microFIT Program and the benefits and costs of micro-scale renewable energy.***
25. ***The OPA should provide resources on renewable energy product quality and continue to encourage proponents to ask installation companies for testimonials and references.***
26. ***Project proponents should be required as a condition of the receipt of a microFIT contract to install an electricity monitoring system or prove that one has previously been installed in the building.***

6. Conclusion

The complete impact of the microFIT Program is currently unknown. As such, the development and public availability of tools and information with which the program can be comprehensively evaluated is critical. According to the available information and analysis capacity, the microFIT Program appears to have met the government's broadly defined policy goals, but has not yet advanced sustainability or achieved policy legitimacy. However, program adjustments can help the microFIT Program achieve these policy imperatives. This analysis has also shown that the program imposes only a modest cost increase on electricity consumers and offers benefits to the province of Ontario which cannot be provided by other types of electricity generation or policies. Therefore, the microFIT Program is deserving of continued support and the commitment and resources to make program adjustments to minimize its few negative impacts. In particular, program administrators must make every effort to reduce program costs and prioritize the goal of stabilizing the solar PV industry in Ontario.

The microFIT Program is at an important juncture. If improvements are not made, the program may be unable to achieve government's goals, advance sustainability or obtain policy legitimacy – in other words, it will be a complete failure. In contrast, the implementation of the program adjustments proposed here could allow the microFIT Program to play a key role in creating new paths in Ontario's

economy, culture, and relationship with the natural environment. The choice is clear: Ontario must seize this opportunity for progress.

Bibliography

American Wind Energy Association (AWEA). *2010 U.S. Small Wind Turbine Market Report*. Washington, DC: AWEA, 2011. Accessed June 20, 2012. http://www.awea.org/_cs_upload/learnabout/smallwind/10860_1.pdf.

Andersen, Colin. "Long Term Electricity Planning – What Communities Need to Know." Speech at 2011 Association of Municipalities of Ontario Annual Conference, London, ON, August 22, 2011. Accessed May 13, 2012. http://www.powerauthority.on.ca/sites/default/files/news/Colin%20Andersen%20-%20AMO%20Conference%20August%202011%20-%20Speech_0.pdf.

Anderson, Kristi, Arne Jungjohann, and Tim Weis. *Harvesting Clean Energy on Ontario Farms: A Transatlantic Comparison.* Washington, DC: Heinrich Böll Stiftung, 2011. Accessed May 15, 2012. http://pubs.pembina.org/reports/harvesting-energy-ontario-june-24-final.pdf.

Arvizu, David, Palani Balaya, Luisa Cabeza, Terry Hollands, Arnulf Jäger-Waldau, Michio Kondo, Charles Konseibo et al. "Direct Solar Energy." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, Kristin Seyboth, Patrick Matschoss, Susanne Kadner, Timm Zwickel et al., 3, 1-100. Cambridge, UK: Cambridge University Press, 2011. Accessed February 7, 2012. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

Association of Municipalities of Ontario (AMO). *Feed-In-Tariff Program Review: AMO Written Submission to the Ministry of Energy and the Ontario Power Authority (OPA).* Toronto: AMO, 2011. Accessed January 9, 2012. http://www.amo.on.ca/AM/Template.cfm?Section=FIT_Review&Template=/CM/ContentDisplay.cfm&ContentID=163978.

———. "Ontario's Latest Energy Reforms Reflect Municipal Concerns." News release, March 22, 2012. http://www.amo.on.ca/AM/Template.cfm?Section=News_Releases&Template=/CM/HTMLDisplay.cfm&ContentID=165203.

Babbage, Maria. “Liberals on Attack Over Tory Plans to Gut Ontario’s Green Energy Plans.” *Canadian Press,* May 11, 2011. Factiva (CPR0000020110512e75b000ad).

Bailie, Alison, Matt Horne, Roger Peters, Amy Taylor, Tim Weis, Paul Cobb, and Kristin Zarowny. *Economic Instruments for On-Site Renewable Energy Applications in the Residential/Farm Sector*. Drayton Valley, AB: Pembina Institute, 2007. Accessed April 2, 2012. http://pubs.pembina.org/reports/Econ_Instru_Res_RE_03-07.pdf.

Bauer, C. *Life Cycle Assessment of Fossil and Biomass Power Generation Chains*. Villigen, Switzerland: Scherrer Institute, 2008.

Baumgartner, Frank R., and Bryan D. Jones. *Agendas and Instability in American Politics.* 2nd ed. Chicago: University of Chicago Press, 1993.

Bentley, Chris. *Directive to the OPA re: Feed-in Tariff Program Review*. Toronto: Ministry of Energy and Infrastructure, 2012. Accessed May 17, 2012. http://www.powerauthority.on.ca/sites/default/files/page/FIT-ReviewApril-2012.pdf.

Benzie, Robert. “Liberals’ Solar Shift Clouds MPPs’ Mood: Quietly Slashing Subsidy for Rural Generators Sparks Caucus Fears.” *Toronto Star,* July 9, 2010. ProQuest (603449592).

Bergman, Noam and Nick Eyre. “What Role for Microgeneration in a Shift to a Low Carbon Domestic Energy Sector in the UK?” *Energy Efficiency* 4 (2011): 335-353. doi: 10.1007/s12053-011-9107-9.

Blackwell, Richard. “Price Dip Shakes Up Solar Panel Market.” *Globe and Mail*, December 5, 2011. ProQuest (907914591).

Boudreau, Ryan. “F.I.T. Connection Review.” Presentation at the Ontario Feed-In Tariff Forum, Toronto, ON, April 3, 2012. http://www.amiando.com/eventResources/g/z/HkejhLl01KstYp/06_Ryan_B.ppt.

Boyle, Godfrey. “Solar Photovoltaics.” In *Renewable Energy: Power for a Sustainable Future,* edited by Godfrey Boyle, 65-104. 2nd ed. Oxford: Oxford University Press, 2004.

Brooks, Keith. *Blue Green Canada* (blog). http://bluegreencanada.ca/blog/transmissions-solar-conference.

Bundesnetzagentur. *Monitoring Report 2010.* Bonn: Bundesnetzagentur, 2010. Accessed January 26, 2012. http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/PressSection/ReportsPublications/2010/MonitoringReport2010pdf.pdf?__blob=publicationFile.

Butler, Don. "Ex-Power Authority Boss Chides FIT Program." *Ottawa Citizen*, September 21, 2011. Factiva (OTCT000020110921e79l00020).

California Public Utilities Commission (CPUC). *California Solar Initiative Annual Program Assessment.* San Francisco: CPUC, 2010. Accessed January 23, 2012. http://www.cpuc.ca.gov/NR/rdonlyres/CE1D2316-405C-4C94-A805-A68A1988D640/0/2010APA_final.pdf.

———. "California Solar Initiative Rebates." Accessed June 20, 2012. http://www.gosolarcalifornia.org/csi/rebates.php.

———. "Net Energy Metering (NEM)." Accessed January 30, 2012. http://www.cpuc.ca.gov/PUC/energy/DistGen/netmetering.htm.

Campbell, Neil, Bill Rupert, and Roger Ware. *Monitoring Report on the IESO-Administered Electricity Markets for the Period from May 2011 to October 2011.* Toronto: Ontario Energy Board, 2012. Accessed June 15, 2012. http://www.ontarioenergyboard.ca/OEB/_Documents/MSP/MSP_Report_20120427.pdf.

———. *Monitoring Report on the IESO-Administered Electricity Markets for the Period from November 2010 to April 2011.* Toronto: Ontario Energy Board, 2011. Accessed March 6, 2012. http://www.ontarioenergyboard.ca/OEB/_Documents/MSP/MSP_Report_20111116.pdf.

Canada. Environment Canada. *Canadian Climate Normals or Averages 1971-2000* (database). Last modified March 14, 2012. http://climate.weatheroffice.gc.ca/prods_servs/normals_documentation_e.html#ND14.

———. Foreign Affairs and International Trade Canada. *Canada – Certain Measures Affecting the Renewable Energy Generation Sector*. Ottawa: Foreign Affairs and International Trade Canada, 2011. WTO Doc. WT/DS412. Accessed May 2, 2012. http://canadians.org/trade/documents/WTO/DS412-submission.pdf.

———. Natural Resources Canada (NRCan). *Micro-Hydropower Systems: A Buyer's Guide.* Ottawa: NRCan, 2004. Accessed February 11, 2012. http://canmetenergy.nrcan.gc.ca/sites/canmetenergy.nrcan.gc.ca/files/pdf/fichier/79276/buyersguidehydroeng.pdf.

———. Statistics Canada. "Canada's Rural Population Since 1851." Last modified May, 2012. http://www12.statcan.gc.ca/census-recensement/2011/as-sa/98-310-x/98-310-x2011003_2-eng.cfm.

———. Statistics Canada. *Consumer Price Index, Historical Summary (1952 to 1971)*. Last modified January 20, 2012. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ46c-eng.htm.

———. Statistics Canada. "Ontario Census Divisions – Annual Population Estimates at July 1" (table). *Annual Demographic Estimates: Subprovincial Areas*. Statistics Canada Catalogue no. 91-214-X. Ottawa, ON: Statistics Canada, 2012. Accessed May 31, 2012. http://www.statcan.gc.ca/pub/91-214-x/2010000/t043-eng.pdf.

———. Statistics Canada. "Summary Tabulation of the Canadian Farm Financial Database – Total Income of Farm Families (Unincorporated Sector)" (table). *Canadian Farm Financial Database* (database). Last modified January 14, 2010. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.pgm?Lang=E&ESAS action=Pick1&ESASData= ESAS2008&Res-Ins=CFFD-BDFEAC/ESASPick&JS=1.

Canadian Federation of Agriculture. "Benefits." Last modified February 19, 2008. http://www.farm-energy.ca/IReF/index.php?page=benefits-14.

———. "Low Head and Ultra Low Head Hydro." Last modified March 31, 2008. http://www.farm-energy.ca/IReF/index.php?page=low-head-and-ultra-low-head-hydro-ataglance.

Canadian Press. “Cut in Rate Paid for Solar Power Will Hurt Rural Ontario, Critics Say.” July 15, 2010. Factiva (CPR0000020100716e67g000av).

———. “Ontario to Cut Rates Paid for Wind, Solar Power.” *CBC News*, March 22, 2011. http://www.cbc.ca/news/canada/toronto/story/2012/03/22/ontario-wind-solar-electricity-rates.html.

Canadian Solar Industries Association (CanSIA). “CanSIA Welcomes FIT Announcement Signaling Ongoing Commitment to Renewable Energy.” News release, March 22, 2012. http://www.cansia.ca/news-media-archive/news-release-cansia-welcomes-fit-announcement-signaling-ongoing-commitment.

———. *Maximizing the Benefits of Early Success: Recommendations for the Sustainability of Ontario’s Solar Energy Sector.* Ottawa: CanSIA, 2011. Accessed January 12, 2012. http://www.cansia.ca/sites/default/files/20111214_cansia_fit_review_submission_final.pdf.

Canadian Wind Energy Association (CanWEA). *2010 CanWEA Small Wind Market Survey: An Overview of Canada’s Small Wind Manufacturing Sector.* Ottawa: CanWEA, 2010. Accessed April 1, 2012. http://www.canwea.ca/pdf/SmallWind/canwea-smallwindmarketsurvey-e-web.pdf.

———. “About the Technology.” Accessed March 14, 2012. http://www.canwea.ca/swe/overview. php?id=47.

Carbon Trust. *Small-Scale Wind Energy: Policy Insights and Practical Guidance*. London: Carbon Trust, 2008. Accessed April 6, 2012. http://www.wind-power-program.com/Library/Policy%20and%20planning%20documents/Carbon-Trust-Small-Scale-Wind-Report.pdf.

Carou, Fernando, and Rob McMonagle. “Economic Benefits of Local Generation: Rethinking How We Power Our Communities.” Presentation at the Connections Energy Symposium, Toronto, ON, December 8, 2011. Received March 12, 2012 from the Association of Municipalities of Ontario.

Carr, Jan, and Benjamin Dachis. “High Price for Green; Ontario Should Follow B.C. in Protecting Consumers.” *National Post,* December 17, 2012. Factiva (FINP000020101217e6ch00040).

Chief Energy Conservation Officer. *Ontario – A New Era in Electricity Conservation.* Toronto: Ontario Power Authority, 2006. Accessed March 16, 2012. http://www.ontla.on.ca/library/repository/ser/257270/2006.pdf.

Chum, Helena, Andre Faaij, José Moreira, Göran Berndes, Parveen Dhamija, Hongmin Dong, Benoît Gabrielle et al. "Bioenergy." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, Kristin Seyboth, Patrick Matschoss, Susanne Kadner, Timm Zwickel et al., 2, 1-187. Cambridge, UK: Cambridge University Press, 2011. Accessed February 7, 2012. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

Clean Energy Ministerial (CEM). *Summary of CEM Accomplishments*. N.p.: CEM, 2012. Accessed July 19, 2012. http://www.cleanenergyministerial.org/pdfs/CEM-ACCOMPLISHMENTS.pdf.

ClearSky Advisors Inc. *Data Requests Regarding the microFIT Program*. Unpublished data, 2012. Received March 15, 2012 from Clearsky Advisors Inc.

———. *Economic Impacts of the Solar PV Sector in Ontario 2008-2018.* Toronto: Canadian Solar Industries Association, 2011. Accessed January 12, 2012. http://www.cansia.ca/sites/default/files/economic_impacts_of_the_solar_photovoltaic_sector_in_ontario_2008-2018_july_26_0.pdf.

———. "Solar in Ontario: 2011 Preview." Accessed January 24, 2012. http://www.renewableenergyworld.com/rea/news/article/2011/01/solar-in-ontario-2011-preview.

Colden, Brad. "microFIT Screening & Reporting Requirements." Presentation during Hydro One Webinar, August 30, 2011. Accessed February 10, 2012. http://www.hydroone.com/IndustrialLDCs/Webinars/microFIT%20Screening%20and%20Reporting%20Requirements%20for%20Embedded%20LDCs.pdf.

Corcoran, Terence. “Ontario’s Iron-Fisted Energy Model.” *National* Post, October 1, 2009. Factiva (FINP000020091001e5a10003t).

Cossent, Rafael, Tomás Gómez, and Luis Olmos. “Large-scale Integration of Renewable and Distributed Generation of Electricity in Spain: Current Situation and Future Needs.” *Energy Policy* 39, no. 12 (2011): 8078-8087. doi: 10.1016/j.enpol.2011.09.069.

Coyle, Jim. “Tories Try to Cut Through ‘Green’ Fog.” *Toronto Star*, May 1, 2009. ProQuest (1693860871).

Crispino, Len. *RE: OCC Submission on Feed-In Tariff (FIT) Program Two Year Review.* Toronto: Ontario Chamber of Commerce, 2011. Accessed April 19, 2012. http://occ.on.ca/assets/Ontario-Chamber-of-Commerce-FIT-2-Year-Review-Submission-December-2011.pdf.

Cross, Brian. “Dreams Fade for Solar Investors.” *Windsor Star*, February 2, 2011. ProQuest (853362751).

D’Aliesio, Renata. “Solar Industry Seeks Its Place in the Sun.” *Globe & Mail*, October 17, 2011. ProQuest (898500720).

———. “Solar Power’s Stuttering Steps.” *Globe and Mail*, December 7, 2011. ProQuest (908745899).

del Río González, Pablo. “Ten Years of Renewable Electricity Policies in Spain: An Analysis of Successive Feed-in Tariff Reforms.” *Energy Policy* 36, no. 8 (2008): 2907-2919. doi: 10.1016/j.enpol.2008.03.025.

Devine-Wright, Hannah, and Patrick Devine-Wright. “Representing the Demand Side: ‘Deficit’ Beliefs About Domestic Electricity Users.” In *ECEEE 2005 Summer Study Proceedings, Panel 6: Dynamics of Consumption.* Stockholm: European Council for an Energy Efficient Economy: 1343-1348. Accessed February 26, 2012. http://www.eceee.org/conference_proceedings/eceee/2005c/Panel_6/6163devine_wright/paper.

Devine-Wright, Patrick. “Energy Citizenship: Psychological Aspects of Evolution in Sustainable Energy Technologies.” In *Governing Technology for Sustainability*, edited by Joseph Murphy, 63-86. London: Earthscan, 2007.

Diebel, Linda. “Canada-Europe Trade Deal Prohibits Provinces, Municipalities from Favouring Local Bidders on Contracts.” *Toronto Star*, February 24, 2012. http://www.thestar.com/news/canada/politics/article/1136423--canada-europe-trade-deal-prohibits-provinces-municipalities-from-favouring-local-bidders-on-contracts.

Dobbyn, Judith, and Gillian Thomas. *Seeing the Light: The Impact of Micro-Generation on the Way We Use Energy.* London: Sustainable Consumption Roundtable, 2005. Accessed February 27, 2012. http://www.sd-commission.org.uk/data/files/publications/Micro-generationreport.pdf.

du Plessis, Valerie, Roland Beshiri, Ray D. Bollman, and Heather Clemenson. *Definitions of “Rural”.* Statistics Canada Catalogue no. 21-601-MIE. Ottawa, ON: Statistics Canada, 2002. Agriculture and Rural Working Paper Series, no. 61. Received May 24, 2012 from the Ontario Ministry of Agriculture, Food and Rural Affairs.

Dynamic Solar Tech Inc. *MicroFIT Costs, Revenues.* Unpublished data, 2012. Received May 7, 2012 from Dynamic Solar Tech Inc.

Ecoinvent. *The Ecoinvent LCI Database, Data v2.2*. Duebendorf, Switzerland: Swiss Centre for Life Cycle Inventories, 2009.

Electricity Conservation and Supply Task Force. *Tough Choices: Addressing Ontario’s Power Needs.* N.p.: Ontario Ministry of Energy, 2004. Accessed January 13, 2012. http://www.centreforenergy.com/documents/242.pdf.

Electricity Distributors Association (EDA). *Electricity is the Answer: The EDA’s Road Map for Delivering Ontario’s Electric Future*. Vaughan, ON: EDA, 2011. Accessed April 21, 2012. http://www.eda-on.ca/eda/edaweb.nsf/0/E044A815BFD1F92E852579480058AB3C/$FILE/Sector%20Review_ final.pdf.

Environmental Defence. “Springtime for Renewable Energy in Ontario: Environmental Defence Welcomes Improvements to Ontario’s Feed-In Tariff Program, North America’s Leading Renewable Energy Policy.” News release, March 22, 2012. http://www.newswire.ca/en/story/942343/springtime-for-renewable-energy-in-ontario-environmental-defence-welcomes-improvements-to-ontario-s-feed-in-tariff-program-north-america-s-leading-ren.

Etcheverry, José, Paul Gipe, William Kemp, Roger Samson, Martijn Vis, Bill Eggertson, Rob McMonagle, Sarah Marchildon, and Dale Marshall. *Smart Generation: Powering Ontario with Renewable Energy.* Toronto: David Suzuki Foundation, 2004. Accessed February 14, 2012. http://www.davidsuzuki.org/publications/downloads/2004/Smart_Generation_full_report.pdf.

Faber, Thomas, John Green, Miguel Gual, Reinhard Haas, Claus Huber, Gustav Resch, Waler Ruijgrok, and John Twidell. *Review Report on Promotion Strategies for Electricity from Renewable Energy Sources in EU Countries*. Edited by Reinhard Haas. Vienna: Institute of Energy Economics, Vienna University of Technology, 2001. Accessed May 15, 2012. http://download.nachhaltigwirtschaften.at/pdf/haas_promotion_res.pdf.

Ferguson, Rob. “Business Fights Solar Rate Cut; McGuinty Government’s Price Drop ‘Crippling and Quite Possibly Bankrupting’ to Farmers.” *Toronto Star*, July 13, 2012. Factiva (TOR0000020100713e67d0000l).

———. “Controversy Flares Over Solar Subsidy Flip-Flop.” *Toronto* Star, July 22, 2010. ProQuest (633510266).

Financial Post. “Solar Energy Cheaper Than You Might Think, Says Researcher.” December 7, 2011. Accessed January 31, 2012. http:// www.financialpost.com/news/Solar+energy+cheaper+than +might+think+says+researcher/5826207/story.html.

FIT Review Coalition. *FIT 2.0 – Blueprint for Ontario’s Solar PV Market*. Toronto: Ontario Solar Network, 2011. Accessed January 10, 2012. http://ontariosolarnetwork.org/Resources/Documents/FIT%202

.0%20Blueprint%20 for%20 Ontario%27s%20Solar%20PV%20Market%20%20Ontario%20Solar%20Network%27s%20FIT%20Review%20 Coalition%20-%20Submitted%202011.12.09.pdf.

Frantzis, Lisa, Jay Paidipati, Matt Stanberry, and Daniel Tomlinson. *Economic Impacts of Extending Federal Solar Tax Credits*. Washington, DC: Solar Energy Research and Education Foundation, 2008. Accessed April 10, 2012. http://www.seia.org/galleries/pdf/Navigant%20Consulting%20Report%209.15.08.pdf.

Franz, Damon, Mona Dzvova, James Loewen, Amy Reardon, Neal Reardon, and Melicia Charles. *California Solar Initiative Annual Program Assessment.* San Francisco: California Public Utilities Commission, 2011. Accessed January 30, 2012. http://www.cpuc.ca.gov/NR/rdonlyres/9BC1AC3A-020C-4E85-99F0-D6CF42D34B03/0/2011_APA_FINAL_PRINT.pdf.

Fraser, Marion. *Getting It Right - Not Quite – Ontario's Green Energy Act.* Toronto: Ontario Sustainable Energy Association, 2011. Accessed April 6, 2012. http://www.ontario-sea.org/Storage/62/5441_Getting_it_Right_-_Not_Quite_-_Ontarios_Green_Energy_Act_GCEC11-121.pdf.

Gandalf Group, The. *Opinion of Renewable Energy Policy and Solar Power: CanSIA Survey of Ontario.* Unpublished report, 2011. Received April 19, 2012 from the Canadian Solar Industries Association.

George, Alexander L. "Domestic Constraints on Regime Change in U.S. Foreign Policy: The Need for Policy Legitimacy." In *Change in the International System,* edited by Ole R. Holsti, Randolph M. Siverson, and Alexander L. George, 233-262. Boulder, CO: Westview Press, 1980.

Gibson, Robert B., Selma Hassan, Susan Holtz, James Tansey, and Graham Whitelaw. *Sustainability Assessment: Criteria and Processes*. London: Earthscan, 2005.

Gipe, Paul, Deborah Doncaster, and David MacLeod. *Powering Ontario Communities: Proposed Policy for Projects Up To 10 MW.* Toronto: Ontario Sustainable Energy Association, 2005. Accessed April 4, 2012. http://www.wind-works.org/FeedLaws/Canada/PoweringOntarioCommunities.pdf.

Gipe, Paul. “Feed-In Tariff Calculator Using Chabot PI Method.” Unpublished data, 2011. Received April 2, 2012.

———. *Renewables Without Limits: Moving Ontario to Advanced Renewable Tariffs by Updating Ontario’s Groundbreaking Standard Offer Program.* Toronto: Ontario Sustainable Energy Association, 2007. Accessed April 3, 2012. http://www.ontario-sea.org/Storage/22/1375_RenewablesWithoutLimits.pdf.

Goddard, John. “Province Has a Plan for Stranded Solar Projects.” *Toronto Star*, August 2, 2011. ProQuest (884398778).

Gohlke, Julia M., Sharon H. Hrynkow, and Christopher J. Portier. “Health, Economy, and Environment: Sustainable Energy Choices for a Nation.” Editorial. *Environmental Health Perspectives* 16, no. 6 (2008): A236-A237. doi:10.1289/ehp.11602.

Green Energy Act Alliance. “Alliance Submission to Ontario Power Authority on Proposed Ground-Mounted Solar microFIT Tariff Rate.” Last modified July 27, 2010. http://www.greenenergyact.ca/Page.asp?PageID=122&ContentID=1435&SiteNodeID=238.

Green Energy Act Alliance and Shine Ontario Association. *Ontario Feed-In Tariff: 2011 Review.* Toronto: Green Energy Act Alliance and Shine Ontario Association, 2011. Accessed January 9, 2012. http://environmentaldefence.ca/sites/default/files/report_files/FIT.Review_Updated.pdf.

Green Party of Ontario (GPO). “Feed-In Tariff Review: Green Party Submission.” Last modified January 16, 2012. http://www.gpo.ca/statement/feed-tariff-review-green-party-submission.

———. *Green Party of Ontario Energy Strategy 2011*. Toronto: GPO, 2011. Accessed July 24, 2012. http://www.gpo.ca/sites/gpo.ca/files/attachments/gpo_issues_paper_energy.pdf.*Guelph Mercury.* “Workers Issued Layoff Notices at Canadian Solar Plant in Guelph.” November 3, 2011. http://www.guelphmercury.com/news/local/article/619320--workers-issued-layoff-notices-at-canadian-solar-plant-in-guelph.

Hamilton, Tyler. *Clean Break* (blog). http://www.cleanbreak.ca/2009/02/22/ontario-aims-to-set-continental-standard-with-green-energy-act/. ———. "Green Power to the People; Plan to Boost Renewable Projects at the Local Level Has Beaten All Expectations Since its October Launch." *Toronto Star*, December 16, 2009. ProQuest (TOR0000020091216e5cg00016).

Heagle, A.L.B., G.F. Naterer, and K. Pope. "Small Wind Turbine Energy Policies for Residential and Small Business Usage in Ontario, Canada." *Energy Policy* 39, no.4 (2011): 1988-1999. doi: 10.1016/j.enpol.2011.01.028.

Helland-Hansen, E.T., T. Holtedahl, and O.A. Lye. *Environmental Effects Update.* Trondheim, Norway: Norwegian University of Science and Technology, 2005.

Hill, Sharon. "Solar Panels Unwelcome Neighbour; 44 Units Planned for Subdivision." *Windsor Star*, June 11, 2011. Factiva (WINSTR0020110611e76b00013).

Howlett, Karen. "Green Firms Fume Over Ontario's Rule Changes." *Globe & Mail*, August 3, 2010. Factiva (GLOB000020100803e6830001l).

Hydro One Networks Inc. (HONI). *CDM Exemption: Hydro One Networks' Undertaking Responses*. Toronto: HONI, 2011. EB-2011-0118. Accessed April 29, 2012. http://www.hydroone.com /RegulatoryAffairs/Documents/EB-2011-0118/HONI_UndertakingsMega_20110812.pdf.

———. *EB-2011-0118 – Hydro One Networks' Request for Exemption from Section 6.2.6 & 6.2.7 of the Distribution System Code – Hydro One Networks' Application*. Toronto: Ontario Energy Board, 2011. EB-2011-0118. Accessed July 18, 2012. http://www.rds.ontarioenergy board.ca/ webdrawer/webdrawer.dll/webdrawer/rec/266550/view/.

Independent Electricity System Operator (IESO). *18-Month Outlook: From December 2011 to May 2013*. Toronto: IESO, 2011. Accessed March 14, 2012, http://www.ieso.ca/imoweb/pubs/marketReports/18MonthOutlook_2011nov.pdf.

———. “Import Scheduled Prices 2007-2011.” Unpublished raw data, 2012. Received April 2, 2012 from the IESO.

———. *The Ontario Reliability Outlook*. Toronto: IESO, 2009. Accessed June 20, 2012, http://www.ieso.ca/imoweb/pubs/marketReports/ORO_Report-Dec2009.pdf.

International Energy Agency (IEA). *Biomass for Power Generation and CHP.* N.p.: Organisation for Economic Co-operation and Development, 2007. Accessed February 24, 2012. http://www.iea.org/techno/essentials3.pdf.

———. *Trends in Photovoltaic Applications: Survey report of selected IEA countries between 1992 and 2009.* N.p.: International Energy Agency, 2010. Accessed January 27, 2012. http://www.iea-pvps.org/index.php?id=92&eID=dam_frontend_push&docID=432.

———. *Trends in Photovoltaic Applications: Survey report of selected IEA countries between 1992 and 2010.* N.p.: International Energy Agency, 2010. Accessed January 24, 2012. http://www.iea-pvps.org/index.php?id=92&eID=dam_frontend_push&docID=899.

Institute of Electrical and Electronics Engineers (IEEE). *IEEE Application Guide for IEEE Std 1547™, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems*. New York: IEEE, 2009. doi: 10.1109/IEEESTD.2008.4816078.

Japan Renewable Energy Policy Platform (JREPP). *Renewables Japan Status Report 2010.* N.p.: JREPP, 2010. Accessed January 29, 2012. http://www.re-policy.jp/jrepp/JSR2010SMR20101004E.pdf.

Kaizuka, Izumi. *PV Status in Japan – Overcoming March 11th*. N.p.: International Energy Agency, 2011. Accessed January 29, 2012. http://www.iea-pvps.org/index.php?id=3&eID=dam_frontend_push&docID=917.

Keirstead, James. “Behavioural Responses to Photovoltaic Systems in the UK Domestic Sector.” *Energy Policy* 35 (2007): 4128-4141. doi: 10.1016/j.enpol.2007.02.019.

Kumar, Arun, Tormod Schei, Alfred Ahenkorah, Rodolfo Caceres Rodriguez, Jean-Michel Devernay, Marcos Freitas, Douglas Hall et al. "Hydropower." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, Kristin Seyboth, Patrick Matschoss, Susanne Kadner, Timm Zwickel et al., 5, 1-182. Cambridge, UK: Cambridge University Press, 2011. Accessed February 7, 2012. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

Lapierre-Fortin, Émanuèle. *Implementing Bill 150: Reflections from the* Field. Guelph, ON: Workforce Planning Board of Waterloo Wellington Dufferin, 2011. Accessed May 15, 2012, http://workgreen.ca/system/files/Implementing%20Bill%20150%20-%20Reflections%20from%20the%20Field.pdf.

Larkin, Stephen, Janet Ramage, and Jonathan Scurlock. "Bioenergy." In *Renewable Energy: Power for a Sustainable Future,* edited by Godfrey Boyle, 105-146. 2nd ed. Oxford: Oxford University Press, 2004.

Lauber, Volkmar, and Lutz Mez. "Three Decades of Renewable Electricity Policies in Germany." *Energy & Environment* 15, no. 4 (2004): 599-623. http://www.swetswise.com.ezproxy.library.yorku.ca/eAccess/viewFulltext.do?articleID=152239456.

Leger Marketing. *Ontario Electoral Poll*. Toronto: Leger Marketing, 2011. Accessed April 19, 2012. http://www.legermarketing.com/admin/upload/publi_pdf/Ontario_Electoral_Poll_14oct2011.pdf.

Lehr, Ulrike, Joachim Nitsch, Marlene Kratzat, Christian Lutz, and Dietmar Edler. "Renewable Energy and Employment in Germany." *Energy Policy* 39 (2008): 108-117. doi: 10.1016/j.enpol.2007.09.004.

Lilley, Wayne. "Green Goals, Bigger Bills: How Ontario's Green Energy Act Got Politically Compromised – and Led to Soaring Electricity Costs." *Toronto Star,* November 27, 2010. ProQuest (814371230).

Lord, Andrew, and James Kelsall. *Environmental, Energy and Resources Law* (blog). http://www.davis.ca/en/entry/environmental-energy-and-resources-law/Ontario-domestic-content-rules-facing-WTO-and-NAFTA-challenges/.

Lovins, Amory B. *Reinventing Fire: Bold Business Solutions for the New Energy Era.* White River Junction, VT: Chelsea Green Publishing, 2011.

Lucas, Hugo, and Rabia Ferroukhl. *Renewable Energy Jobs: Status, Prospects and Policies.* Abu Dhabi: International Renewable Energy Agency, 2011. Accessed January 23, 2012. http://www.irena.org/DocumentDownloads/Publications/RenewableEnergyJobs.pdf.

Mabee, Warren E., Justine Mannion, and Tom Carpenter. "Comparing the Feed-In Tariff Incentives for Renewable Electricity in Ontario and Germany." *Energy Policy* 40 (2008): 480-489. doi: 10.1016/j.enpol.2011.10.052.

MacWhirter, Rebecca. "Electricity Policy in Ontario: Sources of Instability and Implications for Ontario's Green Energy Act." MES Major Research Paper, York University, 2010.

Malecki, Justin. "What the Flux?!." *ClearSky Advisors Inc.* Last modified December 22, 2011. http://www.clearskyadvisors.com/1243/what-the-flux/.

Martinelli, L.A., and S. Filoso. "Polluting Effects of Brazil's Sugar-Ethanol Industry." *Nature* 445, no. 7126 (2007):364.

Martinot, Eric, Ryan Wiser, and Jan Hamrin. *Renewable Energy Policies and Markets in the United States.* San Francisco: Centre for Resource Solutions, 2005. Accessed January 29, 2012. http://martinot.info/Martinot_et_al_CRS.pdf.

McDonald, N.C., and J.M. Pearce. "Producer Responsibility and Recycling Solar Photovoltaic Modules." *Energy Policy* 38, no. 11 (2010): 7041-7047. doi:10.1016/j.enpol.2010.07.023.

Mesa Power Group. "Mesa Power Group Files Legal Action Against Canadian Government for NAFTA Infractions." News release, July 14, 2011. http://www.mesapowergroup.com/index.php/news.

Mitchell, Catherine, Janet Sawin, Govind R. Pokharel, Daniel Kammen, and Zhongying Wang. "Policy, Financing and Implementation." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, ed. Ottmar Edenhofer et al., 11, 1-134. Cambridge, UK: Cambridge University Press, 2011. Accessed February 7, 2012. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_ Report .pdf.

Moe, Espen. "Vested Interests, Energy Efficiency and Renewables in Japan." *Energy Policy* 40, no.1 (2012): 260–273. doi: 10.1016/j.enpol.2011.09.070.

Moore, Michal C., Jananne Sharpless, Marwan Masri, Charles Mizutani, and Nancy J. Deller. *Emerging Renewable Resources Account*. Sacramento, CA: California Energy Commission, 1998. Accessed January 30, 2012. http://www.energy.ca.gov/renewables/documents/archive/emerging_ renewables/500-97-011V3-1st.PDF.

National Farmers Union – Ontario (NFU-O). *June 2010 Statement on Renewable Energy and the Ontario Green Energy Act.* Guelph, ON: NFU-O, 2010. Accessed June 7, 2012. http://nfuontario.ca/upload/ files/userfiles/NFU%20Renewable%20Energy%20Statement,%20June%202010(1).pdf.

———. "NFU Response to FIT Review Report." News release, March 26, 2012. http://www.nfuontario.ca/upload/files/NFU_FIT_review.pdf.

National Renewable Energy Laboratory. *Small Modular Biomass Systems.* Golden, CO: U.S. Department of Energy, 2002. Accessed February 11, 2012. http://www.nrel.gov/docs/fy03osti/33257.pdf.

Nelson, Susan. "Canadian Solar Sees Sustainable Future in Lower-Priced Market." *SNL Energy Power Week Canada*, April 23, 2012. ProQuest (1009771211).

New Democratic Party of Ontario. "New Democrats Will Help Households Make Affordable Green Choices: Horwath." Last modified August 11, 2011. http://ontariondp.com/en/green-choices.

———. "Ontario's Budget Must Address Jobs Crisis: Horwath." News release, April 10, 2012. http://ontariondp.com/en/ontarios-budget-must-address-jobs-crisis-horwath.

North American Electric Reliability Corporation (NERC). *Special Report: Accommodating High Levels of Variable Generation*. Princeton, NJ: NERC, 2009. Accessed July 16, 2012. http://www.nerc.com/docs/pc/ivgtf/IVGTF_Report_041609.pdf.

Office of the Auditor General of Ontario. *2011 Annual Report.* Toronto: Queen's Printer for Ontario, 2011. Accessed January 14, 2012. http://www.auditor.on.ca/en/reports_en/en11/2011ar_en.pdf.

Ontario. Legislative Assembly. Official Report of Debates (Hansard). 39th Parl, 1st Sess (February 23, 2009).

———. Legislative Assembly. Official Report of Debates (Hansard). 39th Parl, 1st Sess (March 2, 2009).

———. Ministry of Agriculture, Food and Rural Affairs (OMAFRA). *Rural Economic Development Program (RED): Program Guidelines*. Guelph, ON: OMAFRA, 2011. Accessed May 31, 2012. http://www.omafra.gov.on.ca/english/rural/red/live/docs/redguidelinesform.pdf.

———. Ministry of Economic Development and Innovation (MEDI). *Inverter, Mount & Tracker Mfrs.* Toronto: Queen's Printer for Ontario, 2012. Received March 19, 2012 from MEDI.

———. Ministry of Economic Development and Innovation. "Ontario Leads in Next Generation Solar Technologies." Last modified December 22, 2011. http://www.ontariocanada.com/ontcan/1medt/en/cleantech_solar_en.jsp.

———. Ministry of Economic Development and Innovation. *Photovoltaic Module Manufacturers and Suppliers in Ontario.* Toronto: Queen's Printer for Ontario, 2011. Received March 19, 2012 from MEDI.

———. Ministry of Energy. "FIT and microFIT Program." Accessed November 2, 2011. http://www.energy.gov.on.ca/en/fit-and-microfit-program/.

———. Ministry of Energy. *Ontario's Feed-In Tariff Program: Two-Year Review Report.* Toronto: Queen's Printer for Ontario, 2012. Accessed March 22, 2012. http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf.

———. Ministry of Energy and Infrastructure (MEI). *Ontario's Long-Term Energy Plan: Building Our Clean Energy Future.* Toronto: Queen's Printer for Ontario, 2010. Accessed January 13, 2012. http://www.mei.gov.on.ca/en/pdf/MEI_LTEP_en.pdf.

———. Ministry of Energy and Infrastructure. *Proposed Green Energy Act Attracts Industry-Wide Support.* Toronto: MEI, 2009. Accessed January 14, 2012. http://www.cansia.ca/sites/default/files/ONT%20MEI%20gea-quotes.pdf.

———. Ministry of Finance. *2009 Ontario Economic Outlook and Fiscal Review.* Toronto: Queen's Printer for Ontario, 2008. Accessed January 13, 2012. http://www.fin.gov.on.ca/en/budget/fallstatement/2009/ paper_all.pdf.

———. Ministry of Finance. "Ontario Fact Sheet April 2012." Accessed April 12, 2012, http://www.fin.gov.on.ca/en/economy/ecupdates/factsheet.html.

———. Ministry of Northern Development, Mines and Forestry (MNDMF). *Northern Ontario: A Profile.* Sudbury, ON: MNDMF, 2011. Accessed April 12, 2012. http://www.mndm.gov.on.ca/northern_development/documents/northern_ontario_e.pdf.

Ontario Chamber of Commerce (OCC). *2011 Pre-Election Business Survey Results*. Toronto: OCC, 2011. Accessed April 19, 2012. http://www.occ.on.ca/assets/OCC-2011-Pre-Election-Business-Survey-Report.pdf.

Ontario Energy Board (OEB). *2010 Yearbook of Electricity Distributors*. Toronto: OEB, 2011. Accessed May 13, 2012. http://www.ontarioenergyboard.ca/ OEB/_Documents/RRR/2010_electricity_ yearbook_excel.xls.

———. *Bill Impact Model for Incremental Investments.* Toronto: OEB, 2010. EB-2010-0377. Accessed March 14, 2012, http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/ webdrawer/rec/306345/view/.

———. *Distribution System Code*. Toronto: OEB, 2011. Accessed April 29, 2012. http://www.ontarioenergyboard.ca/OEB/_Documents/Regulatory/Distribution_System_Code.pdf.

Ontario Federation of Agriculture (OFA). "Become a Member." Accessed April 19, 2012. http://www.ofa.on.ca/become-member/default.aspx.

———. *The Green Energy Feed in Tariff Review: Recommendations of the Ontario Federation of Agriculture.* Guelph, ON: OFA, 2011. Accessed April 19, 2012. http://ofa.on.ca/issues/submission/Green-Energy-Feed-in-Tariff-Review.

Ontario Liberal Party. *The Ontario Liberal Plan for Rural Ontario.* Toronto: Ontario Liberal Party, 2011. Accessed May 15, 2012. http://www.ontarioliberal.ca/OurPlan/pdf/ruralnorthern/rural_platform_mini.pdf.

Ontario Power Authority (OPA). "Applications for microFIT Solar PV Projects – Update." Accessed April 30, 2012. http://microfit.powerauthority.on.ca/applications-microfit-solar-pv-projects-update.

———. *Bi-weekly FIT and microFIT Report*. Toronto: OPA, 2012. Accessed July 17, 2011. http://microfit.powerauthority.on.ca/sites/default/files/Bi-WeeklyReportJune25-2012.pdf.

———. "Bi-Weekly microFIT Program Reports." Accessed March 2, 2012. http://microfit.powerauthority.on.ca/bi-weekly-microfit-program-reports.

———. *EB-2006-0233 – Supplemental Settlement Proposal.* EB-2006-0233, Exhibit S-1-2, Issue 1, Item 1.6 Unpublished submission to the Ontario Energy Board (OEB), March 16, 2007. Received March 14, 2012 from the OEB.

———. "Eligible Participant Schedule." Accessed April 5, 2012. http://microfit.powerauthority.on.ca/eligible-participant-schedule.

———. *FIT/mFIT Price Schedule (April 5, 2012)*. Toronto: OPA, 2012. Accessed June 20, 2012. http://microfit.powerauthority.on.ca/sites/default/files/FIT%20and%20mFIT%20 Price%20 Schedule%20Version%202.0.pdf.

———. “FIT Price Schedule.” Accessed January 14, 2012. http://fit.powerauthority.on.ca/fit-price-schedule.

———. *microFIT Connections by City/Region (March 13, 2012)*. Unpublished data obtained from the OPA in response to Freedom of Information and Protection of Privacy Act Request 2012-012, 2012. Received May 28, 2012.

———. *microFIT Eligible Participant Schedule.* Toronto: OPA, 2012. Accessed May 14, 2012. http://microfit.powerauthority.on.ca/sites/default/files/microFIT%20Eligible%20Participant%20Schedule%20Version%202.0.pdf.

———. *microFIT Price Schedule – Revised August 13, 2010.* Toronto: OPA, 2010. Accessed January 14, 2012. http://microfit.powerauthority.on.ca/pdf/microFIT-Program-price-schedule.pdf.

———. *microFIT Rules: Version 2.0.* Toronto: OPA, 2012. Accessed April 5, 2012. http://microfit.powerauthority.on.ca/sites/default/files/microFIT%20Rules%20Version%202.0.1.pdf.

———. “New FIT Program Proposed for Commercial Aggregators.” Accessed April 1, 2012. http://microfit.powerauthority.on.ca/new-fit-program-proposed-commercial-aggregators.

———. “New Price Category Proposed for microFIT Ground-Mounted Solar PV Projects.” Last modified July 2, 2010. http://www.powerauthority.on.ca/news/new-price-category-proposed-microfit-ground-mounted-solar-pv-projects.

———. “Proposed Feed-In Tariff Price Schedule.” Presentation during Stakeholder Engagement Session 4, April 7, 2009. Accessed March 2, 2012. http://fit.powerauthority.on.ca/Storage/10147_FIT_Stakeholder_ Engagement_-_Session_4_FIT_Price_Schedule_FINAL_(HP).pdf.

———. “Rationale for New Ground-Mounted microFIT and FIT Program Price Category.” Last modified July 14, 2010. http://microfit.powerauthority.on.ca/rationale-new-ground-mounted-microfit-and-fit-program-price-category.

———. “Relocation Options for Constrained microFIT Projects.” Last modified April 5, 2012. http://microfit.powerauthority.on.ca/relocation-options-constrained-microfit-projects.

———. “Rule Change for New microFIT Applications.” Accessed May 1, 2012. http://microfit.powerauthority.on.ca/rule-change-new-microfit-applications.

———. “York Energy Centre (393.0 MW) – Northern York Region.” Accessed March 30, 2012. http://www.powerauthority.on.ca/clean-energy/york-energy-centre-393-mw-northern-york-region.

Ontario Progressive Conservative Party. “Affordable Energy Now: Hudak.” News release, March 22, 2012. http://www.ontariopc.com/news/affordable-energy-now-hudak/.

Ontario Sustainable Energy Association (OSEA). “OSEA Welcomes FIT Review Decision.” News release, March 20, 2012. http://www.ontario-sea.org/Page.asp?PageID=122&ContentID=3667&SiteNodeID=272&BL_ExpandID=.

———. *Submission for the Review of Ontario’s Feed-In Tariff Programs.* Toronto, OSEA, 2011. Accessed January 9, 2012. http://www.ontario-sea.org/ Storage/64/5564_OSEA_Submission_for_ the_ Review_of_Ontario%92s_Feed-in_Tariff_Programs.pdf.

Ontario Waterpower Association (OWA). *A Citizen’s Guide: Understanding the Class Environmental Assessment Process for Waterpower Projects.* Peterborough, ON: OWA, n.d. Accessed April 2, 2012. http://www.owa.ca/assets/files/classea/OWA%20Citizen's%20Guide.pdf.

Oraclepoll Research Limited. *July 2011 Ontario Omnibus Survey Report*. Toronto: Ontario Sustainable Energy Association, 2011. Accessed April 18, 2012. http://www.ontario-sea.org/Storage/60/5146_Ontario_Omnibus_Report_Green_Energy.pdf.

Pal, Leslie. *Beyond Policy Analysis: Public Issue Management in Turbulent Times*. 4th ed. Toronto: Nelson Education, 2010.

Passey, Robert, Ted Spooner, Iain MacGill, Muriel Watt, and Katerina Syngellakis. "The Potential Impacts of Grid-Connected Distributed Generation and How to Address Them: A Review of Technical and Non-Technical Factors." *Energy Policy* 39 (2011): 6280-6290. doi:10.1016/j.enpol.2011.07.027.

Patton, Michael. *Utilization-Focused Evaluation*. 4th ed. Thousand Oaks, CA: Sage Publications, 2008.

Pembina Institute. *Canadian Renewable Electricity Development: Employment Impacts.* N.p.: Clean Air Renewable Energy Coalition, 2004. Accessed April 10, 2012. http://www.cleanairrenewableenergycoalition.com/documents/Employment-Predictions.pdf.

———. "Pembina Reacts to Ontario's Feed-In Tariff Review." News release, March 22, 2012. http://www.pembina.org/media-release/2326.

Peters, B. Guy. "Legitimating Policy Choices." In *American Public Policy: Promise and Performance*. 7th ed. Washington, DC: CQ Press, 2007. http://common.books24x7.com.ezproxy.library.yorku.ca/toc.aspx?bookid=18266.

Peters, Roger and Tim Weis. *Feeding the Grid Renewably: Using Feed-In Tariffs to Capitalize on Renewable Energy.* Drayton Valley, AB: Pembina Institute, 2008. Accessed February 27, 2012. pubs.pembina.org/reports/FITariffs_Primer.pdf.

Pollara. *Green Energy Act, 2009 Survey*. Toronto: Green Energy Act Alliance, 2009. Accessed April 23, 2012. http://www.greenenergyact.ca/Storage/25/1707_GEA_Summary_Report.pdf.

Pollin, Robert, and Heidi Garrett-Peltier, *Building the Green Economy: Employment Effects of Green Energy Investments for Ontario*. Toronto: Green Energy Act Alliance, 2009. Accessed April 12, 2012. http://www.greenenergyact.ca/Storage/25/1722_PERI_ON_Green_Jobs_Report.pdf.

Pristine Power Inc. "Pristine Power Announces Award of a 20 Year Contract to York Energy Centre." News release, December 11, 2008. http://www.vereseninc.com/upload/careers/12/01/7-ppx-08-12-11.pdf.

Radwanski, Adam. “Smitherman Unexpectedly Plugs Back In To the Green-Energy Debate.” *Globe & Mail*, December 27, 2011. ProQuest (912711609).

Reed, Mark S., Anna C. Evely, Georgina Cundill, Ioan Fazey, Jayne Glass, Adele Laing, Jens Newig et al. “What is Social Learning?.” *Ecology and Society* 15*,* no. 4 (2010): n.p. http://www.ecologyandsociety.org/vol15/iss4/.

RenewableUK. *Working for a Green Britain: Vol 2.* London: RenewableUK, 2011. Accessed April 11, 2012. http://www.bwea.com/pdf/publications/Working_for_Green_Britain_V2.pdf.

Rogers, Jennifer C., Eunice A. Simmons, Ian Convery, and Andrew Weatherall. “Social Impacts of Community Renewable Energy Projects: Findings from a Woodfuel Case Study.” *Energy Policy* 42 (2012): 239-247. doi: 10.1016/j.enpol.2011.11.081.

Rowlands, Ian H. “Envisaging Feed-In Tariffs for Solar Photovoltaic Electricity: European Lessons for Canada.” *Renewable and Sustainable Energy Reviews*, 9 (2005): 51-68. doi:10.1016/j.rser.2004.01.010.

———. “Solar PV Electricity and Market Characteristics: Two Canadian Case-Studies.” *Renewable Energy* 30, no. 6 (2005): 815-834. doi: 10.1016/j.renene.2004.08.001.

Sabouba, Ayesha. “Distribution Issues.” Presentation at Solar Ontario 2011, Windsor, ON, May 2011. http://www.cansia.ca/sites/default/files/bing_young.pdf.

Salas, Vicente. *National Survey Report of PV Power Applications in Spain 2008*. N.p.: International Energy Agency, 2009. Accessed January 27, 2012. http://www.iea-pvps.org/index.php?id=93&eID=dam_ frontend_push&docI D=114.

Samco Solar. “Contract Manufacturer Samco Solar Announces New Ontario Facility.” News release, May 17, 2012. http://www.cansia.ca/sites/default/files/press_release_samco_solar_may_17th_ 2011.pdf.

Sathaye, Jayant, Oswaldo Lucon, Atiq Rahman, John Christensen, Fatima Denton, Junichi Fujino, Garvin Heath et al. "Renewable Energy in the Context of Sustainable Development." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, Kristin Seyboth, Patrick Matschoss, Susanne Kadner, Timm Zwickel et al., 9, 1-135. Cambridge, UK: Cambridge University Press, 2011. Accessed February 7, 2012. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

Sauter, Raphael, and Jim Watson. "Strategies for the Deployment of Microgeneration: Implications for Social Acceptance." *Energy Policy* 35 (2007): 2770-2779. doi: 10.1016/j.enpol.2006.12.006.

Schön, Donald A., and Martin Rein. *Frame Reflection: Toward the Resolution of Intractable Policy Controversies.* New York: Basic Books, 1994.

Seccaspina, Paul. *Green Energy & Perceptions of Wind in Ontario for Friends of Wind Ontario.* Montréal, QC: Oraclepoll Research Limited, 2011. Accessed April 19, 2012. http://www.oraclepoll.com/uploads/Friends_of_Wind_Sept7_11am_ver2222222.ppt.

Shufelt, Tim. "Ontario Solar Program in Disarray." *Financial Post*, July 7, 2010. Factiva (CWNS000020100707e67700d1i).

Shypula, Brian. "Hudak Would Pull Plug on microFIT." *Beacon Herald,* March 18, 2011. http://www.stratfordbeaconherald.com/ArticleDisplay.aspx?e=3033873&archive=true.

Simpson, T.W., A.N. Sharpley, R.W. Howarth, H.W. Paerl, and K.R. Mankin. "The New Gold Rush: Fueling Ethanol Production While Protecting Water Quality." *Journal of Environmental Quality* 37, no. 2 (2008): 318-324.

Sims, Ralph, Pedro Mercado, Wolfram Krewitt, Gouri Bhuyan, Damian Flynn, Hannele Holttinen, Gilberto Jannuzzi et al. "Integration of Renewable Energy Into Present and Future Energy Systems." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, Kristin Seyboth, Patrick Matschoss,

Susanne Kadner, Tim Zwickel et al., 8, 1-154. Cambridge, UK: Cambridge University Press, 2011. Accessed November 27, 2011. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

Singh, Virinder, and Jeffrey Fehrs. *The Work That Goes Into Renewable Energy*. Washington, DC: Renewable Energy Policy Project, 2001. Accessed April 10, 2012. http://www.repp.org/articles/static/1/binaries/LABOR_FINAL_REV.pdf.

Slater, Ann. *re: FIT Review.* Unpublished letter, National Farmers Union – Ontario (NFU-O), 2011. Received April 26, 2012 from the NFU-O.

Small, Lorne. *CFFO Submission on Microfit Programming.* Guelph, ON: Christian Farmers Federation of Ontario, 2011. Accessed April 20, 2012. http://www.christianfarmers.org/images/microfit.pdf.

Smitherman, George. *Directive to the CEO of the Ontario Power Authority.* Toronto: Ontario Ministry of Energy and Infrastructure, 2009. Accessed October 25, 2011. http://www.powerauthority.on.ca/sites/default/files/page/15420_FIT_ Directive_Sept_24_09.pdf.

Spears, John. "Ontario Solar Projects Put On Hold." *Toronto Star*, February 11, 2011. http://www.thestar.com/business/article/937782--ontario-solar-projects-put-on-hold.

———. "Review Clouds Outlook for Solar Firms: New Projects Grind to a Halt While Province Determines New Prices." *Toronto Star*, November 8, 2011. Proquest (902586095).

Stevens, Henry. *RE: The New Price Category Proposed for Microfit Ground-Mounted Solar PV Projects*. Guelph, ON: Christian Farmers Federation of Ontario, 2010. Accessed April 20, 2012. http://www.christianfarmers.org/uploadpics/The%20New%20Price%20Category%20Proposed%20for%20Microfit%20Ground-mounted%20Solar%20PV%20Projects.pdf.

Stimmel, Ron. *In the Public Interest: How and Why to Permit for Small Wind Systems.* Washington, DC: American Wind Energy Association, 2008. Accessed February 7, 2012. http://www.awea.org/learnabout/smallwind/upload/InThePublicInterest.pdf.

Teske, Sven, and Volker U. Hoffmann. “A History of Support for Solar Photovoltaics in Germany.” In *Renewable Energy Policy and Politics*, ed. Karl Mallon, 229-240. London: Earthscan, 2006.

Tetra Tech, Inc. *Potential Health and Environmental Impacts Associated with the Manufacture and Use of Photovoltaic Cells*. Palo Alto, CA: Electric Power Research Institute and California Energy Commission, 2003. Accessed July 6, 2012. http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405.

Town of Aurora. *General Committee Meeting Report*. Aurora, ON: Town of Aurora, 2012. February 7, 2012. Accessed March 8, 2012. http://www.town.aurora.on.ca/app/wa/mediaEntry?mediaEntryId=59522.

United Nations Environment Program, Frankfurt School-UNEP Collaborating Centre for Climate & Sustainable Energy Finance, and Bloomberg New Energy Finance. *Global Trends in Renewable Energy Investment 2012*. Frankfurt, Germany: Frankfurt School of Finance and Management, 2012. Accessed July 17, 2012. http://fs-unep-centre.org/sites/default/files/media/globaltrendsreport2012_3.pdf.

United States. Department of Health and Human Services. *Report on Carcinogens.* 12th ed. N.p.: Department of Health and Human Services, 2011. Accessed June 11, 2012. http://ntp.niehs.nih.gov/ntp/roc/twelfth/roc12.pdf.

———. Energy Information Administration. *AEO2012 Early Release Overview*. Washington, DC: U.S. Department of Energy, 2012. Accessed March 21, 2012. http://www.eia.gov/forecasts/aeo/er/pdf/0383er(2012).pdf.

———. Energy Information Administration. *Updated Capital Cost Estimates for Electricity Generation Plants.* Washington, DC: U.S. Department of Energy, 2011. Accessed March 19, 2012, http://www.eia.gov/oiaf/beck_plantcosts/pdf/updatedplantcosts.pdf.Viebahn, P., S. Kronshage,

F. Trieb, and Y. Lechon. *Final Report on Technical Data, Costs, and Life Cycle Inventories of Solar Thermal Power Plants.* Brussels: European Commission, 2008.

Vision Critical. *Party Energy Proposals Poll*. Toronto: Environmental Defence, 2011. Accessed April 27, 2012. http://environmentaldefence.ca/sites/default/files/report_files/PARTY%20ENERGY%20 PROPOSALS% 20POLL.xls.

Walker, Gordon, Sue Hunter, Patrick Devine-Wright, Bob Evans, and Helen Fay. "Harnessing Community Energies: Explaining and Evaluating Community-Based Localism in Renewable Energy Policy in the UK." *Global Environmental Politics* 7, no. 2 (2007): 64-82. http://muse.jhu.edu/journals/gep/summary/v007/7.2walker.html.

Wallner, Jennifer. "Legitimacy and Public Policy: Seeing Beyond Effectiveness, Efficiency and Performance." *The Policy Studies Journal* 36, no. 3 (2008): 421–443. doi: 10.1111/j.1541-0072.2008.00275.x.

Wettlaufer, Paul. "Government Can't Rewrite the Deal." *Ontario Federation of Agriculture*. Last modified July 9, 2010. http://legacy.ofa.on.ca/index.php?p=238&a=2279.

White, Shelley. "It's Not Easy Being Green." *Globe and Mail,* November 29, 2011. ProQuest (906333534).

Winfield, Mark, Robert B. Gibson, Tanya Markvart, Kyrke Gaudreau, and Jennifer Taylor. "Implications of Sustainability Assessment for Electricity System Design: The Case of the Ontario Power Authority's Integrated Power System Plan." *Energy Policy* 38, no. 8 (2010): 4115-4126. doi: 10.1016/j.enpol.2010.03.038.

Winfield, Mark S. *Blue-Green Province: The Environment and the Political Economy of Ontario*. Vancouver: UBC Press, 2012.

Wiser, Ryan, Zhenbin Yang, Maureen Hand, Olav Hohmeyer, David Infield, Peter H. Jensen, Vladimir Nikolaev et al. "Wind Energy." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, edited by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, Kristin

Seyboth, Patrick Matschoss, Susanne Kadner, Timm Zwickel et al., 7, 1-108. Cambridge, UK: Cambridge University Press, 2011. Accessed February 7, 2012. http://srren.ipcc-wg3.de/report/IPCC_SRREN_Full_Report.pdf.

Wolfson, Monica. "Green Act Changes Spark Fear." *The Windsor Star,* November 2, 2011. ProQuest (902206843).

World Health Organization. "Silicosis." Last modified May, 2000. http://www.who.int/peh/Occupational_health/OCHweb/OSHpages/OSHDocuments/Factsheets/Silicosis.htm.

World Trade Organization. "Canada – Certain Measures Affecting the Renewable Energy Generation Sector." Dispute DS412. Accessed April 15, 2012. http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds412_e.htm.

WSE Technologies. "FAQ's." Accessed April 6, 2012. http://www.wsemicrofit.com/faq#oversize.

WWF Canada. "WWF Applauds Changes to Ontario Green Energy Plan" News release, March 22, 2012. http://m.wwf.ca/newsroom/?10601/WWF-applauds-changes-to-Ontario-Green-Energy-Plan.

Yatchew, Adonis, and Andy Basiliauskas. "Ontario Feed-In-Tariff Programs." *Energy Policy* 39, no.7 (2011): 3885-3893. doi: 10.1016/j.enpol.2011.01.033.

Statutes, Regulations and Adopted Texts

European Parliament, *European Parliament Resolution of 8 June 2011 on EU-Canada Trade Relations,* 2011, P7_TA(2011)0257, http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2011-0257+0+DOC+XML+V0//EN.

Green Energy and Green Economy Act, SO 2009, c12.

Ontario Energy Board Act, SO 1998, c 15, Schedule B.

O Reg 359/09.

O Reg 490/09.

Appendix A: Geographic distribution of microFIT Projects

Table 1

Location, renewable fuel, and nameplate capacity of all executed microFIT contracts in Ontario as of March 13, 2012, by city or region

	Landfill gas		Solar (PV)*		Solar (Non-Rooftop)		Solar (Rooftop)		Wind		Total	
City/Region	Total MicroFIT Contracts	Average Contract Capacity (kW)	Total MicroFIT Contracts	Average Contract Capacity (kW)	Total MicroFIT Contracts	Average Contract Capacity (kW)	Total MicroFIT Contracts	Average Contract Capacity (kW)	Total MicroFIT Contracts	Average Contract Capacity (kW)	Total MicroFIT Contracts	Average Contract Capacity (kW)
Acton			6	9.06	10	9.99	9	8.02			25	9.06
Ajax			6	4.40			7	5.96			13	5.24
Algoma Southwest			13	8.68	30	9.74	60	8.18			103	8.70
Algoma, Sudbury District and Rural Greater Sudbury			6	6.03	27	9.27	9	7.67			42	8.46
Alliston			5	6.98	5	8.96	6	7.28			16	7.71
Amherstburg			5	10.00	8	9.36	10	8.89			23	9.29
Amherstview							1	9.98			1	9.98
Ancaster			4	7.42	4	10.00	7	5.71			15	7.31
Arnprior			4	3.78	9	9.94	4	8.73			17	8.21
Aurora			2	2.54			11	5.47			13	5.02
Aylmer			1	10.00	27	9.99	5	10.00			33	9.99
Baden			20	8.15	36	9.87	21	8.79			77	9.13
Barrie			9	6.35	2	10.00	31	8.15			42	7.85
Belleville			20	6.81	11	8.95	23	8.39			54	7.92
Bolton			4	6.88	3	10.00	8	9.30			15	8.80
Bowmanville			14	5.95	6	10.00	26	7.10			46	7.13
Bracebridge			5	8.14	2	6.18	11	8.66			18	8.24

Bradford					1	10.00	7	7.64			8	7.94
Brampton			7	8.49			13	6.35			20	7.10
Brant and Norfolk Counties			24	9.79	77	9.88	44	9.17			145	9.65
Brantford			9	7.12	14	9.47	36	8.63			59	8.60
Brockville			10	9.04	16	9.89	4	8.48			30	9.42
Bruce Peninsula			43	6.64	95	9.06	45	7.63			183	8.14
Burlington			10	5.33	1	10.20	26	7.16			37	6.75
Caledon			9	7.55	9	9.90	12	7.58			30	8.27
Caledon Village			5	9.01	7	10.00	5	6.67			17	8.73
Caledonia			6	7.93	5	9.96	5	9.43			16	9.03
Cambridge			13	6.26	8	9.84	74	7.63			95	7.63
Carleton Place			1	9.88	9	9.69	8	8.72			18	9.27
Chatham–Kent			34	9.44	27	9.93	4	7.70			65	9.53
Cobourg			12	6.13	11	9.09	17	8.92			40	8.13
Collingwood			8	4.86	5	9.15	15	6.29			28	6.39
Concord			1	5.28			2	9.94			3	8.38
Cornwall					1	10.00					1	10.00
Courtice			1	2.10	1	10.00	7	5.31			9	5.47
Delhi			1	10.00	5	10.00	5	10.00			11	10.00
Don Mills			2	6.75			6	6.63			8	6.66
Downsview			2	2.40			1	2.88			3	2.56
Dryden			7	8.28	6	9.01	12	9.17			25	8.88
Dufferin County			10	7.73	35	9.94	17	9.32			62	9.41
Dundas			6	4.83	4	9.70	23	7.56			33	7.33
Dunnville			8	9.71	29	9.65	10	9.13			47	9.55
East Durham Region			8	6.68	24	9.58	17	7.79			49	8.49
East Gwillimbury							1	8.60			1	8.60

East Haldimand County / Northwest Niagara Region / Most of rural Hamilton			28	9.33	86	9.75	81	9.30			195	9.50
East York			9	3.97			11	3.26			20	3.58
Eastern & Central Prescott and Russell United Counties			9	8.48	61	9.89	32	9.89	2	10.00	104	9.77
Elgin County			60	9.57	92	9.82	14	9.33			166	9.69
Elizabethtown-Kitley							1	10.00			1	10.00
Elliot Lake							6	8.82			6	8.82
Elmira			10	8.95	4	9.90	9	7.71			23	8.63
Espanola							2	5.13			2	5.13
Essex			13	9.86	18	9.70	5	7.56			36	9.46
Essex County			47	9.40	137	9.89	53	8.16			237	9.40
Etobicoke			15	4.70			30	5.99			45	5.56
Fergus			6	7.74	9	9.86	9	9.50			24	9.19
Fort Erie							1	10.00			1	10.00
Fort Frances					10	10.00	6	8.97			16	9.61
Frontenac County, Lennox and Addington County, Southwest Leeds and Loyalist Shores			78	7.23	142	9.66	94	8.47			314	8.70
Gananoque			4	10.00	4	9.69	9	8.49			17	9.13
Georgetown			3	6.12	1	10.00	26	8.19			30	8.04

Georgian Bay South Shore			12	9.43	42	9.45	24	8.48			78	9.15
Georgian Bay Southwest Shore			13	8.91	64	9.55	16	7.39			93	9.09
Goderich			19	9.77	31	9.77	2	10.00			52	9.78
Gravenhurst							6	8.27			6	8.27
Greater Sudbury			12	7.56	8	8.25	31	6.45			51	6.99
Grimsby			2	5.46	4	9.92	8	9.13			14	8.83
Guelph			18	5.59	9	10.05	84	7.37			111	7.30
Halton Region			12	7.50	12	9.94	16	9.13			40	8.88
Hamilton			16	5.89	3	7.61	56	6.98			75	6.77
Hanover			2	6.20	11	9.98	4	6.95			17	8.82
Hawkesbury					2	10.00					2	10.00
Huntsville			8	8.16	14	8.19	29	7.47			51	7.77
Ingersoll			8	9.95	4	9.88	6	7.43			18	9.09
Innisfil			9	8.86	8	9.88	7	6.79			24	8.59
Kapuskasing			8	9.95	19	9.99	2	9.90			29	9.97
Kawartha Lakes and Haliburton County			12	6.14	61	9.75	72	8.24			145	8.70
Kenora					1	10.00	9	8.70			10	8.83
Kenora Region			3	9.37	2	9.75	8	7.92			13	8.53
Kent County			172	9.73	238	9.79	13	8.61			423	9.73
Keswick			2	6.36	3	10.00	8	8.19			13	8.33
Kincardine			5	8.64	15	9.80	9	6.95			29	8.71
King City			1	4.80	1	9.88	1	4.95			3	6.54
Kingston			49	6.75	8	8.59	77	7.78			134	7.45
Kingsville			4	9.75	11	9.96	6	7.46			21	9.21
Kitchener			15	5.76	2	9.50	61	6.49			78	6.43
La Salle			4	7.45			11	8.49			15	8.21

Lake Simcoe North Shore			6	8.27	32	9.95	20	8.15			58	9.16
Lake Simcoe Southeast Shore			3	2.31	8	9.41	12	6.68			23	7.06
Lake Simcoe West Shore			44	9.33	74	9.49	25	8.56			143	9.28
Lake Superior East Shore			4	4.78	3	10.00	16	8.92			23	8.34
Lake Superior North Shore			7	5.93	41	9.85	25	8.54			73	9.03
Lambton County			34	9.13	90	9.81	29	8.40			153	9.39
LaSalle			1	8.30	1	10.00	2	7.50			4	8.33
Leamington			30	9.39	19	9.33	9	8.59			58	9.24
Lindsay			1	10.00	11	9.19	21	8.49			33	8.77
Listowel			6	9.93	17	9.66	1	10.00			24	9.74
London			43	6.73	19	9.88	54	8.39			116	8.02
Manitoulin			5	6.72	18	10.03	26	8.08			49	8.66
Maple			6	5.26			10	5.51			16	5.42
Markham			13	6.56	2	10.00	30	6.24			45	6.50
Meaford			2	7.10	4	8.15	3	7.83			9	7.81
Middlesex County			155	9.59	199	9.74	30	9.00			384	9.63
Midland			1	3.40	4	10.00	4	9.63			9	9.10
Milton			9	7.76	1	10.00	50	6.51	1	4.80	61	6.72
Mississauga			24	4.71			43	6.51			67	5.86
Napanee			8	8.11	33	9.84	18	8.63			59	9.23
National Capital Region			38	9.01	116	9.80	90	9.23	1	10.00	245	9.47
Neebing			3	5.25	4	10.00	2	8.88			9	8.17
Newmarket			6	2.88	6	10.00	38	7.05			50	6.90
Niagara Falls			3	8.91	7	9.26	18	7.46			28	8.06

Nipissing Central			3	3.13	16	9.92	11	9.14			30	8.96
Nipissing North			14	8.48	39	9.91	33	9.33			86	9.46
Nipissing South			3	5.17	7	8.99	9	8.70			19	8.25
North Bay			3	9.33			10	7.50			13	7.92
North Peel Region			4	6.18							4	6.18
North York	2	7.00	6	3.77			22	6.53			30	6.01
Northwestern Ontario			5	3.98	4	10.00	2	7.42			11	6.80
Oakville			11	6.23	1	9.98	12	5.93			24	6.24
Ontario Centre			17	8.29	30	9.65	40	9.09			87	9.13
Orangeville			7	5.18	16	9.09	17	8.82			40	8.29
Orillia			20	9.42	12	9.96	11	8.49			43	9.33
Oshawa			5	5.91	1	9.12	22	6.76			28	6.69
Ottawa			63	5.50	20	9.83	240	7.82			323	7.49
Owen Sound			5	5.09	42	9.57	20	7.77			67	8.70
Oxford County			50	9.70	111	9.83	33	9.45			194	9.73
Paris			5	5.41	6	9.08	4	6.30			15	7.12
Parry Sound			2	5.70	3	10.00	6	7.35			11	7.77
Parry Sound Mid-Shore			1	7.36	4	10.00	4	5.94			9	7.90
Parry Sound North Shore			6	6.40	2	9.89	5	8.65			13	7.80
Parry Sound South Shore			5	5.29	1	10.00	1	5.00			7	5.92
Pembroke			5	8.98	19	10.00	12	8.81			36	9.46
Penetanguishene			2	7.30	7	9.23	1	8.00			10	8.72
Perth			12	5.92	11	9.68	9	7.80			32	7.74
Perth County			41	9.60	97	9.78	9	8.80			147	9.67
Petawawa			1	5.13	1	10.00	2	10.00			4	8.78

Peterborough			21	6.46	22	9.55	46	7.96			89	8.00
Peterborough County and North Hastings County			64	8.58	162	9.84	74	8.84			300	9.33
Pickering			5	4.27	4	10.00	8	6.01			17	6.44
Port Colborne			7	3.93	1	10.00	4	8.46			12	5.95
Port Hope			5	4.65	6	10.00	6	6.89			17	7.33
Port Perry			7	6.91	9	10.00	9	8.37			25	8.55
Port Stanley			10	9.30			2	7.85			12	9.06
Quinte Shores, East Northumberland County & Prince Edward County			150	8.38	331	9.74	147	8.69			628	9.17
Rainy River Region			5	8.75	35	9.92	4	8.65			44	9.67
Remote Northeast and Kapuskasing Region			19	9.47	46	9.97	17	9.29			82	9.71
Renfrew			16	8.67	17	9.96	7	8.67			40	9.22
Renfrew County and Lanark Highlands Township			14	8.62	78	9.71	37	9.02			129	9.39
Richmond Hill			11	5.76	1	4.84	20	6.80			32	6.38
Rideau Lakes area			27	8.00	70	9.48	32	8.67			129	8.97
Rockland			1	6.84	2	9.28	3	7.84			6	8.15
Russell					5	9.00	3	7.92			8	8.60
Sarnia			7	7.80	10	9.10	30	7.86			47	8.12

Sault Ste. Marie			10	8.57	2	10.00	31	8.78			43	8.78
Scarborough			13	3.43	2	5.26	35	6.12	2	4.50	52	5.36
Simcoe			12	9.50	19	9.99	13	10.02			44	9.87
Sioux Lookout			1	9.69	2	10.00	2	7.80			5	9.06
Smiths Falls			1	3.30	15	10.14	2	6.94			18	9.41
South and Northeast Niagara Region			8	7.26	23	9.36	62	8.73			93	8.76
South Leeds and Grenville United Counties			32	9.52	112	9.37	18	8.65			162	9.32
Southern Bruce and Huron Counties			135	9.46	299	9.79	49	9.46			483	9.67
St. Catharines			9	9.02	3	9.51	41	8.51			53	8.65
St. Marys			23	8.33	25	9.71	5	9.51			53	9.09
St. Thomas			7	9.89	5	9.92	18	8.95			30	9.33
Stormont, Dundas and Glengarry United Counties			6	8.48	89	9.82	37	8.93			132	9.51
Stouffville			7	5.57	5	9.34	12	7.50			24	7.32
Stratford			28	9.83	30	9.72	11	9.58			69	9.74
Strathroy-Caradoc			16	9.29	14	9.91	2	8.50			32	9.51
Sturgeon Falls			1	10.00	5	9.84	2	7.95			8	9.39
Tecumseh			8	8.67			13	7.91			21	8.20
Thornhill			6	4.11			10	4.46			16	4.33
Thunder Bay			36	8.17	26	9.88	87	8.58			149	8.71
Tillsonburg			4	9.98	14	9.89	10	9.05			28	9.60
Timiskaming North			1	10.00			3	6.63			4	7.47

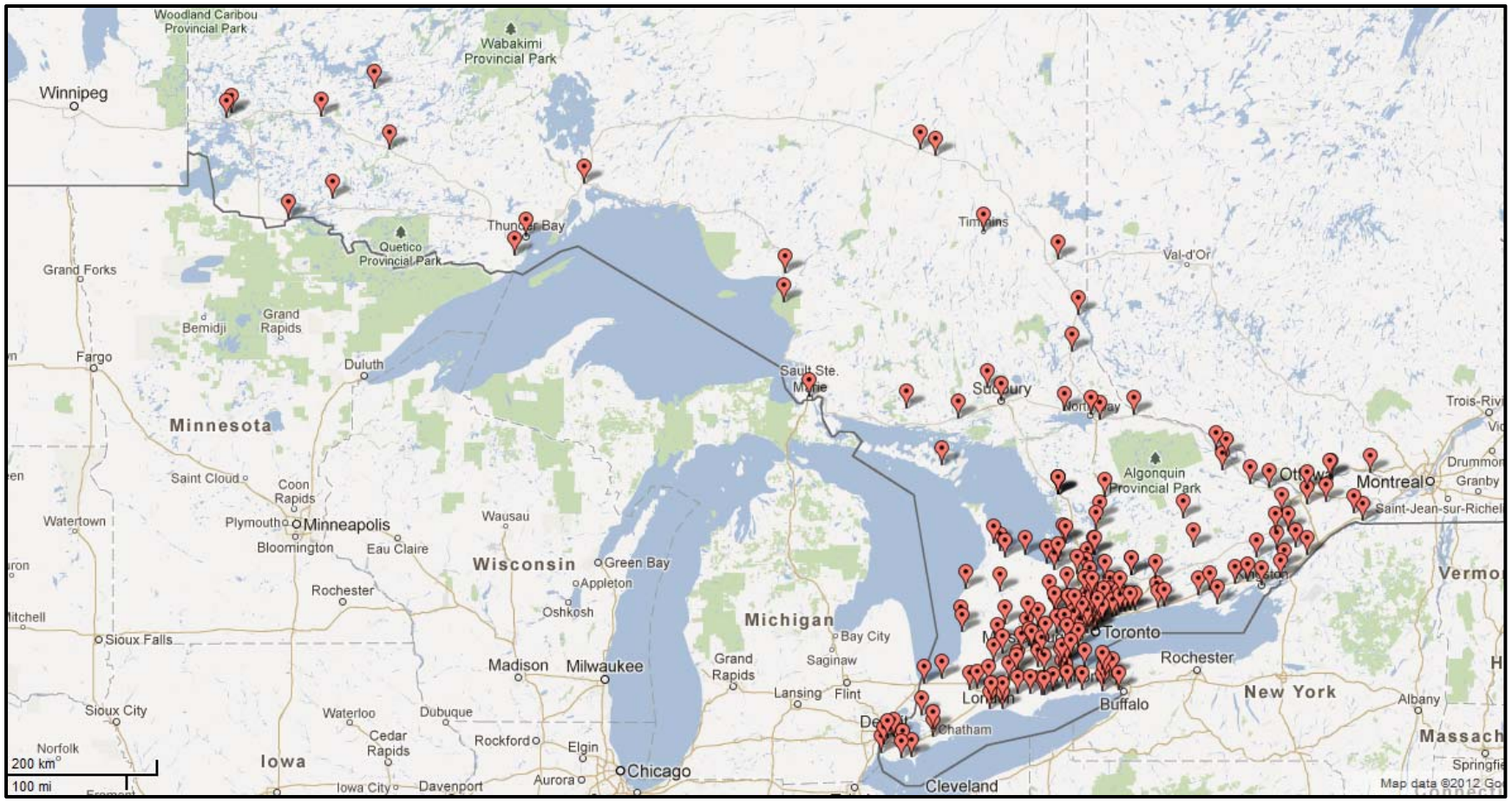
Timiskaming South			1	10.00	11	9.98	6	8.96			18	9.64
Timmins			1	10.00			1	9.88			2	9.94
Toronto			87	2.69			67	4.30			154	3.39
Trenton			4	5.57	26	9.48	14	8.53			44	8.82
Uxbridge			10	7.77	13	8.31	9	8.50			32	8.19
Wallaceburg			30	9.73	27	9.97					57	9.84
Wasaga Beach			2	7.50	1	3.87	11	8.58			14	8.09
Waterloo			28	4.16	4	8.25	37	6.82			69	5.82
Welland			1	9.36	3	10.00	7	10.00			11	9.94
Wellington County & Rural Waterloo Region			71	8.98	122	9.91	126	8.37			319	9.10
West Durham Region			4	8.97	13	10.00	14	9.43			31	9.61
West Haldimand County			17	9.51	66	9.90	29	9.45			112	9.72
West Northumberland County			10	6.42	28	10.02	13	8.20			51	8.85
Weston							2	6.55			2	6.55
Whitby			6	5.48	2	9.94	15	5.95			23	6.17
Whitby Region			1	10.00			1	9.88			2	9.94
Willowdale			3	2.65			20	5.90			23	5.47
Windsor			23	6.81	5	9.98	67	7.16			95	7.22
Woodbridge			7	6.96			6	4.52	1	1.80	14	5.55
Woodstock			18	6.96	18	9.87	20	7.99			56	8.26
York			18	4.49			9	4.13			27	4.37
Grand total	**2**	**7.00**	**2,872**	**7.94**	**4,694**	**9.72**	**4,117**	**8.00**	**7**	**6.51**	**11,692**	**8.68**

*Early microFIT Solar Applicants were not required to specify whether their projects were rooftop or non-rooftop. Unspecified projects fall under the "Solar (PV)" category

Source: Ontario Power Authority, *microFIT Connections by City/Region (March 13, 2012)* (unpublished data obtained from the OPA in response to Freedom of Information and Protection of Privacy Act Request 2012-012, 2012), received May 28, 2012.

Figure 1

The distribution of all executed microFIT contracts in Ontario as of March 13, 2012, by city or region



Source: Ontario Power Authority (OPA), *microFIT Connections by City/Region (March 13, 2012)* (unpublished data obtained from the OPA in response to Freedom of Information and Protection of Privacy Act Request 2012-012, 2012), received May 28, 2012. This map and all others in Appendix A extrapolated from data.

Figure 2

The distribution of all executed microFIT contracts in Ontario as of March 13, 2012, by city or region and number of microFIT projects

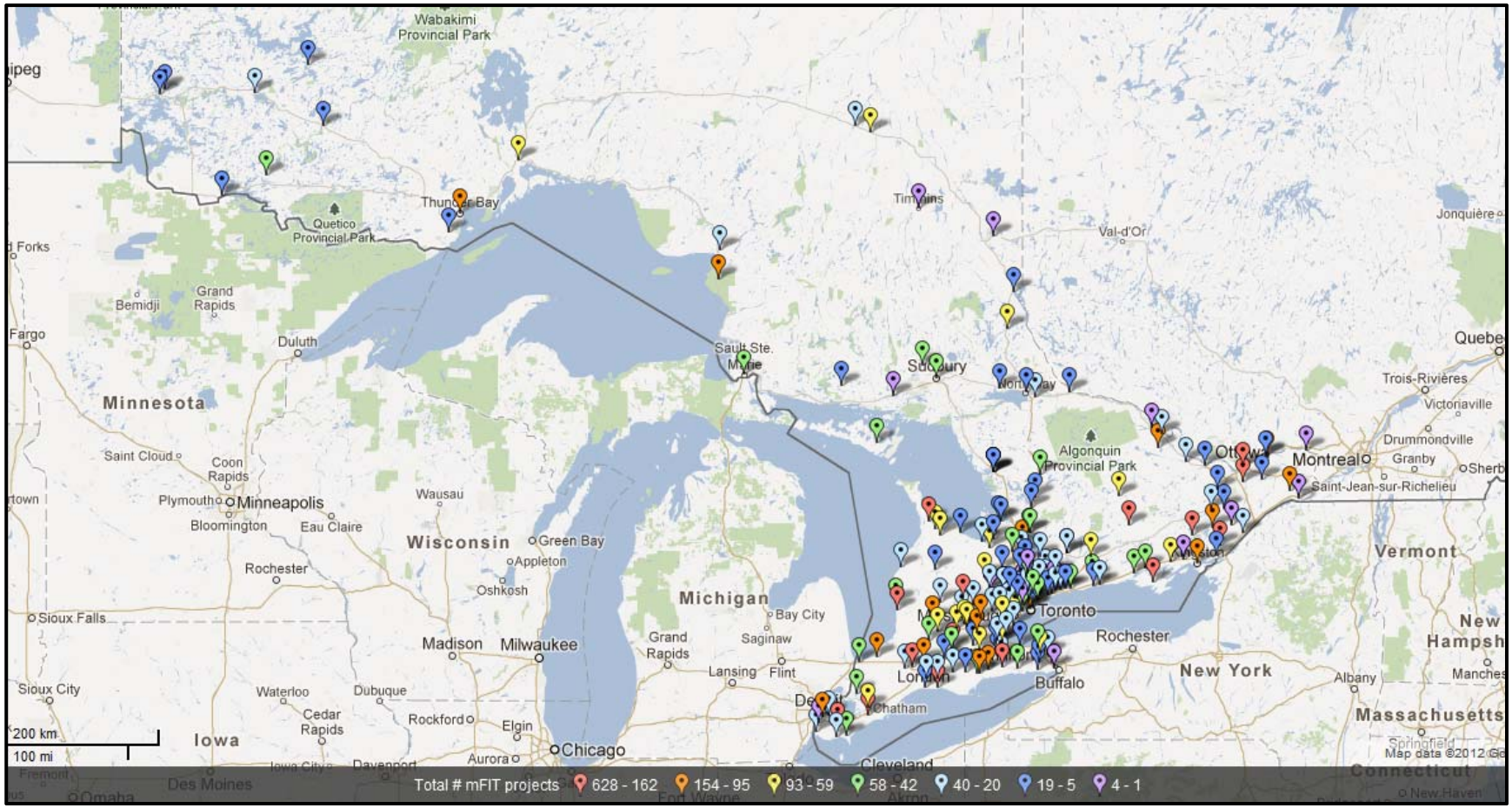


Figure 3

The distribution of all executed microFIT contracts in Ontario as of March 13, 2012, by city or region and number of ground-mounted solar PV projects

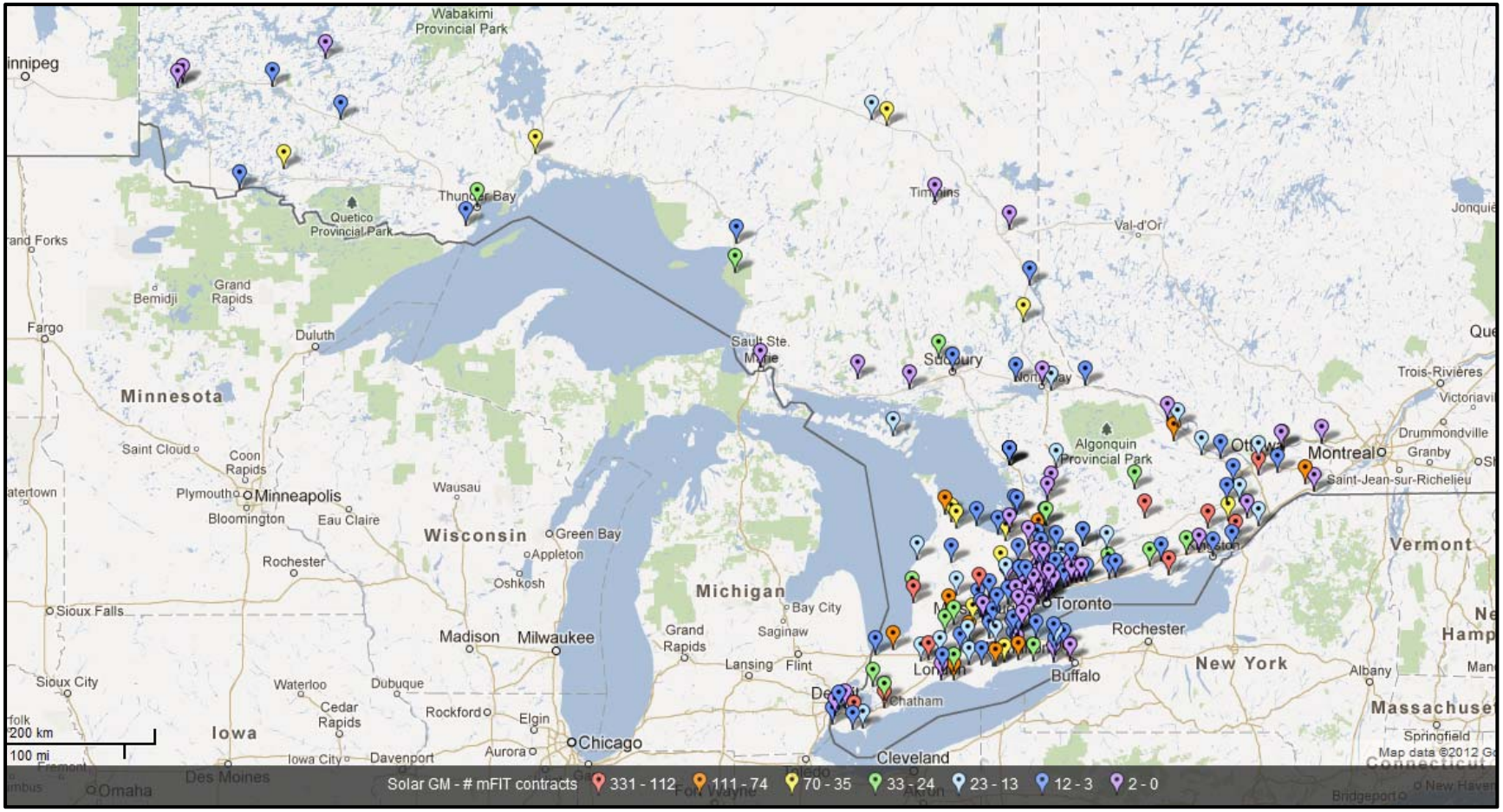


Figure 4

The distribution of all executed microFIT contracts in Ontario as of March 13, 2012, by city or region and number of rooftop solar PV projects

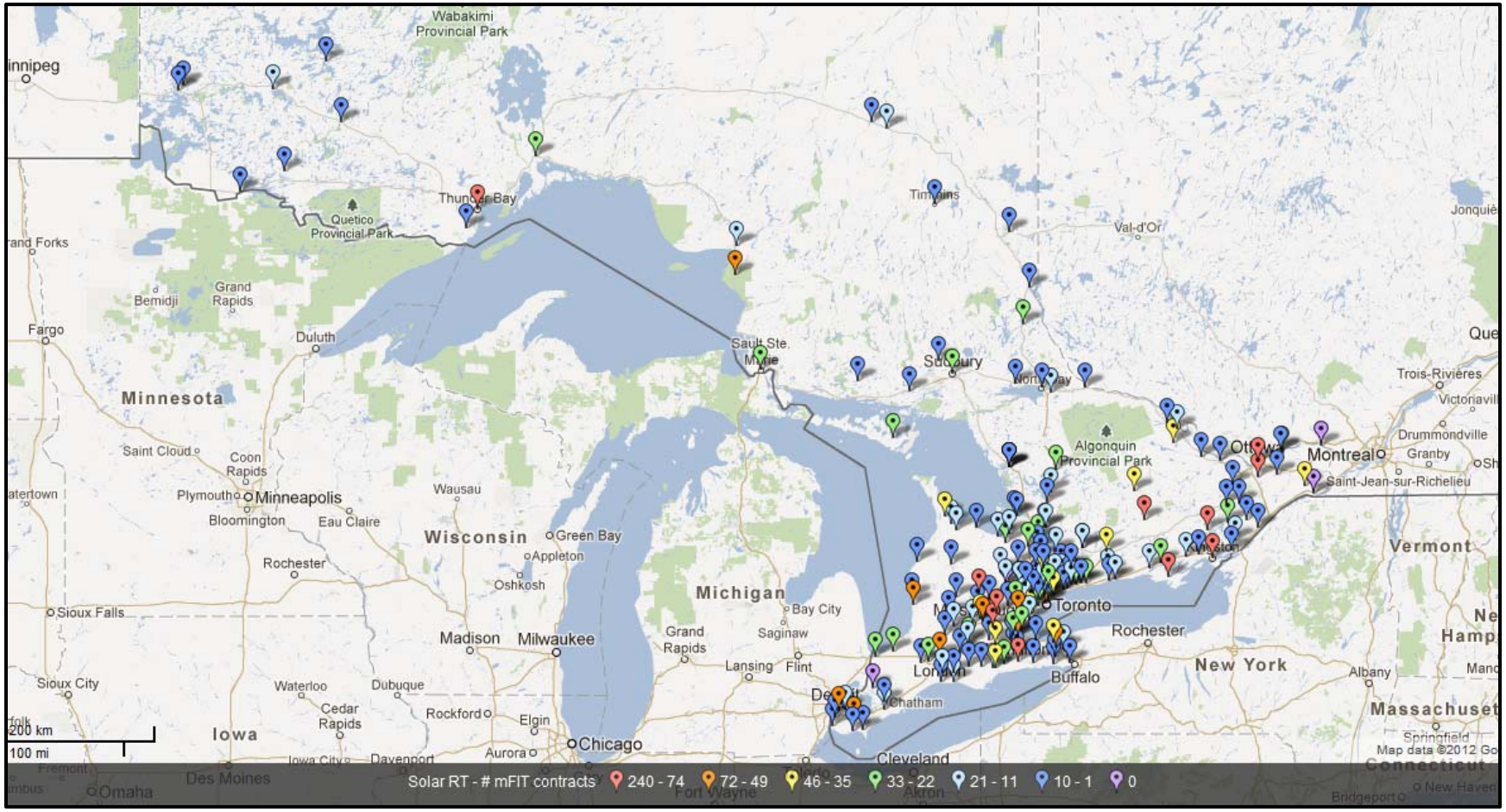
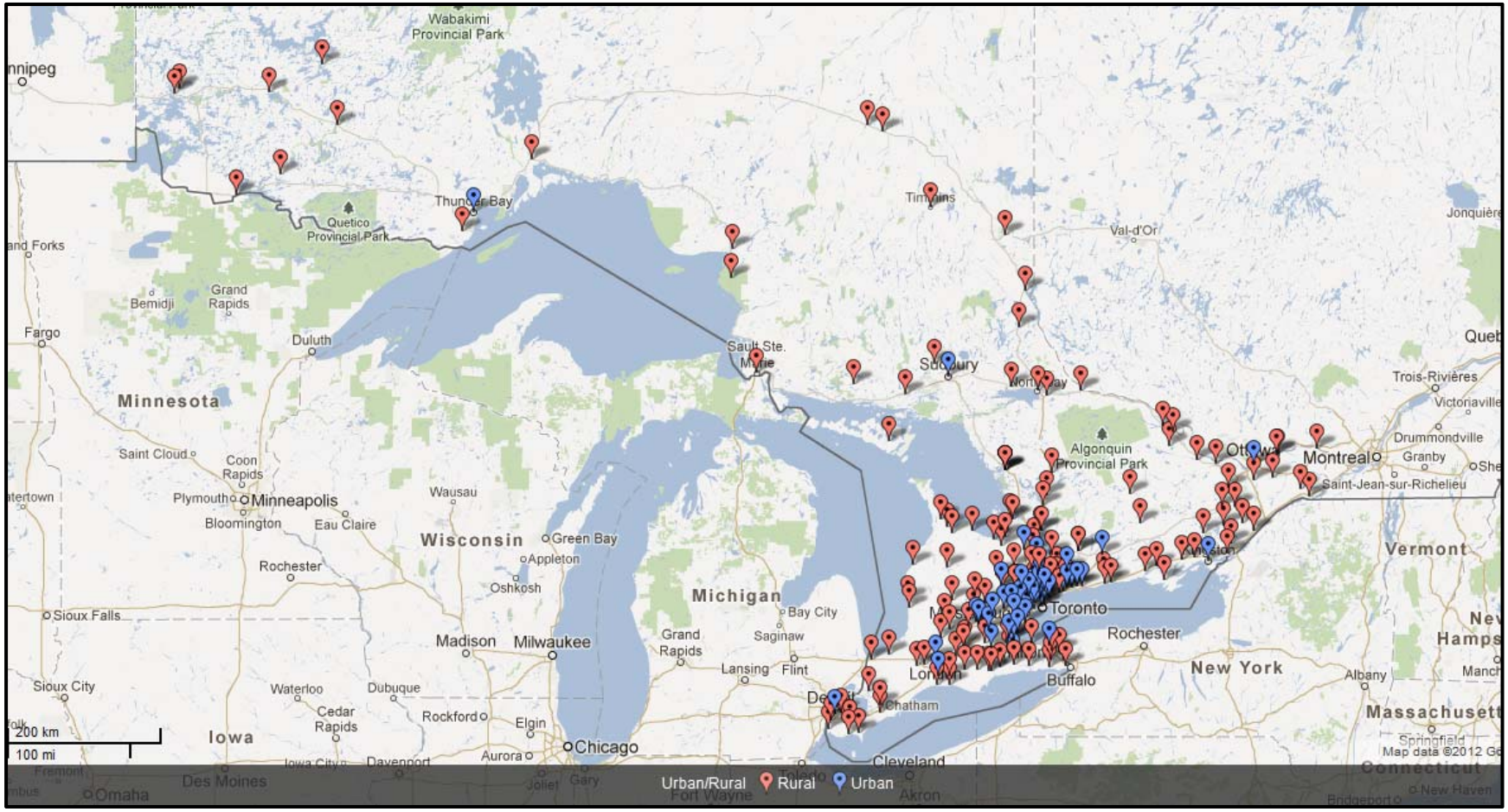


Figure 5

The distribution of all executed microFIT contracts in Ontario as of March 13, 2012, by city or region and urban or rural location



Appendix B: **Estimates of solar PV project costs, 2010-2012**

Table 1

Representative project descriptions and assumptions

Representative project type	**System description (pre-program review)**	**System description (post-program review)**	**Tilt (°)**	**Azimuth (°)**	**Maintenance cost (% of installed cost per year)**
Urban commercial rooftop, ballast-mount	11.96 kW_{DC}/9.88 kW_{AC}	10 kW_{DC}/8.6 kW_{AC}	30	200	0.25
Urban residential rooftop	5.98 kW_{DC}/4.94 kW_{AC}	6.12 kW_{DC}/5.16 kW_{AC}	26	200	0.25
Rural fixed ground-mount	11.96 kW_{DC}/9.88 kW_{AC}	10 kW_{DC}/8.6 kW_{AC}	33	175	0.25
Rural dual-axis tracking ground-mount	11.96 kW_{DC}/9.88 kW_{AC}	10 kW_{DC}/8.6 kW_{AC}	-	-	0.5
Rural rooftop	11.96 kW_{DC}/9.88 kW_{AC}	10 kW_{DC}/8.6 kW_{AC}	26	200	0.25

Source: Dynamic Solar Tech Inc., *MicroFIT Costs, Revenues,* unpublished data, 2012, received May 7, 2012 from Dynamic Solar Tech Inc. All information in Appendix B is from this source. A degradation rate of 0.5% per year and no shade are also assumed.

Table 2

Representative project revenue and return on investment (ROI)

	3rd Quarter 2010		**3rd Quarter 2011**		**2nd Quarter 2012[a]**	
Project type	**20-year revenue (CAD)**	**ROI ratio**	**20-year revenue (CAD)**	**ROI ratio**	**20-year revenue (CAD)**	**ROI ratio**
Urban commercial rooftop, ballast-mount	122,693	1.298	143,693	1.955	77,059	1.631
Urban residential rooftop	60,904	1.288	68,904	1.756	42,090	1.253
Rural fixed ground-mount	At tariff of 80.2¢/kWh: 130,503	At tariff of 80.2¢/kWh: 1.429	107,243	1.524	57,772	1.280

	At tariff of 64.2¢/kWh: 86,243	At tariff of 64.2¢/kWh: 0.944				
Rural dual-axis tracking ground-mount	At tariff of 80.2¢/kWh: 181,506	At tariff of 80.2¢/kWh: 1.571	138,753	1.402	55,289	0.670
	At tariff of 64.2¢/kWh: 122,253	At tariff of 64.2¢/kWh: 1.058				
Rural rooftop	121,792	1.288	142,792	1.943	76,431	1.618

Notes:

a: A revised version of the microFIT Program had not been officially launched at the time of print. As such, cost estimates for 2012 are speculative. In addition, system cost estimates included in the revenue and ROI estimates for the second quarter of 2012 are accurate for that time period, but are likely to have changed since.

Parameters of solar PV project cost estimates

Estimates of the costs of solar PV projects include equipment, engineering, installation, and maintenance. Estimates exclude financing costs, sales taxes (PST, GST, HST), income tax, insurance costs, connection charges, building permits, electrical permits, ongoing LDC charges, potential inverter replacement, disposal costs, and potential costs incurred during roof replacement.