

Powering the green economy with The Feed-In Tariff, Ontario

MEPP Inquiry Paper



Inspiring Innovation and Discovery



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Abstract

According to Ontario's long-term energy plan, the electricity demand will increase from 157 TWh in 2010 to 198 TWh by 2030. Coal-fired plants amounted to 25% of total generation capacity for Ontario in 2003. The coal units were the largest source of emitters of smog-causing pollutants, and are responsible for 77% of greenhouse gas (GHG) emissions from the electricity sector in Canada.

Ontario has introduced crucial new climate change initiatives in recent years. The Green Energy and Green Economy Act 2009, was the 'most ambitious and forward-thinking legislation of its type in North America'. It was created to replace coal combustion with renewable energy and boost local clean energy industry.

The FIT program was established to generate green power as a supplementary form of energy for the national grid and improve air quality. The government offers guaranteed prices to renewable electricity production, for a consecutive twenty years. The 'Domestic Requirement Content' was designed to boost the development of green industry in Ontario and create local jobs.

Contracted 4600 MW green energy, the FIT attracted more than \$27 billion private investment and created more than 20,000 jobs in phase I. However the project has been confronted by three challenges and remained a controversial topic consistently on the media: 1) Cost efficiency, 2) Opposition against wind turbine, 3) WTO ruling against domestic content requirement.

Therefore, the Inquiry paper aims to conduct a comprehensive review of the Feed-in Tariff program, present examples from mature FIT market to facilitate policy learning. The paper discuss and answer three major questions: 1) Evaluation of the FIT program in consideration

of economic, environmental and social concerns, 2) Determine the long-term viability of the program, 3) Improve the policy making process with experience worldwide.

The major findings are: 1) Include the cost of public goods and the value of quality of life for performance measurement; 2) Long-term viability of FIT program is secured by legislation; 3) Enhance inter-disciplinary collaboration to deliver a prosperous future for green technology; 4) Ensure transparency and effective communication with various stakeholders; 5) Adopt consistent regulation framework accompanied by international agreement on GHG emissions and 6) Introduce 'Pollutants Pay' policy as an alternative financing mechanism.

Key words: FIT program, Renewable energy, Progressive environmental policy, Pollutant pay, Policy learning

1. Introduction

1.1. General information

The population of GTA is expected to grow by 3.7 million people between 2010 and 2030, among which are a big proportion of large industrial customers (Ministry of Finance, 2010). According to Ontario’s long-term energy plan, the electricity demand will increase from 157 TWh in 2010 to 198 TWh by 2030 (See Figure 1). Coal-fired plants amounted to 25% of total generation capacity for Ontario in 2003 (Ministry of Finance, 2010). The coal units were the largest source of emitters of smog-causing pollutants, causing more than 150,000 illnesses and over 30 deaths in 2010 (The Lung Association Ontario, 2010). Coal-fired generating units are responsible for 77% of greenhouse gas (hereinafter referred to as ‘GHG’) emissions from the electricity sector in Canada (Environment Canada, 2013).

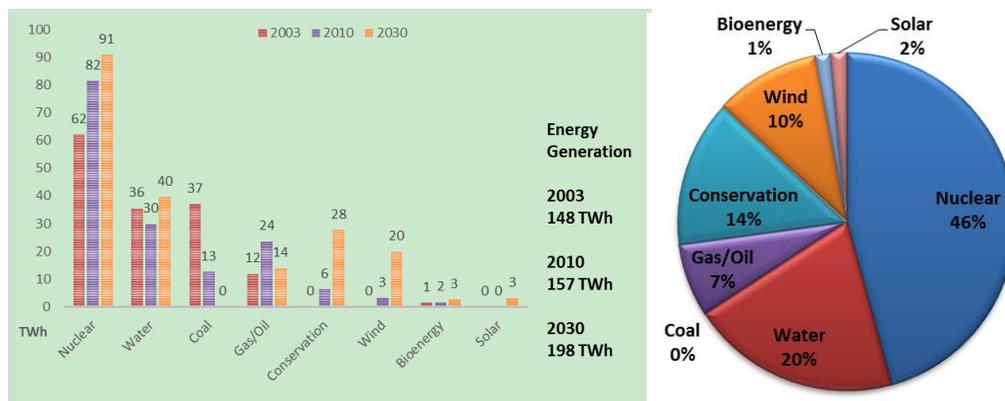


Figure 1 Contrast in Supply Mix

Ontario has introduced crucial new climate change initiatives in recent years. The Green Energy and Green Economy Act 2009 (hereinafter referred to as ‘GEA’), was the ‘most ambitious and forward-thinking legislation of its type in North America’ (MOE, 2009). It is a part of policy initiative to reduce Canada’s greenhouse gas emissions by 15% by 2020, compared to 1990 levels (MOE, 2009). The Act aims to substitute coal-fired generation with renewable energy, making Ontario the first jurisdiction in the world to eliminate coal-fired electricity generation (MOE, 2009). Meanwhile the

GEA expect to expand renewable energy generation and create clean energy jobs in Ontario (MOE, 2009).

The Feed-In Tariff Program was established three month after the legislation of GEA, to subsidize renewable power and improve air quality (MOE, 2009). The government offers guaranteed prices to renewable electricity production, including solar, wind, bioenergy and waterpower, for a consecutive twenty years. The ‘Domestic Requirement Content’ was designed to boost the development of green industry in Ontario and create local jobs.

The economic crisis since 2008 present significant challenge to the climate change initiatives globally, as priority was granted to save budget than emissions

reduction plans (AEA, 2009). In 2010 the Federal Government estimated that Canada will exceed its Kyoto target of 558Mt/yr by 28.8% (See Figure 2). In 2012

Canada officially abandoned the Kyoto Protocol, avoiding a non-compliance Kyoto penalty at up to \$19-billion (The

Globe and Mail, 2012).

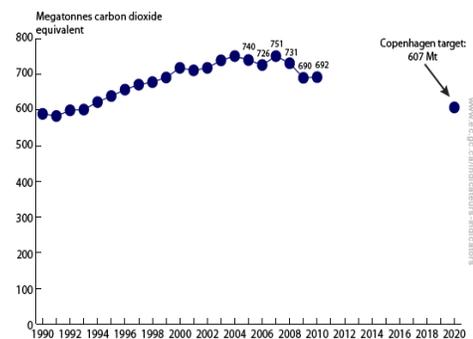


Figure 2 National greenhouse gas emissions, Canada, 1990 to 2010 (Environment Canada, 2013)

Contracted 4600 MW green energy, the FIT attracted more than \$27 billion private investment and created more than 20,000 jobs in phase I (MOE, 2012). However the change in external and internal environment affected sustainability initiatives dramatically. It has remained controversial on media and consistently drawn public attention, due to the following three challenges:

1.2.Challenges

1.2.1. Cost efficiency

The economic efficiency was the primary concern, as FIT program was claimed to raise electricity bills by 40% above the government’s forecast (Gallant & Fox, 2011). The project was suspended for a

two-year-review by the Liberals in 2011, followed by a 15% to 20% price cut in solar PV and wind turbine power in 2012 (See Figure 3) (OPA, 2012).

As shown in Figure 4, apparently the incentive for small scale solar PV was almost highest in the world in 2011 (Renewableenergyworld, 2011). However it is noteworthy that generous financial support is vital to reduce the risks for investors, and enhance industrial development at primary stage (Lesser & Su, 2008).

Fuel	Project Size Tranche	Original FIT Price (¢/kwh)	New FIT Price (¢/kwh)	% Change from Original FIT Price
Solar Rooftop	≤10 kW	80.2	54.9	-31.5%
	> 10 ≤ 100 kW*	71.3	54.8	-23.1%
	> 100 ≤ 500 kW*	63.5	53.9	-15.1%
	>500 kW	53.9	48.7	-9.6%
Solar Groundmount	≤ 10 kW	64.2	44.5	-30.7%
	> 10 kW ≤ 500kW*	44.3	38.8	-12.4%
	> 500 kW ≤ 5 MW *	44.3	35.0	-21.0%
	> 5 MW		34.7	-21.7%
Wind	All sizes	13.5	11.5	-14.8%

Figure 3 FIT price schedule in 2012

Price Summary for Solar PV Tariffs Worldwide				
20-Sep-11			1.387	1.350
Selected programs with contract terms of 15 years or longer.				
Jurisdiction	Years	€/kWh	CAD/kWh	USD/kWh
Small or Non-Differentiated				
Switzerland	25	0.590	0.819	0.796
Ontario MicroFIT	20	0.578	0.802	0.780
Great Britain	20	0.425	0.584	0.608
France	20	0.406	0.644	0.626
Bulgaria	25	0.389	0.539	0.525
Luxembourg	15	0.382	0.530	0.516
Slovakia	15	0.382	0.530	0.516
Italy September 2011	20	0.361	0.501	0.487
Cyprus	20	0.360	0.499	0.486
Israel	20	0.334	0.464	0.451
Slovenia	15	0.332	0.461	0.449
Czech Republic	20	0.304	0.422	0.411
Ecuador	15	0.297	0.411	0.400
Malaysia	21	0.288	0.399	0.389
Germany	20	0.287	0.399	0.388

Figure 4 Price Summary for Solar PV Tariffs Worldwide

1.2.2. Opposition against wind turbine

Municipalities, initially the local decision maker in planning and zoning controls of FIT project, were replaced by Ontario Power Authority (hereinafter referred to as ‘OPA’) in accordance to the GEA (OPA, 2009). The industrial large wind and solar farms received strong opposition in south-western Ontario cities, due to property devaluation and health effects (The Globe and Mail, 2013). In the 2011 Ontario Election the Liberals lost several rural seats and became minority government (Toronto Star, 2011). In 2012 the Ontario Federation of Agriculture argued no more wind turbines should be built as these mega projects were polarizing rural community (The Globe and Mail, 2012). The Liberals re-granted municipalities the power to evaluate future wind and solar project in June 2013 (Sun Media, 2013).

1.2.3. Domestic content requirement

Primarily the domestic content requirement was designed to develop local green economy and stimulate technology innovation. The developers are required to purchase a minimum 50% from Ontario goods and labour for the approval of wind power project over 10 KW, and 60% for solar PV projects (OPA, 2009).

Japan complained to the WTO in 2010, joined by EU and USA, arguing this form of price support granted a commercial benefit for Canadian manufacturers. In May 2013 WTO released a final report, concluding that the FIT program 'violated' the free trade ruling as it provided contingent to domestic products (WTO, 2013).

The impact on various stakeholders, who advocated the policy to support manufacturers and job creation, are critical but inevitable (OPA, 2012). In June 2013, Ontario Energy Minister Bob Chiarelli cancelled the Feed-In Tariff program for major renewable projects over 500 KW, but claimed his confidence in a 'robust and resilient renewable energy sector in Ontario' (The Globe and Mail, 2013).

1.3. Research Question

The frequent and unprecedented change in FIT contract presented serious uncertainty to the infant renewable energy industry in Ontario. FIT has long been cited as a controversial topic since its establishment (Toronto Star, 2012) (Toronto Star, 2013). Yet FITs helps spur technological development through rapid deployment and economies of scale, and decrease generation costs of renewable energy sources (Mendonca, Jacobs, & Sovacool, 2010). Consistent policy framework is vital to support the renewable energy initiatives, yet when Ontario cut one renewable energy policy it failed to clearly identify a new path forward (The Globe and Mail, 2013). Hence the WTO ruling, as a focusing event, highlighted the need to evaluate the program and make visionary decision. The main purpose is to avoid the deconstructed renewable energy market in Ontario.

The policy cycle framework has served as a basic template that systematizes and compares the diverse approaches and models (See Figure 5) (Fischer, Miller, & Sidney, 2007).

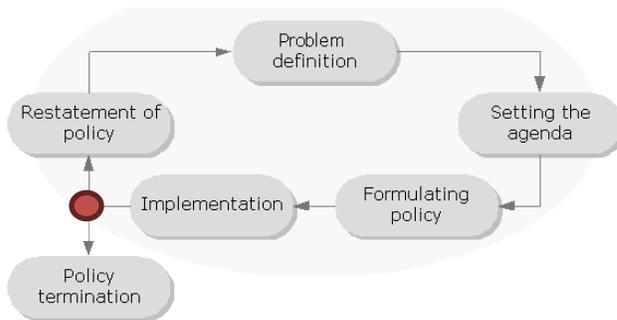


Figure 5 Policy cycle (Wissen, n.d.)

Therefore, the Inquiry paper aims to conduct a comprehensive review of the Feed-in Tariff program, present examples from mature FIT market to facilitate policy learning.

The paper endeavour to answer three major questions:

1. Performance measurement: How to assess the FIT program, in consideration of economic, environmental and social concerns?
2. Policy termination: How is long-term viability of FIT Program?
3. Policy restatement: How can we improve the policy making process to ensure a sustainable development in Ontario's renewable energy industry?

2. Research methodology

The research methodology aims to describe the research design used to achieve the aim and objectives of the research. It identifies the research methods available, the data to be collected and proposes mechanisms for analysing the data. The research methods are constrained by the availability of data resources (such as target participants and time limit) and techniques of analysis.

Research is mainly classified into two types; applied research and pure research (Holt, 1998). Applied research attempts to resolve practical problems or improve traditional thinking. It benefits the industry with wide application of process management, hence is the solution to problems in real practice. Pure research tends to address more theoretical issues through an academic approach. It presents innovative ideas and identifies future research areas; hence it adds value to the exploration of knowledge.

The choice of research methodology depends on several factors, such as the defined project aims and the nature of input data. The Inquiry paper aims to facilitate policy learning for the Feed-in Tariff Program, Ontario. Hence international best practice from FIT market, where they had achieved a certain degree of maturity, is invaluable. Cross-national policy convergence largely determines a country's capacity to tackle environmental problems (Jacobs, 2012). The communication between governmental actors is crucial to achieve higher national targets at lower cost (Jacobs, 2012).

Desk study is used to obtain data from a wide range sources such as official statistics, previous literature, national legislation, industry recommendation and news report etc. The collection of data through desk study should involve a broadly analogous process to present a compatible outcome

3. Findings

3.1. Performance measurement

The FIT Program was designed under the Green Energy Act 2009 to develop renewable industry and deliver vibrant communities for all Ontarians (MOE, 2010). By the end of 2011 in phase I, FIT attracted more than \$27 billion in private sector investment, and created more than 20,000 jobs (MOE, 2012). In addition, the two-year program created 2,500 small and large FIT projects and generated 4,600 MW of green electricity for 1.2 million homes (MOE, 2012).

The FIT program remains a controversial topic for both politicians and environmental economists (McMillan, 2011) (ClearSky, 2013). Cost efficiency has long been highlighted, as the initial investment for FIT phase I was \$8 billion and the annual subsidy to the contracted investor was claimed to be \$4 billion (The Globe and Mail, 2010) (Financial Post, 2012).

However the conflict potential shall be viewed in a comprehensive manner, taking different interest groups into consideration (Nilsson & Persson, 2003). The policy maker and public require complete information and precise analysis, to evaluate the policy in a comprehensive manner. The renewable energy professionals, investors and manufacturers require an objective judgement, to mitigate the level of uncertainty of their life-long career. **Social and environmental externality such as the cost of public goods and the value of quality life has to be included for all the Ontarian's benefit.**

Experience in Germany:

The Feed-In Tariff in German has driven plenty of scattered German innovation, renewable energy sources generates about 23% of national electricity demand in 2012 (Financial Times, 2013). Yet it was at a risk of collapse in 2009 due to political election. The government signed a binding agreement to keep the law sacrosanct, and the German campaign to develop renewable energy posted impressive results. The overall effect has been to harness individual German angst over pollution and global warming into a national movement to build renewable power (AEA, 2009).

3.1.1. Benefit of improved air quality

A clean and reliable electricity system is essential to maintain Ontario's global competitive economy. The supplementary of green energy to the grid helped Ontario to phase out coal-fired electricity generation by end of 2013, one year ahead of the schedule (MOE, 2013). It is the largest climate change initiative in North America (OPA, 2012). In a national survey, the health effects and economic costs of smog in the province of Ontario were estimated to be \$3.64 billion in 2008, and are expected to exceed \$4.32 billion by 2015 (Canadian Medical Association, 2008). Toxic air has direct impacts on human well-being, yet the energy price in Ontario does not reflect the true cost of coal combustion. In fact, the sulphur dioxide and nitrogen oxides emissions have dropped by 90% since Ontario started shutting off coal units in 2003 (MOE, 2013). Therefore, the saved costs in health care shall be measured in defensive expenditures of renewable energy (Freeman, 2003).

3.1.2. Potential benefit of carbon trade

Canada was the initial member of Kyoto Protocol. However due to the lack of concrete measures it had put in place to reduce domestic emissions, Canada's GHG emissions were 30% higher than the committed target in 2011 (The Globe and Mail, 2011). Despite of its withdrawn from the Kyoto Protocol, Canada remains a member state of the United Nations Framework Convention on Climate Change (Environment Canada, 2013).

Policies and regulations are required to place a price on carbon in order to embrace transformative changes nationwide (David Suzuki Foundation, 2009). The Climate and Clean Air Coalition was introduced in 2012 and the government is implementing GHG regulation for energy (Government of Canada, 2012). The Ontario Ministry of Energy (hereinafter referred to as 'MOE') is committed to delivering balanced, low-carbon supplies mix with FIT, so that Ontario will be ready for carbon emission pricing (MOE, 2010). Hence, potentially a greenhouse gas regulation will become part of federal policy in the near future.

The benefit of carbon emission reduction shall be considered when evaluating FIT program. The avoided CO₂ emission from coal combustion is 0.997 tonnes per MWh with renewable energy (Aegent, 2011) (See Figure 6). The benefit of carbon emission reduction in 20 years could exceed \$ 0.7 billion.

	heat rate	CO ₂ emitted	tonnes/MWh	
	MMBtu/MWh	lb/MMBtu	direct	saved vs. coal
coal			0.997	0.000
SCGT*	9.5	113	0.487	0.510
CCGT**	7.0	113	0.359	0.638
hydro/Beck, nuclear, renewables	0.0		0.000	0.997

Figure 6 Values of CO₂ emissions avoided for each replacement

3.2. Policy termination

The Feed-In Tariff has the advantage of investment security, the possibility of fine tuning and the promotion of mid- and long-term technologies (EU, 2005). However due to the dynamic change of external and internal environment, the cancellation of FIT Program has been suggested by various interest groups (Financial Post, 2011) & (Fraser Institute, 2011). In 2011, Progressive Conservative Party of Ontario proposed to cancel both FIT Program and the manufacturing arrangement signed with international consortium, in an effort to win the election (McMillan, 2011).

Various level of legislation provided a fundamental commitment in clean and renewable energy industry in Ontario. It is essential for the policy makers to evaluate the trade-off between political cost and legal cost.

The Government of Canada resolved to:

**Promote an open, efficient and stable domestic market for long-term job creation, economic growth and stability*

**Consult on matters related to internal trade*

Preamble ---Agreement on Internal Trade 1994

(Industry Canada, 1994)

The suspension of FIT program may cause numerous industrial players go bankruptcy and thousands of laid off workers. Severe impacts are also expected among institutional organizations, private

companies and homeowners, who were motivated by the political commitment in renewable energy in 2009 (CBC, 2012).

In 2011 the region of Waterloo borrowed \$16-million to install 25 rooftop solar-power systems on its office building (The Globe and Mail, 2011). The government initiatives are not solely motivated by capital benefit, instead it aims to showcase the regional values of innovation and collaboration in renewable sources of energy (The Region of Waterloo, 2011). The Kitchener business community has become one of Canada's leading centres of excellence on solar energy, and the FIT program is responsible for local manufacturer building its first manufacturing operation outside of China (CanadianSolar, 2013).

The withdrawal of the FIT program could eventually lead to lawsuits and disputes, because the policy interfering with the amount or duration of price support could be interpreted as a challenge to a 'stable business environment'. Solar companies in the UK are planning to sue the British government for \$200 million, as compensation in damage due to the changes to the Feed-in tariff, UK (The Guardian, 2013).

3.3. Policy restatement

Climate change programs are most economically driven, hence are less likely to be affected by the recession where National and international commitments exists (AEA, 2009). Despite the withdrawn from the Kyoto Protocol, Canada reaffirmed its target of reducing GHG emissions by 17% between 2005 and 2020 under the Copenhagen Accord (CBC, 2011) & (Environment Canada, 2013).

The Government of Ontario is committed to fostering the growth of renewable energy projects, and shall remove barriers to promote a green economy.

*---Green Energy Act
(Legislative Assembly of Ontario, 2009)*

The FIT program delivered a substantially growing clean energy industry, with multiple environmental, social and economic benefits (OPA, 2012). Despite the cancelation of major FIT projects over 500KW, a number of wind manufacturers confirmed their confidence in the market. Siemens officially handed

over the first ‘made-in-Canada’ wind turbine blade for domestic installation in July 2013 (Siemens, 2013).

Canada remains No.7 in the Renewable Energy Country Attractiveness Index in August 2013, highlighting the positive impact of the GEA but concerns exist over the WTO ruling (RECIA, 2013). Samsung reduced its renewable investment commitment in Ontario by \$2 billion, as the 2010 wind-power contract was cut from \$9.7-billion to \$6-billion by the government (CBC, 2013).

Policy restatements are necessary and vital to accelerate the future development of clean energies and technologies (AEA, 2009).

3.3.1. Scope of renewable technology

At present wind turbines and solar panels generates 1950 MW and 500 MW power to the grid respectively, about 53% of the total contracted renewable energy in Phase 1 (OPA, 2012). Emerging technology such as biogas and biomass ensures environmental benefit with a relatively low lifetime generation cost (See Figure 7). The potential of different renewable resources have to be assessed throughout the region, as wind sources are limited in specific regions in Ontario (See Figure 8) (Jacobs, 2012). **The addition of new renewable energy technologies and fuel types requires a decentralize energy paradigm and definitive capacity under the support mechanism (APAO, 2011).**

Generating Type ^a	Midpoint	Low	High
Wind onshore	68.08	36.39	168.71
Wind offshore	78.54	59.09	144.38
Solar thermal	193.64	193.64	315.20
Solar PV	192.21	141.10	2195.39
Run of river/small hydro	108.28	46.45	283.02
Large-scale hydro	53.12	53.12	99.33
Nuclear	30.71	24.34	80.26
Coal (lignite)	39.35	34.40	75.35
Coal (high quality)	31.90	30.30	80.85
Coal (integrated coal gas)	44.73	31.94	69.15
Gas (CCGT)	54.62	44.69	73.24
Gas (open)	54.64	54.64	57.33
Waste incineration	11.39	-4.68	61.19
Biomass	48.74	43.64	117.59

Figure 7 Lifetime generation costs by generating type, \$ per MWh (Kooten, 2011)

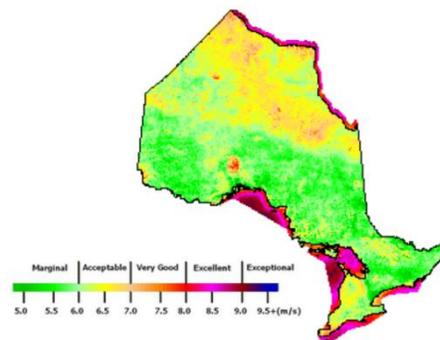


Figure 8 Ontario's Wind Sources (Ontario Ministry of Natural Resources, 2011)

Emerging technology 1: Bioenergy:

Biogas-fuelled vehicles can reduce CO₂ emissions by between 75% and 200% compared with fossil fuels, and enrich the nutrient value of soil (NSCA, 2006). Yet bioenergy consists 1.5 per cent of the total provincial electricity supply in 2030, according to the Long Term Energy Plan (MOE, 2010). On contrast the Ontario Ministry of Agriculture and Food undertakes extensive bioenergy R&D capacity with 20 universities and 24 colleges. (OMAFRA, 2011). Job creation schemes based on subsidies could be harmful if the job created is not sustainable and the profit made is not transferable for R&D innovation. **Policy flexibility and professional assistance are vital as farm biogas cogeneration is normally financed by individual farmers or individual institutions (Foss, 2008). Increased quota on bioenergy shall allow the expansion of the renewable portfolio and provides flexible backup generation.**

Experience from Germany:

Key words: Definitive strategy and implementation plan & Interdisciplinary collaboration & Active involvement of industry association in policy-making process

The Integrated Energy and Climate Change Programme, together with the Biomass Action Plan, served as an important measure to promote bioenergy use in Germany. The Ministry for Economy wanted to include only a limited numbers of technologies in the 1990s. The Ministry for the Environment and the Ministry of Agriculture, together with several renewable energy industry associations, pushed for the inclusion of bioenergy (BMU, 2009). The precise definition of bioenergy products for electricity generation was given in 2005, which includes biomass originated in vegetables or animals as well as biological waste and waste wood (Jacobs, 2012). Currently there are 92 self-sufficient “bioenergy villages” in Germany, with another 350 rural areas or small towns under construction (The Wall Street Journal, 2013).

Emerging technology 2: BIPV

BIPV fully utilizes the space without extra land usage. It serves as a supplementary to energy supply at peak time, which reduces the maintenance expense of national grid. While Proof-mounted panel requires less labour and generates less efficiencies, BIPV can contribute 30% of overhead and profit margin in unit price (see Figure 9) (James, Goodrich, Woodhouse, Margolis, & Ong, 2011). Estimates

indicate that the BIPV market may expand to more than CAD 2.4 billion dollars by 2017

(PikeResearch, 2012).

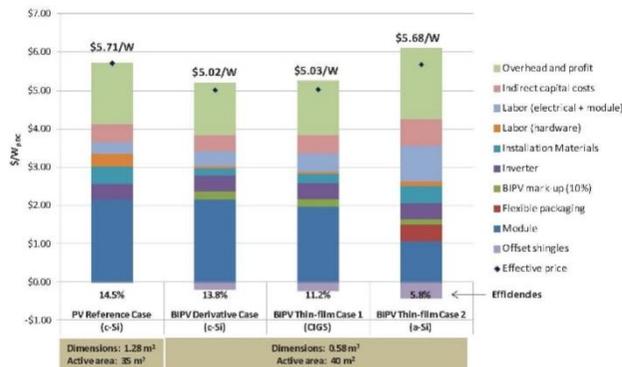


Figure ES-1. Comparison of residential rooftop prices for a rack-mounted the PV Reference Case and three BIPV cases.

Figure 9 Figure 3 Unit price combination of BIPV

Toronto, the most populous city in Canada, is building more skyscrapers than any other cities in North America (The Globe and Mail, 2012). It would be the most promising market for BIPV where glass façade can be installed or replaced with BIPV panels (PV magazine, 2012). In addition the residential buildings are mostly located in downtown Toronto, adjacent to the office buildings. The energy loss during transmission, which is the main barrier of BIPV, can be mitigated.

Yet there is no provincial strategy in Ontario to promote BIPV, and currently BIPV is not included in FIT program. **Integration of BIPV into the FIT program requires OPA to work with industry stakeholders to further elaborate and clarify the various applications in building design** (City of Toronto, 2011).

Experience from France:

Key words: Prioritized policy + Integrated supply chain

French policymakers decided to establish a national industry in the market of building-integrated modules in 2006. The unit price for BIPV was set 25¢cent/KWH higher than solar PV panel, to deliver an annual return of investment of 7% and 10 years payback period for investors. At present BIPV accounted for 58% of the total French photovoltaic market (Ministry of Economic Affairs Netherlands, 2012). The booming industry also leads to an improved supply chain of green building, and attracted expertise in design and installation to France (Sivanandan, 2009).

3.3.2. FIT price

The initial investment of \$ 8 billion along with the annual subsidy at \$ 4 billion has long been claimed as a financial burden to the government (Financial Post, 2012) (The Globe and Mail, 2010). The province faced harsh criticism over prices changes in 2012, as both manufacturers and private investors distrust the government's ability to create a stable investment environment (The Globe and Mail, 2012). However the adjustment in Dec 2012 benefits the government budget, due to the growing local industry and the fluctuation in the PV panel price (McMillan, 2012).

Environmental Policy can also be influenced by focusing events, which highlights the necessity of awareness-raising and cultural shifts driven by strong political will (Nilsson & Persson, 2003).

Following the WTO ruling, the OPA updated the FIT and microFIT price schedule on 16 August 2013. The incentive for Solar PV decreased by 50% on average compared to the initial price in 2009 (See Table 1) (OPA, 2013).

Table 1 FIT Revised Price Schedule

Fuel	Project Size Tranche	FIT Price in 2009 (c/kwh)	FIT Price in 2012 (c/kwh)	FIT Price in 2013 (c/kwh)	% Change from 2009 to 2013
Solar Rooftop	≤ 10 KW	80.20	54.90	39.60	-51%
	> 10 ≤ 100 KW	71.30	54.80	34.50	-52%
	<250 KW	63.50			
	> 100 ≤ 500 KW	53.90	53.90	32.90	-48%~-64%
	> 500 KW	53.90	48.70		
Solar Groundmount	≤ 10 KW	64.20	44.50	29.10	-55%
	> 10 ≤ 500 KW	44.30	38.80	28.80	-17%~-26%
	> 500 ≤ 5 MW	44.30	35.00		
	> 5 MW		34.70		
On-Shore Wind	All sizes	13.50	11.50	11.50	-15%
Waterpower	≤ 10 MW	13.10	13.10	14.80	5%~21%
	>10 MW ≤ 50 MW	12.20	12.20		
Biomass	≤ 10 MW	13.80	13.80	15.60	13%~20%
	> 10 MW	13.00	13.00		
Biogas on Farm	≤ 100 kW	19.50	19.50	26.50	14%~36%
	100 ≤ 250 kW	18.50	18.50	21.00	
Biogas	≤ 500 kW	16.00	16.00	16.40	2%~58%
	> 500 kW ≤ 10 MW	14.70	14.70		
	> 10 MW	10.40	10.40		
Landfill Gas	≤ 10 MW	11.10	11.10	7.70	-25%~-31%
	> 10 MW	10.30	10.30		

Consistent government intervention, through an internationally applicable framework, can reduce global emissions safely and create the green economy (AEA, 2009). Yet the sudden and dramatic fall

in FIT price presents huge uncertainty to the infant industry. In fact the movement was widely considered as a setback for all stakeholders in the renewable energy industry (Gipe, 2013).

The Government of Canada shall provide the public with timely, accurate, clear, objective and complete information about its policies and initiatives. The government must learn as much as possible about public needs in the democratic process. Communication is a two-way process.

---<Communications Policy of the Government of Canada> 2006
(Treasury Board of Canada Secretariat, 2006)

Despite the fact that subsidy leads to increased taxes and rising energy bill, **transparent pricing process has been approved to benefit the mechanism with improved public support** (OPA, 2012) (Green Energy Act Alliance, 2011). **The more rigorous the cost-based tariff calculation methodology that is applied, the more accurately the tariff level reflects the actual technological and market development** (Jacobs, 2012). **The government requires periodically price review process to mitigate financial risk. Adjustable pricing process adds flexibility to the mechanism amid the dynamic change of international market. Rates shall also be subject to the overall long-term energy mix, as to provide higher rates to desired technology development** (Energy Manager Today, 2013).

Experience from Europe:

The robust growth in clean energy resulted from most generous subsidies in Europe, as FIT program emerged in 1990s (the Breakthrough, 2012). Value based tariff, directly or indirectly referring to the avoided costs of conventional power generation, are substantially replaced by cost based tariff in the last two decades (European Commission, 2013). The incentives are calculated on the true cost of green technology investment, plus a guaranteed internal rate of return ranging from 4% to 9% (Jacobs, 2012). The initiative was to provide the renewable energy at the lowest possible cost, for regional carbon emissions reduction (Europe's Energy Portal, 2013).

Additionally at least 6-months-notice shall be granted to the industry prior to a price change, to maintain investment security. Consultation shall allow the involvement of all respondents and be long enough in accordance to the legislation. For example the British government was criticised for providing a seven-weeks consultation in 2011, which failed to combine the inputs from all stakeholders (International Law Office, 2011). On contrast only 16 days were given by OPA to submit feedback for both Price review in June 2013 and FIT 3 Program Document in Sep 2013 (OPA, 2013).

3.3.3. Energy cap

At present the project size caps are 10 MW and 50 MW for solar and waterpower project respectively (OPA, 2013). The energy cap serves as an important cost containment mechanism for FIT programs from government perspective. Yet program size caps can introduce access risk for developers, and limit the ability of a market to achieve economies of scale (NREL, 2011). **Hence such restriction shall be flexible to demonstrate a continuing government support to the renewable energy, while limit the renewable electricity oversupply (Jacobs, 2012). In mature markets such as German, all program-sized caps have been removed and plant-sized limitations eased for sustainable market growth for all technologies (Deutsche Bank Group, 2012). In contrast in developing market such as US, a cumulative ceiling is designated annually or set a capacity cap at program level (Energy Manager Today, 2013).**

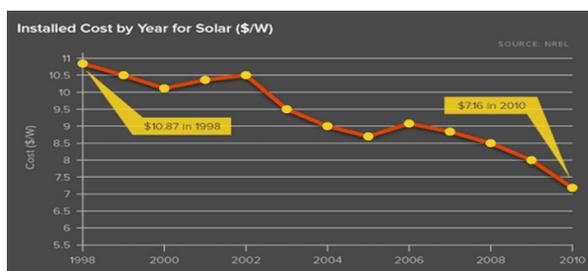


Figure 10 Installed cost by Year for Solar (\$/W)

Lessons learned from Spain:

The solar FIT was uncapped in Spain initially, yet the highly favourable FIT payment level for solar PV led to an overheated solar market in Spain (de la Hoz, Boix, Martin, Martins, & Graells, 2010). The policy transition was not efficient to tackle with the continuous decreasing cost of solar energy (See Figure 10). In 2008 nearly 2760 MW of solar energy was added, four times of the added capacity in 2007 (IEA, 2010) (City of Calabasas, n.d.). Consequently capped solar deployment was introduced to contain ratepayers impacts and yield a more predictable policy result (NREL, 2011).

3.3.4. Financing mechanism

Sustained government campaign of support for longer-term programs, such as FIT would encourage a switch to low-carbon fuels. Policy framework shall provide preference for renewable energy, and reduce uncertainty in payment level (NREL, 2011). The FIT Ontario currently distributes the

additional costs of renewable energy among all provincial electricity consumers. The ratepayer based financing mechanism allows for equal burden sharing and is therefore widely spread in all European Countries (Jacobs, 2012).

However the policy tend to be regressive, as low-income households or non-private vehicle users share the prices rise as a result of the policies. Number of registered vehicle in Ontario exceeds 7.46 million in 2009, 36% of the national total (Statistics Canada, 2010). <Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations> was introduced in 2012, yet the proposed CO2 emission garget will not be effective till the model year 2016 (Government of Canada, 2012). Meanwhile the Canadian government grants more than \$1.4 billion in tax subsidies to oil, coal and gas companies annually (David Suzuki Foundation, 2010).

Renewable energy industry is urging government to help educate the consumer so they can change their behaviour to support low carbon technologies (AEA, 2009). Additional financial scheme are necessary, to sustain the project where government only acts as a regulator (Mendonca, Jacobs, & Sovacool, 2010).

We are taking action in the electricity sector because we recognize the potential for significant emissions reductions. We are committed to build on our strength in the electricity sector and to lead the world in clean electricity generation.

*--- Peter Kent, Canada's Environment Minister. August 19, 2011
(Environment Canada, 2011)*

The combination of carbon tax with the FIT program increases the gap between low-cost renewable power and more expensive conventional generation, making green technology more affordable due to the increased demand (Sustainability Matters, 2012). 'Pollutants Pay' policy will also help to embrace a culture change towards vehicle-oriented lifestyle. Progressive policy such as emission tax would be an efficient and practical approach (McKibbin & Wilcoxon, 2002).

In addition employing FIT separately to reduce GHG is not an optimal decision. Research suggests it costs \$87 per tonne using hydroelectric power and \$820 per tonne using ground-mounted solar power

under FIT (Fraser Institute, 2011). **Environmental tax or cap-and-trade system puts a monetary price on the real cost of carbon emissions. The legislation drove the polluters to renovate their equipment and relocate investment for R&D.**

Experience in Europe:

In Europe, the carbon price under the EU Emissions Trading Scheme was \$45 a tonne in 2005 and the cap-and-trade was mandatory for all the industry (The Guardian, 2013). Hence, the price dropped to \$5 a tonne due to the reduced demand for allowances (Financial Times, 2013).

Experience in British Columbia, Canada:

The policy initiative was to make BC an electricity self-sufficient province by 2016, under the Clean Energy Act (British Columbia Minister of Environment, 2010). The cost of reducing GHG through a carbon tax was \$30 per tonne in British Columbia in 2012 (British Columbia Ministry of Finance, 2012). The carbon tax, introduced in 2008 has raised \$3.7 billion, and the revenue is now optimised to accelerate the development of liquefied natural gas sector (The Globe and Mail, 2013). B.C.'s consumption of fossil fuels has been reduced nearly 18% per capita compared to the rest of Canada, while the province's GDP has remain stable (CBC, 2013). Tax exemption is available for biofuels and renewable energy users, and First Nations under the progressive policy framework (British Columbia Ministry of Small Business and Revenue, 2008).

3.3.5. National binding targets

A commitment to binding targets for the share of renewable energies in the energy mix is vital to tackle with the Climate Change (European Renewable energies Federation, 2012). From micro perspective, such binding objectives through stringent legislation improve the investment security with a predictable market. Regional or international framework for renewable energy has an impact on local policy decisions in terms of policy convergence (Jacobs, 2012).

The Government of Canada committed to reduce total greenhouse gas emissions by 17% from 2005 levels by 2020, following the signature of Copenhagen Accord (Environment Canada, 2013). <The Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations> was published in 2011, to regulate the coal-fired electricity generation (Government of Canada, 2011). As Ontario will successfully phase out coal combustion by end of 2013, robust policies are needed to better incentivise low/zero carbon solutions. **A collective participation between the industry, the government and consumers will have the greatest impact (AEA, 2009).**

'Government shall stand up and take the lead in encouraging and promoting a green economy, with robust policies put in place to tackle climate change and an economically responsible approach to renewable energy'.

*---Green Energy Act
(Legislative Assembly of Ontario, 2009)*

The Government of Canada aims to generate 90% of Canada's electricity from zero-emitting sources by 2020, yet no legislation has been published to fulfil the political commitment (The Canadian Trade Commissioner Service, 2013). **A strong political will, which balance in parliament and public opinion, can induce a stronger control of the outcome of the process** (Nilsson & Persson, 2003).

Experience in Europe:

Mature market for FIT program and leading businesses are committed to their strategies on climate change and want further incentives to act. Renewable deployment in all over EU 27 will reach at least 80% by 2050 under the provisions of Directive 2009/28/EU (European Renewable energies Federation, 2012). Accordingly France published the Electricity Law as she 'must' increase the renewable energy production from 13% to 23% by 2020 (Norton Rose Fulbright, 2013).

4. Summary

Mitigation of climate change is a long-term motivation but the economic crisis is a short term impact. Strong and consistent policy frameworks are vital to address issues of energy security and sustainability with renewable energy (AEA, 2009) (Norton Rose Fulbright, 2013). Feed-in Tariff is the most popular and maturing incentives programs to accelerate such deployment (Zhang, 2013) (Energy Manager Today, 2013).

The Province of Ontario initiative the most progressive renewable energy policy in North America, hence it is to the benefit of all Ontarians and ecology to proceed with the program. The answers to the research questions are summarized as follows:

- Include the cost of public goods and the value of quality of life, to evaluate the FIT program in a systematic and objective manner;
- The strategic development of green energy is secured by legislation, hence the long-term viability of FIT program is protected;
- Provide complete information to the general public, to enhance public awareness of the benefits of a low carbon economy;
- Enhance the inter-disciplinary collaboration between policy maker, academia, industrial organization etc., to deliver a prosperous future for green technology;
- Ensure transparency and effective communication with various stakeholders, to secure a sustained development of green energy industry;
- Review the policy with flexibility and efficiency, to promote renewable technology R&D capability in Ontario and boost the added value to the industry;
- Adopt consistent regulation framework accompanied by international agreement on GHG emissions, to promise the investors with a stabilized investment environment;
- Introduce 'Pollutants Pay' policy as an alternative financing mechanism, to distribute the cost of renewable energy while maintain social equity.

Appendix

Acronyms	Full name
APAO	Agrienergy Producers Association of Ontario
BIPV	Building Integrated Photovoltaic
EU	European Union
FIT	Feed-in Tariff
GEA	Green Energy Act, 2009
GHG	Greenhouse Gas
MOE	Ontario Ministry of Environment
NSCA	National Society for Clean Air and Environmental Protection, UK
OEB	Ontario Energy Board
OPA	Ontario Power Authority
WTO	World Trade Organisation

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