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Understanding the Economic Impact of Renewable Energy Initiatives:

Assessing Ontario's Experience in a Comparative Context

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with contributions from
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Sustainable Energy Initiative
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Preface

This paper examines the debates over Ontario's Green Energy and Green Economy Act as an energy and economic development strategy in a comparative context. The paper incorporates research undertaken by a number of Master of Environmental Studies students at York University's Faculty of Environmental Studies both as project research assistants (Nageen Rehman and Mariana Eret) and through their MES Major Research Papers (Dawn Strifler and Paul Cockburn). MES student Sarah Goldstein provided editorial assistance, and also developed the original graphs for the paper. MES student Alexandria Piccirilli provided additional research assistance. The analysis and conclusions are the sole responsibility of the primary author.

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Executive Summary

This paper explores the debates around the Ontario's Green Energy and Green Economy Act as an energy and economic development strategy. The paper finds that the empirical data on the employment impacts of the Ontario legislation is extremely limited. Rather, the evidence regarding the economic impacts of the GEGEA is found to be almost entirely based on the results of economic modelling exercises. Critics and supporters of the legislation have arrived at very different conclusions through such exercises. These outcomes are similar to those seen in other jurisdictions pursuing renewable energy initiatives. The paper explores the reasons for the different conclusions being reached over the impacts of renewable energy initiatives. Differences in modelling approaches, assumptions regarding the costs of renewable energy technologies relative to non-renewable alternatives and especially the treatment and valuation of environmental and other externalities and risks in modelling the cost impacts of different energy technologies are found to be key factors in explaining the different conclusions. The paper explores the range of ideational perspectives that underlie these differences in modelling approaches and assumptions.

In policy terms, FITs and similar renewable energy initiatives are seen by their proponents as politically feasible mechanisms for addressing institutionally embedded biases within energy systems in favour of conventional technologies. They are also seen as a means of dealing with the consistent failure of governments to implement effective measures to place meaningful value on the externalized environmental and social costs and risks associated with conventional technologies in energy system planning, design and implementation.

Secondly, the paper assesses Ontario's renewable energy initiative as an industrial development strategy. The paper finds that the province was very late in establishing a coherent strategy for the development of the renewable energy manufacturing and services sector. The future prospects for the sector are found to be under serious threat as a result of the uncertainty regarding the province's ongoing commitment to the development of renewable energy resources. In the absence of a resolution of the issue of the province's future direction, and of a coherent sectoral development strategy, the paper finds that there is a serious risk that GEGEA exercise will amount to an expensive but temporary countercyclical intervention as opposed to an investment in development of an industrial sector with potential to make significant long term contributions to the Ontario economy.

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Introduction

Ontario's 2009 *Green Energy and Green Economy Act* (GEGEA)[2] has emerged as a focal point of debates about the economic and environmental merits of initiatives intended to promote the large-scale deployment of low-impact renewable energy technologies such as wind, solar photovoltaic (PV), small scale hydro-electricity and biogas-based generation. Supporters of the feed-in-tariff (FIT) program that lay at the core of the legislation argue that it offers the potential to "combine the benefits of price certainty, grid connection and regulatory simplicity to create the conditions for successful industrial development while limiting costs to ratepayers and reducing and replacing dangerous sources of electricity with clean technology."[3] On the other hand, critics have argued that the program "will not create jobs or improve economic growth in the province of Ontario. Its overall effect will be to increase unit production costs, diminish competitiveness, cut the rate of return to capital in key sectors, reduce employment and make households worse off." [4]

2 S.O. 2009, c-12.

3 "FIT Review Joint Submission," *Green Energy Act Alliance, Shine Ontario, Pembina*, http://www.pembina.org/pub/2299.

4 R.R. McKitrick, *Environmental and Economic Consequences of Ontario's Green Energy Act* (Vancouver: Fraser Institute, 2013), iv.

Project Objectives

The following study explores the evidence and assumptions underlying the debates surrounding the economic impacts of the Ontario initiative.

The following study explores the evidence and assumptions underlying the debates surrounding the economic impacts of the Ontario green energy initiative. The study first sought to review and evaluate the available data and assessments of the economic development impacts of the GEGEA, specifically focusing on the nature and quality of the employment being induced by the FIT program. The study initially intended to explore such questions as:

- the number of renewable energy technology manufacturing facilities established or expanded in Ontario since 2009, including information on their technological focus (e.g. wind, solar, etc.), level of value-added activity (e.g. assembly vs. component production), their current status and number and types of employees;
- the number of renewable energy technology services (installation and maintenance) firms established or expanded in Ontario since 2009, including information on their technological focus, their current status and number and types of employees; and
- the number of renewable energy development enterprises established since 2009 including information on their technological focus, their current status and number and type of employees.

The intention was to provide some empirical grounding for the debates over the GEGEA's economic impact. In practice, it quickly became apparent that the actual empirically based data on the development and structure of the renewable energy industry in Ontario and the levels and types of employment within it is extremely limited. Rather the evidence regarding the economic impacts of the GEGEA is almost entirely based on the results of economic modelling exercises. Critics and supporters of the legislation have arrived at very different conclusions through such exercises.

These findings increased the importance of the second dimension of the study. This stream was comparative, and examined how debates over the economic impacts of renewable energy initiatives like the GEGEA and FIT have played out in other jurisdictions comparable to Ontario. The experiences of Germany, Denmark, Spain and the United Kingdom were examined in detail, as these three continental European jurisdictions have adopted FIT programs similar to Ontario's.[5] The German and Danish programs provided much of the inspiration for Ontario's initiative,[6] while Spain introduced a major FIT program over the same time frame as Ontario. The United Kingdom, for its part, has

5 On the details of the German and Spanish programs see D. Jacob, *Renewable Energy Policy Convergence in the EU* (Burlington, VT: Ashgate, 2012).
6 T. Hamilton, "Time for Green Energy Act in Ontario," *The Toronto Star*, June 2, 2008.

pursued both a "renewables obligation" where electricity suppliers are required to provide a set portion of their output from renewable sources, and more recently a FIT program for solar PV installations.[7] Reference is also made in the paper to the US federal government's clean energy initiatives under the 2009 federal *American Recovery and Reinvestment Act*.

7 G. Edge, "A Harsh Environment: The Non-Fossil Fuel Obligation and the UK Renewables Industry," in *Renewable Energy Policy and Politics: A Handbook for Decision-Making*, ed. K. Mallon (London: Earthscan, 2006), 163-184.

Analytical Approach

An important feature of the debates surrounding renewable energy initiatives is that they are not necessarily bounded by questions directly related to energy policy. Rather, they are embedded within wider ideological debates about the appropriate roles of government, public policy and markets in achieving societal goals.

An important feature of the debates surrounding renewable energy initiatives is that they are not necessarily bounded by questions directly related to energy policy. Rather, they are embedded within wider ideological debates about the appropriate roles of government, public policy and markets in achieving societal goals.

In this context, the study explores common themes and arguments across the different jurisdictions regarding the economic impacts of renewable energy initiatives. The analysis of the economic discourse around renewable energy initiatives, with a focus on identifying and exploring the key assumptions held by different actors in the debate, is intended to help explain and understand the different perspectives of these actors about such initiatives and the different conclusions that they draw about them.[8]

Two major lines of argument around green energy initiatives emerge from this contextual analysis. The first relates to the costs of energy obtained through FIT and similar programs relative both to conventional sources of new energy supply and to alternative, more competitive ways of obtaining new energy supply. The second line of argument emphasizes the concept of renewable energy development as not only a strategy for obtaining new energy supplies, but also as an industrial development strategy.

Within these argumentative analyses, a number of different perspectives exist. Among the key ones active in the renewable energy debate are those of "market fundamentalists",[9] "economic rationalists",[10] "ecological modernists"[11] and "progressive political economists". "Market fundamentalists", as represented by various non-governmental think tanks, have been among the most prominent public critics of renewable energy initiatives. These actors tend to be ideologically opposed to any form of governmental intervention in the market, and have therefore found renewable energy initiatives particularly objectionable. "Economic rationalists" are generally committed to the intelligent use of market mechanisms to achieve public ends, and are often neo-classically grounded academic economists. Economic rationalists have also been important critics of renewable energy initiatives, arguing that they are an inefficient means of achieving environmental and economic policy goals, but they are not necessarily ideologically opposed to interventions into markets for these purposes.

8 On discourse analysis see J. Dryzek, *The Politics of the Earth: Environmental Discourses* (Oxford: Oxford University Press, 2013), chapter 1.
9 Dryzek, *The Politics of the Earth,* 122.
10 Dryzek, *The Politics of the Earth,* "Economic rationalism" 122-144.
11 Dryzek, *The Politics of the Earth*, "Ecological modernism" 165-183.

"Ecological modernists" on the other hand, generally favour a restructuring the economy in a more in a more environmentally sustainable direction, and an active role for the state in those processes. They have tended to support renewable energy initiatives as expressions of the movement in precisely such directions. Although the concept of ecological modernism is less well developed in Canada than in Western Europe, it does potentially overlap with the "progressive political economy" stream of Canadian academic and labour economists. Individuals and organizations within the latter camp tend to argue for public policies that enhance the development of high-value, innovative industrial sectors in Canada,[12] although a wider resurgence of interest in industrial policy in Canada and elsewhere in the OECD has also been noted recently.[13] The development of "green" skills and jobs has emerged as a significant sub-discourse within the "progressive" literature in this area.[14]

12 See, for example, J. Stanford, *A Cure for Dutch Disease: Active Sector Strategies for Canada's Economy* (Ottawa: Canadian Centre for Policy Alternatives, 2012).

13 See, for example, D. Ciuriak & J. M. Curtis, *The Resurgence of Industrial Policy and What It Means for Canada* (Montreal: IRPP, 2013).

14 See, for example, M. Lee & A. Card, *A Green Industrial Revolution in Canada: Climate Justice, Green Jobs and Sustainable Production in Canada* (Ottawa: Canadian Centre for Policy Alternatives, 2012).

Background: Ontario's Green Energy and Green Economy Act

The GEGEA was adopted in May 2009 under the leadership of then Minister of Energy George Smitherman. The centrepiece of the GEGEA initiative was the feed-in tariff (FIT) program established under the legislation. The FIT program provided stable prices under long-term contracts for energy generated from renewable sources – specifically solar, wind, biomass, biogas and waterpower. The Ontario Power Authority (OPA) was given responsibility for implementing the FIT program, entering into contracts with eligible applicants.[15] The program was divided into two categories, FIT and MicroFIT, with the FIT program intended for projects over 10 kW and the MicroFIT program for projects less than 10 kW. Some of the key design features of the FIT program are outlined below.

FIT rates: The original FIT rates and the rates as updated April 5, 2012 and August 26, 2013 are as follows:[16]

Renewable Fuel	Project Size Tranche	Original FIT Price (¢/kWh)	FIT Price (¢/kWh) April 5, 2012	FIT Price (¢/kWh) August 26, 2013
Solar (PV) Rooftop	≤ 10 kW	80.2	54.9	39.6
	> 10 ≤ 100 kW	71.3	54.8	34.5
	> 100 ≤ 500 kW	63.5	53.9	32.9
	> 500 kW	53.9	48.7	N/A
Solar (PV) Non-Rooftop	≤ 10 kW	64.2	44.5	29.1
	> 10 ≤ 500 kW	44.3	38.8	28.8
	> 500 kW ≤ 5MW	44.3	35.0	N/A
	> 5 MW	44.3	34.7	N/A
On-Shore Wind	All Sizes	13.5	11.5	11.5
Waterpower	≤ 10 MW	13.1	13.1	14.8
	> 10MW≤ 50MW	12.2	12.2	14.8
Renewable Biomass	≤ 10 MW	13.8	13.8	15.6
	> 10 MW	13	13	15.6

15 Among other things, proposed FIT projects were subject to an "economic connection test" with respect to their proximity to the electricity grid and the ability of local grids to manage the power generated by FIT projects.

16 "FIT Price Schedule," *Ontario Power Authority,* http://fit.powerauthority.on.ca/fit-program/fit-program-pricing/fit-price-schedule

Renewable Fuel	Project Size Tranche	Original FIT Price (¢/kWh)	FIT Price (¢/kWh) April 5, 2012	FIT Price (¢/kWh) August 26, 2013
On-Farm Biogas	≤ 100 kW	19.5	19.5	26.5
	100 ≤ 250 kW	18.5	18.5	21.0
Biogas	≤ 500 kW	16	16	16.4
	> 500 kW ≤ 10 MW	14.7	14.7	16.4
	> 10 MW	10.4	10.4	16.4
Landfill Gas	≤ 10 MW	11.1	11.1	7.7
	> 10 MW	10.3	10.3	7.7

Domestic content requirement: All FIT projects were initially required to include a minimum amount of goods and services made in Ontario. The domestic content requirement following the 2012 FIT review was 50 per cent for solar projects and 60 per cent for wind projects.[17] As a result of the May 24, 2013 World Trade Organization ruling regarding the Ontario FIT domestic content requirements the requirements were reduced to between nineteen and twenty-eight per cent, depending on the wind and solar PV technologies involved.[18]

Incentive for community/aboriginal groups: Security payments were decreased for aboriginal and community owned projects as a result of the 2012 FIT review. The program also included incentives for projects with significant aboriginal or community participation: 0.75 to 1.5 cents per kwh for projects with aboriginal participation, and 0.5 to 1 cent per kwh for projects with community participation.

Streamlined Regulatory Approvals process: A renewable energy approval (REA) system was established, providing for consolidated environmental approvals of renewable energy projects, and exempting FIT supported projects from municipal planning approval requirements.[19]

The FIT program functions within the targets and parameters set out in the province's 2010 Long Term Energy Plan (LTEP). According to the LTEP, 50 per cent of Ontario's demand is to be met by nuclear power, 13 per cent by wind, solar and bio-energy by 2018. [20] The most recent Supply Mix Directive (February 2011) from the Minister of Energy specified a target of 10,700 MW of renewable generation, excluding hydroelectric, by 2018. [21]

17 "Domestic Content," *Ontario Power Authority,* 2013, http://fit.powerauthority.on.ca/domestic-content, accessed July 2013.

18 The Hon.Bob Chiarelli, Minister of Energy, letter to Mr.Colin Anderson, CEO, Ontario Power Authority, Re: Administrative Matters Related to Renewable Energy and Conservation Programs, August 16, 2013.

19 On the REA see P. Mulvihill, M. Winfield & J. Etcheverry, "Strategic Environmental Assessment and Advanced Renewable Energy in Ontario: Moving Forward or Blowing in the Wind," *Journal of Environmental Assessment Policy and Management* 15, no. 2 (June 2013): 1.

20 "Long Term Energy Plan," *Ontario Ministry of Energy and Infrastructure*, 2010, http://www.energy.gov.on.ca/en/ltep/?.

21 The Hon. B. Duguid, Minister of Energy and Infrastructure, *Supply Mix Directive,* February 17, 2011, 3.

Empirical Evidence of GEGEA Economic Development Impacts

The Ontario government has claimed that $26 billion in investments has been committed to the province as a result of the GEGEA and 20,000 jobs created as of the end of 2011.[22] The 2010 LTEP states that the GEGEA is projected to create 50,000 direct and indirect jobs over the first three years. Specifically, 10,000 jobs would be created in the first year, over 30,000 jobs by 2011 and 50,000 jobs by 2012.[23]

No comprehensive databases on employment in the renewable energy sector in Ontario could be identified.

In practice, actual data on employment in the renewable energy sector in Ontario is very limited. Some information was found to be held by the Ministry of Economic Development and Innovation, such as lists of renewable energy technology suppliers who were known to have established themselves in the province.[24] There are also anecdotal and media reports regarding the establishment of renewable energy manufacturing firms.[25] The two-year review of the FIT program, delivered in March 2012, estimated that 2,000 "direct manufacturing jobs" in the renewable energy sector had been created since the program's initiation in 2009.[26]

However, during the course of this study no comprehensive databases on employment in the renewable energy sector in Ontario could be identified. Earlier research suggested that Statistics Canada data on industrial employment in the province was too coarse to provide information on employment specific to renewable energy technologies, particularly given that Occupational Classification Codes (NOC) and North American Industry Classification (NAICS) codes only exist at levels of aggregation too high to enable appropriate analysis of the renewable energy industry.[27] In comparison, very detailed, survey-based data on renewable energy sector employment is available for the US,[28] United Kingdom,[29] Germany[30] and Denmark.[31] [32] The US federal government has also produced regular, detailed assessments of the job creation impact of the clean

22 "Ontario's Solar Energy Industry Creating Jobs," *Ministry of Ontario*, December 5, 2011, http://news.ontario.ca/mei/en/2011/12/ontarios-solar-energy-industry-creating-jobs.html.

23 "Long Term Energy Plan," *Ontario Ministry of Energy and Infrastructure*, 2010, http://www.energy.gov.on.ca/en/ltep/?.

24 See D.Strifler, "Small Scale, Big Impact: A Comprehensive Review of Ontario's MicroFit Program," Master of Environmental Studies Major Paper, Faculty of Environmental Studies, York University, 2012, 61-62.

25 The Canadian Solar Industries Association, for example, reported that over 35 firms had increased production of solar PV components or entered the solar PV market following the passage of the GEGEA. CaSIA, *Maximizing The Benefits of Early Success: Recommendations for the Sustainability of Ontario's Solar Energy Sector* (Ottawa: CanSIA, 2011), 4.

26 F. Amin, *FIT Program Two Year Review* (Toronto: Queen's Printer for Ontario, 2012), 6.

27 R. Pollin and H. Garrett-Peltier, *Building the Green Economy: Employment Effects of Green Energy* (Toronto: Green Energy Act Alliance, WWF-Canada, Blue-Green Alliance Canada, 2009), 28. See also Strifler, *Small Scale, Big Impact*, 62.

energy components of the 2009 *American Recovery and Reinvestment Act.* As of 2010, the Council of Economic Advisors reported that 179,000 job years had come from energy efficiency spending, 192,900 from renewable generation, 80,600 from grid modernization, 32,200 from green innovation and job training, 9,500 from clean energy equipment manufacturing, and finally, another 2,700 job years in an undefined "other" category.[33]

Modelling Based Information on Ontario

As a result of these data limitations, the bulk of the information on employment impacts that underpins the arguments over the GEGEA effects in Ontario reflects the results of economic modelling, rather than empirical data. A 2009 study[34] completed for the Green Energy Act Alliance for example, employed an input-output methodology to estimate the potential employment benefits of green investments in Ontario, comparing the impact of the 2007 Integrated Power System Plan (IPSP) developed by the OPA with a more aggressive green energy strategy. The study concluded that an investment of $47.1 billion in green energy (defined to include conservation and demand management, on-shore wind, hydroelectric power, bioenergy, solar energy and waste energy recycling) rather than the OPA's 2007 IPSP proposal for an $18.6 billion investment, would increase total job creation by about 55,000, for a total employment expansion of about 90,000 over a ten-year period.

The bulk of the information on employment impacts that underpins the arguments over the GEGEA effects in Ontario reflects the results of economic modelling, rather than empirical data.

Another study, this one by ClearSky Advisors, estimated that the installation of 3000 MW of solar PV capacity by 2018, as per the LTEP, would create 74,217 jobs (person years of employment (PYE)). [35] Of these jobs, 49,000 would be direct and 25,000 indirect.[36] Over the twenty-year life of solar facilities, operating and maintenance positions were predicted to account for 30 per cent of total employment in the sector, manufacturing for 14 per cent and construction labour 24 per cent.[37] After 2018, 1,100 full-time jobs would be sustained in the operation and maintenance of 3,000 MW of solar PV in Ontario.[38]

28 R. Wiser, M. Bolinger et al., *2011 Wind Technologies Market Report* (Oak Ridge: US Department of Energy, 2012).

29 See Cambridge Econometrics, Institute for Employment Research, and IFF Research, *Working for a Green Britain. Employment and Skills in the UK Wind & Marine,* London: Renewable UK, 2011, http://www.bwea.com/pdf/publications/Working_for_Green_Britain.pdf.

30 See M. O'Sullivan (DLR), D. Edler (DIW), T. Nieder (ZSW), T. Rüther (ZSW), U. Lehr (GWS), F. Peter (Prognos), *Employment from renewable energy in Germany: expansion and operation – now and in the future, first report on gross employment*, Bonn: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2012, http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/ee_bruttobeschaeftigung_en_bf.pdf.31 See "Danish Wind Industri: Annual Statistics 2010," *Danish Wind Industry Association,* http://ipaper.ipapercms.dk/Windpower/Branchestatistik/DanishWindIndustryAnnualStatistics2010/.

32 Electricity Human Resources Canada has recently announced its intention to develop a "National Human Resources Strategy for Electricity Related Renewable Energy". See http://electricityhr.ca/renewable-electricity-industry-given-powerful-hr-strategies/.

33 Council of Economic Advisors, *The Economic Impact of the American Recovery and Reinvestment Act of 2009: Second Quarterly Report*, Washington, D.C.: Executive Office of the President, January 13, 2010, http://www.whitehouse.gov/sites/default/files/microsites/100113-economic-impact-arra-second-quarterly-report.pdf. (Accessed May 7, 2013).

34 Pollin and Garrett-Peltier, *Building the Green Economy: Employment Effects of Green Energy,* 28.

35 ClearSky Advisors, *Economic Impacts of the Solar PV Sector in Ontario 2008-2018* (Ottawa: Canadian Solar Industries Association, 2011), 17.

36 ClearSky, *Economic Impacts of Solar PV,* 20.

37 ClearSky, *Economic Impacts of Solar* PV, 21.

38 ClearSky, *Economic Impacts of Solar PV,* 18.

A companion ClearSky study for wind energy projected that the achievement of the wind energy targets contained in the 2010 LTEP would draw $16.4 billion in private sector investments to the province, of which $8.5 billion would be spent locally in Ontario.[39] 80,328 PYE would be created between 2011 and 2018, of which 38,135 PYE would be direct and 42,193 indirect. Twenty-six per cent of the PYE would be in operations and maintenance, 27 per cent in manufacturing, 27 per cent in construction and 15 per cent in other activities.[40] ClearSky's work was notable in that it incorporated a substantial empirical component. In addition to modeling, it included in-depth interviews with large and small wind (43 interviews) and solar (150 interviews) energy developers in Ontario.

The critiques of the GEGEA's economic impact are also grounded in modeling rather than empirical data. A study published in the B.E. Journal of Economic Analysis and Policy in 2012,[41] for example, evaluated the economic impacts of Ontario's FIT program with a particular focus on labour market impacts using a multi-sector, multi-region computable general equilibrium (CGE) model. The simulation concluded that the FIT program will stimulate job creation in the manufacturing and operation of renewable energy facilities, but that these employment gains will be offset by job losses in the other sectors of the economy, resulting in net employment losses. While 12,400 jobs are created in renewable energy generation and manufacturing sectors, assuming an average salary of $50,600 /employee,[42] 1.97 jobs will be lost in non-renewable energy sectors per gain of employment in the renewable energy sector, largely as a result of the higher energy costs flowing from the FIT program.[43]

Given the role of modelling results rather than empirical information in framing the debate around the GEGEA, it becomes critically important to understand the different assumptions being employed by the modellers in reaching their conclusions. Central to these questions is the issue of establishing the costs of renewable energy initiatives relative to conventional alternatives.

39 Clearsky Advisors, *The Economic Impacts of the Wind Energy Sector in Ontario 2011-2018* (Ottawa: Canadian Wind Energy Association, 2011), 21.
40 ClearSky Advisors, *Economic Impacts of Wind*, 26.
41 C. Bohringer, N. J. Rivers, T. F. Rutherford, and R. Wigle, "Green Jobs and Renewable Electricity Policies: Employment Impacts of Ontario's Feed-in Tariff," *The B.E. Journal of Economic Analysis & Policy* 12, no. 1, (2012): 1935.
42 Bohringer, Rivers, Rutherford and Wigle, "Green Jobs and Renewable Electricity Policies," 16.
43 Bohringer, Rivers, Rutherford and Wigle, "Green Jobs and Renewable Electricity Policies," 17. A recent report by from the Fraser Institute makes similar arguments: R.R. McKitrick, *Environmental and Economic Consequences of Ontario's Green Energy Act* (Vancouver: Fraser Institute, 2013).

The Debate Over Renewable Energy Initiative Costs

Critiques of Renewable Energy Initiatives

The central critique of FITs, Renewable Portfolio Standards and similar initiatives for developing renewable energy resources is that they are more expensive for consumers than alternative means of obtaining new energy supplies. Renewable energy programs are seen to provide higher prices to renewable energy suppliers than they would be able to obtain either selling into a competitive wholesale electricity market, as reflected, for example, in Ontario through the Hourly Ontario Electricity Price (HOEP), or some form of technologically neutral competitive RFP or bidding processes for new generation. It is also generally argued that renewable energy sources are, at least currently, inherently more expensive in terms of their overall direct capital and operating costs than their non-renewable competitors, and as a result of their intermittent character, requiring dispatchable resources to maintain steady electricity supplies.

The central critique of FITs, Renewable Portfolio Standards and similar initiatives for developing renewable energy resources is that they are more expensive for consumers than alternative means of obtaining new energy supplies.

As a result, renewable energy programs lead to energy costs that are higher than they might otherwise be. Some analyses focus on the impacts of these higher prices on consumers,[44] while others carry their analysis further, arguing these higher energy costs in turn have negative impacts on the economy as a whole, slowing the pace of economic development and growth, which then translates into negative employment impacts which outweigh any gains in the renewable energy sector. This basic line of argument is central to the critiques of renewable energy initiatives in Ontario,[45] Germany,[46] Spain[47] and the United Kingdom.[48] In some instances there are also regionally specific arguments. In

44 See, for example, Aegent Energy Advisors Inc., "Ontario Electricity Total Bill Impact Analysis August 2010 to July 2015," August 2010, http://www.sygration.com/docs/OntarioElectricityTotalBillImpactAnalysisbyAegentEnergyAdvisors.pdf; J. Carr and B. Dachis, *Zapped: the High Cost of Ontario's Renewable Electricity Subsidies* (Toronto: C.D. Howe Institute, 2011); D. Dewees, *What is Happening to Ontario Electricity Prices* (Ottawa: Sustainable Prosperity, 2012).

45 Bohringer, Rivers, Rutherford, and Wigle, "Green Jobs and Renewable Electricity Policies: Employment Impacts of Ontario's Feed-in Tariff"; R.R. McKitrick, *Environmental and Economic Consequences of Ontario's Green Energy Act.*

46 B. Hillebrand, H. G. Buttermann, J. M. Behringer, and M. Bleuel, "The expansion of renewable energies and employment effects in Germany," *Energy Policy* 34, no. 18 (2006): 3484.

47 G.C. Alvaraz, *Study of the effects on employment of public aid to renewable energy sources* (Madrid: Universidad Rey Juan Carlos, 2009), http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf.

48 J. Constable and L. Moroney, *The Probable Cost of UK Renewable Electricity Subsidies 2002-2030* (Renewable Energy Foundation, 2011), http://www.ref.org.uk/publications/238-the-probable-cost-of-uk-renewable-electricity-subsidies-2002-2030; R. Marsh and T. Miers, *Worth The Candle? The Economic Impact of Renewable Energy Policy in Scotland and the UK* (Kirkcaldy, Scotland: Verso Economics, March 2011).

the case of Ontario, for example, it is argued that the FIT program prompted the development of additional supply that the province did not need in the face declining electricity demand.[49]

Responses from Green Energy Proponents

Modelling Issues

The responses to these critiques from renewable energy proponents have also been relatively consistent across the jurisdictions reviewed. At a conceptual level it has been emphasized that the CGE models typically employed by neo-classical economists for the purposes of modelling the impacts of renewable energy initiatives may incorporate assumptions that any intervention in markets by the state will produce adverse results.[50] There have also been more specific technical critiques of how the models used to assess the impacts of renewable energy policies treat employment creation in different sectors[51] and how the modelling fails to take into account the potential for the development of export markets for renewable energy technologies developed in response to stronger domestic demand.[52]

The cost estimates used by FIT critics in Ontario have been based on relatively simple extensions of the province's LTEP targets for renewables at FIT rates compared with providing the same amounts of energy through conventional sources of supply (principally natural gas), with some allowances for the need for dispatchable supply to address the intermittent nature of renewables.[53] They have not, however, employed dynamic modelling of the province's electricity system to assess how renewables would actually be integrated and employed in the system. Such approaches could account for the potential for solar PV to offset high-cost peaking supply from imports or gas-fired peaking plants.[54] Solar PV, which peaks during the daytime, and wind, which in Ontario peaks overnight, may also be able offset each other and reduce the need for dispatchable back-up[54b]. The geographic distribution of renewable supply and better grid management may assist in managing intermittency issues as well.

49 Carr and Dachis, "Zapped: the High Cost of Ontario's Renewable Electricity Subsidies".

50 For an overview of these types of critiques of CGE modelling see F.Ackerman and A.Nadal, *The Flawed Foundations General Equilibrium: Essays in Economic Theory* (London: Routledge, 2004), Chapter 1.

51 E. Lantz and S. Tegen, *Variables Affecting Economic Development of Wind Energy* (Golden CO: Nation Renewable Energy Laboratory, 2008).

52 U.Lehr, B. Breitschopf, J. Diekmann, J. Horst, M. Klobasa, F. Sensfuß, and J. Steinbach, *Renewable energy deployment – do the benefits outweigh the costs?* (Osnabrück: gws, 2012), http://www.gws-os.com/discussionpapers/gws-paper12-5.pdf.

53 Dewees, *What is Happening to Ontario Electricity Prices*; Carr and Dachis, "Zapped"; McKitrick, *Environmental and Economic Consequences*.

54 Dewees, *What is Happening to Ontario Electricity Prices* does make allowance for this for solar PV.

54b C. E. Hoicka and I. H. Rowlands , "Solar and Wind Resource Complementarity: Advancing Options for Renewable Electricity Integration in Ontario, Canada", *Renewable Energy* (Vol. 36, No. 1, 2011), pp. 97-107.

Similar relatively simple approaches to system modelling have tended to be employed by those critical renewable energy initiatives' impacts in other jurisdictions.[55] A 2011 study by the Pembina Institute on the impact of the FIT program on electricity costs in Ontario was notable in that it used what was likely the most sophisticated model of the actual operation of an electricity market and system to assess the impact of a renewable energy initiative on electricity costs from a consumer point of view. The model took into account such factors as the intermittent nature of renewables, the need to manage peaks and troughs in demand, the presence of assets contracted at fixed prices, transmission and distribution constraints and other factors.[56] The resulting analysis concluded that the impact of the FIT program on electricity costs would be marginal compared to the available alternatives,[57] principally natural gas in the case of Ontario, although that conclusion was subject to a number of additional considerations discussed in the following sections.

Renewable vs. Conventional Energy Economic Costs

A number of lines of argument emerge regarding the costs of renewable energy relative to conventional energy sources, Some are specific to the circumstances of individual jurisdictions, while others are of more general application. In the case of Ontario, renewable energy proponents have pointed out that the market clearing and Hourly Ontario Electricity Prices (HOEP) generated through the province's wholesale electricity market, frequent points of comparison with renewable energy costs, as established through the FIT program,[58] bear little or no relationship to the actual costs of building new generating capacity in the province.

As shown in Figure 1, the HOEP peaked in 2005, where it reached 10 cents/kWh. The market then leveled off to between 4 cents and 6 cents/kWh for a few years. In the context of falling electricity demand, it has fluctuated in the 2 cent to 4 cent/kWh range for the past four years.

The market clearing and Hourly Ontario Electricity Prices generated through the province's wholesale electricity market, frequent points of comparison with renewable energy costs, as established through the FIT program, bear little or no relationship to the actual costs of building new generating capacity in the province.

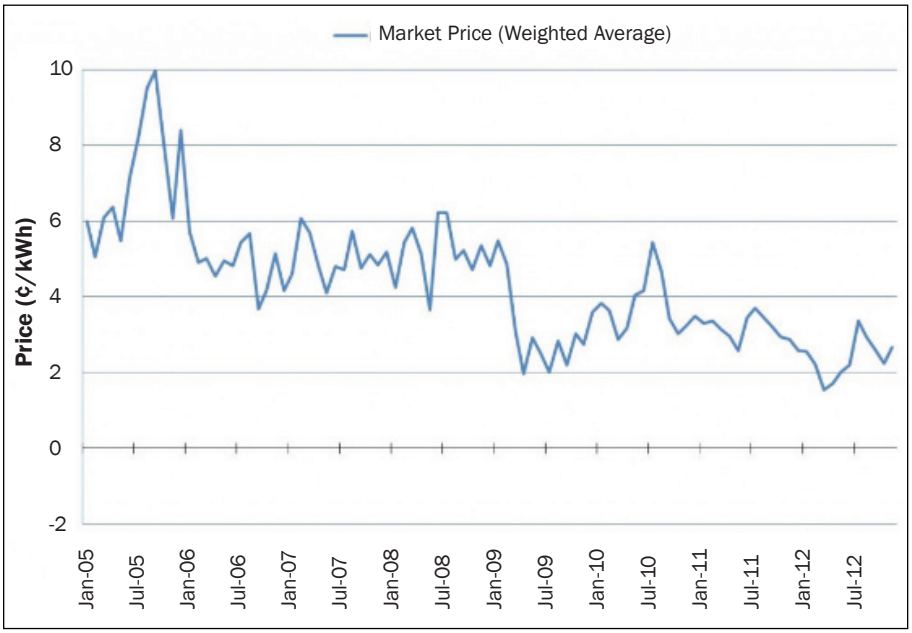
55 See for example, Alvaraz, *Study of the effects on employment of public aid to renewable energy sources.* Some German analysts have considered some market dynamics in a limited way. See T. Thure and C.Kemfert, "Gone with the wind? – Electricity market prices and incentives to invest in thermal power plants under increasing wind energy supply" *Energy Economics* 33, no. 2 (2011): 249.

56 See T. Weis and P.J. Partington, *Behind the switch: pricing Ontario electricity options* (Drayton Valley: The Pembina Institute, 2011), pp.6-11 for a discussion of the modelling approach.

57 Weis and Partington, *Behind the switch: pricing Ontario electricity options*.

58 See, for example, P. Gallant, "Ontario's Power Trip: McGuinty's legacy," *The National Post*, January 17, 2013.

Figure 1: Monthly weighted average HOEP from 2005 to 2012.[59]



It is important to note that these market prices in Ontario are driven by historical assets, principally hydroelectric and nuclear. The capital costs of these assets were either retired long ago, as is the case of Ontario Power Generation's hydro facilities or, in the case of nuclear, were "stranded" – effectively transferred to the provincial government and are being paid down through a separate "debt retirement charge" on electricity consumers' bills.[60] As a result, the market price largely reflects only the operating costs of these facilities.

Given these considerations, no one is likely to build new or refurbish major generating assets in expectation of receiving the market price in Ontario. In fact, all of the new construction of generating plants (principally gas and wind) that has occurred since 2004 has been based on fixed price contracts well above the market price. This is necessary to take into account the capital costs of new construction, and the need to provide an adequate return on investment to attract private capital. The refurbishment of the Bruce A nuclear facility proceeded on the same basis.[61] The costs of power from these facilities is addressed through a "global adjustment" added to consumers' electricity bills, reflecting the difference between the market price and the price guaranteed to new electricity suppliers via their contracts.[62] As indicated in Figure 2, the "global adjustment" accounts for an increasing portion of Ontario electricity consumers' actual energy bills.

59 Environmental Commissioner of Ontario, *The Mysteries of Electricity Pricing in Ontario* (Toronto: ECO 2013), http://www.eco.on.ca/blog/2013/02/20/the-mysteries-of-electricity-pricing-in-ontario/?utm_source=rss&utm_medium=rss&utm_campaign=the-mysteries-of-electricity-pricing-in-ontario. Reproduced with permission.

60 For a detailed discussion of Ontario Hydro's 'stranded' debt, see Auditor General of Ontario, *2011 Annual Report* (Toronto: Queen's Printer for Ontario, 2011), chapter 3, Section 3.04, 124-126.

61 See Auditor General of Ontario, *The Bruce Power Refurbishment Agreement* (Toronto: Queen's Printer, 2007).

62 ECO, *Mysteries of Electricity Pricing in Ontario.*

Figure 2: HOEP, Global Adjustment and Combined Price, 2005-2012.[63]

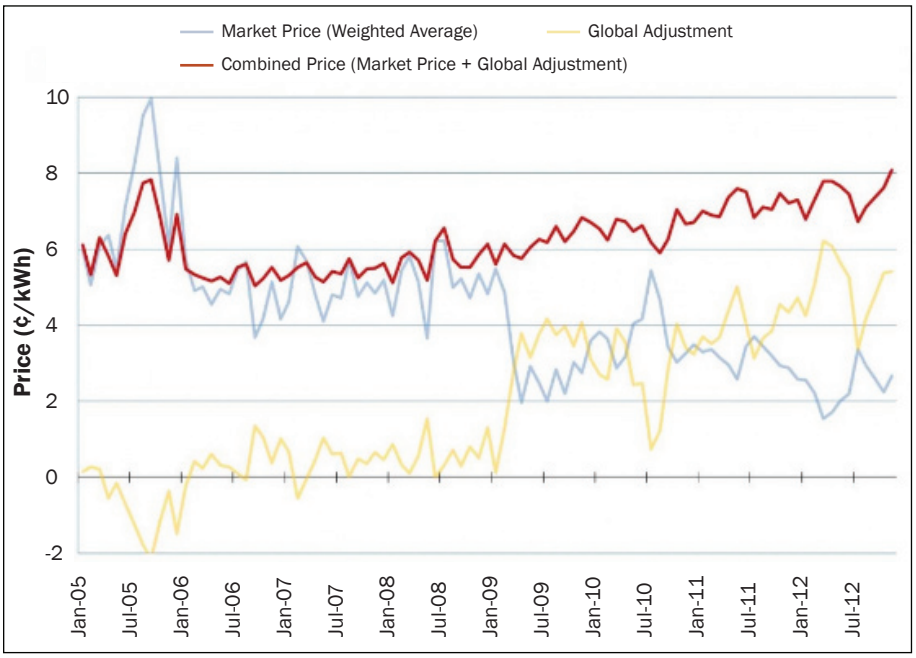
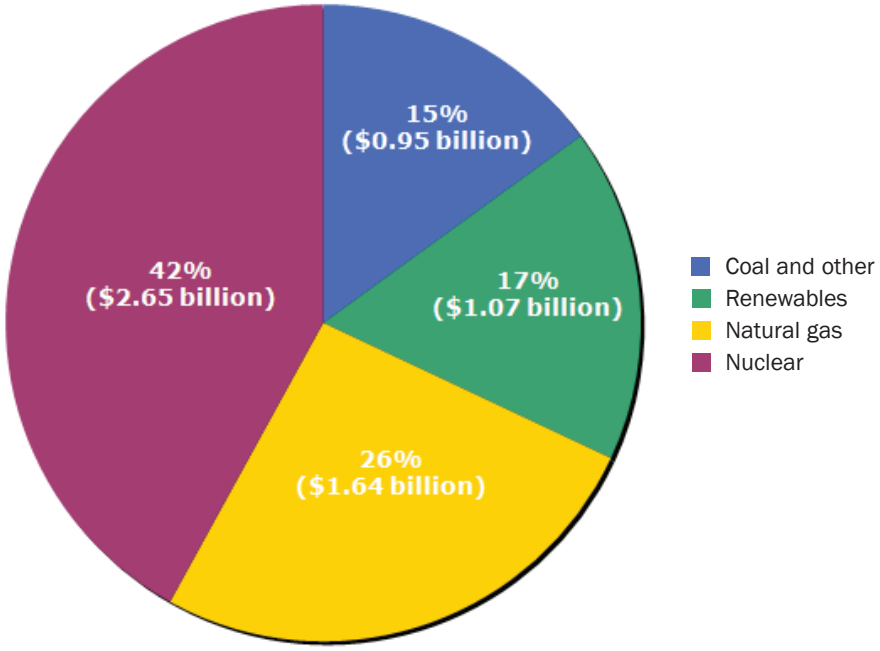


Figure 3: Estimated Components of Technology Adjustment, by Technology, October 2011-September 2012 (Total cost of $6.3 billion).[64]

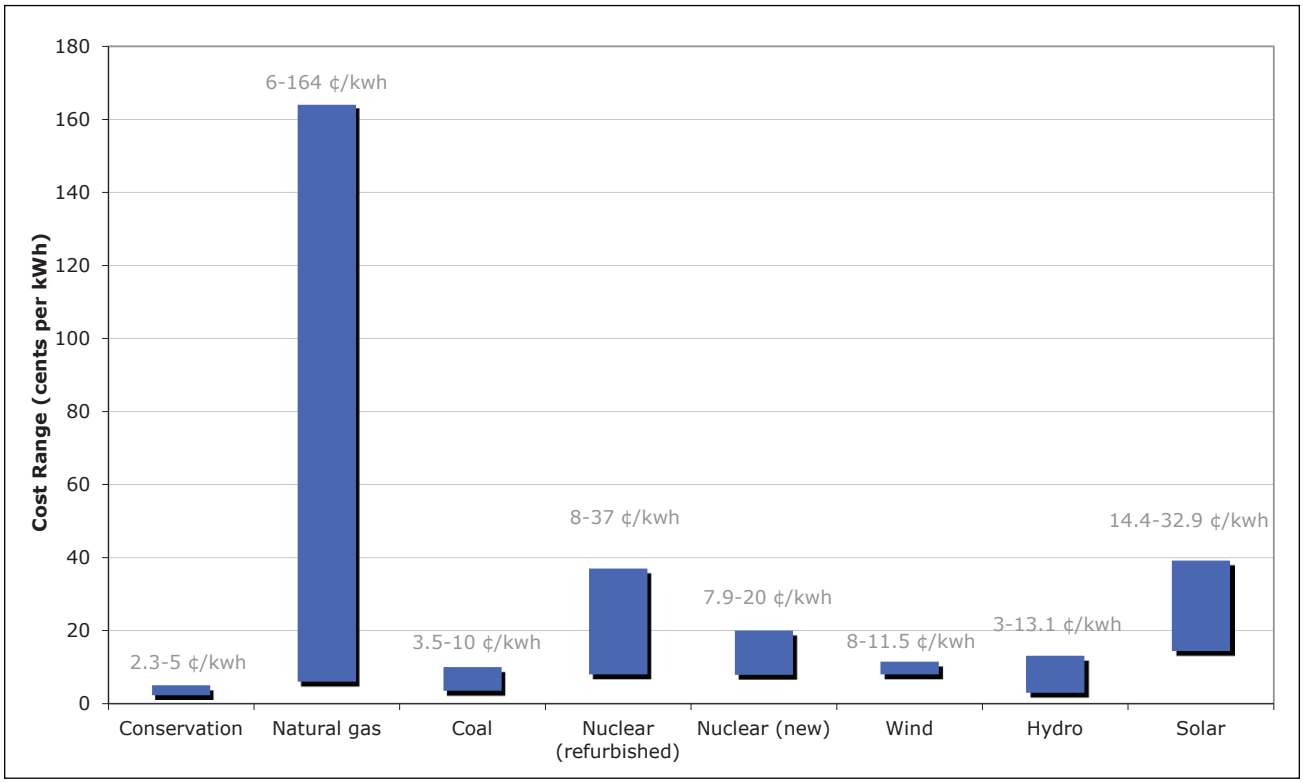


63 ECO, *Mysteries of Electricity Pricing in Ontario.* Reproduced with permission.
64 Adapted from J. Spears, "Mad about your hydro bill: Blame nuclear and gas plants," *The Toronto Star*, April 18, 2013, using data from Navigant Consultants.

To date, as shown in Figure 3, the overwhelming portion of the global adjustment costs have been related to nuclear, gas-fired, and now declining coal-fired generation, rather than renewable energy projects.

In comparing the actual economic costs of potential sources of new supply, it is important to compare options on the basis of both their capital costs and operating and maintenance costs over the expected life of the project. This figure is usually referred to as the Levelized Unit Electricity Cost (LUEC). As shown in Figure 4, estimates of the LUEC, based on published figures supported by some degree of substantiation, for the electricity conservation and supply technologies currently available to Ontario vary widely.

Figure 4: Economic Costs of New Energy Conservation and Supply Technologies: Ontario[65]



65 Data and sources in Appendix 1.

The range of cost estimates for nuclear, in particular, have risen significantly over the past decade as a result of experience with refurbishment projects in Ontario and elsewhere, new construction in Europe, and more rigorous bid requirements in North America.[66] On the other hand, prices for natural gas-fired electricity in North America have fallen with the emergence of a "glut" of supply resulting from the shale gas "fracking" boom in the United States.[67] The costs of renewable energy technologies have also declined substantially over the past decade. Notably, solar PV costs have fallen by approximately 50 per cent, and a similar reduction in solar PV costs is anticipated over the next ten years.[68] The capital costs of wind turbines in North America fell substantially between the early 1980s (approximately US$4,000/kW) and the beginning of the last decade (US$700/kW), peaked (US$1500/kW) in 2008 as demand for turbines rose, and then fell again, into the US$900-1270/kW range.[69]

On a levelized basis, the economic costs of renewables, particularly wind, biogas and hydro, are now falling within the range of costs for non-renewable alternatives.

The result is that on a levelized basis, the economic costs of renewables, particularly wind, biogas and hydro, are now falling within the range of costs for non-renewable alternatives.[70] An important exception to this is with respect to natural gas in non-peaking applications. The current low natural gas prices in North America make it difficult for renewables to compete in such applications in the absence of pricing for carbon and other environmental externalities. In Ontario the 2011 review of the FIT program recognized that the original program rates were too high, particularly for commercial proponents.[71] As a result, there were substantial reductions in the rates for wind and solar FIT contracts through the 2012 FIT review,[72] although it is important to note that the projects that were contracted before the review will largely be paid at the original FIT rates.[73]

The rates incorporated into the original FIT program, particularly for wind and solar, were grounded in an excessive rate of return on investment for commercial developers. The original FIT rate for onshore wind was 13.5 cents/kWh, well above the 8-10 cents/kWh rates that the OPA reported it had obtained through the earlier RFP processes for large scale projects.[74]

66 S. Schneider, A. Froggatt, S. Thomas, *World Nuclear Industry Status Report 2010-11: Nuclear Power in a Post-Fukishima World* (Washington DC: Worldwatch Institute, 2011), http://www.worldwatch.org/system/files/pdf/WorldNuclearIndustryStatusReport2011_%20FINAL.pdf. See also "Nuclear Power: Fracked Off," *The Economist*, May 30, 2013.

67 Bernard, "The Canadian Energy Market: Recent Continental Challenges".

68 S. Lacey, "Solar gets cheap fast".

69 Wiser and Bolinger et.al., *2011 Wind Technologies Market Report*.

70 Carr and Dachis, "Zapped", assume 11 cents; Bohringer et.al., "Green Jobs and Renewable Electricity Policies" 12.3 cents economic costs for conventional technologies (principally natural gas); "Ontario Total Bill Impact Analysis Aug 2011 to July 2015," *Aegent Energy Advisors*, on.cme-mec.ca/download.php?file=gecusdzx.pdf 6.5 cents kWh, although this has been criticized as too low. Dewees suggests 9 cents/kWh more reasonable (Dewees, *What Is Happening to Ontario Electricity Prices?*, 18).

71 F. Amin, "Ontario's Feed-in Tariff Program: Two-Year Review Report," *Ministry of Energy,* 2012, http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf.

72 "FIT Price Schedule," *Ontario Power Authority*, http://fit.powerauthority.on.ca/fit-program/fit-program-pricing/fit-price-schedule, accessed July 2013.

73 Recent changes to the rules for wind energy reduce payments during periods of low demand. See J. Spears, "New wind power rules coming in Ontario to curb output," *The Toronto Star*, March 4, 2013.

74 Cited in Weis and Partington, Behind the *Switch*, Figure 5.

In effect, the original program design and rates of return were geared towards the needs of smaller, community-based, aboriginal and farm-based renewable energy developers. In practice, the capacity of such proponents to propose and finance projects in Ontario was far less developed than was the case in the European jurisdictions that inspired the FIT program. As a result, participation in the Ontario program ended up being dominated by large commercial scale developers, who did not require such high rates for their projects to be viable.[75]

Other important features of the European FIT programs intended to control costs were also overlooked in the design of the Ontario program. These included such measures as the incorporation of annual degression rates or reductions in FIT rates to account for improvements in technology, economies of scale and increased efficiency on the part of developers. Rates in Europe have also been tied to market prices for electricity or to the achievement of annual targets for the development specific technologies – rising if targets are not being met and falling if they are exceeded.[76]

Even the post-FIT review rates for solar PV remain well above recent projected costs for solar PV, but are potentially competitive if displacing natural gas in meeting high peak demand. In Germany the availability of increasing amounts of solar PV has already led to significant declines in daytime peak power pricing.[77] Solar PV costs are expected to continue to fall substantially in the medium term. FIT rates will need to be adjusted to reflect these developments.

One of the central features of renewable energy proponents' responses to critics of the impact of renewable energy development initiatives has been to question the treatment of externalized costs and risks associated with conventional energy supply, which are avoided in the development of renewable energy sources.

Treatment of Subsidies and Externalized Costs and Risks

One of the central features of renewable energy proponents' responses to critics of the impact of renewable energy development initiatives has been to question the treatment of externalized costs and risks associated with conventional energy supply, which are avoided in the development of renewable energy sources. These costs may include the fuel life-cycle environmental and social impacts of non-renewable energy sources, such as greenhouse gas emissions, emissions of other air and water pollutants and the generation of extremely hazardous and long-lived waste streams. They also include such factors as the risks of catastrophic accidents. Additionally, renewable energy proponents highlight the impact of historical subsidies for the development of conventional

75 As of May 2011, individual, cooperative and community-based proponents constituted less than 4 per cent of the total number of FIT contracts and less than 9 per cent of the total power contracted in Ontario (S. Martin, *The Sustainability Case for Community Power: Empowering Communities Through Renewable Energy,* Major Research Paper, Faculty of Environmental Studies, York University, 2011, Table 7.

76 Jacob, *Renewable Energy Convergence in the EU*, 123-126.

77 G. Parkinson, "Why generators are terrified of solar," *RENew Economy*, March 26, 2012, http://reneweconomy.com.au/2012/why-generators-are-terrified-of-solar-44279.

technologies, particularly nuclear and, in some jurisdictions, fossil fuels.[78] The FIT rates built into Germany's original program explicitly factored in the avoided external environmental costs of conventional power generation.[79]

Renewable energy proponents also argue for consideration of the risks associated with conventional fuel costs and security of supply[80], as well as wider energy sustainability considerations such as system resilience, flexibility and adaptive capacity, where low-impact renewable energy sources offer potentially significant advantages over more centralized conventional technologies.[81] With very few exceptions, studies concluding that renewable energy programs lead to higher electricity costs relative to non-renewable technologies or market-based approaches to acquiring new supply ignore considerations beyond the direct economic and operating costs of the alternative technologies in their analyses.[82] Even where the avoided environmental costs associated with renewable energy technologies have been considered by critics of renewable energy programs, the analysis has been limited to greenhouse gas emissions and air pollution.[83] Other types of impacts, such as water pollution or waste generation are not considered.

Moreover, even these more comprehensive analyses have only considered air pollution and greenhouse gas emissions at the point of electricity generation. They do not consider emissions or other environmental impacts on a fuel life-cycle basis. This is a crucial omission from the perspective of renewable energy proponents, as major impacts may occur through the extraction and processing of fuels, and the disposal of the resulting waste materials, all of which are avoided with renewable energy technologies, particularly wind and solar. Uranium mining and milling to provide fuel for nuclear power plants, for example is associated with serious and extensive contamination of surface and groundwater resources, air pollution, and the generation of extremely toxic, high volume, difficult to manage and extremely long-lived waste streams.[84]

This is a crucial omission ... as major impacts may occur through the extraction and processing of fuels, and the disposal of the resulting waste materials, all of which are avoided with renewable energy technologies, particularly wind and solar.

78 E. Lantz and S. Tegen, *NREL Response to the Report* Study of the Effects on Employment of Public Aid to Renewable Energy Sources *from King Juan Carlos University (Spain)* (Golden, CO: National Renewable Energy Laboratory, 2009). See also Max Wei, Shana Patadia, and Daniel M. Kammen, "Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?," *Energy Policy* 38, no. 2(2010): 920.

79 D. Jacob, *Renewable Energy Policy Convergence in the EU* (Burlington, VT: Ashgate, 2012), 66.

80 K. Mallon, "Myths, Pitfalls and Oversights," in *Renewable Energy Policy and Politics: A Handbook for Decision-Making*, ed. K. Mallon (London: Earthscan, 2006) 5-33.

81 M. Winfield, R. Gibson, T. Martvart, K. Gaudreau, and J. Taylor, "Implications of sustainability assessment for electricity system design: The case of the Ontario Power Authority's integrated power system plan," *Energy Policy* 38 (2010): 4115.

82 London Economics International, *"Examining the potential cost of the Ontario Green Energy Act, 2009 – (prepared for the Official Opposition in Ontario)* (Toronto: London Economics International, 2009) provides a good example of such a study.

82 Hillebrand et al., "The expansion of renewable energies and employment effects in Germany," made an allowance of a Carbon Dioxide price of up to E10/tonne. See also D.Dewees, *The Economics of Renewable Electricity Policy in Ontario* (Toronto: Working Paper, Department of Economics, University of Toronto, 2013), which considers GHG and air pollution impacts

83 See Winfield et al., *Nuclear Power in Canada: An Examination of Impacts, Risks and Sustainability* (Drayton Valley: Pembina Institute, December 2006), pp.23-42.

84 See Winfield et al., Nuclear Power in Canada: An Examination of Impacts, Risks and Sustainability (Drayton Valley: Pembina Institute, December 2006), pp.23-42.

The omission of the upstream impacts of natural gas extraction is particularly relevant to Ontario, where natural gas is generally regarded as the primary alternative to renewable energy sources. Hydraulic fracturing or "fracking" has come to dominate North American natural gas output. There are increasing concerns over the environmental impacts of this production method, particularly over groundwater contamination,[85] and the potential for very substantial fugitive releases of methane, a greenhouse gas twenty-five times more potent than carbon dioxide.[86]

In modelling exercises by renewable energy proponents where externalized environmental costs and risks are taken into account, the net cost of renewable energy programs emerges as comparable if not better than the outcomes relying on conventional supplies, even where the analysis is limited to atmospheric emissions at the point of generation.[87] As an example, the 2011 Pembina Institute study on Ontario made provision for the avoided environmental costs associated with renewable energy development by attaching a price to the carbon dioxide that would be emitted from the competing conventional technologies. The study also made some allowances for the price risks associated with commodity fuel supplies (e.g. natural gas) and anticipated the reductions in the province's FIT rates. The findings of that study, comparing the impacts of Ontario's existing renewable energy strategy to one in which the FIT program would be terminated and the required supply would be made up primarily through combined cycle natural gas, are shown in Figure 5. As is evident in the figure, the difference in consumer prices between the two scenarios was marginal.

In modelling exercises by renewable energy proponents where externalized environmental costs and risks are taken into account, the net cost of renewable energy programs emerges as comparable if not better than the outcomes relying on conventional supplies, even where the analysis is limited to atmospheric emissions at the point of generation.

There is considerable space for debate in this type of analysis, particularly regarding the appropriate valuation of avoided environmental costs associated with renewable energy sources. Absent a meaningful federal or provincial policy framework for carbon pricing or a functioning market for carbon, a range of possibilities for pricing the avoided carbon value of emissions from conventional sources exists, from recent prices in jurisdictions where carbon markets do exist ($5-$15/tonne)[89] through to the marginal costs that have been identified as being needed to avoid dangerous climate change or actually achieve the provincial and federal governments' emission targets ($50-$200/tonne).[90] These issues are again particularly relevant to Ontario, where natural gas-fired generation is generally accepted as the most likely alternative to renewable energy supplies. Although on a point-of-generation basis natural gas fired generation is substantially less carbon intense than coal-fired generation,

85 R.B. Jackson, et. al., "Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction," *Proceedings of the National Academy of Sciences of the United States* pnas.1221635110 PNAS June 24, 2013.

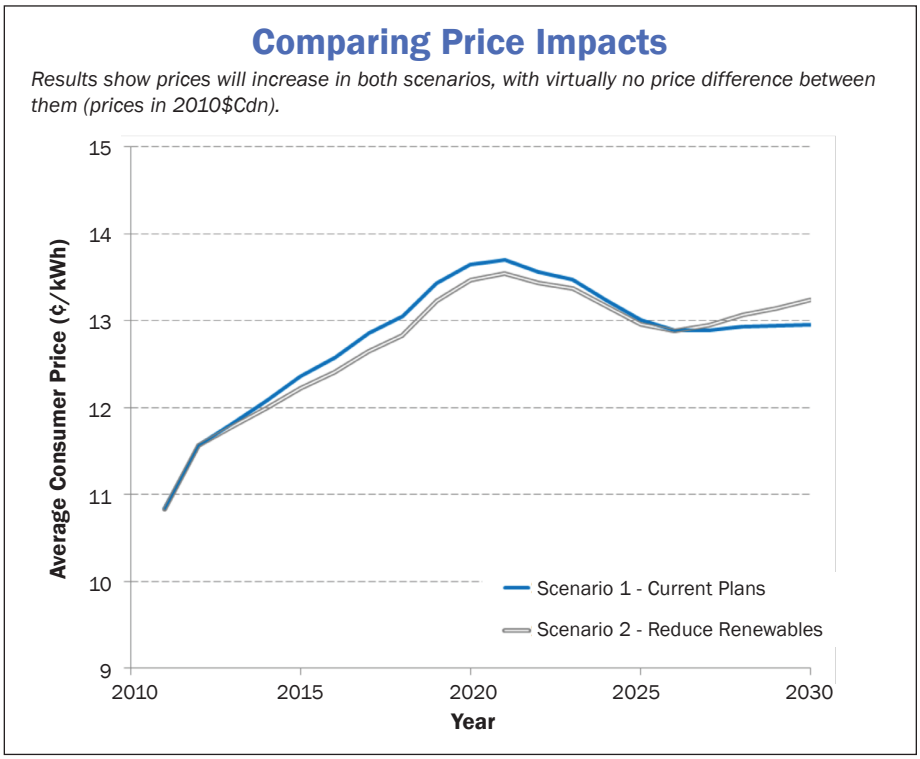
86 R. W. Howarth, R. Santoro and A. Ingraffea, "Methane and the greenhouse-gas footprint of natural gas from shale formations: A letter" *Climatic Change* (2011) 106:679–690

87 See, for example, Weis and Partington, *Behind the Switch*; Clearsky Advisors, *The Economic Impacts of the Wind Energy Sector in Ontario 2011-2018*.

89 See "ETS RIP?," *The Economist*, April 20, 2013.

90 See M.K. Jaccard and Associates, *Climate Leadership; Economic Prosperity* (Drayton Valley and Vancouver: Pembina Institute, David Suzuki Foundation, 2009). Similar debates exist over the appropriate economic valuation of air pollution impacts Dewees, *The Economics of Renewable Electricity Policy in Ontario*, pp.4-5.

Figure 5: Consumer Price Impact of Current Planned and Reduced Renewable Scenarios for Ontario 2010-2030 – Pembina Institute, 2011[88]



it is a far more carbon intense energy source than wind power or solar PV.[91] Similar debates exist over the appropriate economic valuation of other air pollution impacts[92] and around the valuation of other cost risks associated with conventional technologies, such as fuel cost risks with natural gas,[93] and construction, waste fuel management and decommissioning costs with nuclear.[94]

However, consideration of these types of factors does narrow the consumer cost impact of renewable energy initiatives relative to conventional supply options, potentially to the point of insignificance. In this case, key elements of critics' arguments about negative employment impacts flowing from such initiatives are significantly weakened. In effect, the critics are ignoring what, in the eyes of renewable energy proponents, are major elements of the real costs of non-renewable energy alternatives to society.

88 Weis and Partington, *Behind the switch.* Reproduced with permission.

91 Recent estimates put onshore wind at 9-12 gCO_2/KWh; solar PV at 32-46 gCO_2/KWh, and combined cycle natural gas at 443-469 g CO_2/KWh. See W. Moomaw, P. Burgherr, G. Heath, M. Lenzen, J. Nyboer, and A. Verbruggen, "Annex II: Methodology" in *IPCC: Special Report on Renewable Energy Sources and Climate Change Mitigation* (Geneva: IPCC, 2011) and Benjamin K. Sovacool, "Valuing the greenhouse gas emissions from nuclear power: A critical survey," *Energy Policy* 36 (2008): 2950.

92 Dewees, *The Economics of Renewable Electricity Policy in Ontario*, pp.4-5, for example, notes that estimates of the value of the health and environmental impacts of coal-fired electricity range from $20.36/MWh to $132/MWh.

93 See Dewees, *What is Happening to Ontario Electricity Prices?*, on ClearSky's approach.

94 See, for example, M. Winfield et al., *Nuclear Power in Canada: An Examination of Impacts, Risks and Sustainability* (Drayton Valley: Pembina Institute, December 2006), 75,89-90, 110.

The question of the treatment of externalities, risks and subsidies for non-renewable energy sources is a central element of the rationale for renewable energy initiatives.

More broadly, the question of the treatment of externalities, risks and subsidies for non-renewable energy sources is a central element of the rationale for renewable energy initiatives. Proposals for a technologically neutral, full-life-cycle-cost, level playing field bid system for major new electricity supply, as generally favoured by "economic rationalists" and as most recently suggested by the Commission on the Reform of Public Services in Ontario (a.k.a. the Drummond Commission),[95] have been longstanding positions of some ENGOs engaged with energy issues in Ontario.[96] The pursuit of such a model was part of the rationale for Ontario's 1998-2004 experiment with a market-based electricity system paradigm.[97]

In practice such systems, even those based on only narrowly defined economic (i.e. direct capital and operating) costs, and excluding consideration of environmental, social and fuel cycle costs and risks, have been impossible to achieve in the face of the institutionalized support for conventional technologies, particularly nuclear energy.[98] These challenges have been reinforced by the extent to which long-term infrastructure investments, particularly with respect to the transmission grid, have tended to lock-in dependence on conventional, and relatively centralized, supply technologies.[99] In this context, renewable energy initiatives such as FITs, RFPs and renewables obligations represent potentially second best (in "economic rationalist" terms), but politically feasible alternatives, to address these embedded biases in energy system design. FIT programs have been regarded as particularly advantageous to individual and community-based energy developers, as these actors typically lack the financial and institutional capacity to deal with the transaction costs and financial risks associated with competitive bidding processes.[100]

95 D. Drummond, *Commission on the Reform of Ontario's Public Services* (Toronto: Ministry of Finance 2012), recommendation 12-15, http://www.fin.gov.on.ca/en/reformcommission/.

96 See for example, Ontario Clean Air Alliance Research Inc*., The Darlington Re-Build Consumer Protection Plan* (Toronto: Ontario Clean Air Alliance, 2009). This position has always been qualified by arguments in favour of a conservation-first loading-order as followed in California and more recently BC, in recognition of well-described and understood market failures with respect to energy conservation. See Mallinson, *Electricity Conservation Policy in Ontario.*

97 See for example, R.J. Daniels and Michael Trebilcock, "A Future for Ontario Hydro: A Review of Structural and Regulatory Options," in *Ontario Hydro at the Millennium: Has Monopoly's Moment Passed?*, ed. R. Daniels (Toronto: UTP, 1996).

98 On Ontario's experience in this regard see J. Swift and K. Stewart, *Hydro: The Decline and Fall of Ontario's Electric Empire* (Toronto: Between the Lines, 2004). See also M. Winfield and B. Macwhirter, *Competing Paradigms and Hard Path Inertia: The Search for Sustainability in Ontario Electricity Policy (Working Paper)* (Toronto: Sustainable Energy Initiative, Faculty of Environmental Studies, York University, April 2013), http://sei.info.yorku.ca/files/2013/03/CompetingParadigms-03-12-2013.pdf.

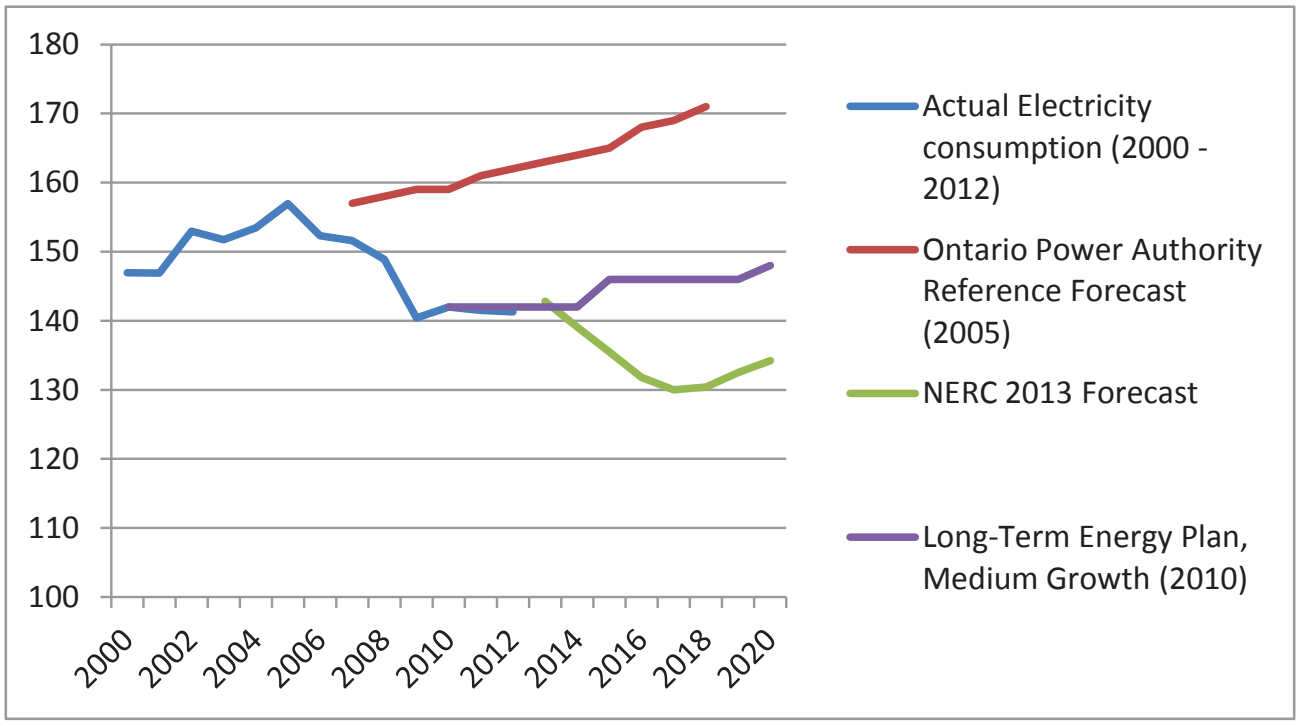
99 See P.Lehmann, F.Creutzig, M-H Ehlers, N.Friedrichsen, C.Heson, L.Hirth and R.Pietzcker, "Carbon Lock-Out: Advancing Renewable Energy Policy in Europe," *Energies*, 2012, 5, 323-354.

100 See, for example, M. Mendonça, *Feed-in Tariffs: Accelerating the Deployment of Renewable Energy* (London: EarthScan 2007).

The Need for New Energy Supply

As noted earlier, one of the critiques of the Ontario FIT program has been to question the need for new supply in the context of demand that, as shown in Figure 6, has fallen rather than grown, as the government had anticipated at the time of the GEGEA adoption.[101] There seems no reasonable expectation of significant growth in demand for the foreseeable future.[102]

Figure 6: Ontario Electricity Consumption 1975-2013 (Forecast 2013-2018) tWh/yr[103]



101 Carr and Dachis, "Zapped".

102 The Ontario Independent Electricity System Operator has recently updated its forecasts to indicate continued declines in demand to 2017. *18-Month Outlook: From June 2013 to November 2014* (Toronto: IESO, May 24, 2013), 4.

103 Data from "Supply Overview," *Independent Electricity System Operator*, December 18, 2012, http://www.ieso.ca/imoweb/media/md_supply.asp, and Haines, Anderson and Weis, *Analysis of New Nuclear: Darlington Environmental Impact Statement.*

In all of the jurisdictions studied, questions about the need for additional renewable energy supplies, even where demand is falling, are fundamentally connected to wider questions about the future direction of their energy systems and the future role of nuclear energy. These questions have moved to the forefront in the aftermath of the March 2011 Fukushima nuclear disaster, which has prompted many jurisdictions to move in the direction of phasing nuclear energy out of their energy systems.[104] In Ontario, the Fukushima disaster did not prompt the government to reconsider the centrality of nuclear energy to the province's electricity system.[105] However, a number of the province's nuclear facilities are approaching the end of their normal operating lives, most notably the Darlington facility east of Toronto (3,512 MW) and Bruce B (3,263 MW) facility at Tiverton. The Pickering B facility (2,064 MW), for its part, is scheduled for decommissioning in 2020 if not required earlier.[106] Decisions about whether and how to replace or refurbish this capacity will have major implications for the province's future electricity needs, in particular the potential for growth in renewables beyond the government's current targets.[107]

Conclusions: The Cost Debate

The debates over the costs of renewable energy initiatives in Ontario and Europe are grounded in disputes over a number of key factors. These include the economic costs assigned to different energy technologies, the treatment of subsidies provided to conventional technologies and of the externalities and risks associated with conventional generation technologies relative to renewable alternatives. There are also issues over the approaches to modelling the impacts of renewable energy technologies on energy system operations and costs.

Critics of renewable energy initiatives argue that they result in energy costs that are higher than necessary. This is attributed to the costs of renewable energy technologies relative to conventional, non-renewable technologies, and to the higher costs associated with FIT or RFP systems relative to more competitive systems for acquiring new electricity supplies.

Supporters of renewable energy initiatives argue that their critics have tended to use relatively unsophisticated approaches to modelling the integration of renewable energy sources into energy systems and their resulting cost impacts. Moreover, they argue that critics of renewable energy initiatives underestimate or ignore entirely the value of avoided externalities and risks associated with renewable energy technologies relative to their non-renewable counterparts. By employing dynamic models of the behaviour of energy systems

104 M. Schneider, A. Froggatt, S. Thomas, *World Nuclear Industry Status Report 2010-11: Nuclear Power in a Post-Fukishima World* (Washington DC: Worldwatch Institute, 2011), http://www.worldwatch.org/system/files/pdf/WorldNuclearIndustryStatusReport2011_%20FINAL.pdf.

105 The Hon. B. Duguid, Minister of Energy, quoted in Linda Nguyen, "Ontario says it's full steam ahead on nuclear projects," ipolitics, March 18, 2011, http://www.ipolitics.ca/2011/03/18/ontario-says-its-full-steam-ahead-on-nuclear-projects/.

106 J. Spears, "Aging Pickering nuclear plant seeks five more years," *The Toronto Star*, May 29, 2013.

107 The provincial government has recently indicated that it will delay proceeding with a new build nuclear facility at Darlington, J. Spears, "Ontario considering nuclear slowdown, minister says," *The Toronto Star*, May 9, 2013.

and markets, and by allocating economic value to the subsidies and avoided externalities and risks associated with conventional technologies, even on a point of generation as opposed to fuel life cycle basis, proponents conclude that when these factors are taken into account the overall cost impact of renewable energy initiatives relative to conventional alternatives is marginal. Overall employment losses due to increased energy costs are therefore unlikely.

Within these broader boundaries there is considerable scope for additional debate. This is especially the case regarding the appropriate capital and operating costs to be allocated to different technologies and with respect to the appropriate economic values to be placed on avoided externalities and risks.

In policy terms, FITs and similar renewable energy initiatives are seen by their proponents as politically feasible mechanisms for addressing institutionally embedded biases with energy systems in favour of conventional technologies. They are also seen as a means of dealing with the consistent failure of efforts to implement effective measures to place meaningful value on the externalized environmental and social costs and risks associated with conventional technologies in energy system planning, design and implementation. The debates over the economic impact of renewable energy initiatives in the US have been less specifically focused on their effects on employment than in Ontario and the EU, but have been grounded in themes similar to those seen in those jurisdictions.[108]

In policy terms, FITs and similar renewable energy initiatives are seen by their proponents as politically feasible mechanisms for addressing institutionally embedded biases with energy systems in favour of conventional technologies.

108 See for example, A.P. Morriss, W.T. Bogart, A. Dorchak, & R.E. Meiners, "7 Myths About Green Jobs," *University of Illinois College of Law,* 2009, http://amherstislandwindinfo.com/aiw-docs/morriss_jobs.pdf. (Accessed June 15, 2013). Also, Max Wei, Shana Patadia, & Daniel M. Kammen, "Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?," *Energy Policy* 38, no. 2 (2010): 920.

Renewable Energy Development as Industrial Strategy

A second major theme in the debates over the economic impact of green energy initiatives relates to their role as economic development strategies. The goals of the renewable energy initiatives reviewed for the purposes of this study have generally gone beyond providing electricity supplies at lower environmental impacts and energy security risks than conventional, non-renewable alternatives. Rather, reflecting an evolution of the role of environmental technologies, renewable energy strategies are also conceived of as industrial strategies, intended to facilitate the development of renewable energy technology manufacturing and service industries in the host jurisdictions. Such goals were central to Ontario's green energy initiatives,[109] and have been a central feature of critiques of the province's green energy program.[110]

Ecological Modernism and the Emergence of "Green" Industrial Development Strategies

Environmental technologies and services were initially conceived of as facilitative adjuncts to economic growth and development, the latter understood in conventional terms of industrialization, urbanization and resource extraction and processing. The technological focus was on add-on "end of pipe" pollution control technologies, intended to mitigate the worst and most obvious environmental impacts of industrial activities in order to render them more socially acceptable. Investments in environmental technologies were seen as regrettable but necessary costs of doing business from the viewpoints of governments and industrial operators. There was little or no formal recognition of environmental or "green" technologies and services as a distinct sector of economic activity in government policy.

This initial view dominated in North America from the time of the recognition of environmental pollution as a significant public and health concern in the second half of the 19th century until the late 1980s. Views on the role of environmental or "green" technologies began to shift from that point onwards. The efforts of the Canada-US International Joint Commission highlighted the long-term ineffectiveness of end-of-pipe pollution control technologies, while

109 See, for example, FIT Review Joint Submission," *Green Energy Act Alliance, Shine Ontario, Pembina*, http://www.pembina.org/pub/2299, 6.

110 See, for example, McKitrick, *The Environmental and Economic Consequences of Ontario's Green Energy Act.*

at the global level the work of the World Commission on the Environment and Development (a.k.a. the Brundtland commission) emphasized the theme of economic and environmental interdependence through the concept of "sustainable development."[111]

The modification of industrial activities to prevent the generation of pollutants and to improve the energy, materials and water efficiency of activities was seen as offering the potential both to reduce extractive and assimilative pressures on local environments and the global biosphere and to increase the productivity of economic activities.[112] Northern European countries, whose energy and material security constraints had been highlighted during the energy "shocks" of the 1970s, generally recognized these potential connections earlier than North America.[113] In Ontario, there was formal recognition of potential positive linkages between economic and environmental policies in the early 1990s, accompanied by the identification of environmental services and technologies as a distinct sector of the economy and the creation of a first generation of strategies for its development.[114]

Emerging in North America during the second half of the last decade, the most recent stage in the evolution of the role of environmental or "green" industries has moved such activities from being adjuncts to the mainstream economy towards a much more central position. While the focus on pollution prevention and the energy, water and materials efficiency of conventional economic activities continued, increasing attention was paid to the potential role of the design, development, manufacturing, installation and servicing of "green" technologies, particularly renewable energy technologies, as major components of the industrial economy. This "ecological modernist" vision of a restructuring of the economy along more environmentally sustainable lines[115] is grounded in the apparent success of countries like Finland, Norway, Sweden, Denmark, Germany and the Netherlands. The aforementioned countries have combined the retention of substantial value-added manufacturing activities, in which environmental technologies figure significantly, with consistently high rankings in measures of environmental performance.[116]

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111 World Commission on Environment and Development, *Our Common Future* (Toronto: Oxford University Press, 1987).

112 See, for example, J. MacNeill, P. Winsemius and T. Yakushiji, *Beyond Interdependence: The Meshing of the World's Economy and the Earth's Ecology* (New York: Oxford University Press, 1991).

113 See C. Hay, *EU Environmental Policies: A short history of the policy strategies* (Brussels: European Environment Bureau, 2005), http://www.eeb.org/publication/chapter-3.pdf.

114 Ontario Green Industry Ministerial Advisory Committee, *Ontario's Green Industry Strategy* (Toronto: Ministry of Energy and the Environment, 1994).

115 Dryzek, *The Politics of the Earth*, 170-173

116 Dryzek, *The Politics of the Earth,* 165-183.

In Denmark, for example, employment in the wind sector approaches 30,000 individuals (2009), principally in design, manufacturing and service-based activities.[117] The energy technology sector accounts for 11 per cent of the country's total manufacturing economy.[118] Employment in Germany's renewable energy sector in 2011 was placed at 381,600, again strongly weighted in the direction of value-added design and manufacturing activities.[119] The sector experienced substantial growth in employment over the second half of the previous decade in both countries.

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Ecological Modernism Comes to North America

The apparent success of these jurisdictions had a major influence in North America in the formulation of policy responses to the challenges of climate change mitigation and the impact of the 2008 economic downturn on manufacturing activities. On the announcement of the energy and climate change leaders for his incoming administration, US President-elect Barack Obama made the following statement about the potential for his administration to integrate energy, environmental and economic objectives:

> "We can seize boundless opportunities for our people. We can create millions of jobs, starting with a 21st century Economic Recovery Plan that puts Americans to work building wind farms, solar panels, and fuel-efficient cars. We can spark the dynamism of our economy through long term investments in renewable energy that will give life to new businesses and industries, with good jobs that pay well and can't be outsourced. We will make public buildings more efficient, modernize our electric grid, reduce greenhouse gas emissions, and protect and preserve our natural resources."[120]

The pursuit of similar objectives was a major rationale for Ontario's GEGEA. In particular, the relatively generous rates built into the original FIT program established under the legislation were intended to facilitate the rapid development of a critical mass of activity in the province's renewable energy sector.[121] The provincial government and supporters of the legislation hoped that the strong domestic market produced by the FIT program would provide the foundation for the development of a renewable energy technology manufacturing and services sector that would then be able to sell its products and services beyond the province's borders.

117 Within the wind sector in Denmark 51 per cent of employees are in production, 11 per cent in testing and development of new products, 10 per cent process and quality assurance, 10 per cent sales and marketing, and 11 per cent service and maintenance. Danish Wind Industri: Annual Statistics 2010," *Danish Wind Industry Association,* http://ipaper.ipapercms.dk/Windpower/Branchestatistik/DanishWindIndustryAnnualStatistics2010/.

118 "Wind energy -The case of Denmark," *Center for Politiske Studier (CEPOS),* 2009, http://www.cepos.dk/fileadmin/user_upload/Arkiv/PDF/Wind_energy_-_the_case_of_Denmark.pdf.

119 Within the renewable energy sector in Germany 74,000 in manufacturing/production of onshore wind technologies vs. 17,800 in operation and maintenance, 103,000 in solar PV production vs. 7,600 in operations and maintenance. O'Sullivan et al., *Employment from renewable energy in Germany*.

120 Quoted in transcript, "Obama's energy and environment team announcement," *The New York Times*, December 16, 2008.

121 See Amin, *Ontario's Feed-in Tariff Program: Two-Year Review Report*.

At the time of the development of the GEGEA a number of factors were at work that suggested such a strategy could be successful, despite the relative dominance of European, particularly Danish and German, suppliers in the international renewable energy technology and services market. Ontario had the advantage of relative proximity and long-established relationships to the US market, where the incoming federal administration, as noted earlier, was signaling its intention to make major investments in the development of renewable energy sources.[122] Many US state governments were also indicating their interest in the rapid and large-scale development of renewable energy resources.[123] At the same time, wind turbine prices were rising substantially as global and North American demand began to outstrip the existing capacity of the established manufacturers.[124] Ontario's historical strengths in mechanical and electro-mechanical engineering, design and manufacturing, products of the province's long-standing engagement with the production of transportation equipment, were seen as potentially transferable to renewable energy technology production, particularly wind turbines.[125] These strengths could provide the province with a potential comparative advantage relative to the US states contemplating moves into the renewable energy technology supply and services sector themselves. At the same time, the interest of these states reinforced the need for Ontario to establish a presence in the sector relatively quickly.

The Ideological Debate: Market Fundamentalists, Progressives, Industrial Strategy and Green Energy

The debates around the industrial development rationale for renewable energy initiatives like the GEGEA are embedded in wider debates about the appropriate role of government in the development of specific industries and sectors. The most prominent and vociferous public critics of this aspect of renewable energy initiatives tend to represent the "market fundamentalist" schools of thought. These critics take the view that such strategies are almost certain to be unsuccessful, grounded in a belief that government is much less efficient and effective than the market at picking potential economic winners and losers. The author of a recent Fraser Institute critique of the GEGEA noted that:

> "With regards to job creation, there is nothing special about subsidizing electricity generation. It's just as harmful as subsidizing anything else. We have long and lamentable experience in Canada with failed job creation schemes based on subsidies to money-losing industries. From Sprung cucumbers to Bricklin sports cars, governments have regularly

The debates around the industrial development rationale for renewable energy initiatives like the GEGEA are embedded in wider debates about the appropriate role of government in the development of specific industries and sectors.

122 See T. Weis and M. Bramley, *Backgrounder: Canada vs. U.S. Investments in Renewables and Energy Efficiency* (Drayton Valley: The Pembina Institute, March 2009), http://www.pembina.org/pub/1786.

123 See, for example, Barry S. Rabe, "The Aversion to Direct Cost Imposition: Selecting Climate Policy Tools in the United States," *Governance: An International Journal of Policy, Administration, and Institutions* 23 (2010): 583. See also B.S. Rabe, ed., *Greenhouse Governance: Addressing Climate Change in America* (Washington, D.C.: Brookings Institution Press, 2010).

124 See, for example, Wiser and Bolinger, *2011 Wind Technologies Market Report*.

125 See, for example, "Linamar partners on wind turbines," *The Globe and Mail*, May 5, 2010.

learned and relearned, at taxpayer expense, the immutable rule that if a business plan depends on subsidies, the jobs it creates are not sustainable, and if the business is profitable on its own, it doesn't need subsidies." [126]

On the other hand, those more sympathetic to the renewable energy initiatives tend to be grounded in the view that advanced industrial economies need to pursue active industrial strategies to retain and build high value-added economic activities. Researchers in this more "progressive political economy" camp highlight the presence of active industrial strategies in the northern European economies (e.g. Germany, Denmark, Sweden, Finland) that have retained significant manufacturing activities and a role for "green" technologies in that process.[127] More specifically, they argue strongly for active strategies to enhance the development of high-value, innovative industrial sectors in Canada.[128] The development of "green" skills and jobs has emerged as a significant sub-theme within this school of thought.[129]

GEGEA as a Sectoral Development Strategy

The potential for the development of a renewable energy technology manufacturing and services industry in Ontario was a fundamental rationale for the adoption of GEGEA. However, the experiences of European jurisdictions that have succeeded in developing substantial renewable energy manufacturing carry with them some important considerations for the design of such a strategy in Ontario. Studies of the German and Danish renewable energy industries highlight the need to move beyond the domestic markets, whose emergence was spurred by FIT programs, in order for an upstream renewable energy technology industry to be viable. In the long term, export markets are consistently identified as the key source of employment growth in renewable energy sectors in these jurisdictions.[130]

The implication for Ontario is that the GEGEA FIT program alone, whose primary impact would be the development of a domestic market for renewable energy technologies, would not be sufficient to sustain a renewable energy manufacturing and services sector in the province. Rather, the development of a domestic market would need to be complemented by an active sectoral development strategy to identify and develop markets outside of Ontario.

126 R. McKitrick, "Ontario's Power Trip: The failure of the Green Energy Act," *The Financial Post*, May 16, 2011.

127 Broadly, Dryzek on "Ecological Modernism" in *The Politics of Earth*, Danish Wind Industry Association, *Danish Wind Industri: Annual Statistics 2010*, and O'Sullivan et al., *Employment from renewable energy in Germany.*

128 See, for example, J. Stanford, *A Cure for Dutch Disease: Active Sector Strategies for Canada's Economy* (Ottawa: Canadian Centre for Policy Alternatives, 2012).

129 See, for example, M. Lee and A. Card, *A Green Industrial Revolution in Canada: Climate Justice, Green Jobs and Sustainable Production in Canada* (Ottawa: Canadian Centre for Policy Alternatives, 2012).

130 Danish Wind Industry Association, *Danish Wind Industri: Annual Statistics 2010*; Lehr et al., *Renewable energy deployment – do the benefits outweigh the costs?.*

The Government of Ontario has considerable experience in the development of sectoral strategies, a concept first introduced under the NDP government of then Premier Bob Rae in the early 1990s.[131] Sectoral strategies were typically structured around sectoral councils with representation from the sector and related industry, labour, NGO and academic interests. The councils were provided with research and institutional support through the relevant provincial government agencies, and were mandated to develop strategies for the development of their sectors, with a focus on measures the provincial government could take to support those efforts.

Although widely regarded as one of the most effective initiatives of the Rae government,[132] the concept of such strategies was abandoned in favour of a simplified approach focused on tax cuts and removing regulatory "burdens" on industry during the Progressive Conservative governments of Harris and Eves. The sectoral approach re-emerged under Liberal Premier McGuinty.[133] Recent strategies related to the mining[134] and financial services sectors[135] have been highlighted as particularly successful.[136]

Unfortunately, no sectoral development strategy accompanied the GEGEA when it was adopted in 2009. Rather, there was a series of *ad hoc* initiatives towards the development of upstream manufacturing and services elements of the sector. A January 2010 agreement with the South Korean industrial giant Samsung exchanged guarantees of a portion of available FIT contracts for promises of investment in Ontario in renewable energy technology manufacturing activities.[137] Domestic content requirements were also incorporated into the original FIT program to promote the development of a renewable energy industry in the province. These required that a minimum portion of the capital costs of FIT contracted projects be sourced in Ontario.[138] The domestic content requirements were subsequently subject to a successful challenge under World Trade Organization rules by the European Union, Japan

No sectoral development strategy accompanied the GEGEA when it was adopted in 2009. Rather, there was a series of ad hoc initiatives towards the development of upstream manufacturing and services elements of the sector.

131 See, for example, C. Rachlis and D. Wolfe, "An Insiders View of the NDP Government of Ontario: The Politics of Permanent Opposition Meets the Economics of Permanent Recession," in *The Government and Politics of Ontario 5th Edition*, ed. G. White (Toronto: University of Toronto Press, 1997), 348-351; see also Ministry of Finance, *1991 Budget* (Toronto: Queen's Printer, 1991); Budget Paper E "Ontario in the 1990s"; Government of Ontario, *An Industrial Policy Framework for Ontario* (Toronto: Queen's Printer 1992).

132 T. Courchene and C.R. Telmer, *From Heartland to North American Regional State: The Social Fiscal and Federal Evolution of Ontario* (Toronto: University of Toronto, 1998).

133 See M. Winfield, *Blue-Green Province: The Environment and the Political Economy of Ontario* (Vancouver: UBC Press, 2012), 93, 153.

134 See, for example, Ontario Mineral Industry Cluster, *Ontario's Mineral Industry Cluster: An Economic Powerhouse* (Toronto: OMIC, N.D.).

135 See the Toronto Financial Services Alliance, www.tfsa.ca. See also *Business Sector Strategy: Financial Services Sector* (Toronto: Queen's Printer for Ontario, 2013).

136 See, for example, A.Radwanski, T.Kiladze, T.Perkins, "What's wrong with Ontario - and how to make it right," *The Globe and Mail*, February 18, 2012.

137 Canwest News Service, "Ontario signs green energy deal with Samsung team," *The Financial Post,* January 21, 2010, http://www.financialpost.com/story.html?id=2468582. Under the agreement, 2,500 MW of renewable energy capacity was dedicated to Samsung in exchange for four manufacturing plants which would create 1,440 jobs. The government claimed that the agreement as a whole would create approximately 16,000 jobs.

138 "FIT Program, microFIT Program," *Ontario Power Authority*, 2010, http://fit.powerauthority.on.ca/home.html?q=domestic-content-1.

and the United States.[139] Despite the scale of the investments being directed towards the sector, lack of any apparent overall strategy for the development of the renewable energy sector beyond these measures has prompted the observation that:

> "The Ontario government touts its intention to become a leader in exporting clean energy technologies, portraying these technologies as one of the province's strengths. However, its current policy framework is not designed to support this aim."[140]

In fact, formal consideration of a sectoral strategy for the renewable energy sector in Ontario did not occur until the two-year review of the FIT program, initiated in October 2011. The review report, authored by the Deputy Minister of Energy, concluded that the program should continue, and potentially be expanded, subject to reductions in the rates paid for some types of FIT projects and a strengthening of the mechanisms to favour projects that were initiated or supported at the community level.[141] The report's key recommendation from an economic development perspective was to propose the development of a "Clean Energy Economic Development Strategy" – effectively a sectoral development strategy for the renewable energy sector.[142] The report specifically recommended that the province:[143]

- provide targeted financial support through the Smart Grid Fund to Ontario-based demonstration and capacity-building projects that test, develop and bring to market the next generation of technology solutions;
- work with key stakeholders to consider the potential for a clean energy institute to spur domestic innovation and achieve greater global market presence for Ontario-based companies;
- support domestic manufacturers by showcasing Ontario's smart energy solutions through a strategic export strategy; and
- create a Clean Energy Task Force to advise the Ministers of Energy and Economic Development and Innovation on potential strategies for Ontario's clean energy sector.

The establishment of the Clean Energy Task Force and strategy was announced the following month. The Task Force was mandated to "help broaden Ontario's energy focus by facilitating collaboration within Ontario's clean energy industry to identify export markets, marketing opportunities and approaches

139 S. McCarthy, "Ontario loses final WTO appeal on Green Energy Act," *The Globe and Mail*, May 6, 2013.

140 T. Khanberg and Robert Joshi, *Smarter and Stronger: Taking Charge of Canada's Energy Technology Future* (Toronto: Mowat Centre, School of Public Policy and Governance, University of Toronto, 2012), 44.

141 Amin, *Ontario's Feed-in Tariff Program: Two-Year Review Report.*

142 Amin, *Ontario's Feed-in Tariff Program: Two-Year Review Report*, Recommendation 6.1.

143 There were also recommendations for a rationalization of the province's approach to energy research and development from the Mowat Centre. See Khanberg and Joshi, *Smarter and Stronger*, 55, Recommendations 2 and 3.

to demonstrate Ontario's advanced clean energy systems".[144] The province also committed to leading cleantech trade missions to support domestic manufacturers by showcasing Ontario's clean energy solutions in key markets including Asia, the Middle East and the United States and delivering on the province's Smart Grid Fund and other targeted investments to spur innovation in priority areas. [145]

Conclusions: Ontario's GEGEA as Industrial Strategy

The debate around the notion of the GEGEA as an industrial development strategy is grounded in wider ideological arguments about the appropriate roles of markets and governments in economic policy. The most aggressive public critics of GEGEA as an industrial development strategy have tended to come from a strong "market fundamentalist" orientation and have records of opposing any form of government intervention in the marketplace (e.g. the Fraser Institute). Supporters of the initiative, on the other hand, tend to reflect "ecological modernist" and "progressive political economy" perspectives. These schools of thought highlight the importance of government interventions in the economy to counteract the pull of resource commodity export dependence in relatively resource rich economies like Canada's and to support the development of a more diversified economy grounded in the provision of value-added goods and services.

At the time of the formulation of the GEGEA initiative, there was considerable potential for major growth in Ontario and US demand for renewable energy technologies. Local and global shortfalls in supply and manufacturing capacity for these technologies were emerging at the same time. In combination with the province's historical strength in related engineering and manufacturing activities, there was an apparent potential for the province to establish itself as a significant player in the sector. However, even at that stage the challenges to the successful pursuit of such a strategy were considerable. Other jurisdictions pursuing the development of renewable energy resources were likely to prefer domestically sourced equipment wherever possible. More recently the entry of China into renewable energy technology supply market is posing challenges even for long-established players like Germany and Denmark.[146] The three-year delay between the adoption of the GEGEA and the beginning of the establishment of a coherent strategy for the development of the renewable energy technology and services sector is likely to have cost important opportunities in these contexts.

The three-year delay between the adoption of the GEGEA and the beginning of the establishment of a coherent strategy for the development of the renewable energy technology and services sector is likely to have cost important opportunities.

144 Government of Ontario, "Expanding Ontario's Clean Energy Economy McGuinty Government Launches Clean Energy Economic Development Strategy," *Press Release*, April 12, 2012.

145 See Government of Ontario, "Expanding Ontario's Clean Energy Economy McGuinty Government Launches Clean Energy Economic Development Strategy".

146 See, for example, Jing Cao and Felix Groba, *Chinese Renewable Energy Technology Export: The Role of Policy, Innovation and Markets* (Berlin: DIW German Institute for Economic Research, 2013), http://www.diw.de/documents/publikationen/73/diw_01.c.414422.de/dp1263.pdf.

Even with the establishment of a Clean Energy Economic Development Strategy, the upstream renewable energy industry in Ontario continues to face significant domestic challenges.

Even with the establishment over the past year of a Clean Energy Economic Development Strategy, the upstream renewable energy industry in Ontario continues to face significant domestic challenges. Increasing uncertainty over the province's direction with respect to renewable energy has worked to discourage long-term investment in manufacturing capacity. Changes in program rules, delays in project application processing and obtaining connections to the grid reinforced these concerns. Political conflicts over the impact of the FIT program that raised questions about its continued existence beyond the October 2011 election and the more than year long moratorium on FIT applications while the program was under review following that election, added to the doubts about the program's future.[147]

More broadly, a considerable build-out of the renewable energy capacity contracted between 2009 and 2011 remains to be completed.[148] However, once this is accomplished by 2018, if not earlier, there is no certainty regarding the province's intentions with respect to renewable energy beyond that date. In fact, the province's current 2010 Long-Term Energy Plan, intended to outline the province's plans to 2030, implies that all growth in renewable energy generation will be completed by 2018.[149] The questions about the potential for future growth in renewables are reinforced by the projections of little or no growth in electricity demand for the foreseeable future (see Figure 5 above), and the government's continued commitment to nuclear energy, particularly the refurbishment of the Darlington Nuclear Facility. The lack of fully developed strategies around the role of smart grid technologies in the integration of intermittent renewable energy technologies into the electricity system further complicates the scene, as does the near absence of strategies for the development of grid-scale energy storage resources. Without such strategies the usefulness of the renewable energy resources that are under development in the province will be limited.[150]

147 See, for example, T. Hamilton, "Ontario teaches world how not to run a FIT program," *The Toronto Star*, October 5, 2012. On the impact of instability see also G. Holburn, K. Lui and C. Morand, *Policy Risk and Private Investment in Wind Power: A Survey of Evidence from Ontario* (London: University of Western Ontario Ivey School of Business, 2009), http://www.thinkingpower.ca/PDFs/Governance/PolicyRiskPaper.pdf; D. Strifler, *Small Scale, Big Impact,* 61-82.

148 March 2012 FIT Review report gives figure of 7,100 MW contracted through the FIT program (4,600MW FIT and 2,500 via the January 2010 Samsung Agreement), Amin, *FIT Two Year Review Report,* 4. As of May 2013, the IESO reported 1,560 MW of wind capacity installed in Ontario. Solar and biomass installed capacity amounted to 122 MW. "Supply Overview," *IESO,* http://www.ieso.ca/imoweb/media/md_supply.asp.

149 Ontario Ministry of Energy and Infrastructure, *Ontario's Long-Term Energy Plan*, 31-32.

150 For a detailed discussion of energy storage issues in Ontario see Sustainable Energy Initiative, York University, "Storage Options for Renewable Energy: Developing RE to Commercialization," September 21, 2012 Seminar. Video at http://www.youtube.com/watch?v=vx4gXvUTZ90.

The government's May 2013 announcement of the termination of the FIT program for all but small projects (<500 kW) in favour of competitive bidding processes, and the commitment of the remaining 900 MW of capacity space available until 2018 for the smaller renewable energy projects with municipal participation, with no indication of any commitments to renewables beyond that date, reinforce those concerns.[151] The announcement a few weeks later that the province was dropping its commitment to purchase renewable energy with Samsung from 2500MW to 1369MW had the same effect. With a forty-five per cent reduction relative to the original January 2010 agreement, it is unclear whether the difference in energy supply will be obtained from other sources or removed from the province's energy plans completely.[152] A Danish-style outcome may still be possible, where a strong export industry was built on the basis of rapid domestic development, but where the domestic market is now relatively limited. However, the window to pursue a similar strategy is now very short, and would require a very well developed strategy for a still relatively nascent sector.

A Danish-style outcome may still be possible, where a strong export industry was built on the basis of rapid domestic development, but where the domestic market is now relatively limited.

151 Ontario Ministry of Energy, "Ontario Working with Communities to Secure Clean Energy Future," *News Release,* May 30, 2013.

152 J. Spears, "Samsung green deal scaled back," *The Toronto Star,* June 21, 2013.

Conclusions

Proponents of renewable energy initiatives like the Ontario FIT program argue that they offer the potential to deliver more environmentally sustainable, cost-effective and secure energy supplies, while fostering the development of domestic renewable energy technology manufacturing and services sectors. Critics of such initiatives argue that they increase energy costs unnecessarily, and that they will result in the loss of more jobs than they create.

This paper examined the available empirical evidence regarding the economic development impacts Ontario GEGEA FIT program. The paper also analysed Ontario's debates around the FIT program as both a sustainable energy and economic development strategy in the context the debates over renewable energy initiatives in other jurisdictions comparable to Ontario, including Germany, the United Kingdom, Spain and Denmark.

The study found that the publicly available empirical evidence regarding the employment impacts of the FIT program in Ontario is extremely limited. The situation in Ontario is in stark contrast to that in the other jurisdictions reviewed where very detailed information on the structure, types of activities and levels of employment in the renewable energy sector is available. In the absence of reliable and comprehensive information about the development of the renewable energy industry in Ontario the debates over the economic impacts of the GEGEA have been grounded in the results of modelling exercises rather than empirical data. This observation applies with respect to both the anticipated expansion of employment in the renewable energy sector and the impacts of the GEGEA on the wider economy. Understanding the assumptions embedded within the models used to examine the impacts of the legislation is therefore central to understanding the different conclusions reached by participants in the debate over its effects.

In this context, a number of important conclusions can be derived from the comparative exploration of the debates surrounding the economic development impact of Ontario's GEGEA. In Ontario and the other jurisdictions reviewed, arguments about the negative impacts of renewable energy initiatives on the economy as a whole are largely premised on assumptions that renewable energy development will cost more than the available conventional, non-renewable alternatives. Renewable energy technologies are seen as inherently more expensive than the available alternatives, in part due to their intermittent nature. In addition, it is argued that renewable energy initiatives, such as FITs and RPS result in higher prices and energy costs to consumers than competitive processes for acquiring new energy supplies. These higher energy costs feedback into the wider economy, reducing economic growth and overall employment, typically in a manner that overwhelms the employment gains flowing from the development of a renewable energy sector.

These arguments turn, in large part, on the approaches used to model the integration of renewable resources into energy systems and markets and the assumptions made about the economic costs of different conventional and renewable technologies and their relative roles in energy systems. The treatment of the environmental and social externalities and technological, fuel cost and security and catastrophic accident risks related to conventional technologies relative to those related to renewable energy alternatives are central issues in the debate. In particular, proponents of renewable energy initiatives argue that FITs and similar programs are a politically feasible way of dealing with subsidies and externalities associated with non-renewable energy sources that are typically overlooked by their critics and that governments have consistently failed to address in the design of electricity markets and systems. When these factors are taken into consideration, the additional costs of renewable energy initiatives, relative to conventional technologies and approaches to acquiring new energy supplies, are significantly reduced if not eliminated.

Proponents of renewable energy initiatives argue that FITs and similar programs are a politically feasible way of dealing with subsidies and externalities associated with non-renewable energy sources that are typically overlooked by their critics and that governments have consistently failed to address in the design of electricity markets and systems.

At the same time, these technical arguments are embedded in wider debates about the appropriate role of government in economic development. Some "market fundamentalists" who have been prominent critics of renewable energy initiatives tend to object to any effort at industrial strategy beyond the provision of fundamental infrastructure. On the other hand, those in the "progressive political economy" tradition and "ecological modernists" see a rationale for renewable energy initiatives in the context of the need for a more active role of the state in general economic strategy, and in moving the economy and society in the direction of sustainability. This is especially true in Canada's case, where it is argued there is a strong pull away from innovation and value added economic activities and towards resource commodity export dependency.

Even those who accept the need for more active economic strategies, and who argue that at the time of the GEGEA's formulation there was the potential for the development of a renewable energy technology and services industry in Ontario, find it hard to argue that there were not serious flaws in the design and execution of the province's FIT initiative as an energy and industrial development strategy. The rates incorporated into the original FIT program for commerical developers of wind and solar PV resources were excessive, leaving the program vulnerable to criticism of its economic costs. Important features of the European FIT programs, such as linking rates to the avoided environmental costs of conventional technologies or the pace of renewable energy deployment, and incorporating degression rates into FIT programs, designed to control costs and manage the pace of development, were overlooked in the Ontario program.

The Ontario program structure eliminated the opportunities for annual adjustments in rates and targets, as applications were made and contracts granted at the front end of the program up to near the total targets for renewable energy contained in the LTEP. Instead, the structure created a "gold rush" response from potential developers seeking FIT contracts. That in turn

led to the creation of overcapacity in manufacturing and services in some sectors, like solar PV, which would have to be reduced in the "bust" following the build-out of the initial round of contracts. A more phased roll-out of the program might have also reduced delays in contract processing and in obtaining grid connections for project developers in the long term. The lack of effective strategies around the role of smart grid technologies in the integration of intermittent renewable energy technologies into the electricity system and for the development of grid-scale energy storage resources further complicated the scene. The absence of such strategies may limit the usefulness of the renewable energy resources that are under development in the province.

More broadly, from an economic development perspective, movement on the establishment of a comprehensive strategy for the development of a renewable technology manufacturing and services sector in Ontario occurred far too late. Such a strategy only began to emerge in the aftermath of the 2011-12 FIT review. A strategy should have been initiated in tandem with the introduction of the GEGEA in 2009, if not earlier. As a result, the province may have missed crucial windows in the domestic and international renewable energy technology and services markets. The *ad hoc* measures that were taken in relation to the development of the sector were open to political (e.g. the Samsung Agreement) or trade (e.g. local content requirements) challenge.

The most serious challenge now facing the sector is the high level of uncertainty about the provincial government's long-term commitment to renewable energy development.

The most serious challenge now facing the sector is the high level of uncertainty about the provincial government's long-term commitment to renewable energy development. As of the fall of 2013, there continued to be no certainty about the existence of a significant domestic market for these technologies beyond 2018, either under a FIT or competitive bidding structure. The build-out of the supply contracted but not yet installed through the FIT program over the next few years still offers some potential for industrial development. However, it will be difficult to justify significant investments in manufacturing capacity without some prospect of the continuation of a meaningful domestic market.

Looking Forward

The provincial government made a series of announcements regarding renewable energy in May and June 2013. Requirements for local government participation in new projects were introduced, and the FIT program was terminated for anything other than small projects. Reductions in the government's commitments under the Samsung agreement were also implemented. These steps may respond to local objections to wind projects and concerns over economic costs. Unfortunately, they may also signal the end of the possibility of the substantial development of a renewable energy industry in Ontario.

If such an outcome is to be avoided, the province needs to clarify its commitment to renewable energy development beyond the 2018 target contained in the 2010 Long-Term Energy Plan. Steps need to be taken to account for externalities, risks, liabilities and potential contributions to sustainability of all technologies on a full life-cycle, level playing field basis in future efforts at system planning.[152b]

At the same time, if it intends to continue to pursue the development of the renewable energy sector, the province needs to advance its clean energy economic development strategy to take advantage of the 2013-2018 build out of existing contracts. Among other things this will require:

- the development of a comprehensive, empirically-based profile of the renewable energy technology and services sector in Ontario, similar to those which exist in other jurisdictions pursuing the development of their renewable energy sectors;
- the identification of areas of potential comparative advantage in renewable energy technology and services for Ontario;
- the assessment of potential external markets for the Ontario industry in Canada, the United States and overseas, including close monitoring of policy and program commitments and supply chains in these markets;
- the assessment of education and skills development requirements within the sector and the development of appropriate mechanisms to ensure that these needs are addressed through Ontario's post-secondary institutions;
- market development and research and development support as outlined in the Deputy Minister's 2012 FIT review report; and
- the development and implementation of energy storage and smart grid strategies to support the integration of renewable energy resources into the province's energy systems up to their full potential.

If these steps are not taken, the province runs considerable risk that, from an economic development perspective, the GEGEA exercise will amount to an expensive but temporary countercyclical intervention as opposed to an investment in development of an industrial sector with potential to make significant long term contributions to the Ontario economy.

152b M. Winfield, R. Gibson, T. Martvart, K. Gaudreau, and J. Taylor, "Implications of sustainability assessment for electricity system design: The case of the Ontario Power Authority's integrated power system plan," *Energy Policy* 38 (2010): 4115.

Appendix 1

Data and Data Sources for Figure 4: Economic Costs of New Energy Conservation and Supply Technologies for Ontario

Technology	Costs (cents/kwh)
Conservation	2.3-5[153]
Natural Gas	6[154]-8.5[155] - 11[156]-16.4[157] - 164 (peaking)[158]
Coal	3.5[159] - 10[160]
Nuclear (refurbished)	8 (Bruce[161]) - 37[162]
Nuclear (New)	7.9[163] – 15[164] – 20+[165]
Wind	<8[166]-11.5[167]
Hydro	~3[168]-13.1[169]
Solar	14.4[170] - 22[171]-39.2[172]

153 R. Mallinson, Electricity Conservation Policy in Ontario: Assessing a System in Progress (Studies in Ontario Electricity Policy Series – P*aper No.4 (Toronto: Sustainable Energy Initiative, Facult*y of Environmental York University, 2013), 5-6; Ontario Clean Air Alliance, Ontario's Electricity Options: A Cost Comparison (*Toronto: Ontario Clean Air Alliance, May 2012),* http://www.cleanairalliance.org/files/costcompare.pdf.

154 "Ontario's Electricity Options," OCAA, May 2012, http://www.cleanairalliance.org/files/costcompare.pdf. Also U.S. Energy Information Administration *Levelized Cost of New Generation Resources in the Annual Energy Outlook 2013, January 28, 2013,* http://www.eia.gov/forecasts/aeo/er/electricity_generation.cfm. (Accessed May 15, 2013).

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156 Carr and Dachis, "Zapped," 3.

157 Bohringer, Rivers, Rutherford and Wigle, "Green Jobs and Renewable Electricity Policies".

158 Environmental Commissioner of Ontario, Re-thinking Energy Conservation in Ontario – Results: Annual Energy Conservation Progress Report – 2009 (Volume Two), November, 2010, page 35.

159 R. Wong and E. Whittingham, Comparison of Combustion Technologies for Electricity G*eneration: 2006 Update Including a Discussion of Carbon Capture and Storage in an Ontario Context (Dr*ayton Valley: Pembina Institute, 2006), 8 (Table 1).

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161 Based on conclusions of Auditor General of Ontario, *The Bruce Power Refurbishment Agreement, and cost overruns.*
162 Ontario Clean Air Alliance, "Ontario's Electricity Options".
163 OPA cited in Bohringer, Rivers, Rutherford and Wigle, "Green Jobs and Renewable Electricity Policies".
164 Moody's Investment Service cited in Haines, Weis and Anderson, A*nalysis of New Nuclear.*
165 Estimate based on reported outcome of Ontario 2009 RFP process. Haines, Weis and Anderson, Analysis *of New Nuclear,* Table 3.
166 OPA pre-2009 contacted electricity price, cited in Weis and Partington, Behind the *Switch, Figure 5.*
167 Ontario 2012 FIT rate.
168 "Hydro-Quebec Export Prices of Interruptible Electricity," Jean-Pierre Bernard, "The Canadian Energy Market: Recent Continental Challenge," presentation to the Walter Gordon Public Policy Symposium, March 17, 2013.
169 Ontario 2012 FIT rate.
170 U.S. Energy Information Administration *Levelized Cost of New Generation Resources in the Annual Energy Outlook 2013, January 28, 2013,* http://www.eia.gov/forecasts/aeo/er/electricity_generation.cfm. (Accessed May 15, 2013).
171 Rocky Mountain Institute cited in S. Lacey, "Solar gets cheap fast," The Grist, June 1*0, 2011,* http://grist.org/solar-power/2011-06-09-solar-getting-cheaper-fast/.
172 Ontario August 2013 Micro-FIT rate.

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