Where Should The Green Choices Be Made?

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EXECUTIVE SUMMARY

This paper examines, from the point of view of consumers, programs designed to promote the use of renewable energy. The focus is on electricity, given the important and growing role of that form of energy in modern society.

The paper first discusses the objectives typical of such programs:

- Diversify sources of energy. In turn, this often has a number of sub-objectives
    - Protect customers from fossil-fuel price spikes and supply shortages
    - Improve national security by reducing reliance on imports, especially of hydro-carbons

- Reduce the cost of RE by expanding the RE market
- Protect the environment and public health
- Increase local economic development opportunities

These objectives are then compared to the priorities stated by consumers in response to surveys:

- Availability and reliability of supply and rate stability; then
- Environmental protection; and then
- Impacts on electricity prices and the local economy generally

Next, the paper turns to the various policies and programs used to promote renewable energy, and in particular

- Government subsidies, whether financed from general revenues or by a levy on sale of electricity
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- Renewables portfolio standards, which mandate that a certain percentage of electricity sold to customers must come from renewables
-
- Green marketing, which attempts to persuade customers to voluntarily pay for higher-cost energy having a specified proportion coming from renewables

- Other government programs, including customer information and research and development

Each approach has strengths and weaknesses. However, it seems unlikely that voluntary approaches such as green marketing will have a significant impact, largely because there is not enough motivation for customers to participate. Government subsidies are more likely to be successful and can be targeted relatively precisely. On the negative, large government-subsidized programs can create resistance and are vulnerable to loss of funding.

The most promising approach seems to be renewables portfolio standards, i.e. mandatory inclusion of a target percentage of renewable energy in the electricity sold. This approach has the benefits of being effective in reaching overall goals, efficient in minimizing the costs of doing so, and acceptable to consumers, who know that all will be doing their part.

INTRODUCTION

In this report, renewable energy (hereinafter RE) is defined as energy from resources that can be replaced by natural processes such as sunshine, wind, flowing water, biological processes or geothermal heat flow. This replacement is at a rate that is at least equal to the rate at which the resource is being used.

RE has become an important issue on the energy agenda of many countries, as well as international organizations concerned with energy. As of 2005, at least 48 countries had some type of policies in place to promote RE.[1] About $30 billion was invested in RE projects worldwide in 2004 (excluding large hydropower), compared to a conventional power investment of $150 billion. (Large hydropower received an additional $20 billion to $25 billion investment.) [2]

RE policies and projects fall into four main domains of application: (a) electric power generation (b) home and space heating (c) fuels for motor vehicles and other forms of transport, and (d) rural off-grid sources of power. While all four are important, many of the opportunities that have been identified, and the programs that have been undertaken or that are being considered, concern electricity generation. As well, at this juncture, much more information is available concerning electricity from renewable than for the three other areas. Finally, most of the growth in energy consumption is in the form of electricity, and in general providing for growth in demand for energy really means providing for growth in electricity.[3]

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[1] Worldwatch Institute, *Renewables 2005: Global Status Report*, REN21 Network, 2005 (hereinafter REN21)
[2] RE was responsible for 1.7 million jobs world-wide in 2004. Of these, 0.9 million were in biofuels production. In turn, of these, 400,000 worked in the Brazilian ethanol industry.

[3] "More that 85% of the growth in U.S. energy demand since 1980 has been met by electricity… And the electrification of our energy economy is accelerating. .. Over the next two decades, these trends will move about 15% of our entire energy economy from conventional thermal processes to electrically powered ones." Peter Huber and Mark Mills, *The Bottomless Well* (Basic Books, 2005) at 18.

Accordingly, this report will focus on renewable energy in the context of electric power generation. Unless otherwise stated, the references and analysis shall be applicable to electric RE.

RE power generation capacity worldwide was 160 GW (excluding large hydro), or 4% of the total capacity as of the end of 2004. RE output was 3.2% of total world electricity output during 2004. Many countries have set targets specifying that from 5% to 30% of their electricity will be from renewable by 2010-2012.

The report starts by discussing the objectives pursued by policies that increase the proportion of electricity coming from renewable sources. These objectives are compared to consumer priorities as expressed through surveys and through actual purchasing patterns.

The report then turns to the different policy alternatives that have been implemented and suggested. Advantages and disadvantages of each are discussed, both from stated objectives of RE policies, and from the point of view of consumers.

The final section of the report applies the findings of the previous sections to the particular circumstances of Canada and of Ontario. Ontario is a particularly interesting case study because existing supply sources will clearly be inadequate at least at current levels of conservation, and there are a number of recent policy reviews searching for the best way forward. The report then makes some closing observations concerning the appropriate policy approach for RE.

THE OBJECTIVES OF RENEWABLE ENERGY POLICIES

Various authors describe goals for RE policies slightly differently, but there is a good deal of commonality to them. A typical set is as follows:

- Diversify sources of energy. In turn, this often has a number of sub-objectives
  - Protect customers from fossil-fuel price spikes and supply shortages
  - Improve national security by reducing reliance on imports, especially of hydro-carbons

- Reduce the cost of RE by expanding the RE market
- Protect the environment and public health
- Increase local economic development opportunities.[4]

These objectives, in turn, have resonance within a meaningful framework that costs the RE measures on the basis of the net costs of the total resources (TRC) required to produce the energy. In turn, the TRC of the RE measures may be compared with the costs of attempting to meet or reduce demand without implementing such measures.

It should be noted that the objectives do not coincide completely with consumer energy policy goals as revealed through various consumer surveys. In order of priority, these are:

1. Availability and reliability of supply and rate stability; then

2. Environmental protection; and then

3. Impacts on electricity prices and the local economy generally[5]

[4] This particular set of objectives follows those found in Ryan Wiser, Hevin Porter, Robert Grace, and Chase Kappel, *Evaluating State Renewables Portfolio Standards: A Focus on Geothermal Energy*, National Geothermal Cooperative, 2003.
[5] Ontario Power Authority, *Electricity in Ontario: Supply Mix Advic*e, 2005 at page 12

The themes of diversifying sources of energy, protecting the environment, and economic development recur in RE policies. Each deserves to be discussed in turn.

Diversifying Sources of Energy

This theme subsumes a number of more specific objectives. These include the reduction of reliance on fossil fuels, especially oil and natural gas. Prices of these fuels are rising globally, and their price volatility seems to be increasing as well. Since these fuels are one source used to generate electricity, these price increases are largely passed on to customers. In addition, because of the interrelationships between energy choices, substitutability and demand, price changes in any sector tend to trigger price responses across the sector. Further, while fossil fuels weigh so heavily in the mix, special efforts have to be made to "buffer" the price volatility of fossil inputs, through reserves and multi-year amortizations. Otherwise, while the price of electricity may be sending correct price signals, the volatility is likely to overwhelm most consumers' expectations of reasonable rate stability. Clearly RE measures may both dampen demand and provide better results under a TRC test

Reliability of supply and national security are also sub-objectives of diversification. Most countries import a portion of the fossil fuels they burn. This is especially true of oil and natural gas. For those countries, diversification to other sources is a way of reducing their dependence on foreign energy sources, and the risk that might come with a disruption of supply, for reasons of political instability, strategic advantage, or any other external factor.

Renewable energy, from wind, biomass, solar photovoltaic cells and roof panels, and geothermal sources would certainly contribute to diversity. Thus, their development is generally in line with consumer preferences for reliability of supply and for rate stability.

However, RE is not the only way to achieve diversification and its sub-objectives. Coal-fired generators, nuclear reactors, and hydropower are three alternatives to oil and gas. While each of these alternatives may have other deficiencies particularly with respect to a TRC analysis, none is dependent on foreign imports, and none has fuel that is subject to sudden price hikes.[6] If diversity of supply becomes the principal objective, one may anticipate that efforts will be directed to attempting to “fix” the problems associated with these mature technologies. [7] Clearly, that appears to be the hope of the current provincial government in Ontario, at least with respect to the nuclear industry.[8]

On the other hand, expanding the sources beyond the current state of the mature technologies set out above can create greater security. However, to be assured policy preference, RE must win its way the markets by being the clear choice as a preferred or one of the preferred options in any TRC analysis.

Environmental Protection

Environmental impacts can usefully grouped into two categories. The first consists have harmful or “contaminant” emissions. Traditionally, these were sulphur dioxide (SO2), nitrogen oxide and nitrogen dioxide (NOX), and mercury (HG). Over the past twenty years, concerns have also grown concerning greenhouse gases such as carbon dioxide (CO2), a major contributor to global warming. Energy sources that have minimal or no harmful emissions are often referred to as “clean”. Renewable energy is typically “clean” energy, and its substitution for fossil-based generators can reduce harmful emissions. This is consistent with consumers’ expressed second priority.

[6] Nuclear generators have experienced structural problems, with the accompanying costs of refurbishing and repairing them. However, these costs often are amortized over a period of years, and do not typically cause electricity price instability.
[7] Most eligibility criteria for renewable energy sources allow small-scale hydropower projects but not large-scale projects. This is discussed below.
[8] http://www.neimagazine.com/story.asp?sectionCode=132&storyCode=2036791

It must also be noted that nuclear power generation and large-scale hydropower projects have no significant contaminant emissions within this definition.[9] As well, emissions from coal can be reduced by burning the coal at very high temperatures. Current coal industry advocates are attempting to demonstrate that emissions can be “scrubbed” to remove SO2, NOX and HG. Carbon dioxide can be captured and sequestrated, albeit at a high cost. In light of this, RE must meet more than this narrow goal for policy acceptance.

The second category of environmental impact contains such harmful effects as threats to certain habitats and species of fish or animal that live there, disruption of human and other communities, through flooding or otherwise, noise and aesthetic pollution, and waste and byproducts that must be disposed of. While the latter is not a contaminant within our defined criteria, it could easily become one if proper programs of containment are not supplied.

The source of power most often criticized on these grounds is large-scale hydropower. The recent Three Gorges Power project in China is perhaps the poster child for these problems where environmental degradation is going hand-in hand with the rapid industrialization with attendant need for massive power development.[10]

However, small-scale hydropower developments and wind generators also have environmental impacts. For instance, the latter contribute to noise pollution, the turbines can kill migratory and local birds, and the aesthetics of a wind farm are seldom pleasing[11].

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[9] There are claims that large reservoirs behind hydro dams can emit significant amounts of greenhouse gases. However, these problems would seem to be limited to very shallow reservoirs in tropical climates, where rotting biomass can emit methane and carbon dioxide. See note 23 below.

[10] http://www.probeinternational.org/tgp/index.cfm?DSP=content&ContentID=13424

[11] In Massachusetts, a wind power development in Cape Cod has led to political brawl between politicians on the left and right stemming from opposition from local residents, see http://www.boston.com/news/nation/articles/2006/04/27/kennedy_faces_fight_on_cape_wind/

Clearly, energy generation is not a frictionless exercise and objective measures are clearly preferable in evaluating options. However, the choice can be problematic. Some power sources do well on some environmental measures and badly on others. Some authors have developed a summary index by weighting the different environmental aspects. For example, the Ontario Power Agency uses the following weights[12]:

Environmental dimension	Weight
Greenhouse gases	20
Contaminant emissions	10
Radioactivity	1
Land use	1
Water impacts	1
Waste impacts	1
Resource availability	1

It is arguable that such an index may reflect political and subjective concerns rather than adhering to a TRC cost analysis for example. However, while such weights necessarily have a large element of subjectivity, their general magnitudes would seem to reflect most consumers' priorities and the majority concern with global warming and emissions that are directly harmful to human health.

[12] OPA *Report*, page 30. Applying these weights to different power sources, on a life-cycle basis that includes manufacturing equipment and disposing of waste, hydropower ranks best, with wind second. Solar photovoltaic is third, with nuclear and biomass tied for fourth. There is then a significant gap before natural gas, which comes in at about double the level of nuclear and biomass. Finally, conventional coal is three times as bad as natural gas.

Local Economic Development

Advocates of RE generally stress the economic development benefits of implementing renewable energy projects. Major aspects are new investment and job creation.[13] These include building and operating new facilities and, in some cases, developing and manufacturing equipment. Sometimes there is the hope of becoming a technological leader and exporting equipment to other jurisdictions.

Once again, a potentially supportable objective may serve to distort the overall goals, particularly where investment and job creation are the main reason for undertaking RE initiatives. For example, in 1999 the Texas legislature considered the issue of whether eligible fuels could be used in existing facilities that had historically used ineligible fuels.[14] The benefit of the fuel switch would produce many, if not all, of the intended benefits of the policy. Fuel-source conversions in existing facilities could be among the most cost-effective ways to achieve the legislation's goals. The avoided capital costs could be substantial.

But the Public Utility Commission of Texas found that the point of the legislation was to provide for new capital investment in order to increase economic development in Texas and provide jobs, and to cause RE technology costs to decrease through the development of new capacity. It refused to qualify as "renewable" energy produced by using qualified fuels in retrofitted plants.

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[13] When Ontario announced that it would purchase RE generated by independent micro-producers, including wind energy at 11 cents per kWh (a "feed-in tariff" as explained below), Paul Gipe, a U.S.-based wind-energy expert, was quoted as saying that Ontario would be wise to concentrate on wind turbines from Enercon, a German manufacturer, because "it has labour-intensive technology that would make the biggest impact in terms of job creation". *Toronto Star*, 2005/08/22.

[14] Nancy Rader and Scott Hempling, *The Renewables Portfolio Standard: A Practical Guide*, National Association of Regulatory Utility Commissions (NARUC), February 2001, at pages 22 and 23. Most likely, biomass fuel would have been used in coal-burning facilities, or landfill methane in natural gas-burning facilities.

A less dramatic, but more pervasive, symptom of the preoccupation with local investment and local jobs is the requirement, imposed by some state RE projects, that the resulting renewables generating plant be situated geographically within the state. This is regardless of whether RE could be produced more efficiently elsewhere, with resulting environmental benefits accruing to the entire region.[15]

The Missing Objective: Low Cost and Low Price

The third priority expressed by consumers is low price for the electricity they consume. Once again, the key ingredient in any quest grounded in RE technologies to deliver upon this goal, in a manner in keeping with the public interest is the matching of the costs associated with the production and consequential costs of RE with other energy source alternatives. It is an equation that is vital for policy success but not always performed. Frequently, the efficiency calculation will be confined to the portfolio of renewable energy sources itself.[16] RE strategies are often combined with conservation strategies to form a plan to meet expected demand. [17] A classic TRC is not usually performed.

Electricity from renewables can cost significantly more than electricity from traditional sources. For example, Ontario is prepared to pay independent producers 11 cents per kWh for electricity from wind, biomass, and small-scale hydro, and 42 cents per kWh for solar energy. By contrast, OPG currently obtains large-scale hydropower from Niagara Falls for 3.3 cents per kWh, and nuclear power from Darlington for 4.9 cents per kWh. Over all, power costs OPG an average of 4.5 cents per kWh, and is sold at 4.7 cents per kWh. Simply replacing such power supply with RE would obviously increase both the average cost and the price to customers.[18]

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[15] Not only are such in-state requirements potentially inefficient, they may also be unconstitutional in the U.S.

[16] For example, RE policies may consider how to quickly increase the use of a given RE technology, so as to achieve economies of scale in that technology and bring its cost down.

[17] See R. Neal Elliott and Anna Shipley,'Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets" ACEE, 2005, http://www.aceee.org/pubs/e052full.pdf

[18] Globe and Mail, 2006/03/29, at page B2. The hope is that current subsidies will lead to quickly declining unit costs in future.

Indeed, in certain circumstances and if industry assumptions concerning clean up are accepted, retrofitting existing generators may be more cost-effective than building new RE generators. For example, Katrina Observe and her associates at Carnegie-Mellon have shown that, using data from Texas for 2002, cleaning up emissions from an existing coal generator may lead to the same environmental benefits as building a new RE generator, but at considerably lower cost.[19]

Thus, the achievement of low cost as a consumer priority may be only attainable within a context that does not concentrate exclusively on the price per kiwi hour directly generated but instead on the costs that must be absorbed by consumers in ways external to their hydro bill. As we have discussed, RE proponents are faced with significant pushback from advocates of "clean coal" or of strategies that seek to clean up or mitigate the problems associated with power generation based on older technologies. It is vital that full costs of options that are alternatives to RE are known and transparent in the decision-making process.

<u>The Strange Case of Hydropower</u>

Many RE policies and programs treat hydropower differently according to whether it comes from large scale or small-scale operations. Small-scale hydro, usually defined as coming from installations with less than 10 MW generating capacity (or, in some cases, less than 30 MW), count as renewable energy. Large-scale hydro, from installations with more than 10 MW capacity (or, in some cases, more than 30 MW), are excluded and do not count as renewables.

[19] Katerina Dobesova, Jay Apt, and Lester B. Lave, *Are Renewables Portfolio Standards Cost-Effective Emission Abatement Policy?*, Carnegie-Mellon Electricity Industry center, Working Paper CEIC-04-06. The cost of wind-generated electricity, including subsidies and transmission, is 8.9 cents per kWh. The cost of coal-generated electricity is 1.85 cents, plus 0.23 cents for transmission. Contaminant emissions (SO2, NOX, HG) add another 1.1 cents to coal, for a total of 3.2 cents per kWh. While Dobesova et al do not quantify the cost of reducing greenhouse gas emissions, they point out that the margin between wind energy at 8.9 cents and coal at 3.2 cents is 5.7 cents per kWh, in their view more than enough to capture and sequestrate the CO2 and leave savings that can provide consumers with lower prices.

On the surface, this seems strange. Hydropower almost by definition is renewable.[20] Furthermore, it is a very low cost source of electricity, with many studies claiming it is the lowest cost source.[21]

Some observers claim that, while large scale hydro may rank well in terms of emissions, it does badly on other dimensions of environmental harm.[22] In particular, they point to

- Reduction of oxygen in the water, affecting fish and other species
- Changing both levels and cycles of water levels, thus impacting riparian habitats
- Through the construction of reservoirs and dams, flooding large tracts of land and further disrupting habitats, including flora, fauna
- Disrupting human communities, directly through flooding or indirectly
- Impeding the movement of fish upstream to spawning grounds[23]

Note that the last three of the five criticisms apply to dams and reservoirs, rather than to large-scale hydropower generation itself. Some hydro projects, described as "run-of-the-river", do not use man-made reservoirs and thus largely avoid these problems.

As well, many existing dams and reservoirs have not yet been used for generating hydropower. For example, it is estimated that the U.S. has a current capacity of 80,000 MW from hydropower, with potential for another 30,000 MW. Of these, 21,000 MW

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[20] International Rivers Network claims that "large hydro reservoirs are often rendered non-renewable by sedimentation". However, this could be taken care of by periodic dredging.

[21] See Environment and Energy Study Institute, *Renewable Energy Fact Sheet* (May 2006), claiming costs of as low as 0.6 cents per kWh. See also OPA, *op. cit*., at page 34, and REN21, *op. cit*., at page 12, showing large scale hydro costs in the 3 to 4 cent range, but still the lowest-cost source currently, especially if subsidies are taken into account.

[22] Recently, some scientists have claimed that hydropower dams in tropical countries produce significant amounts of carbon dioxide and methane, two greenhouse gases. This is due to trees and plants rotting on the reservoir's bottom. The impact can be greater than the emissions from a fossil-fuel generator of equivalent capacity. *New Scientist*, 2005/02/24.

[23] U.S. Department of Energy, Energy Efficiency and Renewable Energy Programs, 2005/08/09. The report also points out some benefits, associated with large reservoirs: water supply and flood control (the original purpose of most dams), and recreational opportunities such as fishing, swimming and boating

could be realized without constructing new dams.[24] While most of these would be small scale hydro, there may be some large-scale opportunities among them.

Finally, the difference between small and large-scale hydro projects is largely quantitative: small-scale hydro shares many of the same problems described above with large-scale hydro. A small installation on a small river can have as much of an impact on local habitats as a large-scale installation on a large river. For example, in Sweden, where small-scale hydro is widespread, 177 species of freshwater fish are threatened, such as brown trout. As well, plant and animal communities whose habitats depend on yearly fluctuations in water level are at risk, e.g. the "dipper" bird and the water shrew.[25]

Further, while it is clear that small projects cause in aggregate less environmental harm than large projects, the opposite may be true when measured per unit of capacity. Several thousand small-scale hydro projects may be needed as the equivalent of one large-scale project. Cumulatively, the amount of land flooded by the thousands of small-scale projects can be many times the amount of land flooded by the one large-scale project. For example, Hydro Quebec estimates, based on hundreds of projects, that the average size of reservoir per unit of capacity (hectares per MW) averages 249 for hydro plants in the 2 MW to 99 MW range, but only 16 for plants in the 2000 MW to 2999 MW range.[26]

Given similar environmental impacts, inclusion of small-scale hydro, and exclusion of large-scale hydro, from the category of renewable energy seems puzzling. However, the explanation lies in the two other objectives of RE policies: diversity, and local economic development.

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[24] Environment and Energy Study Institute, *op. cit*. Only 3% of the more than 75,000 dams in the U.S. are currently used to generate hydropower. The World Commission on Dams estimates that, worldwide, around 5,300 (11%) of the world's large dams (i.e. 15 meters or higher) were built solely for hydropower. A further 13,300 (28%) were built for more than one function. That leaves at least 61% of the world's large dams performing no hydro function currently.
[25] Swedish Society for Nature Conservation, *Running Water*, 2002.
[26] Jean-Etienne Klimpt, Yves Guerard, and Erik Arsenault, *Comments on the CEC's Working Paper, Environmental Challenges and Opportunities of the Evolving North American Electricity Market*, 2002/01/10, at page 12.

Allowing large hydro to qualify, as RE would be counterproductive to strategies that encourage development particularly those that operate on a fixed target basis. Effectively, large hydro would crowd out all other sources of renewable energy. Large hydro supplied 16% of global energy production in 2004, with a capacity of 720 GW.[27] By contrast, all other renewable sources, including small hydro, amounted to 160 GW of capacity. (Small hydro accounted for 61 GW of the 160 GW). Further, large hydro has an inherent cost advantage (i.e. stripped of subsidies). Other renewable sources could not compete. If for reasons of diversity one wants to encourage these other sources, it is important to either target them directly, or at least to ensure that promotional measures do not include large hydro.

Concerns for local economic development are also at play in the exclusion of large hydro. Large-scale hydro provides proportionately fewer jobs, and, once built, relatively little new spending must be incurred. Further, programs to encourage RE may exclude large-scale hydro as an indirect way of sourcing production in areas where the most political benefits can be reaped. For example, Hydro Quebec alleges that the exclusion from RE policies of large-scale hydro, by the U.S. government and various states, is a protectionist measure that violates NAFTA.[28]

From the point of view of consumers, excluding large scale hydro from RE policies depends on the relative costs (higher prices), including costs of mitigation of project effects, as well as the potential benefits (more diversity in supply) associated with the exclusion. Unfortunately, while these costs and benefits have mostly been described in qualitative terms, there have been few efforts to directly set them off against each other and see where, on net, the consumer interest may lie.

[27] REN21, op. cit., at page 7. The Appendix to the Report shows a figure of 740 GW, but is probably a typo.
[28] Klimpt et al, op. cit. Canada is the world's largest producer of hydro-based electricity, producing 12% of the world total in 2004 (REN21, op. cit., at page 7)

THE VARIETY OF RENEWABLE ENERGY POLICIES

A large variety of policies and programs have been developed to promote renewable energy. These can be grouped into four categories

1. Government subsidies
2. Government requirements that a minimum percentage of commercially sold electricity come from renewable sources
3. Programs that lead customers to voluntarily choose electricity from renewable sources, even if it costs more
4. Government procurement of RE, support of R&D, and other measures.

GOVERNMENT SUBSIDIES

Government Subsidies from General Revenues

Government subsidies are the oldest form of promotion of various forms of energy. Traditionally, these are funded from general tax revenues, and are targeted by politicians to programs selected by them. While the bulk of these subsidies go to conventional energy sources, increasingly some of the money is finding its way to renewable energy.[29]

An example is the U.S. federal government Production Tax Credit (PTC) of 1.8 cents per qualifying kWh, for a term of 10 years. Originally limited to wind and closed-loop biomass (i.e. dedicated to electricity) generated energy, and only to generators that came on line by the end of 2005, the PTC was extended by the *Energy Policy Act* of 2005, to include open-loop biomass, geothermal, small hydro, landfill gas and trash combustion.

[29] For example, REN21 estimates that in 2004 the U.S. and Europe together supported renewable energy on the order of $10 billion.

Projects must now be in-service by the end of 2007 to qualify.[30] The *Energy Policy Act* did not, however, provide a national target.

The Act is rather indifferent as to the method of developing new energy. It provides for assistance to nuclear energy, in the form of a new 1. 8-cent/kWh-production tax credit (for an 8-year period) for new nuclear power facilities. As well, clean coal facilities benefit from (1) a 20% credit for integrated gasification combined cycle projects (2) a 15% credit for clean coal facilities producing electricity and (3) a 20% credit for industrial gasification projects.

States also fund RE projects. For example, California has a renewable energy fund of $200 million per year, which as of mid-2005 had funded 972 MW of wind capacity. Oregon has a similar fund of $10 million per year, which had funded 41 MW of wind energy.[31]

Government subsidies can be targeted very precisely, which is both an advantage and a drawback. One drawback, as illustrated by the Energy Policy Act of 2005, is that special interests can have a disproportionate impact on the allocation of funds. Political rather than public interest concerns may predominate. As well, funding may vary over time with the performance of the economy, and with other pressures for government spending. As a result, it can be risky for a producer of renewable energy to rely upon government subsidies.

<u>Government Subsidies from Surcharges</u>

An alternative is to have government impose a surcharge on all users of electricity, and use the result to fund desirable activity. This surcharge, often called a System Benefits

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[30] The *Act* is more than 1700 pages long and contains hundreds of provisions. Tax breaks alone amount to $4.3 billion for nuclear power, $2.8 billion for fossil fuel production, $2.7 billion for electricity from renewable sources, $1.6 billion for clean coal, and $1.3 billion for conservation and energy efficiency.

[31] Ryan H. Wiser, *An Overview of Policies Driving Wind Power Development in the West*, NWCC Western Transmission Workshop III, Sacramento, ca., 2005/02/01

Charge (SBC), can be an amount per kWh used (e.g. California, $0.003/kWh), or a flat monthly amount per customer (e.g. Pennsylvania, $5/month).[32]

Its transparent nature makes the SBC very visible and a target for attack by opposing stakeholders. Ratepayers who are opposed tend to view it as another form of taxation. Interestingly, surveys show that while respondents strongly opposed a rate-payer-based SBC (over half the respondents), they strongly supported a charge levied at the power generation level (three quarters of the respondents).[33]Presumably, the results reflect the belief that the charge will not be passed on to consumers.

Perhaps as a result, most SBC's are low, less than a dollar per month per household, and so raise limited funds. However, they are used fairly widely at the state level in the U.S., where general tax revenues are not as large as at the federal level.

On the plus side, an SBC is a long-term charge, and so tends to produce more stable funding. This is important for the undertaking of long-term projects where payback for capital outlay may take some time. As well, there seems to be less scope for political interference particularly for the purpose of redirecting funds.

Feed-In Tariffs

Feed-in tariffs are also a form of government funding of renewable energy. Under such an arrangement, the government, or a private utility, undertakes to purchase RE from independent producers at above-market prices, under long-term contracts. These measures can be targeted at specific technologies or kinds of fuel, and are intended to promote the development of that technology or fuel, in the hope that as volume grows, innovation and economies of scale will bring down the unit cost.

[32] Public Service Commission of Maryland, *Report on Renewable Portfolio Standards,* 2003
[33] Survey of Minnesotans performed by LGD Insight for ME3, and reported by Steven M. Hoffman in *Energy-Efficiency and Renewable Energy in a Restructured Electricity System, Minnesotans for an Energy-Efficient Economy*, March 1999. Hoffman concludes: "Opposition to the SBC, therefore, seems to be based on language and application rather than the principle of a fund designed to support public benefit programs."

By mid 2005 there were 37 countries, states of the U.S., or Canadian provinces with feed-in policies. In most countries, feed-in policies have had the largest effect on wind power, but have also influenced biomass and small hydro. In Spain, feed-in tariffs have spurred investment in solar thermal energy generation.[34]

As mentioned above, Ontario is prepared to pay independent producers 11 cents per kWh for electricity from wind, biomass, and small-scale hydro, and 42 cents per kWh for solar energy. This is an example of a two-tier feed-in tariff, with one rate for renewables in general, and a higher rate for a particularly costly kind of renewable.

Feed-in tariffs can be financed through general tax revenues or through a SBC.

Other Government Subsidies and Measures

Other government subsidies cover a wide range, from investment tax credits to accelerated capital cost allowance (CCA) to grants. For example, the *Energy Policy Act of 2005* shortened the lives over which electric transmission and distribution facilities' lives can be depreciated, from 20 to 15 years. Eighteen states have property tax incentives for renewable energy, 11 states have personal tax incentives, 10 have sales tax incentives, and 10 have corporate tax incentives.[35] As well, both federal and state governments provide loan guarantees to selected projects.

MINIMUM RENEWABLES CONTENT FOR ELECTRICITY (RPS)

This approach is often referred to as Renewables Portfolio Standards (RPS). It specifies that commercially sold electricity come at least in part from renewable sources. Most commonly, the target is set in terms of percentages: by a given year, a certain percentage of electricity sold in retail markets must come from renewables. Less frequently, the

[34] REN21, *op. cit.*, at Tables 4 and 5
[35] Public Utilities Commission of Maryland, op. cit.

target is stated in terms of a minimum capacity, in MW, that is to come from renewables. In both cases, the targets increase gradually with time.

It is up to electricity retailers to make arrangements to meet the targets. They can either generate their own eligible electricity from renewables, or they can purchase such energies from others who generate it. Proponents of RPS believe that, by leaving arrangements to market participants, objectives will be met as efficiently as possible.

To further encourage such efficiency, many RPS schemes allow for Tradable Renewals Credits or Certificates (TRC). A generator of renewable energy will be allowed to issue TRCs to the effect that the electricity is eligible for the plan objectives. These TRCs can be detached from the electricity itself and bought and sold on their own. Thus a producer of RE really produces two things, electricity and TRCs, which are sold on two different markets, and at two different prices. Sale of TRCs produces a second revenue stream for producers of RE, and thus helps defray their costs.

The value of the TRCs stems from their use in meeting the RPS goals: every retailer must have a sufficient quantity of them. As RE capacity grows over time, and costs of RE drops, the price of TRCs will also drop. When the price becomes negligible, market forces are producing the desired quantity or proportion of RE, and the RPS becomes redundant and can be phased out. Or so the theory goes.

RPS schemes have become increasingly widespread. Currently they exist in 20 U.S. states and the District of Columbia, as well as Nova Scotia and PEI.[36] National RPS schemes exist in Italy, Australia, United Kingdom, Japan, Sweden, Poland, and Thailand. By 2005, there were 38 countries, states, and provinces with RPS policies.[37]

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[36] The 2005 Energy Bill originally contained a national RPS for the U.S., but this was rejected by the House of Representatives. Opposition included arguments that renewable resources vary from state to state; that states hold different views on the resources to be supported; and that electricity regulation is largely at the state level. Testimony of David K. Garman, Assistant Secretary, Energy Efficiency and Renewable Energy, before the Committee on Energy and Natural Resources, United States Senate, March 8, 2005.
[37] REN21, *op. cit.*, Table 6 and Note 28.

A number of authors have studied the performance of existing RPS policies, and as a result, have made recommendations as to the design and implementation of such policies. The most comprehensive is by Nancy Rader and Scott Hempling, who identify seven steps.[38]

1. <u>Shape the goal</u>

How much renewable energy should the target aim at? This is the stage at which benefits should be weighed against costs.[39] Issues include:

- Should the goal be in terms of capacity or of electricity produced?
- Should the goal be a fixed amount or a percentage of sales?
- Choosing a schedule: ramp up slowly enough to allow competition among different sources of RE
- Are the goals set for a long enough period? Is there political and regulatory commitment?

2. <u>Select eligible resources</u>

Inclusion of various resources will depend on the weights of the various goals, e.g. environmental protection, diversity of sources

- Take into account financial support required for each type of resource
- Take into account existence of other programs and subsidies
- Does electricity generated out-of-jurisdiction count?[40]

[38] Rader and Hempling, *op. cit.*
[39] Rader and Hempling, *op. cit*,, at page 29, note 3, note that cost benefit analysis is only concerned with efficiency. Equity goals are better determined by “political judgment and moral values rather than the logic of economic efficiency.”
[40] In the U.S., limiting RE to in-state sources may infringe the Commerce Clause of the Constitution. From a policy point of view, environmental benefits cross state lines, and so the lowest cost sources should be used, regardless of location. However, to the degree that investment and jobs are concerns, it is attractive to limit eligibility to local sources.

3. <u>Translate into retailer obligations</u>

- Obligations should be imposed on all retailers of electricity, to ensure competitive neutrality, but this may be difficult politically
- How should the obligation be allocated among retailers? Pro rata? Based on past sales or on forecasts?
- Should the allocation be specific to the individual products sold by the retailer, or should the allocation be to the retailer as a whole?[41]

4. <u>Review interdependence of goals and eligible resources</u>

Balance supply of, and demand for, RE. If supply is in excess of demand to meet the goals, little or new investment will take place.[42] If supply is too far short of demand, the targets will not be met and cynicism may develop.

5. <u>Mechanisms for compliance</u>

Compliance can be demonstrated through either tradable renewables credits as described above or through "contract-path verification", i.e. tracing the electricity sold back to its generation. Generally, the former provides retailers and generators more flexibility and opportunities to lower costs. As well, TRCs are administratively less burdensome. However, many jurisdictions still trace electricity back to the source.

As well, compliance can be more or less flexible. For example, retailers may be allowed "grace periods" to make up any shortfalls in targets.

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[41] Rader and Hempling believe that it is preferable to require that each product meet the target. This is less misleading to consumers, who will then know exactly what they are buying. It will also lead to a higher level of investment in RE. If consumers voluntarily will buy more of a given renewable energy product, the retailer will not be able to reduce the renewables content of another product, as it would if the target were set for the retailer as a whole.

[42] This was the experience in Maine. The state set a high target of 30% for RE. But it allowed large hydro power and co-generation to be eligible, so 50% of the supply was eligible. As a result, the RPS had no practical effect. Generally, including large hydro in the North East limits the market for wind-generated electricity (Nancy Rader, "Getting it Right and Wrong in the States", *Wind Power Monthly*, 2001)

6. **Enforcement**

Penalties must be significant. Experience shows that, otherwise, compliance will be spotty. [43]

7. **Administrative mechanisms**

Regulators or other bodies must be empowered to administer the RPS, and adequate resources made available to do so.

A properly designed and implemented RPS has many advantages.[44] Chief among these are:

- It will ensure a given quantity or proportion of RE will be produced
- Costs will be lower thanks to the use of private markets and their flexibility
- A RPS policy can be competitively neutral
- The administrative burden and costs can be relatively low
- RPS is applicable in both restructured and regulated markets

However, the RPS approach also has disadvantages:

- An RPS can be complex and difficult to design well
- RPS is less flexible than other policies in targeting specific RE sources or ensuring resource flexibility[45]
- Cost impacts are hard to predict
- RPS may not lead to long-term contracts, hence may not be as encouraging to developers of RE

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[43] Arizona's initial plan had no penalties whatsoever.
[44] R. Wiser, K. Porter, and R. Grace, *Evaluating Experience with Renewable Portfolio Standards in the United States,* Laurence Berkely National Laboratory, University of California Berkely, Working Paper LBNL-54439, March 2004.
[45] Some jurisdictions have two-tier RPS policies, e.g. one target for, say solar energy, and a much higher target for all renewable sources. However, the more tiers in the RPS policy, the further away from a pure RPS plan, the fewer efficiencies to be obtained from flexibility and substitution via market forces.

- Experience to date is limited, due to the recent start dates of most RPS policies
- Care must be taken to accommodate public utilities that are subject to traditional regulation. For example, they must be allowed to enter into long-term contracts, with assurances of being able to recover the costs of these contracts. More generally, there should be mechanisms so that the costs of RPS can be recovered from ratepayers.

Although it is early to evaluate the effectiveness of RPS, some studies have already been performed, with favorable results. For example, the Energy Information Agency in the U.S. estimates that, by the end of 2004, over 2,000 MW of renewable energy has been motivated, at least in part, by RPS policies.[46]

A list of U.S. states that have implemented RPS is given in Appendix A.

VOLUNTARY CUSTOMER CHOICE (GREEN POWER)

A different approach is to encourage customers to voluntarily choose to purchase “green” electricity or “products”, even if they cost more than conventional electricity. Such programs go under the name of “green pricing” when offered by a regulated monopoly, and “green marketing” when made available in a competitive marketplace. In both cases, however, the underling principles are the same. Customers are motivated by the environmental benefits, and perhaps sometimes by the increase in diversity of sources, to pay more for more costly electricity.[47] In return, they are assured that the electricity they purchase has a certain proportion that comes from “green” sources. In practice, these green sources are renewable energy, such as wind, small hydro, biomass, geothermal, and solar.

[46] Testimony of David K. Garman, op. cit.
[47] As mentioned above, the extra cost is partly subsidized by federal and state governments.

The principal attraction of green power programs is that participation is voluntary. Each individual customer decides whether the befit is worth the extra cost.

But voluntary participation is also the principal drawback of green power programs. Each individual pays the full costs of the renewable electricity he or she buys. But the environmental and diversity benefits go overwhelmingly to others. It is easy to sit back and let others bear the costs, secure in the knowledge that one will share in the benefits. This is an example of the classic “free rider” problem. Some goods, services, or amenities must be provided collectively. Otherwise they will not be provided at all, or if they are, it will be in very small quantities.

Partly as a result of the free rider problem, the percentage of customers participating is very small, on the order of 1% to 3% nationally in the United States. These actual “take rates” are much lower than the proportion saying that they would be willing to pay extra for green power, which range above 40%.[48] These numbers vary by state, but the gap remains very wide. For example, the Public Service Commission of Colorado found that 70% to 80% of respondents expressed a willingness to pay for green power, but only 5% to 8% actually subscribed.[49]

Apart from externalities and the ensuing free rider problem, green power suffers from consumers’ lack of information. This can manifest itself in a lack of trust: consumers cannot be sure that what they are getting is really electricity from renewable sources. Another manifestation is a lack of awareness of the availability of electricity from renewable sources. For example, in a survey by Ryan Wiser, green power was available to 40% of the population nationally, but only 8% of respondents were aware that it was available to them.[50]

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[48] Ryan Wiser, *Using Contingent Valuation to Explore Willingness to Pay for Renewable Energy: A Comparison of collective and Voluntary Payment Vehicles*, Lawrence Berkely National Laboratory, University of California Berkely, Working Paper LBNL-53239, August 2003 (hereinafter referred to as Willingness to Pay)
[49] Cited in Hoffman, *op. cit.*
[50] Wiser, *Willingness to Pay, op. cit.*

Wiser's study also confirms empirically that consumers are more willing to pay for RE if the program is collective rather than individual, i.e. if payment of the extra price is mandatory rather than voluntary. This, of course, is consistent with consumer recognition of a free rider problem. Wiser measured the percentage of respondents who were willing to pay an extra 50 cents per month, $3 per month, and $8 per month. He distinguished four scenarios, according to whether payment is collective or voluntary, and according to whether provision of the electricity was by government or the private sector. The results are as follows[51]:

Willingness to pay (% of respondents)			
	50 cents/month	$3/month	$8/month
1.Collective payment, government provision	63	50	44
2. Voluntary payment, government provision	58	48	41
3. Voluntary payment, private provision	59	57	44
4. Collective payment, private provision	79	60	46

Note that Scenario 1 corresponds to a Systems Benefit Charge as described above, Scenario 3 corresponds to green power, and scenario 4 corresponds to a RPS policy. Clearly the RPS policy (collective payment) generates the greatest amount of support at any price level.

Of those who were not willing to pay, between a third and a quarter cited as a reason that they could not afford to pay. Another 20% to 30% opposed all new government programs. Finally, over 40% of those not willing to pay said that the benefits of renewable energy were not worth the costs. [52]

[51] Wiser, *ibid.*, Table 5
[52] Wiser, *ibid.*, Table 11. Under the "green power" scenario (scenario 3), only 13% of respondents who were not willing to pay cited "not worth it" as a reason.

The preference for a compulsory surcharge over a voluntary one was confirmed in a parallel survey by Wiser. Of his respondents, 53% favored a mandatory surcharge, versus 47% in favor of a voluntary one.[53] This difference is quite small, given both the theoretic free-riding problems with voluntary surcharges, and the empirical evidence that only 1% to 3% of consumers actually avail themselves of green programs.[54]

The lack of effectiveness of green power and green marketing translates into very low percentages of consumers voluntarily signing up to these programs. As pointed out above, nationally in the U.S., only 1% to 3% of consumers choose to pay for green power through a voluntary program, even though green products are available to about 40% of them.

Nancy Rader gives some reasons for this failure of green programs:[55]

- Green marketing efforts are aimed primarily at the residential sector, generally omitting commercial and industrial customers
- Competitive markets leave very thin margins for new competitors, let alone competitors selling higher-cost renewables products
- The transaction costs to sign up green consumers can be very high, e.g. $100 in advertising and marketing to acquire a new green customer
- As a result, to save costs, green marketers reduce "green" content, often reselling power from existing utility-owned sources, rather than expanding renewables output by building new capacity. Redirecting existing RE from a utility's portfolio does not improve the environment, and so misleads consumers

[53] The most likely profile of those willing to pay was: younger; female; higher income and education levels; and trust in government.

[54] Some criticize green power programs, saying that their potential market is limited to households, or about one third of the total market in the U.S. But, as REN21, *op. cit*., points out at page 26: "Many large companies in the United States, from aerospace contractors to natural foods companies, are voluntarily buying green power products. Among these corporate buyers are IBM, Dow, Dupont, Alcoa, Intel, HP, Interface, Johnson & Johnson, Pitney Bowes, Staples, Baxter, FedEx, Kinkos, General Motors and Toyota."

[55] Nancy Rader, "California Green Power Marketing: Predictably Disappointing", *Local Power News* (December 1998), available online at http://www.local.org/rader. html

- Even though most green marketers are acquiring utility renewables at very little cost, they are charging consumers between one and three cents per kWh more, and often asking for government subsidies in addition
- New renewables are likely to be built for the green market only if supported by public policy measures, such as subsidies.
- Most consumers are not altruistic enough to voluntarily pay large green premiums in exchange for very little personal benefit, especially if they don't trust the marketers' claims
- Very large numbers of consumers would have to voluntarily sign up, in order to make a difference

In conclusion, while green choice programs are laudable, particularly as they relate to overall consumer energy awareness, they are unlikely to have a significant impact on supply of renewable energy.

GOVERNMENT PROCUREMENT AND OTHER PROGRAMS

Various levels of government can also act directly by purchasing renewable energy for their own uses. For example, in 2001 the State of New York committed all state facilities to purchase at least 20% of their energy from renewables by 2010. Connecticut has made a similar commitment. New Jersey and Pennsylvania have committed to 10%, and Maryland to 6%.[56] While Maine has committed to 50%, its inclusion of large-scale hydro and co-generation lead many commentators to claim that its target is meaningless.

Benefits of government procurement policies are that they are simple to design and implement, and, if held through competitive bidding, can be quite efficient. Unfortunately, government share of total electricity consumption is too small to have much of a direct impact. Government purchases, however, can have indirect impacts,

[56] Blair Swezey, *Renewable Power Markets and Policies*, National Renewable Energy Laboratory (Golden, Colorado), May 2005

"leading by example", and making customers aware of renewable energy. In this sense, green power programs can be a complement to other policies. They are not a substitute.

A related government activity is consumer education and awareness. This is useful in a variety of ways, from encouraging conservation and energy efficiency to stressing the benefits of renewables. In turn, this can build support for a variety of policies including the ones discussed above.

CHOICE OF RENEWABLE ENERGY POLICY

Given the variety of RE policies available, it is a difficult matter to choose which policies to implement. As a result, governments often implement multiple policies without consideration of comparative merits of the policies, of how they interact, or of whether they complement each other. Such analyses are too complex to be performed with pencil and paper. Rather, they require more sophisticated models of energy supply and how it interacts with the rest of the economy.

Several such models exist. As an example, consider the one maintained by Resources for the Future, called the Haiku electricity market model. A version, based on 2002 data, was used by Karen Palmer and Dallas Burtraw to compare three different electricity policies.[57] These were (a) a RPS policy (b) a renewable energy production credit (REPC), and (c) a carbon cap-and-trade policy, i.e. place a limit on carbon emissions, but allow suppliers to buy and sell a right to emit. The conclusions of the study are as follows.

First, RPS policies are more cost-effective than REPC policies, both to increase the use of renewable energy, and to reduce carbon emissions. Subsidies tend to result in a lower price of electricity, in general, and hence higher total demand. By contrast, RPS policies require the purchase of higher-cost renewables, and so result in higher prices and lower

[57] Karen Palmer and Dallas Burtraw, *Electricity, Renewables, and Climate Change: Searching for a Cost-Effective Policy*, Resources for the Future, May 2004.

total demand. Achieving a given level of carbon emissions is easier at a lower level of demand.

Second, both RPS and REPC are less effective than carbon caps at reducing carbon emissions. As noted in the previous paragraph, by lowering the average price for electricity, REPC increases demand, to some extent counteracting the switch to renewables. As well, under a RPS policy, renewables displace the most costly traditional source of generation. This turns out to be natural-gas-fired generators, which contribute much less to carbon emissions than do coal-fired generators. Under a RPS requiring that 15% of electricity sold come from renewable sources, coal emissions are largely unchanged.

Third, to reduce carbon emissions significantly, a climate policy, implemented as some form of carbon caps, or limitations on carbon emissions, is the most efficient policy. A “carbon tax” would have to be so high as to be politically unacceptable. And, as stated above, both subsidies and RPC are not that effective.

A companion study by Carolyn Fisher and Richard Newell, using a welfare-theoretic model, comes up with the same qualitative conclusions.[58] To achieve a 5.8% reduction in carbon emissions, an RPS policy is 7.5 times as costly in terms of social welfare (consumer surplus plus producers’ surplus) as an emissions tax. However, RPS costs 40% less than a direct government subsidy to renewables production. (The latter is a subsidy funded by general revenues, not by a surcharge or SBC. A surcharge also reduces the demand for electricity, and hence carbon emissions.)

More of these quantitative comparisons of scenarios would be welcome. In their absence, policy choices will depend in large part on experience and judgment. RPS will have a big role to play, harnessing as it does the efficiencies of market forces to the substitution of renewable energy for traditional sources. However, RPS is not as effective as other

[58] Carolyn Fisher and Richard Newell, *Environmental and technology Policies for Climate Change and Renewable Energy*, Resources for the Future, Discussion Paper 04-05, April 2004.

policies in targeting the use of specific sources of renewable energy, or the replacement of specific (polluting) sources of traditional energy. Policies such as feed-in tariffs or specific production subsidies seem more effective at promoting specific renewables. Emission caps or emission taxes seem more effective at reducing specific harmful traditional sources.

Finally, the role of green power and of government procurement is likely to be minor. While desirable in themselves, such programs are unlikely to have a large enough impact to be relied upon as the main RE policy.[59]

APPLICATIONS TO CANADA

The discussion to this point draws upon international experience, and especially that of the United States. However, in some ways, circumstances in Canada are unique. It is important, therefore to examine how the above conclusions should be adjusted before they are applied here.

The mix of different sources in the current supply of electricity varies from country to country. The percentages for some countries are as follows:[60]

	Canada	U.S.	Denmark	Germany	Spain	Japan	Norway
Capacity (GW)	112.5	948.4	12.7	115.6	50.6	241.3	26.6
Fossil (%)	30	70	79	67	52	61	1
Hydro (%)	60	7	0	4	25	8	99
Nuclear (%)	9	20	0	20	15	29	0
Renewable(%)	1	2	21	9	8	2	0

[59] The implementation of carbon tax regime with cap or trading provisions has not been assessed in this report, but it potentially has features that are complimentary to the promotion of RE growth.
[60] OPA, op. cit., Table 2.4.5 at page 102; EIA, Annual Energy Review 2004, Table 11.17; Testimony of David Garman, op. cit., Palmer and Burtraw, op. cit.

In the United States, 50% of electricity is generated from coal, 20% from nuclear, 18% from natural gas, 7% from large hydro, 2% from oil, and 2% from renewables (excluding large hydro).[61] By contrast, Denmark, Germany, and Spain are emphasizing renewables, as can be seen from the table above.

Canadian provinces also show a lot of variation. Thus, British Columbia obtains about 80% of its electricity from large hydro on the Columbia and Peace Rivers. By contrast, Ontario's electricity capacity comes 37% from nuclear, 21% from coal, 16% from natural gas, and 26% from renewables, of which about 25% is hydropower.[62] Interestingly, the mix of power actually produced differs from that of generating capacity: 51% of production is from nuclear, 19% from coal, 7% from natural gas (mainly at peaks), and 23% from hydro and renewables.

Ontario is perhaps the province that faces the most serious electricity generation problems. The provincial government ordered the phasing out of coal-fired generators, because of their contaminant emissions and greenhouse gases[63]. As well, a large number of its nuclear power units must be either upgraded or retired within the next 15 years.[64] This reduction in capacity, combined with a forecast annual growth rate in demand of 0.9% per year, and peak usage to grow at 1.3% per year, is leading to potentially serious shortfalls.

Compared to most other countries, Canada relies relatively heavily on hydropower. This is mostly in the form of large hydro stations, although increasingly small hydro developments are coming on stream. This is especially true in Ontario and some of the Atlantic Provinces, where there are few if any opportunities for further development of large hydro. Correspondingly, there is a low dependence on fossil fuels, compared to other countries. As well, renewable energy (excluding large hydro) is still in its infancy, compared to countries such as Denmark, Germany, and Spain. Still, operation of large

[61] Testimony of David Garman, *op. cit*.
[62] OPA, *op. cit*.
[63] This commitment appears to have been on hold as a result of government announcements of June 13, 2006 http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&body=yes&news_id=134
[64] *Ibid*., at page 9

hydro plants that are already in place produces electricity that is virtually free of emissions, renewable in the dictionary sense of the word, whose supply is secure[65], and which has a very low cost per kWh. The challenge is meeting future growth in demand, rather than retrofitting or phasing out these existing sources.

Canada is also in the unusual position for an industrial country of having large uranium deposits and plentiful opportunities for storage of waste, compared to other countries. While the supply of nuclear fuel is finite, known reserves will likely suffice indefinitely. Reliability and operability of nuclear plants has been a problem in the past. The Government of Ontario appears satisfied that improved designs will be much more reliable. Research in this area is being pursued by many stakeholders.

Canada is also a net exporter of oil and gas, although it is not clear how long conventional reserves will last. However, if technology develops successfully for exploitation of tar sands in the Prairies, Canada may have the second largest reserves of any country. The problem of noxious emissions remains.

While coal reserves are finite, they are in such sufficient supply that they can be expected to meet needs indefinitely. Traditional coal-fired generators are particularly polluting. New processes, such as coal gasification, accompanied by capture and sequestration of CO2 emissions, are much superior, but still emit gases, and furthermore are still very costly, at around 8 to 9.5 cents per kWh currently.[66]

National figures conceal significant differences, as mentioned above. Ontario has harnessed its feasible large-scale hydro. New large-scale hydro would have to be imported from Manitoba or, less likely, from Labrador. Unfortunately, the costs of building the necessary transmission facilities are significant. Furthermore, the construction would cause some damage to habitats.

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[65] Under certain extreme scenarios, global warming could interfere with the operation of certain hydro generators.

[66] OPA, op. cit., at page 28

As stated above, Ontario is phasing out its existing coal-fired plants, and new, clean gasification processes for coal are still too costly. In the absence of a ratcheting up of conservation programs,(a commitment that has been stronger in rhetoric than in practice), the expansion of nuclear power to supply base-load demand has been identified as the preferred option. While natural gas-fired generators can still supply peak demand, the price of natural gas is rising, and could well rise further. As well, reserves are limited. This leaves Ontario with a need for electricity from other sources, and in particular "new" renewable energy. For the reasons given above, this need is particularly pressing in Ontario, compared with most other provinces.

Given its need for renewable energy, Ontario has several options it can pursue. One is a feed-in tariff, setting higher prices to sellers of wind, biomass, and waste, small hydro, and especially solar energy. Such a policy has just been initiated, as mentioned above. A complementary policy could be RPS, setting a goal of some 10% RE by 2010. Such a goal already exists in Ontario, but it is currently voluntary. This report recommends that cost-effective RPS be made mandatory as part of the energy package provided by accredited suppliers.

Other policies, such as green marketing and government procurement, while helpful, are unlikely to be core solutions. At best, they serve to prepare the culture for adoption of strategies that are likely to have initial price tags that are higher than current costs but result in lower overall energy and societal costs in the future. The green choice in RE cannot simply be left to the individual consumer to mandate.

In summary, RE forms an increasingly important component of an energy policy, but its design and implementation must adhere to principles of total costing of initiatives and a evolve practical approach to take-up. Public interest stakeholders must be vigilant to ensure that RE projects and programs are not simply window dressing or the "sound bite" for positive political spin. RE program implementation also cannot rely on public good will and good intentions to ensure success.

APPENDIX

STATE MINIMUM RENEWABLE ELECTRICITY REQUIREMENTS
(AS OF APRIL 2006)[67]

State	Target	Technology	Comments
Arizona	0.2% in 2001 1% in 2005 1.1% in 2012	60% solar PV and solar thermal electric 40% solar hot water and in-state landfill gas, biomass and wind	Applies to all retailers Draft rules to increase target to 15% by 2025
California	20% in 2017	Solar PV, solar thermal, wind, biomass, landfill gas, digester gas, geothermal, ocean	Applies to 3 largest suppliers. Direct access service providers included beginning in 2006
Colorado	10% in 2015 4% of total energy from solar (half from customer-sited resources)	Solar, wind, geothermal, biomass, small hydro (new ← 10 MW, existing ← 30 MW), fuel cells using eligible resources	Applies to all retailers with more than 40,000 customers TRC trading certificates Instate counts 1.25 times
Connecticut	Class I: 7% in 2010 Class II: 3% in 2004	Class I: solar, wind, landfill gas, new run-of-river small hydro, fuel cells, ocean biomass Class II: MSW, existing run-of-river small hydro	Applies to investor owned utilities only Credit trading program Non-compliance penalty of 5.5 cents/kWh

[67] Updated from Union of Concerned Scientists, *Powerful Solutions: Seven Ways to Switch America toRenewable Electricity*, January 1999, updated online at http://www.ucsusa.org/clean_energy

Delaware	10% in 2019	Solar, wind, ocean, geothermal, biomass, landfill gas, co-firing, small hydro (<30 MW)	Applies to all competitive suppliers. Exemptions for munis and RECs if they offer voluntary green power
Hawaii	20% in 2020	Wind, solar, landfill gas, hydro,MSW, geothermal, ocean, biomass, hydrogen fuels Also savings from conservation	Applies to all utilities Affiliates may aggregate their renewable portfolios
Iowa	105 average MW (around 2% of 1999 sales)	Solar, wind, methane recovery, biomass	Applies to investor owned utilities only
Maine	30% of sales in 2000 (start of competition)	Fuel cells, tidal, solar, wind, geothermal, hydro, biomass, and high efficiency cogeneration	Eligible renewables were over 50% of sales in 1998
Maryland	7.5% in 2019	Solar, wind, biomass, landfill gas, ocean, fuel cells, small hydro (< 30 MW)	Applies to all retail sales except annual sales in excess of 300 million kWh to a single customer
Massachusetts	4% in 2009 plus 1% per year thereafter	Solar, wind, ocean thermal, wave, tidal, landfill gas, advanced biomass, existing hydro and MSW	Applies to investor owned utilities only Tradable credits

Minnesota	825 MW wind by 2006 125 MW biomass in 2002 Another 10% by 2015	Wind, biomass, solar, small hydro (<60 MW), preference for in-state projects	19% target in 2015 for Xcel, the largest utility
Montana	15% in 2015 At least 75 MW from community projects	Wind, solar, geothermal, landfill gas, small hydro (<10 MW), farm methane, wastewater, co-firing	Applies to all investor owned utilities
Nevada	20% in 2015, of which 5% from solar	Wind, solar, small hydro (< 30 MW), geothermal, biomass, energy recovery (< 15 MW), energy efficiency measures	Applies to all retail suppliers except coops, munis, or general improvement districts
New Jersey	2.5% in 2008 Class I: 3.84% in 2008 Solar: 0.16% in 2008	Class I: solar, wind, geothermal, wave, landfill gas, fuel cells, sustainable biomass ClassII: MSW and small hydro (<30 MW)	Applies to retail and basic generation suppliers TRCs
New Mexico	10% in 2011	Wind, solar, biomass, geothermal, small hydro (< 5 MW), landfill gas, fuel cells	Applies to all retailers except coops and munis Credit-trading program Preference to in-state resources

New York	24% in 2013 from existing or new RE 6.56% in 2013 from new RE 2% from customer sites	Main Tier: Wind, solar, ocean, biomass, biogas, incremental hydro and small run-of-river hydro (< 30 MW) Customer Tier: Solar, wind, methane digesters	Applies to investor owned utilities only
Pennsylvania	Tier I: 8% in 2020 Tier II: 10% in 2020 Solar: 0.5% in 2020	Tier I: Solar PV, solar thermal, wind, low-impact hydro, geothermal, biomass, fuel cells, coal mine methane Tier II: Waste coal, distributed generation. demand-side management, large scale hydro, wastes, IGCC	Applies to investor owned utilities only
Rhode Island	16% in 2019	Solar, wind, ocean, geothermal, biomass. co-firing, small hydro (<30 MW)	Applies to all utilities except two Voluntary green power purchases do not count TRC trading system
Texas	5880 MW in 2015 (about 4.2% of 2015 sales)	Solar, wind, hydro, geothermal, wave, tidal, biomass, wastes, landfill gas	Munis and coops included only if they opt in to retail competition Out-of-state not eligible unless dedicated transmission line

Washington, D.C.	Tier I: 11% in 2022 Solar PV: 0.386% in 2022	Tier I: Solar, wind, biomass, landfill gas, geothermal, ocean, fuel cells	Applies to all retail sales Must be from a facility in the region or an adjacent state
Wisconsin	10% in 2015 (at least 6% above 2004 levels)	Wind, solar, biomass, geothermal, tidal, small hydro (<60 MW)	Applies to investor owned utilities, munis and coops

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Apt Jay, Dobesova Katerina and Lave Lester B., *Are Renewables Portfolio Standards Cost-Effective Emission Abatement Policy?*, Carnegie-Mellon Electricity Industry center, Working Paper CEIC-04-06. The cost of wind-generated electricity, including subsidies and transmission, is 8.9 cents per kWh. The cost of coal-generated electricity is 1.85 cents, plus 0.23 cents for transmission. Contaminant emissions (SO2, NOX, HG) add another 1.1 cents to coal, for a total of 3.2 cents per kWh. While Dobesova et al do not quantify the cost of reducing greenhouse gas emissions, they point out that the margin between wind energy at 8.9 cents and coal at 3.2 cents is 5.7 cents per kWh, in their view more than enough to capture and sequestrate the CO2 and leave savings that can provide consumers with lower prices.

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Environment and Energy Study Institute, *op. cit*. Only 3% of the more than 75,000 dams in the U.S. are currently used to generate hydropower. The World Commission on Dams estimates that, worldwide, around 5,300 (11%) of the world's large dams (i.e. 15 meters or higher) were built solely for hydropower. A further 13,300 (28%) were built for more than one function. That leaves at least 61% of the world's large dams performing no hydro function currently

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Garman David K. Assistant Secretary, Energy Efficiency and Renewable Energy, Testimony, before the Committee on Energy and Natural Resources, United States Senate, March 8, 2005. The 2005 Energy Bill originally contained a

national RPS for the U.S., but this was rejected by the House of Representatives. Opposition included arguments that renewable resources vary from state to state; that states hold different views on the resources to be supported; and that electricity regulation is largely at the state level.

Garman David K. Testimony, op.cit Some jurisdictions have two-tier RPS policies, e.g. one target for, say solar energy, and a much higher target for all renewable sources. However, the more tiers in the RPS policy, the further away from a pure RPS plan, the fewer efficiencies to be obtained from flexibility and substitution via market forces.

Garman David, op. cit Testimony

Garman David, Testimony, op.cit., Burtraw and Palmer, op. cit.   OPA, op. cit., Table 2.4.5 at page 102; EIA, Annual Energy Review 2004, Table 11.17; Globe and Mail, 2006/03/29, at page B2. The hope is that current subsidies will lead to quickly declining unit costs in future.

Grace Robert, Kappel Chase, Porter Kevin and Wiser Ryan This particular set of objectives follows those found in, , , *Evaluating State Renewables Portfolio Standards: A Focus on Geothermal Energy*, National Geothermal Cooperative, 2003.

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Hempling and Rader *op. cit*

Hempling and Rader *op. cit*,, at page 29, note 3, note that cost benefit analysis is only concerned with efficiency. Equity goals are better determined by “political judgment and moral values rather than the logic of economic efficiency.”

Hempling Scott and Rader Nancy, *The Renewables Portfolio Standard: A Practical Guide*, National Association of Regulatory Utility Commissions (NARUC), February 2001, at pages 22 and 23. Most likely, biomass fuel would have been used in coal-burning facilities, or landfill methane in natural gas-burning facilities.

Hoffman Steven M., in *Energy-Efficiency and Renewable Energy in a Restructured Electricity System, Minnesotans for an Energy-Efficient Economy*, March 1999. Hoffman concludes: “Opposition to the SBC, therefore, seems to be based on language and application rather than the principle of a fund designed to support public benefit programs.”

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http://www.energy.gov.on.ca/index.cfm?fuseaction=english.news&body=yes&news_id=134 This commitment appears to have been on hold as a result of government announcements of June 13, 2006

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International Rivers Network claims that "large hydro reservoirs are often rendered non-renewable by sedimentation". However, this could be taken care of by periodic dredging.

Klimpt et al, op. cit. Canada is the world's largest producer of hydro-based electricity, producing 12% of the world total in 2004 (REN21, op. cit., at page 7)
More that 85% of the growth in U.S. energy demand since 1980 has been met by electricity… And the electrification of our energy economy is accelerating. . Over the next two decades, these trends will move about 15% of our entire energy economy from conventional thermal processes to electrically powered ones

New Scientist, 2005/02/24. Recently, some scientists have claimed that hydropower dams in tropical countries produce significant amounts of carbon dioxide and methane, two greenhouse gases. This is due to trees and plants rotting on the reservoir's bottom. The impact can be greater than the emissions from a fossil-fuel generator of equivalent capacity.

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OPA, *op. cit*.

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Rader Nancy, "Getting it Right and Wrong in the States", *Wind Power Monthly*, 2001) This was the experience in Maine. The state set a high target of 30% for RE. But it allowed large hydro power and co-generation to be eligible, so 50% of the supply was eligible. As a result, the RPS had no practical effect. Generally, including large hydro in the North East limits the market for wind-generated electricity ([1] Arizona's initial plan had no penalties whatsoever.

REN21, op. cit., at page 7. The Appendix to the Report shows a figure of 740 GW, but is probably a typo.

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