> Increasing Productivity and Moving Towards a Renewable Future:

A New Electricity Strategy *for* Ontario

Ontario Clean Air Alliance

October 2005

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Laidlaw Foundation

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About the Ontario Clean Air Alliance

The Ontario Clean Air Alliance is a coalition of health, environmental, and consumer organizations, faith communities, municipalities, utilities, unions, and individuals working for cleaner air through a coal phase-out and the shift to a renewable electricity future. Our partner organizations represent more than six million Ontarians.

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Foreword

In Ontario, we used to think that where energy was concerned, cheaper was better. "Live Better Electrically!" But coal pollutes; nuclear power has turned out to be far more expensive than expected (although its costs are still partly hidden from Ontario users); and renewable sources will be expensive to develop.

In recent years science has exposed heavy costs from polluting sources of electricity: disease, morbidity, climate change. This study points out that our "cheap" energy pricing is not even able to generate economic benefit in the narrower sense. Nevertheless, moving to a mindset that seeks out energy efficiencies and focuses on non-polluting, renewable sources will take time and a willingness to confront the costs of adaptation.

This study argues that we should face up to paying the full cost of our electricity. Unfortunately, we have spent decades organizing ourselves on the assumption that energy will remain cheap. For example, we commute long distances, our houses, our appliances and our cars are mostly energy-inefficient, our vegetables and fruits travel thousands of miles to reach us.

Energy prices need to go up, substantially, to act as signals for change. But governments at all levels also need to ease our way, by providing better public transit, by encouraging greater urban density, by assisting lower-income families with the costs of adjustment.

This study proposes a multitude of measures. Many of them will appear preposterous to those who still hope that electricity can remain cheap. But whether or not any particular measure survives debate, the Clean Air Alliance deserves our thanks for bringing them forward at this time.

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Foreword

Soon after the August 2003 blackout, The Conference Board of Canada issued a report that analyzed the reasons for this event and mentioned the need for Ontario to have a comprehensive strategy. In this new report by Ontario Clean Air Alliance, *A New Electricity Strategy for Ontario*, the same point is being made. It is critical for Ontario to develop and implement a strategy that can meet both energy security and environmental objectives.

There are a lot of similar recommendations between these two reports as to what should be included in an electricity strategy for the province. Both studies recommend stopping the subsidization of electricity and having prices better reflect costs. Such a measure would provide the right price signals for improved energy conservation and increased electricity productivity as well as encouraging new investments in generation and transmission. Both reports also recommend incentives for energy conservation and a greater focus on distributed generation and renewable energy sources. Of course, there are some divergent views between the Conference Board and the Ontario Clean Air Alliance on what Ontario must do. Nevertheless, both provide important policy advice that the Ontario government should consider.

A New Electricity Strategy for Ontario presents some bold recommendations such as having 60 per cent of electricity generation come from renewable energy sources by 2020. It even goes as far as suggesting that the longer-term goal should be 100 per cent. It also cautions the province about investing in nuclear and coal power generation. It suggests that such investments must make economic sense and meet clear environmental goals.

This report presents some interesting perspectives that could be counter to popular opinion. For example, it argues that raising electricity rates would improve not only electricity productivity, but also Ontario's standard of living. This may seem at first counterintuitive but the report does show strong positive correlations between these factors. This research finding requires further investigation into potential causal relationships. How can higher electricity rates increase the province's income per capita? It is just one of many examples of the value of reading this report and reflecting on the findings of the research and the possible consequences of its recommendations.

Overall, this report makes an important contribution to a subject that is a priority for the province. Ontario faces major challenges in ensuring its energy security while also meeting environmental goals such as improved air quality and reductions in greenhouse gas emissions. Although I would not necessarily agree with every point made, this report suggests ways of meeting these challenges that merit serious review and debate. I applaud Ontario Clean Air Alliance for this contribution to a critical issue that must be addressed for the future of this province.

Gilles Rhéaume
Vice-President
Policy, Business and Society
The Conference Board of Canada

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1.0 Introduction – Choosing the right path

> It used to be that the favourite Canadian topic of conversation was the weather, but this subject is rapidly being eclipsed by discussions of rising energy costs, including rising rates for electricity. The potential impact of these rising rates on residential energy bills and industrial competitiveness have raised serious concerns about Ontario's future prosperity and its ability to remain economically competitive.

From a broader economic perspective, however, many of the concerns expressed about rising electricity rates are based on a fundamental myth – that jurisdictions with lower electricity prices have a competitive advantage that leads to a better quality of life and better economic performance. This report takes a detailed look at the real relationship between electricity costs and economic performance and finds that, in fact, it is jurisdictions with higher costs that are the most productive users of electricity and the most successful in terms of general prosperity (as measured by incomes and GDP).

When we compare Ontario to its North American economic peer group (states and provinces with populations of six million or more), we find that it trails in general productivity as well as more specifically in electricity productivity (kilowatt hours used per unit of goods produced). As a result, it also trails the pack in its overall economic success as measured by GDP per capita.

What we also see is a direct relationship between electricity prices and electricity productivity, with Ontario and Quebec boasting among the lowest prices in their peer group, but as well some of the lowest electricity productivity levels. In fact, today Ontario is one of the largest per capita electricity consumers in the world, using, for example, 60% more electricity per capita than neighbouring New York State.

Ontario has largely kept its electricity prices artificially low by providing massive public subsidies to its dismally performing fleet of nuclear power stations — a system that the International Energy Association ranked as having the worst reliability record in the OECD from 1990-2002. Despite the claim of nuclear boosters that nuclear power would be "too cheap to meter," it has proven to be anything but. Cost overruns, delays, unexpected shutdowns and ongoing maintenance problems have made nuclear the highest-cost and highest-risk power source in Ontario.

This fact has been disguised to electricity consumers by the off-loading of a $15 billion nuclear debt onto taxpayers and ratepayers and the cross-subsidization of nuclear by Ontario's low-cost heritage waterpower system. But the reality is that Ontario's outdated "cheap power" strategy has actually resulted in high-cost power being sold at artificially low prices that simply encourage inefficient use and wastage.

With a clearer understanding of the links between true power costs and economic performance, we can begin to intelligently redesign our power system to focus on rewarding efficient use instead of subsidizing inefficient consumption. To do this, we need to adopt a much more diverse and flexible approach to our electricity system, an approach that properly prioritizes conservation and efficiency as our least-cost and highest-benefit options for meeting our incremental power needs.

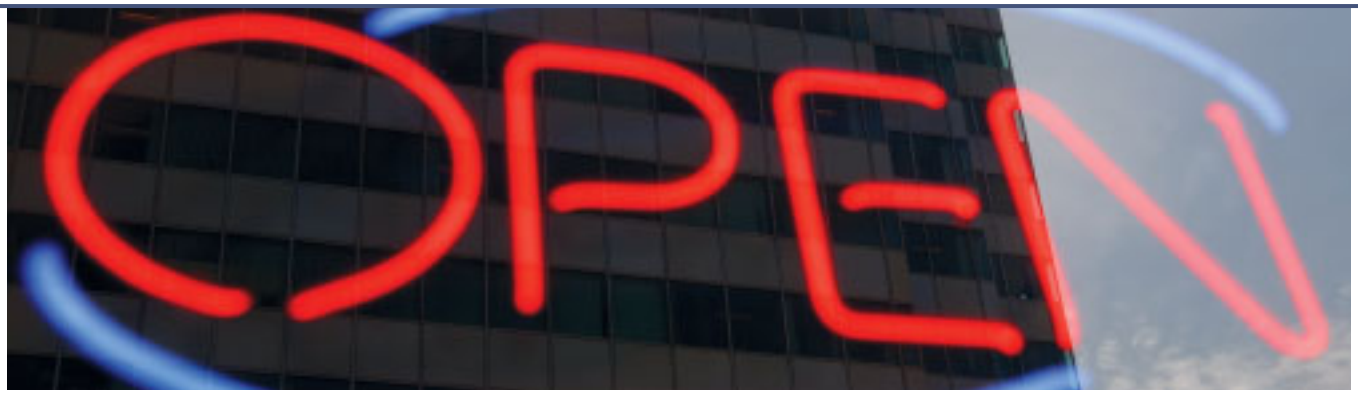
We also need to rethink our current focus on providing increasing quantities of electricity and move instead to a focus on finding the most efficient way to provide required services. In other words, we need to think about the best way to keep our beer cold and our showers hot instead of simply continuing to try to pump out more and more kilowatts. This focus on end products and services rather than production can also help increase badly needed innovation and efficiency in our electricity system.

Similarly, by embracing the longer-term goal of moving to a 100% renewable electricity system – with an interim goal of 60% renewable power by 2020 – we can set the stage for significant improvements in our energy productivity, while creating new energy-sector economic opportunities, and an improved quality of life for all Ontarians.

To be successful, Ontario will need to put in place the right motivations and structures to drive significantly higher electricity productivity. A real-cost rate for electricity usage that encourages all users to invest in efficiency and conservation measures is one such key motivator. This would also produce many ancillary benefits, such as cleaner air, less need for expensive generation and transmission infrastructure and more efficient industries, while helping to ensure that the bottom-line impacts of higher energy costs are minimized or even eliminated.

The result of this approach will be to truly move Ontario forward as a province that is ready and able to compete in the global knowledge economy.

2.0 Living better electrically – for awhile



2.1 The early years: growing supply and falling prices

"Hydro, it can be truly said, is the corner-stone of the economy and progress of this great Province"

– Ontario Hydro 1950 Annual Report

"Mismanagement of Ontario Hydro is the biggest public-policy boondoggle in postwar Canada"

– Jeffrey Simpson, Globe and Mail, April 15, 2005

2.1.1 Ontario Hydro's Golden Age: 1906 to 1961

Ontario Hydro was created in 1906 to sell electricity to the province's electricity consumers at the lowest possible price while developing the province's low-cost waterpower resources.

Ontario Hydro was given numerous special privileges to help it fulfill its mission:

- It was a non-profit, Crown corporation that was not required to earn a commercial rate of return;
- It was exempt from federal and provincial corporate income taxation;
- Its bonds were guaranteed by the Province of Ontario, which reduced its cost of borrowing capital; and
- It was given a virtual monopoly on the generation and transmission of electricity in Ontario.

Ontario Hydro's mission and special privileges were economically rational from 1906 until the late 1950s as a result of two factors:

1. Ontario had plentiful untapped low-cost waterpower supplies; and
2. there were significant economies of scale to be realized in the generation and transmission of these resources as Ontario developed its major electricity infrastructure, which meant that the average cost of producing a kilowatt-hour (kWh) of electricity fell as output increased.

As a result, low electricity prices led to increased demand for electricity, which in turn led to increased output and even lower prices. Specifically, the residential price of electricity fell by 80% between 1914 and 1949, from 5.08 cents per kWh in 1914 to 0.99 cents per kWh in 1949 (See **Figure 1**). While over roughly the same period, Ontario's total electricity consumption grew by 4.8% per year from 1919 to 1949.

The pattern of rising demand and supply over this period represented a virtuous spiral of continually increasing electricity consumption and generation

and falling prices that dramatically raised the quality of life for Ontario residents and gave Ontario's industries a competitive advantage in the marketplace.

The huge economic benefits associated with the development of Ontario's low-cost waterpower resources during the first half of the 20th century created a near universal belief that a continuation of low electricity prices and ever-increasing electricity consumption and generation would be a prerequisite for the province's continued prosperity. According to Robert Macaulay, a cabinet minister in the Leslie Frost and John Robarts Governments and a former Vice-Chairman of Ontario Hydro:

> *"Where energy is abundant and inexpensive, there will be found a progressive nation with a high standard of living. Where energy is scarce and costly, one will find a retarded nation with a low standard of living … Whether Canada progresses materially and culturally depends upon the availability here of abundant energy at a low price."*[1]

This belief was the seed that led to the greatest public-policy boondoggle in post-war Canada.

2.2 Times change, but Hydro doesn't

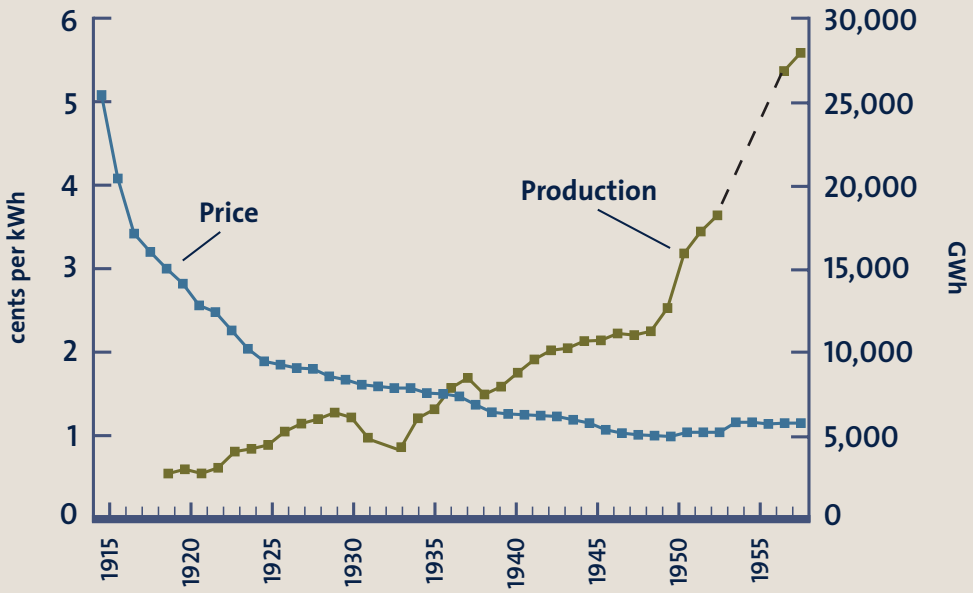
2.2.2 The Greatest Public-Policy Boondogle: 1962 to 1998

The virtually full exploitation of Southern Ontario's supply of large-scale untapped waterpower resources occurred between 1958 and 1959 with the completion of the Sir Adam Beck II Generating Station at Niagara Falls and the R.H. Saunders Generating Station on the St. Lawrence River.

Ontario Hydro's transformation into a primarily coal and nuclear electricity generating company began in 1962 when it brought its Lakeview coal-fired power plant in Mississauga into commercial operation[2] – at the time, the largest coal-fired generating station in the world.[79]

In 1961, Ontario Hydro had generated 98.3% of its electricity from waterpower.[3] However, in 1962, with the rise of coal power, waterpower generation fell to 88.4%.[4] By 1963, Ontario Hydro's generation mix was 77.3% waterpower; 22.5% coal power and 3/100ths of 1% nuclear power.[5]

Figure 1:
Ontario's Electricity Prices and Production: 1914 to 1957



Thus began a seismic shift in the nature and cost of Ontario Hydro's power production, with much higher cost coal and nuclear power making up an increasing percentage of the company's generation mix. This shift, which completely undermined the "virtuous cycle" strategy of increasing demand allowing for increasing economies of scale in production and lower prices, was not accompanied by a change to Ontario Hydro's business model including its special privileges described in Section 2.1.1.

In fact, the now broken link between rising consumption and decreasing prices was papered over by the Ontario Government's decision to allow Hydro to use its low-cost waterpower facilities to cross-subsidize its high-cost coal and nuclear generating stations. As a consequence, between 1962 and 1998, Ontario Hydro became a vehicle to subsidize the generation and sale of coal and nuclear power. As a result, waterpower fell from 98.3% of Ontario Hydro's generation mix in 1961 to 25.2% in 1998. Fossil power (primarily coal) and nuclear power rose to 27.4% and 47.4% respectively.[6]

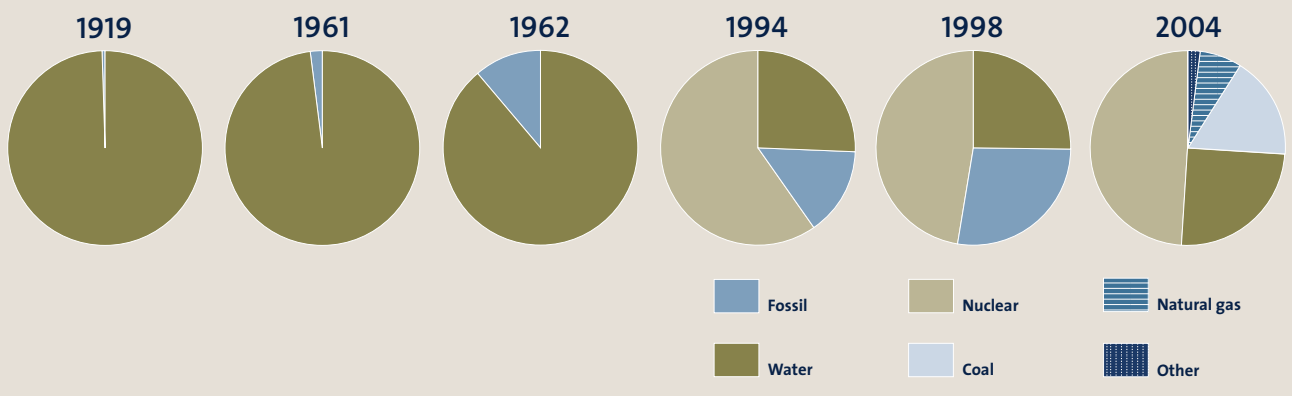
As **Figure 3** shows, in 1998 Ontario Hydro's cost of waterpower was 1.1 cents per kWh; its cost of fossil power was 4.3 cents per kWh; and its cost of nuclear power was 7.7 cents per kWh. As a consequence, in 1998, Ontario Hydro's average cost of power, 5.1 cents per kWh, was significantly higher than the cost of waterpower and significantly lower than the cost of nuclear power. As a result, in 1998, waterpower was providing a $1.3 billion cross-subsidy to nuclear power that permitted the sale of nuclear power at less than cost.[80]

Ontario Hydro's decision to subsidize the generation and sale of coal and nuclear electricity was economically irrational for two reasons. First, unlike its historical experience with waterpower, there were no similar economies of scale in the generation of coal and nuclear electricity. As a result, Ontario Hydro's "Live Better Electrically" sales campaign, which increased the demand for coal and nuclear generation, led to higher costs and higher rates, not lower costs and rates as Ontario Hydro predicted in 1960.[8]

Second, large-scale coal and nuclear generating stations were not Ontario's least-cost and least-risk options to meet its incremental electricity service needs. Ontario Hydro could have, for example, met Ontario's incremental electricity needs at a much lower cost by importing waterpower from Manitoba and/or Quebec and by aggressively pursuing natural gas-fired combined heat and power production. Instead, it pursued the highest-cost and highest-risk options, including a made-in-Ontario nuclear program.[9]

Investing in coal and nuclear allowed Ontario Hydro to become an energy monolith, which various governments have struggled to control and direct ever

Figure 2: Ontario's Electricity Supply Mix



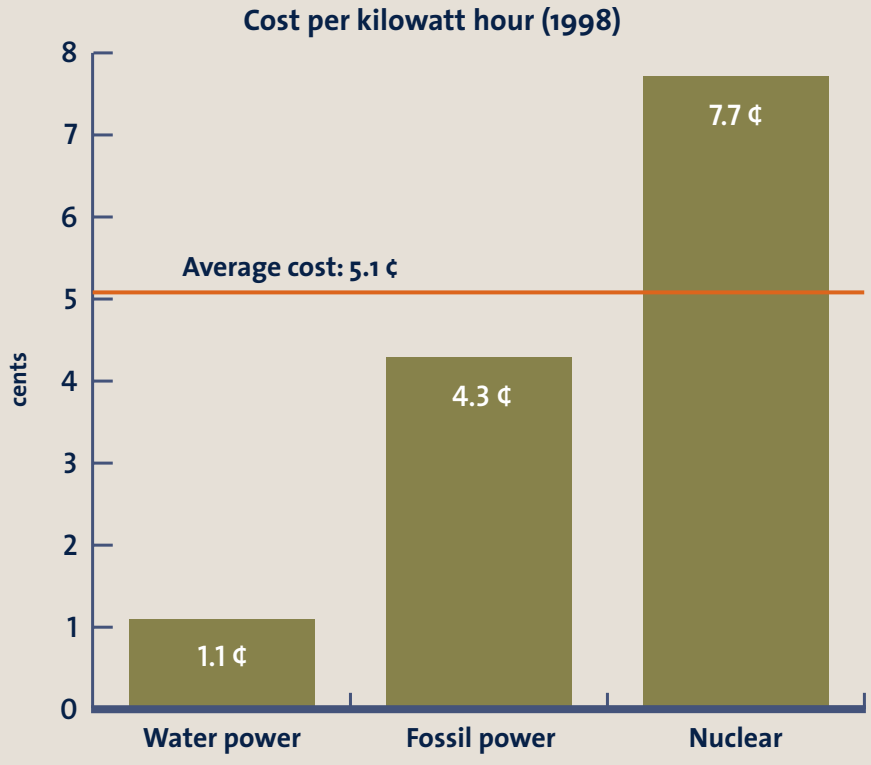
since. Ontario Hydro's firm belief that the route to future prosperity lay with ever-increasing rates of domestic electricity production was reflected in the utility's record of producing highly inflated demand forecasts, which in turn led to an emphasis on constructing massive centralized generating stations (such as the Darlington Nuclear Station) and a congruent interest in policies (such as the cancellation of electricity conservation programs in the 1990s) that would keep demand high in order to justify these extended and very costly mega-projects.

In 1979, for example, Hydro predicted that electricity demand would grow at an average annual rate of 4.6% between 1980 and 2000, more than three times the actual annual growth rate – 1.3% – for this period. The difference between Hydro's forecast and actual demand was the equivalent of five Darlington-size nuclear generating stations.[100]

In 1989, Hydro issued a report, *Providing the Balance of Power*, calling for the construction of 10 new CANDU nuclear reactors by 2014.[101] According to Hydro, Ontario's total electricity consumption would be 205 billion kWh in 2005.[102] However, according to a recent forecast by the Independent Electricity System Operator, Ontario's actual electricity consumption will be only 155.5 billion kWh in 2005.[103] In this case, the difference between Hydro's forecast and reality is the equivalent of three Pickering-size nuclear generating stations.[104]

For Hydro itself, the strategy of developing and controlling almost all electricity infrastructure in-province led to the development of a powerful centralized institution with an economic impact that rivaled that of the Government of Ontario itself. In the mid 1960s, for example, Hydro's capital expenditures comprised 17% of the total capital spending by all levels of government in the province. By the late 1970s, as a result of its ambitious nuclear expansion program, Hydro was responsible for almost 75% of public-sector capital spending in Ontario.[105]

Figure 3:
Ontario Hydro's electricity generation costs – 1998



Unfortunately, the result for the province as a whole of this ill-advised strategy was a huge cost in terms of a reduced rate of economic growth, excessive electricity generation, transmission and distribution costs, a less reliable power system and excessive health and environmental costs.

2.3 The result: The wrong system in the wrong place

2.3.1 The cost of going nuclear

As a result of its programs to increase the demand and supply of electricity, by 1998 Ontario Hydro was obtaining 73% of its electricity supply needs from its coal and nuclear generating stations.[81] This left Ontario with a high-cost supply mix, a factor that was only disguised from consumers through the cross-subsidization from waterpower and the creation of huge nuclear debt along with numerous other hidden subsidies (see Section 2.1.1 for more details on these).

The lack of competitiveness of Ontario Hydro's nuclear assets was most clearly revealed in 1999 when the company was broken-up and its $15.1 billion nuclear stranded debt was transferred to the Ontario Electricity Financial Corporation, not the new owner of its nuclear generation assets, Ontario Power Generation.[10] According to the Ontario Electricity Financial Corporation, the stranded debt could not "reasonably be serviced and retired by commercial companies in the competitive electricity market."[11]

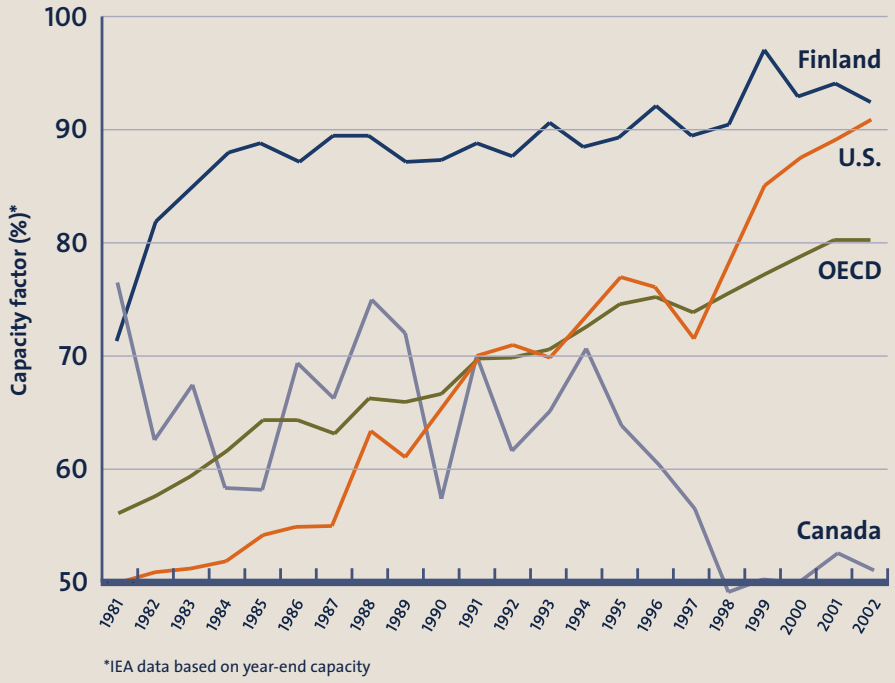
The result is that the cross subsidization of nuclear power has now been extended to include all generation in the province through the nuclear debt retirement charge that is levied on every kilowatt consumed in Ontario to help pay-off the OEFC's $15.1 billion nuclear stranded debt.

2.3.2 Nuclear cost overruns

Darlington

In 1983, Ontario Hydro estimated that the capital cost of the Darlington Nuclear Station would be $4 billion. Its actual cost was 3.6 times greater, at $14.3 billion. [82]

Figure 4: An International Comparison of Nuclear Reliability: 1981 – 2002



Pickering A Unit 4

In August 1997, the Ontario Hydro Board of Directors approved the re-start of all four of the Pickering A nuclear reactors at a total cost of $780 million and an expectation that Unit 4 would return to service in June 2000.

In August 1999, Ontario Power Generation (OPG) estimated that the cost of returning Pickering A Unit 4 to service would be $457 million.

In September 2003, Pickering A Unit 4 returned to service at a total cost of $1.25 billion. This meant its return to service was more than three years late and the actual cost was more than 2.7 times budget.[83]

Pickering A Unit 1

In August 1999, OPG estimated that the cost of returning Pickering A Unit 1 to service would be $213 million.[84]

In March 2004, OPG and the OPG Review Committee estimated that the cost of re-starting Unit 1 would be $825 million.[85]

In July 2004, OPG and Ontario Energy Minister Duncan estimated that the Pickering Unit 1 re-start would cost $900 million.[86]

In November 2004, OPG estimated that the total cost of the Pickering A Unit 1 re-start will be $975 million to $1 billion.[87] In other words, OPG's most recent cost estimate is more than four times its original estimate.

2.3.3 Declining Nuclear Performance

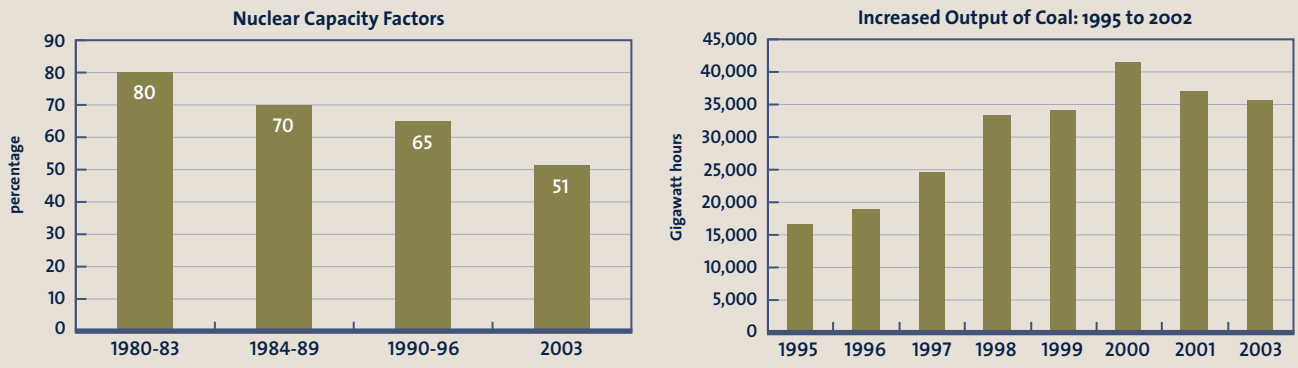
Meanwhile, the performance of Ontario's nuclear fleet has continued to deteriorate. According to the International Energy Agency, Canadian nuclear reliability for the period 1990 to 2002 has been the worst in the OECD (see **Figure 4**).[12] As **Figure 5** shows, the capacity factors (actual output as a percent of maximum design output) of Ontario's nuclear power plants declined from 80% between 1980 and 1983 to 51% in 2003.[13]

As a consequence, the output of Ontario's coal-fired power plants had to be increased by 120% between 1995 and 2003 to keep the lights on in Ontario.[14] Similarly, as a result of Ontario's heavy dependency on unreliable CANDU nuclear reactors, it took Ontario more than 8 days to fully recover from the August 14, 2003 blackout versus less than 2 days for New York State.[15]

2.3.4 Excessive Transmission and Distribution Losses

Ontario Hydro's decision to meet Ontario's electricity needs using a relatively small number of large, centralized power plants and a high-voltage transmission

Figure 5: Nuclear availability declines and use of coal soars



system, as opposed to a decentralized system with many small plants located close to consuming loads, entails significant transmission and distribution electricity lines losses. For example, in 2002, Ontario's electricity transmission and distribution line losses equaled 11.5 billion kWh.[16] This was equivalent to 7.5% of Ontario's total electricity generation or 50% of the output of the giant Nanticoke coal-fired power plant.[17]

2.3.5 Reduced Security of Supply

The highly centralized nature of Ontario's electricity generation system has also reduced our security of electricity supply. For example, despite the fact that the City of Toronto consumes approximately 20% of the province's electricity supply, it imports virtually all of its electricity from outside of the city via two Hydro One high-voltage transmission lines. Toronto's excessive dependency on power imports increases its vulnerability in the event of a province-wide blackout or a failure of a Hydro One transmission line.[18] **Figure 6** shows local electricity generation as a percentage of total local electricity consumption for a number of municipalities – Ottawa and Toronto, for example, produce only approximately 7% and 1% respectively of the electricity that they consume.

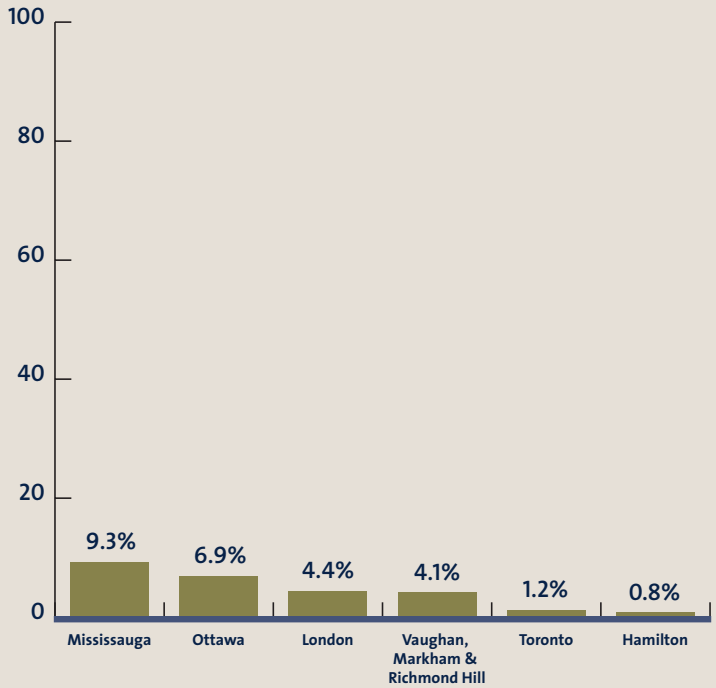
2.3.6 Public Health and Environmental Costs

In 1998 the Ontario Medical Association (OMA) reported that air pollution is "a public health crisis" in Ontario.[22] In 2001, the OMA released a report that indicated that ozone levels are continuing to rise in Ontario. According to the OMA, the "overall increasing trend in annual average ozone levels in Ontario will continue to cause serious health damage for the people of Ontario."[24]

According to the OMA's report, *The Illness Costs of Air Pollution in Ontario*, air pollution costs Ontario $7.8 billion per year in health care costs, lost work time and other quantifiable expenses, as well as killing over 5,800 Ontarians each year.[23]

The coal-fired power plants run by OPG are major

Figure 6:
Local electricity generation as a percentage of local electricity consumption

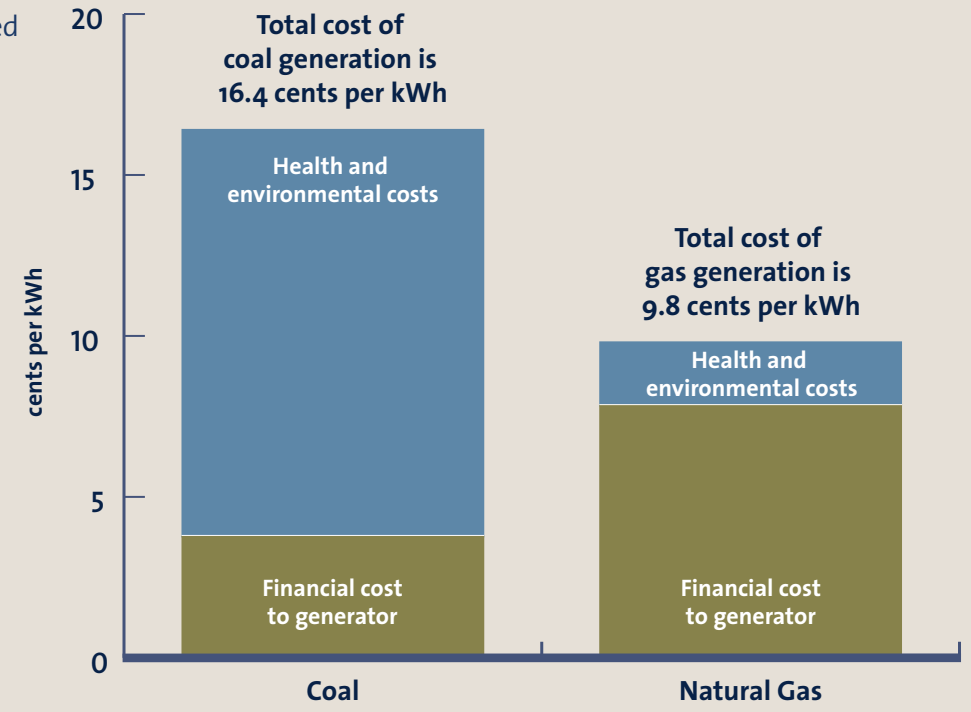


contributors to the public-health crisis caused by air pollution in Ontario:

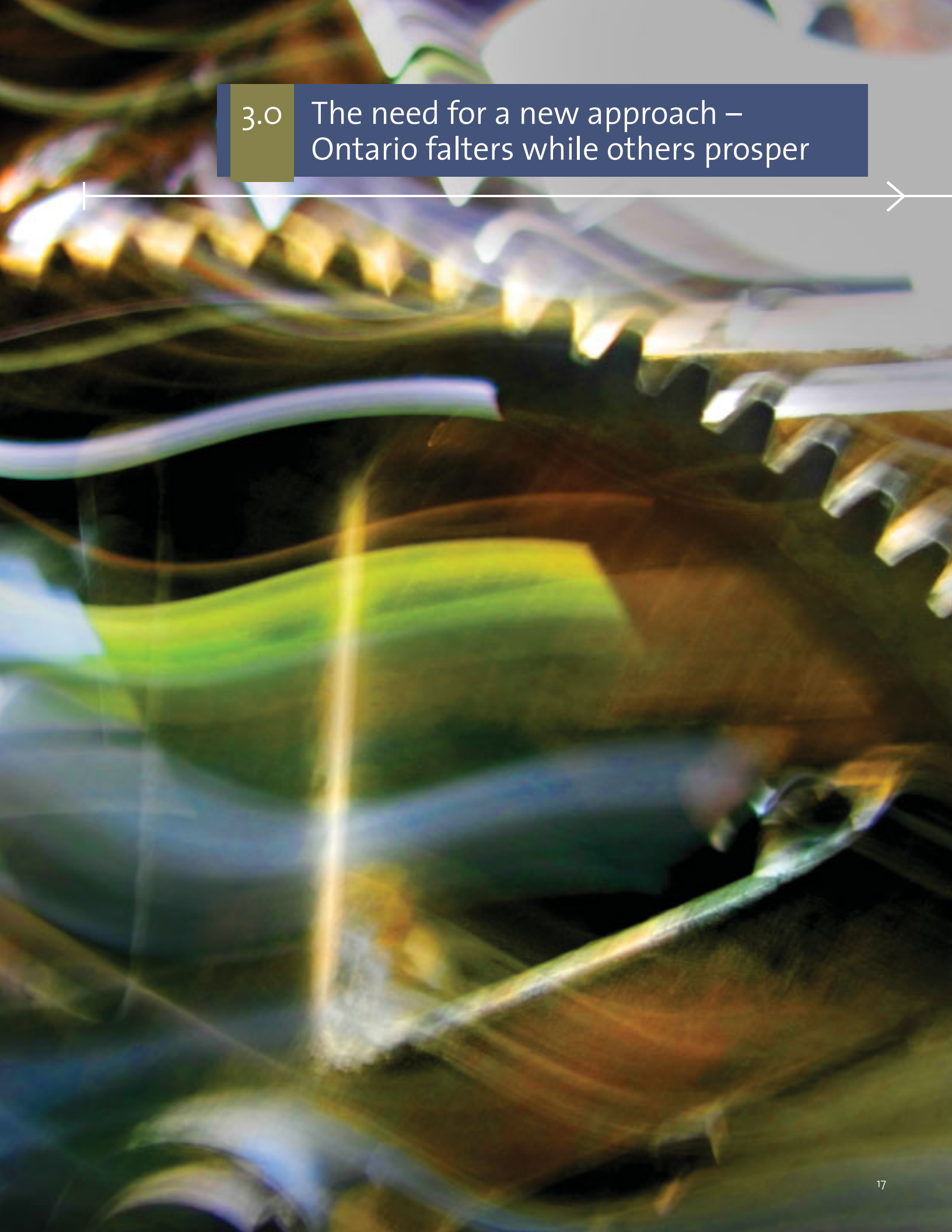
1. In 2003 OPG's coal plants produced as much air pollution as 6.1 million cars.[25]
3. OPG's coal plants are responsible for 67% of Ontario's chromium emissions (a carcinogen)[27]; 39% of Ontario's airborne mercury emissions (a neurotoxin)[28]; 27% of Ontario's sulphur dioxide emissions (smog and acid rain)[29]; 27% of Ontario's arsenic emissions (a carcinogen)[30]; 20% of Ontario's carbon dioxide emissions (global warming and climate change)[31]; and 14% of Ontario's nitrogen oxides emissions (smog and acid rain)[32].
4. OPG's Nanticoke coal-fired power plant on Lake Erie is Canada's #1 air polluter. Nanticoke produces more air pollution than is reported by all the polluters in Saskatchewan, Manitoba, New Brunswick or Nova Scotia respectively.[33]
5. OPG's Lambton coal-fired power plant near Sarnia is Ontario's #2 air polluter.
6. The Atikokan and Thunder Bay coal-fired power plants are the largest sources of sulphur dioxide (acid rain) and mercury (a potent neurotoxin) in northwestern Ontario.[34]

According to a report for the Government of Ontario, the province's coal plants kill 668 people per year in Ontario and cause 928 hospital admissions, 1,100 emergency room visits and 333,660 minor illnesses.[74] According to the same report, switching from coal to natural gas for electricity generation would reduce our total cost of power generation by $1.7 billon per year.[75] The net savings from replacing coal with energy conservation and renewables would be even greater. As **Figure 7** reveals, the total cost per kWh of coal-fired electricity generation is 67% greater than for natural gas-fired generation. Ontario's increasing reliance on coal power has, in other words, come at a steep economic and social cost.

Figure 7:
Full cost comparison of coal and natural gas-fired electricity generation



3.0 The need for a new approach – Ontario falters while others prosper



3.1 Economically Excessive Consumption, Low Productivity and a Lower Standard of Living

As Figure 11 shows, Ontario's electricity consumption per capita is amongst the highest in the world. For example, Ontario's electricity consumption per capita is 60% greater than that of neighbouring New York State.

Ontario's excessive electricity consumption per capita is due to two factors: First, the decision to price coal and nuclear generated electricity supply at less than cost; and second, Ontario Hydro's "Live Better Electrically" (launched in 1957) and "Go Electric" campaigns, which promoted the use of electricity for heating applications (e.g., space-heating, water-heating, cooking and drying) despite the fact that natural gas is a lower cost and more efficient option for heating end-uses.[35]

According to Ontario's Task Force on Competitiveness, Productivity and Economic Progress, Ontario is one of the richest jurisdictions in the world. However, the Task Force has identified 12 U.S. states that have a higher standard of living (Gross Domestic Product per Capita) than Ontario among the province's peer group (states and provinces with a population of six million or more). The Task Force based its ranking on preliminary GDP figures. Final year-end data actually puts Ontario in 15th place – see **Figure 8**[36].

This prosperity gap, or the difference between our Gross Domestic Product per capita and those of the richest U.S. states, is due to our lagging productivity, according to the Task Force.[37]

Table 1 shows the electricity prices for Ontario, Quebec and the 14 richest states. Ontario and Quebec have the third lowest and the lowest electricity prices respectively amongst the 16 member group.

Table 2 shows the electricity productivity ratios for Ontario, Quebec and the 14 most prosperous states. These ratios measure the value of the goods and services produced per kilowatt-hour (kWh) of electricity generation. In terms of electricity productivity, Ontario is 9th out of 16.

Figure 9 shows the relationship between the price of electricity and electricity productivity for Ontario, Quebec and the 14 richest U.S. states. As **Figure 9** reveals, jurisdictions with higher electricity prices have higher levels of electricity productivity. For example, New York State's price of electricity and its level of electricity productivity are both higher than those of Ontario.

Clearly, the price of electricity is an important signal for investments in electricity efficiency and

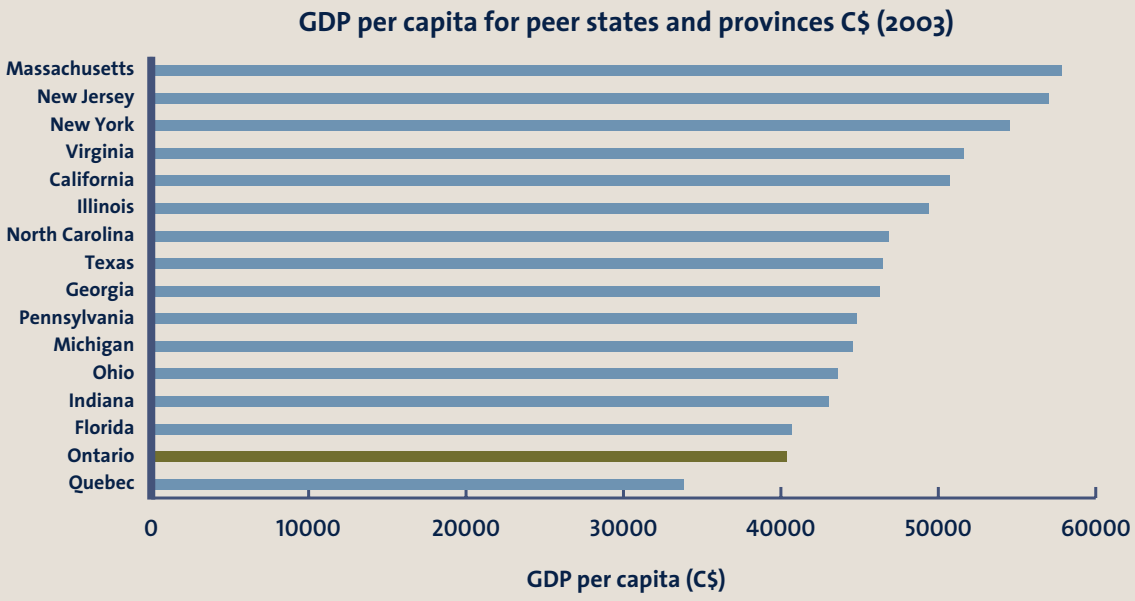
productivity measures. There are a number of components that generally come together to create a highly productive energy environment:

- Continual industrial and commercial process improvements that lead either directly or indirectly to improved energy efficiency. Examples include more efficient motors, better designed production systems, new technologies (LED lighting), capturing of waste heat or reuse/recycling of other wastes, etc.;
- Innovation in product or process design (such as viewing heating and cooling as "services" that can be provided on a district-wide basis) or redesigning products to use less material and energy;
- A policy framework that encourages and rewards efficiency and makes efficiency the economically rational choice, such as demand-response programs or incentives for electrical utilities to encourage efficiency.

These components tend to have many synergistic elements that multiply their productivity benefits: better designs and processes lead to higher-quality products and less waste; new LED or CFL lighting also requires less maintenance; demand response lowers peak prices but also reduces the need for expensive new generation and transmission infrastructure; etc. However, in the absence of a rational price signal (i.e., paying the full cost of electricity production), there is a sub-optimal incentive for companies to be innovative or invest in energy efficiency.

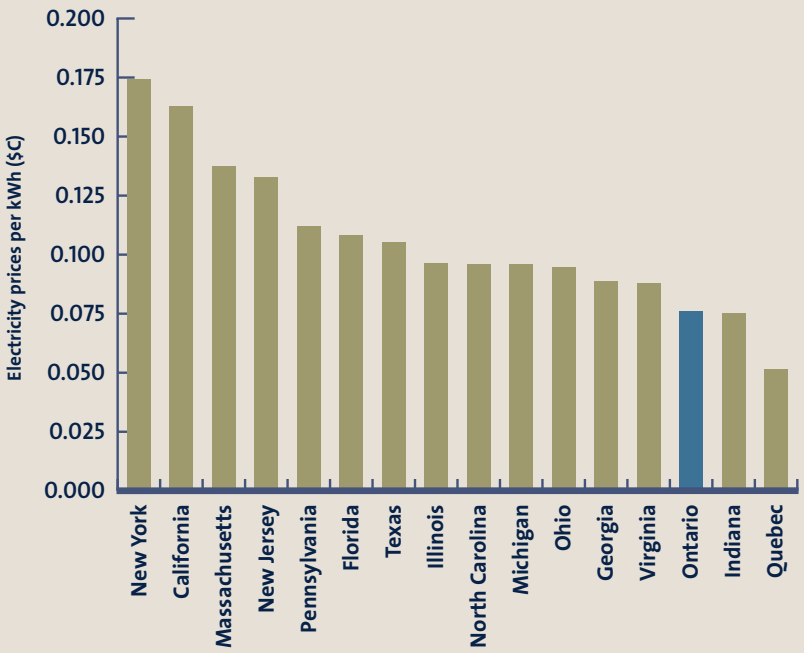
Our regression analysis (outlined in **Figures 9** and **10**) shows that there is a strong positive correlation between electricity prices, electricity productivity and living standards (GDP per capita). Four of the five richest jurisdictions in the 16 member peer group (Massachusetts, New York, New Jersey and California) have the highest electricity prices and the highest electricity productivity ratios. Similarly three of the four poorest jurisdictions in the peer group (Ontario, Indiana and Quebec) have the lowest electricity prices and low electricity productivity ratios. Clearly, Ontario can raise its electricity productivity and its standard of living by raising its electricity prices up to their full cost.

Figure 8: The prosperity gap: Ontario trails in GDP per capita



State/ Province	Average Price per kWh (C$ 2003)
New York	$0.1743
California	$0.1628
Massachusetts	$0.1372
New Jersey	$0.1326
Pennsylvania	$0.1118
Florida	$0.1082
Texas	$0.1051
Illinois	$0.0964
North Carolina	$0.0961
Michigan	$0.0960
Ohio	$0.0946
Georgia	$0.0886
Virginia	$0.0879
Ontario	$0.0761
Indiana	$0.0753
Quebec	$0.0513

Table 1 Electricity Prices for 2003



State/Province	GDP per kWh (C$ 2003)
New York	$7.65
California	$9.79
Massachusetts	$7.75
New Jersey	$8.75
Pennsylvania	$2.70
Florida	$3.38
Texas	$2.72
Illinois	$3.25
North Carolina	$3.04
Michigan	$4.06
Ohio	$3.42
Georgia	$3.20
Virginia	$5.04
Ontario	$3.29
Indiana	$2.19
Quebec	$1.52

Table 2 Electricity Productivity for 2003

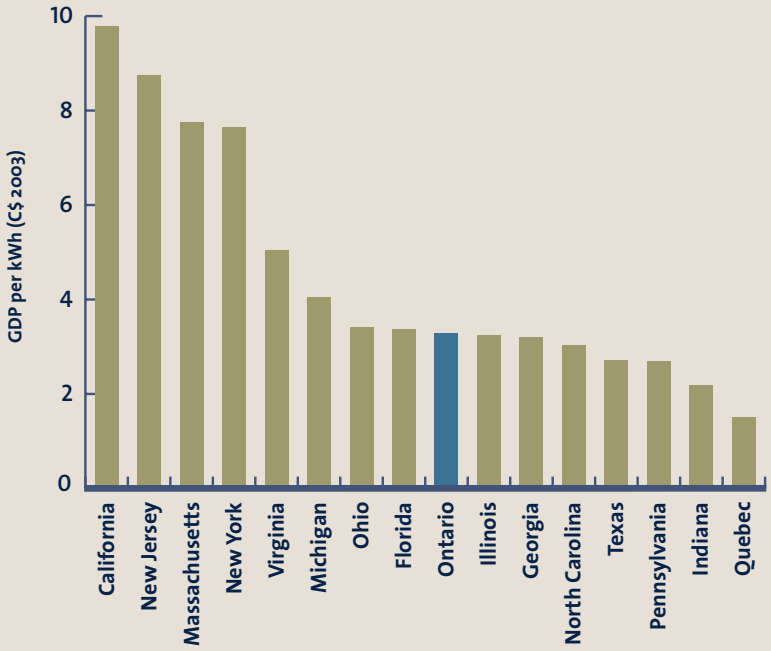


Figure 9: Relationship Between Electricity Prices and Electricity Productivity

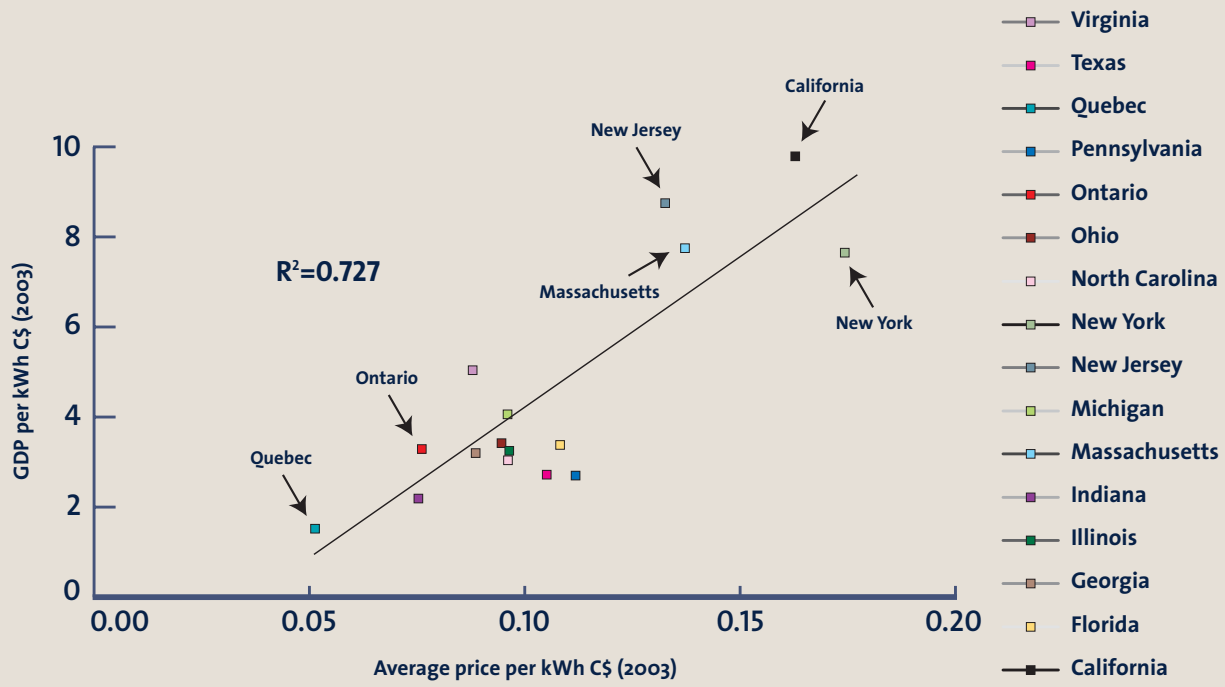
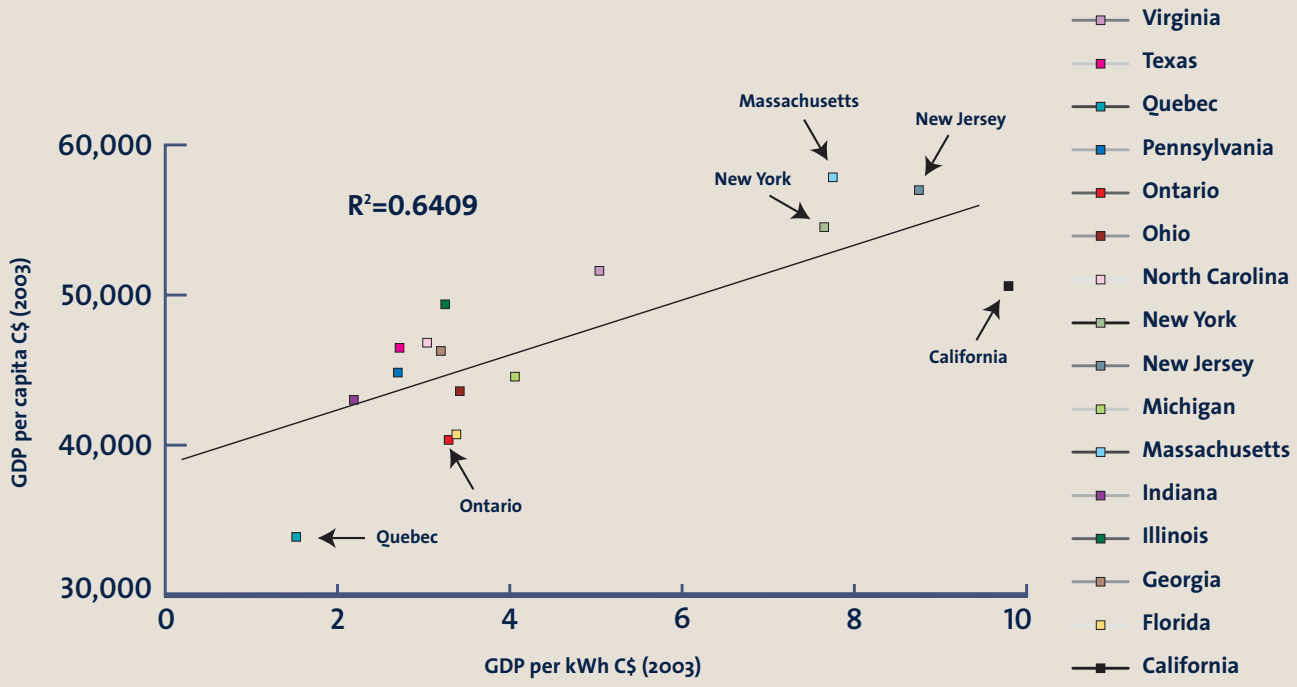


Figure 10: Relationship Between Electricity Productivity and GDP per capita



3.1.1 What has been done and what needs to be done to increase Ontario's electricity productivity

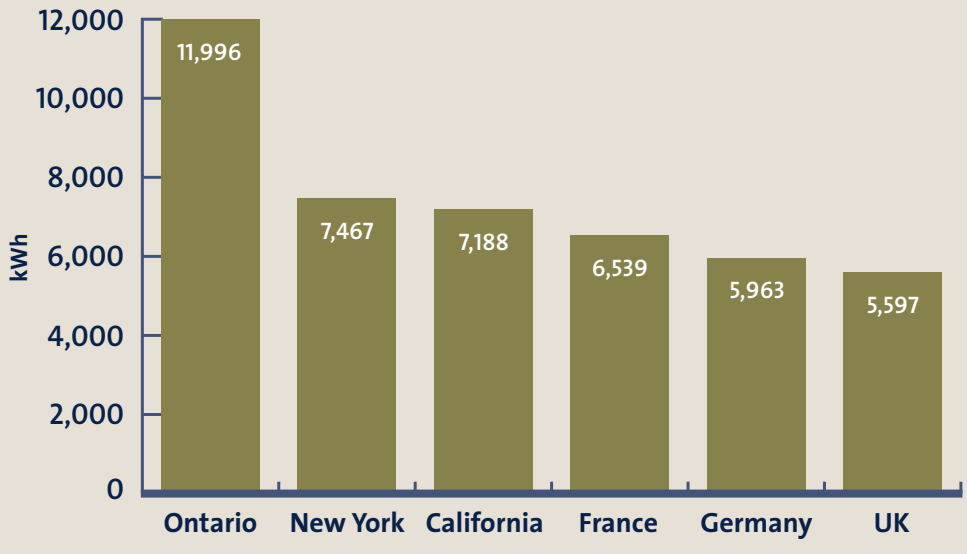
The Task Force on Competitiveness, Productivity and Economic Progress has identified a number of areas that Ontario needs to address to close the productivity gap with its peer group. These include total capital investment as a percentage of GDP (where Ontario lags behind its peer group[89]) innovation, specialized support (e.g., cooperation between industries and universities), giving our cities more financial tools to address their growing needs and tilting government's investment focus away from current consumption and toward longer-term investments.

All of these areas can be addressed, in part, by improving our electricity productivity. For example, by focusing more on the lifecycle energy costs of capital investments, we will make more energy-efficient choices that have greater long-term value. Similarly, by embracing efficiency as a societal goal, we can drive innovation and the development of new technology and systems in Ontario. And by creating a more distributed and flexible electricity system, we create new financial and development opportunities for our larger urban centres.

The Task Force notes that closing the prosperity gap with North America's leaders will require appropriate attitudes, investments, motivations and structures. All of these areas are also key to developing an intelligent energy policy that provides energy users with the proper motivations and structures to maximize the productivity of our energy investments.

As things stand, Ontario's electricity system is at a major crossroads. The government is committed to phasing-out coal power by early 2009 and all of our nuclear generating units will have reached the end of their operational lifespans by 2020 at the latest. Much of the rest of our power infrastructure also requires upgrading and renewal. The question facing Ontario is whether to stay with a highly centralized generation system that will almost certainly be built around a few large nuclear generating stations (producing power that is subsidized either by ratepayers or taxpayers) or move to a system that encourages and rewards electricity productivity and therefore helps Ontario close the prosperity gap with the leading U.S. states.

Figure 11:
Per capita electricity consumption in 2000



3.1.2 The Transition Years: 1999 to 2005

Between 1999 and 2005 the Government of Ontario has taken a number of important actions to increase the financial and ecological sustainability of Ontario's electricity system.

- In 1999 Ontario Hydro was broken-up into five separate companies. Ontario Hydro's generation assets were transferred to OPG and its transmission and distribution assets were transferred to Hydro One. Both of these companies are for-profit corporations and are required to make income tax payments to the Government of Ontario according to the standard federal and provincial corporate income laws.
- Most of Ontario's more than 80 municipal electric utilities now have commercial, for-profit mandates (returning these profits in many cases to their municipal or public owners).
- In 2002 the Government of Ontario committed to phasing-out OPG's coal plants by 2015. Premier McGuinty has advanced the complete phase-out date to early 2009.
- The promotion of energy conservation has been made a profitable course of action for Hydro One and Ontario's more than 80 municipal electric utilities.
- The Government of Ontario has used a competitive bidding process to obtain new renewable and high-efficiency natural gas-fired electricity supplies from independent power producers.
- The Government of Ontario is seeking to enter into long-term hydro-electricity import contracts with Manitoba, Quebec and Labrador.
- A new provincial agency, the Ontario Power Authority (OPA), has been created to ensure that Ontario has the optimal mix of electricity supply and conservation resources. Unlike the former Ontario Hydro, the OPA will not build, own or operate electricity generation facilities and therefore should not have an institutional bias in favour of large mono-generation power plants.

In May 2005, Ontario's Energy Minister, Dwight Duncan, asked the OPA to develop an Integrated Power System Plan to meet Ontario's electricity needs in 2015, 2020 and 2025.[38]

The Ontario Clean Air Alliance believes Ontario can meet its future energy needs most efficiently and with the greatest societal benefit by adopting the goal of moving toward a 100% renewable energy supply as soon as practically possible. Such a goal is especially well-suited as a driver for improved electricity productivity for two reasons:

- it naturally addresses many of the externalized environmental and health costs that are not properly reflected in current fossil and nuclear generation costs by reducing or eliminating these impacts.
- much greater energy efficiency is a mandatory precursor to a successful transition to a renewable power base, which in turn will help to restore a virtuous cycle to our energy system (the more efficient we are, the more we can rely on low-impact renewable power and the more our electricity productivity increases).

What follows is the outline of a strategy to move Ontario towards a 100% renewable electricity system, a system which will also help us close the productivity gap and increase our security of supply.

3.2 Creating the right motivations and structures

We have seen from our earlier discussion the importance of proper pricing to encourage high levels of electricity productivity. In Ontario, however, we still have an electricity price structure that is distorted by a number of hidden subsidies for nuclear power. We must eliminate these hidden subsidies and move to a real-cost structure in electricity pricing as a first step in developing a new electricity strategy for the three following key reasons:

a) To increase our electricity productivity and raise our standard of living;
b) To increase our security of supply; and
c) To ensure inter-generational equity.

The five key actions that must be taken to reduce nuclear subsidies and raise the market price of electricity to its full cost are:

a) requiring OPG to earn a competitive rate of return on its capital;

b) raising OPG's water rental rates to their full market value;
c) eliminating the Ontario Electricity Financial Corporation's unfunded liability;
d) eliminating any Government of Ontario responsibility for nuclear decommissioning and long-term storage of nuclear wastes liabilities for all nuclear plant restarts, retrofits or new builds; and
e) eliminating the *Nuclear Liability Act's* $75 million cap on nuclear operators' liabilities in the event of a nuclear accident for all nuclear plant restarts, retrofits or new builds.

These measures can also be used to provide the Ontario Government with increased revenues that it can use to finance public spending (e.g., schools, universities, health-care), deficit reduction or other public-interest measures.

3.2.1 A Competitive Return on Capital

A competitive rate of return on equity for OPG would be at least 15% after taxes.[39]

OPG's average return on equity was 2.35% between 1999 and 2004 inclusive.[40] To earn a competitive return on equity (15%), OPG's after-tax return on equity must rise by 12.65 percentage points relative to this six year average. Assuming a 35% marginal income tax rate, its pre-tax return on equity must rise by 19.46 percentage points. Given OPG's 2004 shareholder equity of $5.021 billion, this means that OPG's revenues would have to rise by $977 million. (By comparison, in 2003 Hydro Quebec's return on equity was 13.2% and its dividend payments to the Province of Quebec were $965 million.)[41] A $977 million rise in OPG's revenue requirement would raise Ontario's electricity rates by approximately 7.2%.[42]

3.2.2 Pricing Water at Its Market Value

OPG uses provincially owned water resources to produce hydro-electricity. OPG produces approximately 22% of Ontario's electricity from its heritage waterpower facilities at a very low cost – less than 1 cent per kWh.[90]

The market value of these water resources equals the difference between the competitive price of electricity generation, 5.8 cents per kWh in 2003, and OPG's cost of producing hydro-electricity times its total annual hydro-electricity generation. In 2003, the annual market value of these water resources was approximately $1.6 billion,[43] however, OPG's actual waterpower payments to the Government of Ontario were only $430 million.[44]

Therefore, below-market value water rental rates essentially provided an approximately $1.2 billion subsidy to OPG's above-average cost nuclear generation. Eliminating this subsidy would raise electricity rates by approximately 9%.

3.2.3 The Ontario Electricity Financial Corporation's Unfunded Liability

In 1999, Ontario Hydro was broken up into five companies. All of its generation assets were transferred to OPG. In order to keep OPG solvent, $19.433 billion of Ontario Hydro's debt or unfunded liabilities associated with electricity generation facilities was transferred to the Ontario Electricity Financial Corporation (an agency of the Government of Ontario) as "stranded debt" or "unfunded liability." The majority of this "stranded debt," $15.147 billion, was nuclear-related.[45]

According to the Ontario Electricity Financial Corporation (OEFC), the government had "a long-term plan in place to retire OEFC's liabilities." The plan consisted of a nuclear debt retirement charge (0.7 cents per kWh) and using all of the province's corporate income, property and capital tax revenues from OPG, Hydro One and Ontario's more than 80 municipal electric utilities to pay off the stranded debts of the former Ontario Hydro.[46] (For the year ended March 31, 2004 the OEFC received $1 billion in debt retirement charge revenue paid by ratepayers and $627 million in electricity sector tax revenues.)

There were two problems with this plan. First, as **Figure 12** reveals, the OEFC's unfunded liabilities have grown over time due to the poor performance of OPG's nuclear reactors (and therefore lower or negative returns from OPG) and the electricity rate cap.

Second, it is more economically rational and fair to use tax revenues from the electricity sector to pay

for public services (e.g., schools and hospitals), while ensuring that debt repayment is undertaken directly by ratepayers. This ensures that we have real-cost pricing for electricity and, therefore, appropriate price signals for electricity consumers, not hidden subsidies in the form of foregone tax revenues to governments.

The OEFC's unfunded liability should be paid off by Ontario's electricity consumers, not taxpayers, over a reasonably short time frame in order to promote inter-generational equity. (In other words, the current generation of electricity consumers should not be allowed to shift the costs of their electricity consumption and generation onto future generations.) For example, starting in 2004 the unfunded liability could have been paid off over 10 years by raising electricity rates by approximately $1.9 billion per year[48] or approximately 14.1%.

3.2.4 Long-Term Storage of Radioactive Nuclear Wastes

According to the Nuclear Waste Management Organization, the cost for the long-term storage of Canada's radioactive used nuclear fuel is conservatively estimated to be about $24 billion.[49]

The responsibility for funding the long-term storage of Ontario's used nuclear fuel is described in the Ontario Nuclear Funds Agreement between OPG and the Government of Ontario. The limits to OPG's financial exposure under the Ontario Nuclear Funds Agreement with respect to the long-term storage and disposal of used fuel are as follows (all amounts are present value as at January 1, 1999): (i) OPG will bear all costs up to $4.6 billion; (ii) OPG and the Province will share, on an equal basis, costs incurred between $4.6 billion and $6.6 billion; (iii) OPG will be responsible for 10% of the costs incurred between $6.6 and $10 billion and the Province will be responsible for the remaining 90%; (iv) the Province will be responsible for any costs above $10 billion.[50]

In 2001, OPG leased its Bruce A and Bruce B nuclear generating stations to privately owned Bruce Power. The lease has an initial term of 18 years and includes options to extend the lease for up to another 25 years. However, OPG (in conjunction with the provincial government through the Nuclear Funds Agreement) continues to assume long-term responsibility

Figure 12:
The Ontario Electricity Financial Corporation's Unfunded Liabilities

for the used fuel and low- and intermediate-level radioactive waste generated by Bruce Power, as well as responsibility for the eventual decommissioning of the Bruce nuclear reactors.[51]

It is not appropriate for Ontario's taxpayers to subsidize an electric power company's costs of storing its long-term radioactive nuclear wastes. Therefore all nuclear re-start, retrofit or new build projects should be required to assume complete responsibility for the long-term storage of their wastes.

3.2.5 Nuclear Decommissioning

According to the Ontario Nuclear Funds Agreement, the Government of Ontario will provide financial guarantees to the Canadian Nuclear Safety Commission for OPG's nuclear reactor decommissioning liabilities in return for an annual guarantee fee equal to 0.5% of the amount guaranteed.[88]

It is not appropriate for Ontario taxpayers to provide financial guarantees with respect to the liabilities of electric power companies. The Government of Ontario should not provide financial guarantees to the Canadian Nuclear Safety Commission with respect to the decommissioning liabilities of future nuclear power plants.

3.2.6 The Nuclear Liability Act

The *Nuclear Liability Act* limits the liability of OPG and/or Bruce Power in the event of a nuclear accident to $75 million. All liability in excess of $75 million is borne by Canadian taxpayers.

The *Nuclear Liability Act's* risk-subsidy for nuclear power promotes investments in nuclear power at the expense of lower-cost and lower-risk options (energy conservation and efficiency, new renewables and high-efficiency natural gas-fired power plants) to meet our electricity needs.

All nuclear re-start, retrofit and new build projects should be required to assume full responsibility for all of their liabilities.

3.3 Moving to real cost electricity rates

3.3.1 Eliminating subsidies while mitigating impacts

Eliminating just some of the current subsidies to nuclear power (OPG below-market return on equity, below-market value waterpower charges, OEFC's unfunded liability) would raise Ontario's electricity rates by approximately 30%. We recommend that the Minister of Energy direct the OPA to develop a strategy to eliminate the subsidies for nuclear power and to raise the price of electricity up to its full cost.

Electricity consumers can mitigate the bill impacts of higher electricity rates by increasing their electricity efficiency and switching to lower cost fuels for space and water heating (e.g., natural gas, propane). For example, if Ontario's electricity consumers could achieve New York State's level of electricity efficiency, our per capita electricity consumption would fall by 38%.

Currently, for residential and other small volume consumers, the price of electricity does not vary by time of day. This flat-rate system fails to take into account the higher cost of supplying electricity during peak demand periods (e.g., a hot summer day or a cold winter day). For residential consumers, the cost of electricity (not including transmission, distribution and debt retirement charges) is capped at 5 to 5.8 cents per kWh despite the fact that the cost of importing coal-fired electricity from the U.S. can exceed 60 cents per kWh on a smog alert day. This means that, on peak days the cost of electricity can be more than 12 times greater than its price.[91]

Therefore, it is essential that the move towards a 30% increase in average electricity rates be combined with a move toward time-of-day sensitive pricing that will encourage consumers to shift demand to off-peak periods (see section 4.2.1 for more on the benefits of such incentives). The Government of Ontario's smart meter initiative will permit Ontario's electric utilities to implement time-of-day rates for Ontario's residential and small-volume consumers.

3.3.2 Protecting Low-income Electricity Consumers

Ontario's electricity rates must rise on average by approximately 30% to increase our electricity productivity, raise our standard of living and protect public health and the environment. However, these gains must not be achieved at the expense of low-income Ontarians.

In 2003, 14.3% of Ontario residents (or 1,733,000 persons) were living at or below the "pre-tax, post-transfer low income cut offs" (LICOs)[92] – a widely accepted measure of poverty.

Table 3 shows the average electricity bills of Ontario households by quintiles. The average household's electricity bill was $936 per year in 2003; whereas for the 20% of Ontario households with the lowest incomes (the lowest quintile), the average annual electricity bill was almost 50% lower at $480 per year.

The OCAA is proposing the following three-pronged strategy to ensure that rising electricity rates will not lead to a net increase in the energy bills of Ontario's low-income households (homeowners and tenants).

1. Ontario's municipal electric utilities, the Ontario Power Authority and Hydro One should develop aggressive energy conservation programs to increase the energy efficiency and lower the electricity bills of their residential consumers.
2. Ontario's municipal electric utilities, the Ontario Power Authority, Hydro One, Enbridge Gas Distribution and Union Gas should implement programs to finance the conversion of homes from electric baseboard heaters to natural gas, propane or electric ground-source heat pumps for space heating. The upfront capital costs of conversion (as well as for conservation measures such as appliance replacement) should be financed by the utilities and recovered by monthly premiums on the participants' utility bills that will be offset by their savings on total energy costs. This will ensure that low-income residents are able to switch to a lower cost option for space heating, etc., while enjoying an immediate net reduction in their utility bills.
3. The Government of Ontario should use a portion of its increased electricity-related tax and water revenues and dividends to finance an electricity rebate for all residential electricity ratepayers. The annual rebate for all residential ratepayers should equal the average bill impact for Ontario households in the lowest income quintile. Therefore, if electricity rates are raised by 30%, the electricity rebate for each residential electricity ratepayer would be $144 per year ($480 per year x 30%), an amount that can be credited to consumers on their electricity bill. All residential electricity ratepayers should receive the same rebate (e.g., $144 per year) irrespective of their actual consumption. This will permit the cost/benefit of consuming/saving an additional kWh to equal its full (marginal) cost.

Table 3: Electricity Spending by Ontario Households in 2003

Ontario 2003	All classes	Lowest quintile	Second quintile	Third quintile	Fourth quintile	Highest quintile
	Median per household	Median per household	Median per household	Median per household	Median per household	Median per household
Electricity (spending $)	**$936**	**$480**	**$804**	**$900**	**$1,140**	**$1,368**

4.0 A new electricity strategy for Ontario: 2005–2020

4.1 Key components and goals

Ontario needs to take a multi-faceted and integrated approach to closing the electricity productivity gap – we need to fundamentally shift our thinking about energy to a mindset of maximizing value instead of subsidizing use.

In the same vein, we must fundamentally change our thinking about electricity to focus on the most efficient and productive way of delivering end products or services (a cold beer, a hot shower) instead of simply focusing on how to produce more kilowatt hours.

The Ontario Clean Air Alliance believes that the best options to move towards a financially and ecologically sustainable electricity system (in order of priority) are:

a) energy conservation and efficiency;
b) new renewables;
c) natural gas-fired combined heat and power plants; and
d) natural gas-fired combined-cycle power plants.

4.2 Energy Conservation and Efficiency

Energy conservation and efficiency are the best options for moving towards a 100% renewable electricity system for the following reasons:

1. In order to meet all of our electricity needs from renewable sources we must reduce our aggregate level of electricity consumption – we simply cannot meet 100% of our electricity needs from renewable sources if our total level of electricity consumption continues to increase.
2. Energy conservation and efficiency investments can reduce the bills of all electricity consumers, even with rising energy rates.
3. Energy efficiency investments increase our productivity and make our industries more competitive in international markets.

As we have already noted, Ontario's per capita electricity consumption is amongst the highest in the world. However, as a consequence, we have a tremendous opportunity to simultaneously reduce our level of electricity consumption and increase our standard of living. For example, if Ontario could achieve the State of New York's level of electricity efficiency by 2020, our total electricity consumption would be 27% less than it was in 2005 despite a projected 18% increase in our population.

The State of California has had aggressive energy efficiency and conservation programs in place (to a greater or lesser degree) since the early 1970s. The result is that California's per capita electricity use has

remained essentially static since 1975, while per capita electricity use for the United States as a whole has grown by close to 50%.[94] California has also found that energy efficiency and conservation measures are by far the cheapest way to meet incremental power needs (see **Figure 13**).

Even in the absence of coordinated efficiency programs and strong price signals, our annual electricity growth rates have been on a downward trend over the last three decades. As **Figure 14** indicates, our annual electricity growth rate has fallen from almost 8% during the 1960s to 0.5% per year between 1990 and 2003. Some of the reasons for this trend include:

- Better technology, construction techniques and materials, leading to an estimated "natural" efficiency gain for the economy as a whole of around 1% a year between 1990 and 2003;[95]
- The continued economic shift from heavy manufacturing to a knowledge-based economy centered around service industries. These industries are more concerned with the quality and reliability of power than quantity.

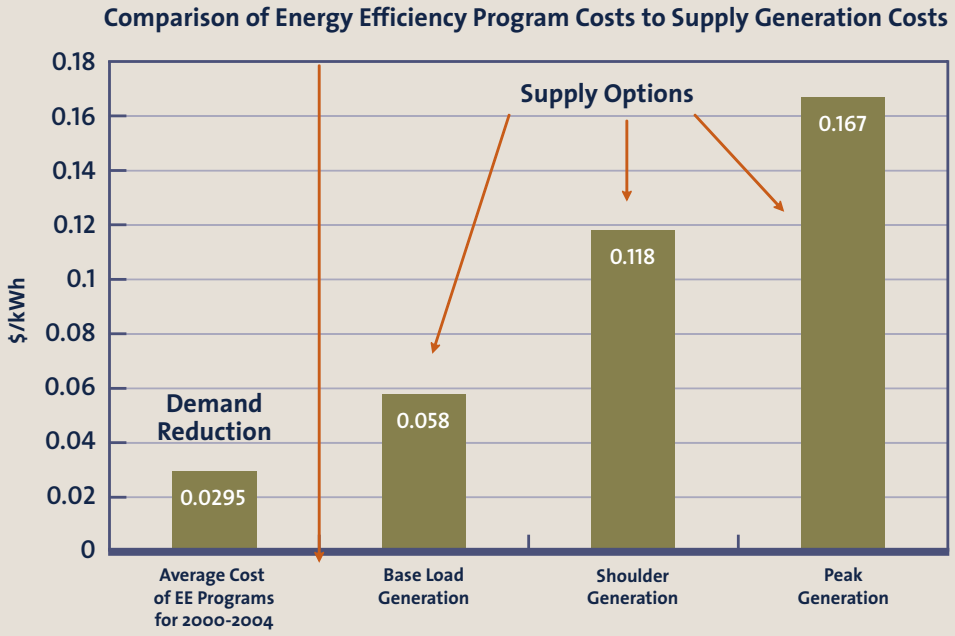
A simple extrapolation of the business-as-usual trend leads to the conclusion that we will reach a negative electricity growth rate in the near future. This means that the question we are really facing is not how can we meet rising demand for below-cost power, but how much more can we reduce aggregate consumption and increase productivity through better price signals and policies promoting efficiency.

4.2.1 Demand Response

Paying customers to reduce their demand during periods of peak system demand can provide significant benefits to Ontario, including:

1. Reduced need for high-cost coal-fired electricity imports from the United States. In 2002, on peak days, Ontario paid up to 60 cents per kWh for U.S. coal-fired electricity imports.[52] Instead of sending our money to the U.S. to pay for coal-fired electricity imports we can keep our money in Ontario by paying industrial, commercial and residential consumers to shift some of their electricity consumption from peak to off-peak periods.
2. Reduced need for new electricity generation and transmission infrastructure.

Figure 13: California's costs of electricity conservation and supply



3. A dramatic reduction in the spot price of electricity. For example, according to National Economic Research Associates, a 2–5% reduction in demand on peak days could reduce spot prices by 50% or more.[53]
4. Reduced risk of blackouts and brownouts.
5. Reduced price volatility as spikes in demand (and therefore price) are moderated by demand-response measures.

The Independent System Operator New England (ISO New England), the New York Independent System Operator and the Pennsylvania-New Jersey-Maryland Interconnection have all established demand-response programs that pay their customers to reduce demand during periods of system peak demand and/or supply shortages. For example, the ISO New England pays its customers up to $1 per kWh to reduce demand during peak periods.[54] According to ISO New England:

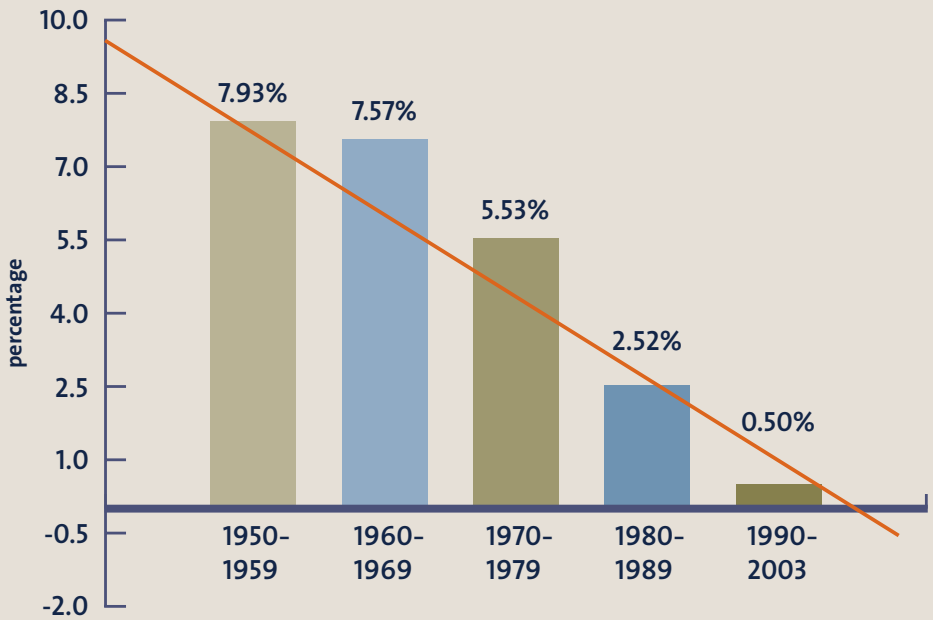
> *"Demand response participants provide an important resource for New England. They help ensure the power grid's reliability, reduce wholesale price volatility that drives up the cost of power for everyone, and reduce air pollution by enabling older, less efficient power plants to run less often."* [55]

Ontario's Independent Electricity System Operator (IESO) has recently implemented a weak and ineffectual demand-response program. At a maximum, the IESO's program will only purchase an aggregate total of 100 MW of demand reductions from electricity consumers, despite the fact that the province's peak-day demand in 2005 has exceeded 26,000 MW. Therefore, at best, the IESO's program will reduce peak-day demand by less than 4/10ths of 1%.

The OPA should pay large industrial and commercial customers, electric utilities (e.g., Toronto Hydro) and market aggregators (e.g., Ozz Corporation) the same price per kilowatt-hour (kWh) for demand reductions (a negawatt) as it pays generators for electricity supply during peak demand periods. Furthermore, the OPA should purchase all available demand reductions whenever Ontario's electricity demand is 20,000 MW or greater and/or the price of electricity is 7.0 cents per kWh or greater.

If the OPA pays the electric utilities to reduce their consumption during peak periods, the utilities can

Figure 14:
Ontario's declining annual electricity (kWh) growth rates



implement programs to occasionally cycle off selected major appliances of their residential and commercial customers for short time periods in exchange for a monthly discount on their electricity bills. For example, Florida Power and Light's Residential On Call program pays customers for permission to cycle off their air-conditioners, water heaters and pool pumps for short periods of time.[56]

4.2.2 Electric Utility Conservation Programs

The promotion of energy conservation is now a profitable course of action for Hydro One and Ontario's more than 80 municipal electric utilities. These utilities are now entitled to retain a small percentage of the cost savings generated for their customers by their energy conservation programs. For example, if Toronto Hydro's energy conservation programs reduce its customers' bills by $100 million, Toronto Hydro will get a $5 million profit bonus. These higher profits can be passed on to the utility's shareholders (provincial and municipal governments) to pay for public services (e.g., schools, hospitals, parks and public transit).

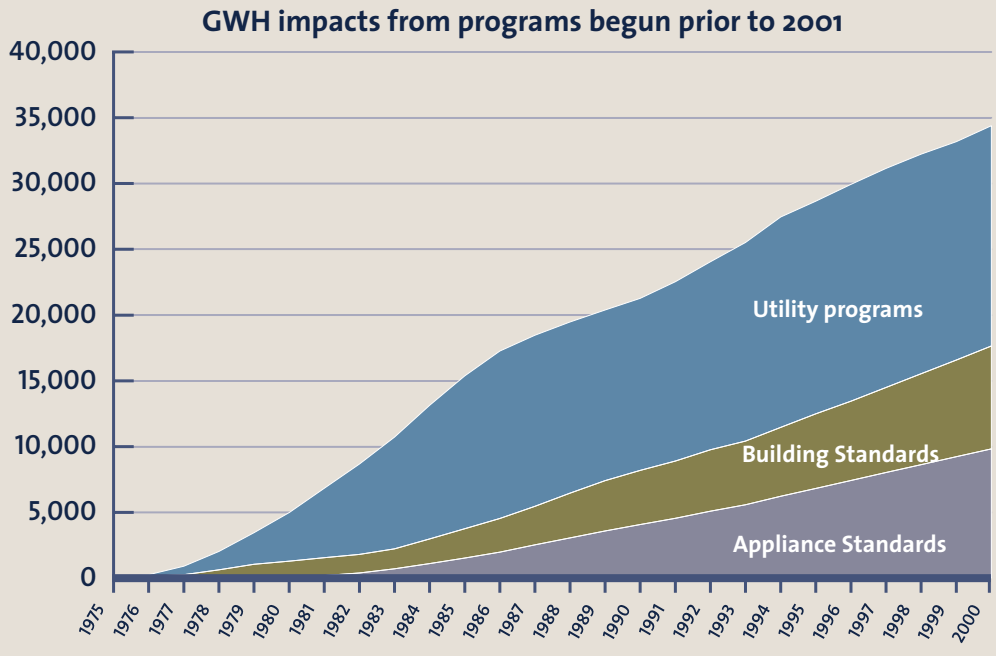
The OPA should establish minimum energy conservation targets for Ontario's electric utilities and the OPA and the Ontario Energy Board should encourage the electric utilities to develop cost-effective conservation programs that exceed the minimum target goals.

4.2.3 Energy Efficiency Standards

The Government of Ontario should establish stricter minimum energy efficiency standards for new buildings, appliances and electric motors. The up-front costs of such measures will be recovered through decreased lifecycle energy costs and greater economic efficiency. In many cases, additional up-front costs may be minimized or avoided through good planning and design.

In California, improved standards for buildings and appliances have accounted for half of the total energy savings delivered by its energy efficiency programs (see **Figure 15**). Improved standards are a good way of allowing companies to move toward greater efficiency on a level-playing-field basis. From another

Figure 15:
Electricity savings produced by California's conservation programs and standards



perspective, they disallow the unfair advantage of energy-inefficient choices that achieve lower costs by externalizing environmental and health costs and by pushing such costs onto future generations.

4.2.4 Chief Conservation Officer

The Ontario Power Authority's Chief Conservation Officer (CCO) should be a public advocate for aggressive energy conservation goals for Ontario.

The CCO should also publicly review the actions of the Ontario Ministry of Energy, the Ontario Energy Board and Ontario's electric utilities with respect to the promotion of energy conservation and efficiency and develop a strategy for the province to reach or exceed New York State's level of electricity productivity – which is currently 2.3 times Ontario's level – by 2020.

Finally, in addition to implementing an aggressive demand response program, the Ontario Power Authority should, if necessary, implement its own energy conservation programs to supplement those of Ontario's electric utilities, particularly to deal with sectors that are not being well-served by utility programs (focusing on specific industry sectors, for example).

4.3 More Renewable Power

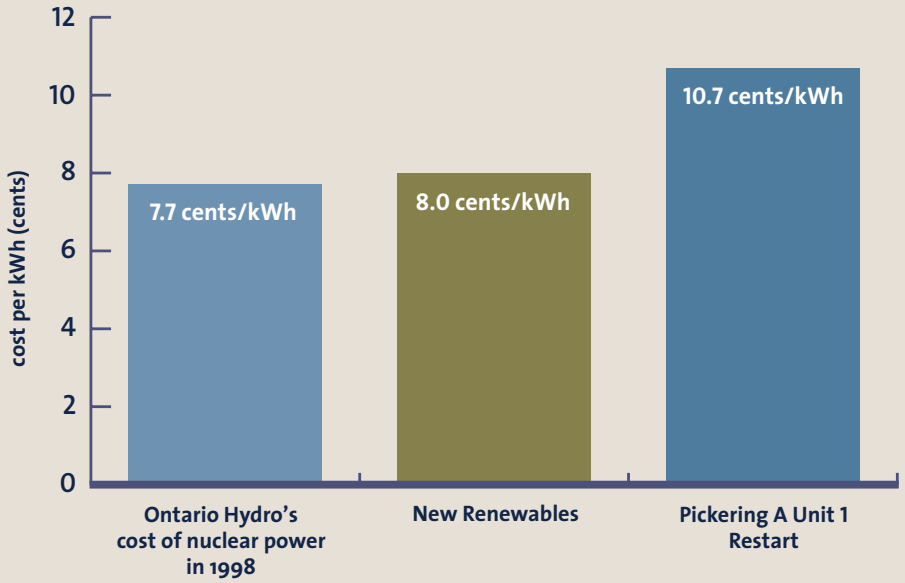
In November 2004, Energy Minister Duncan announced that as a result of its competitive bidding process for new renewable electricity supplies, the government has signed contracts with power producers for 10 new green power projects. The projects include:

- Umbata Falls Hydroelectric Project, a partnership of the Pic River First Nation and Innergex III Income Fund;
- Trail Road Landfill Gas Generating Station, Hydro Ottawa;
- Eastview Landfill Gas Energy Project, Guelph Hydro; and
- Five wind farms to be operated by Erie Shores Wind Farm, Superior Wind Energy, Canadian Hydro Developers and EPCOR.[57]

As **Figure 16** reveals, the cost of these new green power supplies, 8 cents per kWh, is competitive with subsidized nuclear power.

In April 2005, Energy Minister Duncan announced that the Government will conduct competitive bidding processes in 2005 to purchase up to an additional 1,200 MW of green power.[59]

Figure 16:
Cost Comparison: New Renewables versus Nuclear Power



The Ontario Power Authority (OPA) should have annual competitive bidding processes for green power. If the OPA were to purchase an additional 1,200 MW of green power per year for 10 years, by 2015 its new green power supplies would be equivalent to 24% of Ontario's total electricity generation in 2003.[60]

A competitive bidding process is the best option to obtain renewable power from large investor-owned power companies. However, for individuals, farmers and local community organizations interested in developing small renewable power projects, participating in the OPA's competitive bidding process is simply not feasible (too costly and complex given their likely returns).

Therefore to facilitate the development of small-scale (10 MW or less) projects, the OPA should establish standard offer prices for these projects and should enter into electricity supply contracts with all small-scale renewable projects that are willing to accept the standard offer price. Prices determined by the competitive bidding processes should be used as benchmarks to establish the standard offer price, which could be adjusted to recognize the added benefits of small, geographically diverse renewable supplies.

4.3.1 Waterpower imports from Manitoba

Ontario also has the potential to import very significant quantities of clean waterpower from Manitoba. As a first step, Ontario could contract for 1,500 MW of Manitoba waterpower, which would provide the province with 8.8 to 11 billion kWh of electricity per year at a cost of 6.7 to 7.8 cents per kWh.[61] These power imports would be equivalent to 5.8% to 7.3% of Ontario's electricity generation in 2003.[62]

In the longer-term, Ontario could import more than 5,000 MW of clean power from Manitoba.[63] Five thousand megawatts is equivalent to 46% of Ontario's existing installed nuclear generation capacity.[64]

All electricity imports should be combined with the full development of aggressive conservation and efficiency measures within Ontario in order to maximize benefits and minimize environmental impacts.

4.3.2 Waterpower imports from Labrador

Ontario also has the potential to import waterpower from Labrador. In March 2005, Ontario submitted a joint proposal with Hydro Quebec and SNC-Lavalin to the Government of Newfoundland and Labrador to support the development of 2,824 MW of waterpower on the lower Churchill River in Labrador. The joint proposal would assist with the development of the 2,000 MW Gull Island site and an additional 824 MW at Muskrat Falls. Under the proposal, Ontario would receive 670 MW from Gull Island and 275 MW from Muskrat Falls for a total of 945 MW – equivalent to 8.7% of Ontario's existing installed nuclear generation capacity.

As part of the agreement, Hydro-Quebec would also advance construction of a 1,250 MW interconnection with Ontario, to be in service by 2009. In addition, Hydro Quebec has indicated a willingness to provide Ontario with 675 MW of power by 2011, which is representative of Ontario's expected share of the Gull Island's output.[65]

4.3.3 Waterpower imports from Quebec

Given Quebec's position at the bottom of the electricity productivity scale for its peer group (see **Table 2**), Hydro Quebec has the potential to dramatically increase its profits by investing in domestic energy conservation measures to make electricity available from its existing waterpower stations for export to Ontario and the U.S. Northeast.[96] This would be one of the lowest-cost options to meet Ontario's electricity supply needs and could also contribute to strengthening national unity.

4.4 Natural Gas- and Biomass-fired Combined Heat and Power

Virtually all of Ontario's buildings and factories use natural gas for heating. However, it is much more productive to use natural gas (or biomass) to simultaneously produce both heat and power (electricity). The energy efficiency of a combined heat and power

plant can exceed 80%; whereas the energy efficiencies of nuclear reactors, coal-fired power plants and natural gas combined-cycle power plants are approximately 30%, 34% and up to 58% respectively.[66]

According to a report prepared for the Ontario Ministry of Energy, Ontario's total combined heat and power potential in 2020 will be 16,514 MW.[67] This is equivalent to 95% of Ontario's existing installed coal and nuclear generation capacity.[68]

Many U.S. jurisdictions are moving quickly to embrace distributed combined heat and power projects through coordinated initiatives that facilitate technology transfer, promote the development of standardized off-the-shelf equipment, ensure equal access to the grid for self-generators and raise awareness of the potential for everyone from farmers and municipalities to industries to develop combined heat and power projects. (See the Northeast Combined Heat and Power Initiative, www.northeastchp.org, for example.)

Unfortunately, combined heat and power projects face very significant market barriers that are thwarting its development in Ontario. As a result, in 2005, when the Government of Ontario used a competitive bidding process to contract for 2,225 MW of new natural gas fired generation capacity, only 90 MW or 4% of this new capacity was combined heat and power despite the fact that it is the lowest-cost option for producing electricity from natural gas.[69]

There are several market barriers to combined heat and power projects beginning with the fact that such projects require a host facility (e.g., a recreation centre, shopping centre, wastewater treatment plant, office building or factory). However, such host facilities are typically reluctant to become electricity generators or enter into a partnership agreement with a power producer to produce electricity for a number of reasons:

- Electricity generation is not part of their core business.
- Ontario's subsidized prices for grid-supplied electricity reduces a host facility's incentive to generate its own power.
- Host facilities that meet some or all of their electricity requirements from combined heat and power are required to pay the province 0.7 cents for each kWh that they self-generate in order to help pay-off Ontario's $20 billion unfunded electricity liability.
- The timing of the Government's competitive bidding processes is unlikely to be consistent with investment planning processes of potential combined heat and power host facilities.
- For small-scale combined heat and power projects, the costs of participating in the Government's competitive bidding processes for new supply are simply too great.

Therefore to facilitate the development of combined heat and power projects, the OPA should establish a standard offer price for combined heat and power projects and enter into electricity supply contracts with those that are willing to accept the standard offer price.

In addition, the Minister of Finance should exempt new combined heat and power projects from the 0.7 cent per kWh nuclear debt retirement charge.

Impact on North American Natural Gas Demand

if Ontario were to replace all of its coal and nuclear plants exclusively with high-efficiency combined-cycle natural gas-fired power plants by 2020, North American natural gas consumption would rise by 2.5%.[97]

However, if the coal and nuclear power plants are replaced by natural gas combined heat and power (cogeneration) plants, the increase in natural gas consumption would be reduced by 30% or more.[98] As a consequence, under this scenario, the increase in North American gas consumption as a result of replacing all of our coal and nuclear generation with natural gas would be only 1.75%.

If, however, Ontario's 17,316 MW of coal and nuclear capacity are phased-out using a combination of one-third energy conservation, one-third renewables and one-third natural gas-fired combined heat and power, North American natural gas consumption would rise by only 6/10ths of 1%.

See Appendix C for more details.

Prices determined by the competitive bidding processes for natural gas-fired combined-cycle power plants should be used as benchmarks to help set the standard offer price. The price should also vary inversely with the project's size and directly with its overall efficiency.

4.5 Natural Gas-Fired Combined-Cycle Power Plants

Natural gas-fired combined-cycle power plants can achieve energy efficiencies of up to 58%.[70] As a consequence, since it will take several years for Ontario to fully develop its conservation, renewable energy and combined heat and power potential, natural gas-fired combined-cycle power plants have an important role to play as a bridging technology.

As a result of a competitive bidding process in 2005, the Government of Ontario agreed to enter into 20-year supply contracts with four natural gas-fired combined-cycle power plants. The average cost of these new supplies, based on the previous two years' actual natural gas prices and a 45% capacity factor, is 7.8 cents per kWh.[71] Based on a 90% capacity factor, the cost of these new supplies will fall to 6.8 cents per kWh.[72] Based on the U.S. Department of Energy's natural gas price forecast and a 90% capacity factor, the cost of these new electricity supplies will be approximately 6 cents per kWh in 2010.[73]

The contracts for these new supplies contain a number of stringent conditions to ensure stable pricing and reliable supplies[99], including that:

- If the independent power producer has capital cost overruns, it cannot pass them on to the Government of Ontario or Ontario's electricity consumers.
- If the power plant fails to achieve its Milestone Date for commercial operation, the independent power supplier will be required to pay the Government up to $300 per MW of contracted capacity per day for each day after the Milestone Date until commercial operation is achieved.
- The Government can terminate an independent

power supplier's contract if it is 18 months late in bringing its power online.
- The Government can also terminate the supply contract if the power plant is unable to achieve capacity utilization rates of 70% during the second contract year; 75% during the third contract year; and 80% during the fourth and each subsequent contract year.
- Moreover, if the Government terminates the contract for one of the above reasons, the independent power supplier is required to pay the province's incremental cost of obtaining replacement power for the duration of the original contract term.

As other jurisdictions, such as California, have discovered, including such provisions is essential to ensuring that contracted power supplies are delivered on-time and on-budget. Similarly, Ontario's recent experiences with huge cost overruns and delays in re-starting its nuclear units points to the need for proper controls and guarantees for all new power supply contracts.

4.6 Nuclear Power

The Ontario Clean Air Alliance believes that the least-cost and least-risk options to meet Ontario's incremental electricity needs are energy conservation, new renewables and high-efficiency natural gas-fired power plants. If the Government believes that re-investing in nuclear power may be an appropriate option to meet Ontario's incremental supply needs, we urge the Government to establish a competitive bidding process for new supplies where nuclear suppliers are required to compete on a level playing field with suppliers of high-efficiency natural gas-fired combined-cycle power plants.

Specifically to create a level playing field between natural gas combined-cycle power plants and nuclear power, all nuclear re-start, retrofit or new build proposals must be subject to the same terms and conditions as natural gas-fired power plants, namely:
- The nuclear power producer must be subject to the same financial penalties and risks of contract termination for failure to achieve its commercial in-service dates or capacity utilization rates as natural gas power plant producers.
- Any nuclear cost overruns must be borne 100% by the nuclear power producer and not passed on to Ontario electricity consumers.
- In addition, the nuclear power producer must be responsible for 100% of the costs associated with the decommissioning of its nuclear power plant, the long-term storage of its radioactive wastes; and a catastrophic accident at its plant.

4.7 Clean Coal

Current so-called "clean coal" technology consists of end-of-pipe scrubbers and filters capable of only partially addressing a subset of the pollutants released

Table 4:
Pembina Institute's Electricity-Grid Supply Mix in 2020

Note: The Pembina report's analysis of Ontario's new waterpower potential did not take into account the potential for waterpower imports from Manitoba, Quebec or Labrador.

	Billion kWh	Percent
Existing waterpower	33.572	32%
Existing peaking gas and replaced oil	12.208	12%
Wind	18.396	18%
New waterpower	8.760	8%
Biomass	5.606	5%
New natural gas-fired combined-cycle power plants	25.623	25%
Total	**104.165**	**100%**

by coal plants. Current technology, such as selective catalytic reduction, desulphurization, precipitators and filters, will have no impact whatsoever on the millions of tonnes of climate-change causing carbon dioxide (CO_2) released annually by Ontario's coal plants. It would cost more than $3 billion to retrofit all the units at Ontario's four remaining coal plants with such end-of-pipe technology. The result would be a reduction in total emissions of the coal plants of only one-half of 1%.[108]

Some "clean coal" advocates are banking on coal gasification to address coal plant CO_2 and other emissions. Coal gasification would permit the capture and storage of the CO_2 emissions from coal plants by, for example, injecting captured CO_2 into old oil and gas wells. This technology would require large underground reservoirs, such as those found in the Western Canadian Sedimentary Basin. However, even its own promoters acknowledge that "Gasification is still not mature technology for power plant applications. Significant work remains to be undertaken to make this a competitive technology…"[109] Currently, the projected capital costs of a coal gasification plant are three to five times higher than those of a high efficiency natural gas-fired power plant.[110]

In 2001, Ontario's then Minister of the Environment, Elizabeth Witmer, issued a regulation which directed Ontario Power Generation to phase-out coal burning at the Lakeview Generating Station by April 30, 2005. According to this regulation, if the Lakeview site is used to generate electricity post-April 30, 2005, the emissions from its power plant must meet or be lower than the emissions from a natural gas-fired power plant.[111]

The government should subject all proposals for so-called clean coal to the Witmer Standard. That is, they should only be considered if their greenhouse gas, nitrogen oxides, sulphur dioxide and mercury emissions rates are all equal to or lower than those of a natural gas-fired power plant. Current "clean coal" technology simply cannot meet this standard.

4.8 The Pembina Report – Ontario can replace both coal and nuclear

In 2004 the Pembina Institute for Appropriate Development issued its report: *Power for the Future: Towards a Sustainable Electricity System for Ontario*. This report analyzes the potential to meet Ontario's electricity service needs in 2020 with a combination of energy conservation, renewable sources and natural gas-fired power plants.

According to Pembina's analysis, if Ontario aggressively promotes energy conservation and renewable power, the province will be able to completely phase-out all of its coal and nuclear generation by 2020. Specifically, under this scenario, Ontario would obtain 63% of its grid-supplied electricity from renewable sources by 2020 and 37% from natural gas-fired generation (see **Table 4**). The report did not analyze the potential for Ontario to obtain additional renewable electricity supplies from Manitoba, Quebec or Labrador.

4.9 New Opportunities

New energy technologies and services are going to be one of the world's growth industries over the next few decades as fossil fuel prices continue to rise and societies look for ways to reduce the health and environmental impacts of conventional power production. Such technologies include everything from solar films, wind turbines and fuel cells to power-cycle control systems, smart meters, district heating and cooling systems or new lighting,

Unfortunately, today Ontario lags behind in this sector, having only recently begun to develop aggressive conservation and renewable power programs. And, as we have seen in the discussion of electricity productivity, we still lag many competitors in making the most of the power we do consume.

Some of the elements that have been missing in Ontario to promote the growth of this industry are a ready domestic market for new energy technologies and innovative approaches to reducing energy use, as well as channels for moving energy research from

academic institutions to markets.

But the biggest stumbling block in Ontario has been the billions of public dollars consumed by the development and maintenance of CANDU nuclear technology that has never met its developers' promises. The federal government, for example, has spent an estimated $6 billion on the development of CANDU nuclear technology (this does not include the actual cost of building, maintaining or retrofitting nuclear power plants).[106] The result of this spending has been a technology that has proved costly and unreliable in actual operation. In contrast, Canada's total expenditure on renewable energy research and development in 2003 was only $38 million.[107]

The many attributes that make Ontario a leader in other sectors, such as an educated workforce, a high quality of life, access to markets, etc., make it well-positioned to compete in the area of energy technology if we direct our spending to areas with high potential – such as energy efficiency – and away from further spending on under-performing CANDU nuclear technology.

4.9.1 Making the adjustment: Impact on manufacturers and resource industries

It is often asserted that higher electricity prices will have adverse impacts on Ontario's electricity-intensive industries. However, 21st century Ontario is primarily a knowledge-based economy and the vast majority of our companies are not in energy-intensive industries. Appendix A contains Statistics Canada's analysis of the electricity costs of Canada's industries as a percent of their total cost of production (Statistics Canada does not provide this information on a province by province basis).

On average, electricity is responsible for only 0.83% of the cost of producing goods and services in Canada. Electricity costs are also a very small component of total production costs for Ontario's important automobile industry. For example, for motor vehicle manufacturing, motor vehicle body and trailer manufacturing and motor vehicle parts manufacturing, electricity is responsible for 0.16%, 0.50% and 0.72% of total production costs respectively.

On the other hand, electricity is responsible for 3-5% of the total costs of mining; 4.75% of the costs of steel mills; 3.8% of the costs of paper mills; 4.47% of the costs of pulp mills; 5.11% of the costs of paperboard mills; 9.35% of the costs of newsprint mills; and 7.3% of the cost of cement and concrete product manufacturing. Appendix B shows the contribution of these industries to Ontario's gross domestic product (GDP). Mining is responsible for 0.6%; primary and fabricated metal production is responsible for 2.81%; pulp, paper and paperboard mills are responsible for 0.55%; and cement manufacturing is responsible for 0.27%.

The financially and ecologically sustainable option to increase the competitiveness of Ontario's electricity-intensive industries is to increase their productivity in the use of electricity.

For many energy intensive industries, special arrangements to receive below-market rate power have been or are being phased-out. This has led to

some speculation that industries such as pulp and paper will find it even more difficult to compete with low-cost foreign suppliers. However, one of the significant challenges facing the Ontario pulp-and-paper sector is that many of its mills are older and less efficient, which means that continuing to supply these mills with below-cost power will really only serve as a band-aid solution.

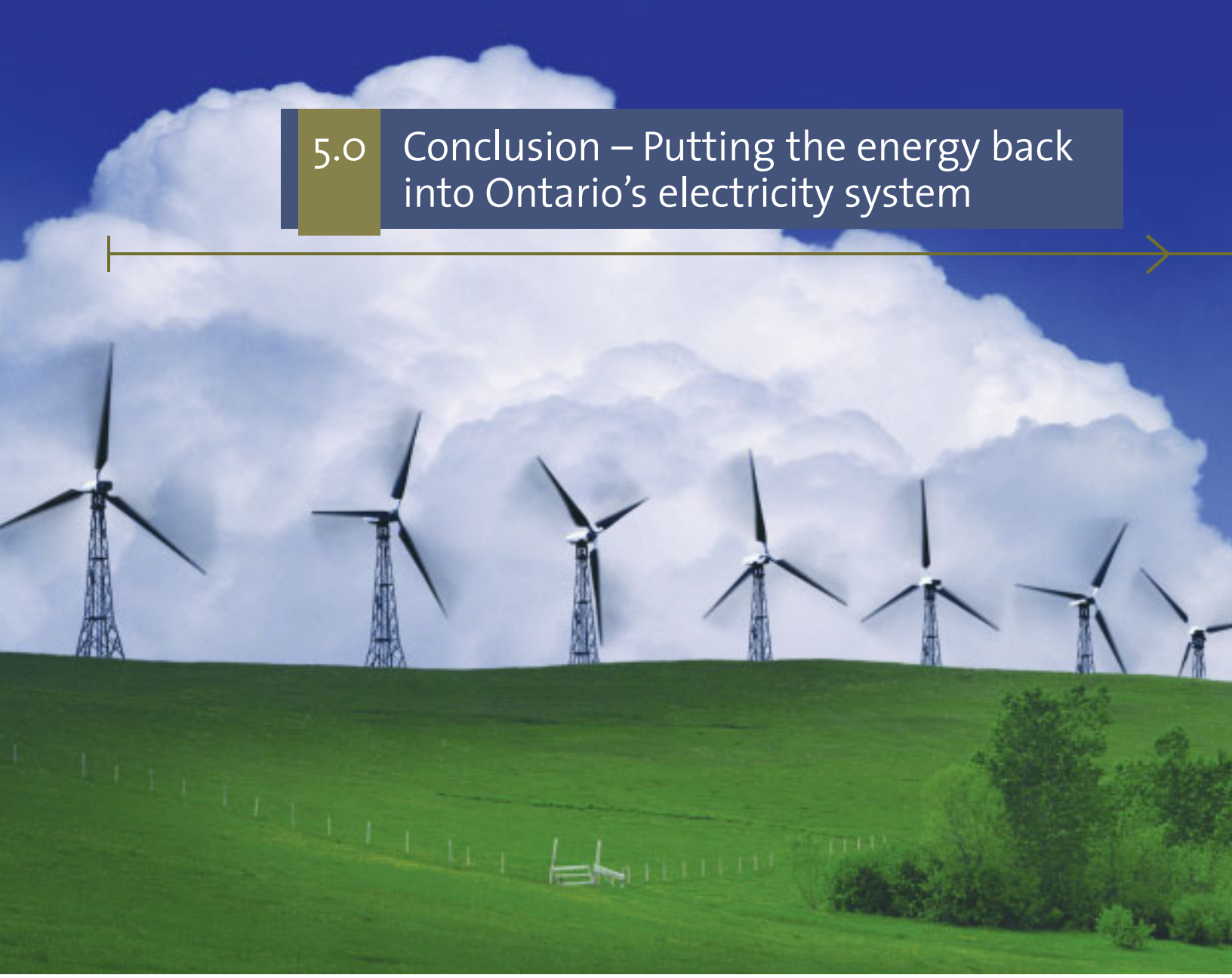
A better strategy would be to upgrade these mills, to make them more productive in terms of both production and energy use. Pulp and paper production is also well suited to co-generation systems because they require both heat and power and because the mills themselves produce wood waste that can be used in such systems. In its 2005 budget, the federal government announced increased support for co-generation systems, including faster capital depreciation measures and a $1 billion new energy technology support fund. The Ontario Government has also announced $350 million in loan guarantees for upgrading mills and developing mill co-generation projects and a $150 million Forest Sector Prosperity Fund "to leverage new capital investments in a variety of areas."

Another option for the forestry sector to self-generate lies in hydro-power development or redevelopment. Many forestry mills were originally directly tied to hydro projects, but these facilities were largely divested in recent decades. Now there is growing interest in redeveloping some of the heritage waterpower assets that have been largely orphaned by OPG's focus on nuclear technology. A recent study by Tembec Inc., for example, calculated that production from generating stations on the Mattagami River in northeastern Ontario could be increased by 384 megawatts by modernizing generation equipment and structures.

As we have noted earlier, currently hydro-power provides a large cross-subsidy to nuclear power. Eliminating this cross subsidy while increasing incentives for renewable power could be a first step toward creating a more rational electricity pricing structure for regions such as the Northwest.

As the Task Force on Competitiveness, Productivity and Economic Progress notes, Ontario industry has been "less effective in adding value" than many of its peers and this is an area where Ontario's businesses need to turn their attention, in its view. Ontario's future lies in being a skilled and efficient producer of high value-added products and services, a strategy that meshes seamlessly with a focus on increasing energy productivity.

5.0 Conclusion – Putting the energy back into Ontario's electricity system



> Moving to real and transparent energy rates can bring many benefits to Ontario – increased productivity, reduced pollution and other health and environmental impacts, a more responsive and reliable electricity system, more competitive industries and a higher quality of life. And contrary to conventional wisdom, such a move will not lead to major economic distress, but will, in fact, increase overall prosperity if it is part of an integrated package of measures designed to promote energy efficiency and conservation, demand response and new cleaner supply sources.

The ultimate goal of such a package is to combine a real cost electricity rate that serves as a clear signal about the costs of consumption (in other words, a meaningful marginal rate for electricity consumption) with measures that result in significant reductions in demand for electricity. Ideally, these two measures can counter-balance one another to ensure that efficiency and productivity are properly rewarded while the net cost impacts of higher rates are eliminated or minimized.

Even without removing hidden costs from our current electricity system, Ontario electricity consumers are likely to see higher prices as a result of everything from rising fossil fuel costs to the costs of rebuilding an aging and inefficient electricity system. This serves as an added impetus for Ontario businesses, consumers and governments to focus on dramatically improving energy efficiency and productivity as a way of offsetting these rising costs.

The transition to a real cost rate for electricity will require the phasing-in of some elements (such as the complete removal of hidden subsidies for nuclear power) along with the rapid introduction of others, such as protection measures for low-income consumers (heating system upgrades and electricity bill rebates for example) and aggressive demand response and efficiency and conservation programs.

There is no question, however, that such an approach is in Ontario's best long-term interests. We simply cannot continue to subsidize wasteful consumption and allow demand for electricity to grow completely unchecked. Not only are the health and environmental costs of such an approach unacceptable, so are the costs to Ontario's competitive position in an increasingly global knowledge economy.

5.1 Summary of recommendations

Ontario should set a target for moving to a 100% renewable electricity system as soon as practically possible. It should adopt an interim goal of 60% grid-supplied renewable power by 2020.

To stimulate an increase in our electricity productivity and our standard of living (GDP per capita) the Government of Ontario should eliminate the hidden subsidies for nuclear electricity generation and consumption. Eliminating three of the six hidden subsidies for nuclear power would raise electricity rates by approximately 30% relative to 2003 prices. The Minister of Energy should direct the Ontario Power Authority (OPA) to develop a strategy to eliminate the subsidies for nuclear power and raise electricity rates up to their full cost.

Low income households (home owners and tenants) should be protected from higher electricity rates through a combination of measures, including energy conservation programs, heating system retrofits, and electricity rebates. The goal of this combination of programs should be to ensure that higher electricity rates will not lead to higher energy bills for low-income consumers.

Ontario should establish an on-bill rebate for residential customers based on the impact of higher electricity rates on the province's lowest income group. This flat-rate rebate should be financed through the increased revenues returned to government by Ontario Power Generation and would ensure that a strong incentive remains for residential customers to conserve electricity.

The OPA should be instructed to develop a strategy for Ontario to reach New York State's level of electricity productivity (currently 2.3 times Ontario's rate) by 2020

The province should encourage the development of strong conservation and efficiency programs by Hydro One, Ontario's municipal electric utilities (e.g., Hydro Ottawa, Toronto Hydro) and the OPA. The OPA should also develop an effective demand-response program as soon as possible to reduce peak demand, peak prices and the need to import high-cost coal-fired electricity from the U.S. on peak demand days. Instead of sending our money to U.S. coal-fired generators, we should use it to pay Ontario consumers to reduce their peak day demands.

The OPA should seek competitive bids for large renewable power projects on an annual basis (e.g. securing a minimum of 1,200 MW a year) while also establishing a

standard offer price for small (10 MW or less) renewable projects. All new renewable projects should be exempted from the province's nuclear debt retirement charge.

To obtain additional electricity supplies and to increase the competitiveness of Ontario's industries, the OPA should establish a standard offer price for biomass and natural gas-fired combined heat and power systems based on prices determined through the open bidding process for combined-cycle gas generators. The OPA should enter into supply contracts with all combined heat and power suppliers that are willing to accept the standard offer price. All new combined heat and power projects should be exempted from the province's nuclear debt retirement charge.

The Government of Ontario and the OPA should expeditiously assess the potential for cost-effective and ecologically sustainable waterpower imports from Manitoba, Quebec and Labrador.

All "clean coal" projects should be subject to the Witmer Standard, i.e., they should only be considered if their greenhouse gas, nitrogen oxides, sulphur dioxide and mercury emission rates are all equal to or lower than those of a natural gas-fired power plant.

Nuclear re-starts, retrofits or new builds are not a cost-effective or reliable electricity supply options. If the Government believes that re-investing in nuclear power may be an appropriate option to meet Ontario's incremental supply needs, we urge the Government to establish a competitive bidding process for new supplies where nuclear suppliers are required to compete on a level playing field with suppliers of high-efficiency natural gas-fired combined-cycle power plants. Specifically, all nuclear re-start, retrofit or new build proposals must be subject to the same terms and conditions as natural gas-fired power plants, namely:

- The nuclear power producer must be subject to the same financial penalties and risks of contract termination for failure to achieve its commercial in-service dates or capacity utilization rates.
- Any nuclear cost overruns must be borne 100% by the nuclear power producer and not passed on to Ontario electricity consumers.
- In addition, the nuclear power producer must be responsible for 100% of the costs associated with the decommissioning of its nuclear power plant, the long-term storage of its radioactive wastes; and a catastrophic accident at its plant.

Appendix A Statistics Canada – Ratio of Electric Power to Gross Output [1]

Current dollars – 2001 (in millions)

Seq No.	NAICS Code	Description	Electric power	Output	Ratio
1	111400	Greenhouse, Nursery and Floriculture Production	44	2655	1.66%
2	111A00	Crop Production (except Greenhouse, Nursery and Floriculture Production)	171	14120	1.21%
3	112500	Animal Aquaculture	2	776	0.26%
4	112A00	Animal Production (except Animal Aquaculture)	421	20609	2.04%
5	113000	Forestry and Logging	31	11268	0.28%
6	114000	Fishing, Hunting and Trapping	5	2202	0.23%
7	115100	Support Activities for Crop Production	2	290	0.69%
8	115200	Support Activities for Animal Production	8	340	2.35%
9	115300	Support Activities for Forestry	2	1368	0.15%
10	211100	Oil and Gas Extraction	708	65064	1.09%
11	212100	Coal Mining	53	1742	3.04%
12	212210	Iron Ore Mining	52	1445	3.60%
13	212220	Gold and Silver Ore Mining	103	2225	4.63%
14	212230	Copper, Nickel, Lead and Zinc Ore Mining	144	3943	3.65%
15	212290	Other Metal Ore Mining	39	734	5.31%
16	212310	Stone Mining and Quarrying	32	884	3.62%
17	212320	Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying	20	1149	1.74%
18	212392	Diamond Extraction	0	718	0.00%
19	212393	Salt Mining	10	426	2.35%
20	212396	Potash Mining	60	1673	3.59%
21	21239X	Asbestos and Other Non-Metallic Mineral Mining and Quarrying	20	587	3.41%
22	213100	Support Activities for Mining and Oil and Gas Extraction	105	9348	1.12%
23	221100	Electric Power Generation, Transmission and Distribution	0	31530	0.00%
24	221200	Natural Gas Distribution	13	3755	0.35%
25	221300	Water, Sewage and Other Systems	2	510	0.39%
26	2300A0	Residential Building Construction	20	43195	0.05%
27	2300B0	Non-residential Building Construction	25	23221	0.11%
28	2300C0	Transportation Engineering Construction	7	8061	0.09%
29	2300D0	Oil and Gas Engineering Construction	9	23709	0.04%
30	2300E0	Electric Power Engineering Construction	1	4309	0.02%
31	2300F0	Communication Engineering Construction	1	2588	0.04%
32	2300G0	Other Engineering Construction	4	6773	0.06%
33	2300H0	Repair Construction	16	19595	0.08%
34	2300I0	Other Activities of the Construction Industry	6	1048	0.57%
35	311100	Animal Food Manufacturing	50	5276	0.95%
36	311210	Flour Milling and Malt Manufacturing	22	1573	1.40%

37	311220	Starch and Vegetable Fat and Oil Manufacturing	31	2877	1.08%
38	311230	Breakfast Cereal Manufacturing	7	1506	0.46%
39	311310	Sugar Manufacturing	3	832	0.36%
40	3113A0	Confectionery Product Manufacturing	22	2668	0.82%
41	311410	Frozen Food Manufacturing	32	2635	1.21%
42	311420	Fruit and Vegetable Canning, Pickling and Drying	22	3756	0.59%
43	311500	Dairy Product Manufacturing	60	10671	0.56%
44	311611	Animal (except Poultry) Slaughtering	46	10639	0.43%
45	311614	Rendering and Meat Processing from Carcasses	36	4629	0.78%
46	311615	Poultry Processing	31	4267	0.73%
47	311700	Seafood Product Preparation and Packaging	37	4376	0.85%
48	311810	Bread and Bakery Product Manufacturing	51	3565	1.43%
49	311821	Cookie and Cracker Manufacturing	8	962	0.83%
50	311822	Flour Mixes and Dough Manufacturing from Purchased Flour	6	681	0.88%
51	31182A	Dry Pasta and Tortilla Manufacturing	4	255	1.57%
52	311910	Snack Food Manufacturing	11	1657	0.66%
53	311920	Coffee and Tea Manufacturing	5	974	0.51%
54	3119A0	Other Miscellaneous Food Manufacturing	23	2206	1.04%
55	312110	Soft Drink and Ice Manufacturing	20	3565	0.56%
56	312120	Breweries	22	4325	0.51%
57	312130	Wineries	4	703	0.57%
58	312140	Distilleries	6	1197	0.50%
59	312200	Tobacco Manufacturing	9	3412	0.26%
60	313100	Fibre, Yarn and Thread Mills	20	727	2.75%
61	313200	Fabric Mills	46	2747	1.67%
62	313300	Textile and Fabric Finishing and Fabric Coating	15	824	1.82%
63	314110	Carpet and Rug Mills	14	1012	1.38%
64	314120	Curtain and Linen Mills	9	774	1.16%
65	314910	Textile Bag and Canvas Mills	5	448	1.12%
66	314990	All Other Textile Product Mills	13	700	1.86%
67	315110	Hosiery and Sock Mills	7	519	1.35%
68	315190	Other Clothing Knitting Mills	4	663	0.60%
69	315210	Cut and Sew Clothing Contracting	10	1372	0.73%
70	315220	Men's and Boys' Cut and Sew Clothing Manufacturing	11	2400	0.46%
71	315230	Women's and Girls' Cut and Sew Clothing Manufacturing	8	3046	0.26%
72	315290	Other Cut and Sew Clothing Manufacturing	2	484	0.41%
73	315900	Clothing Accessories and Other Clothing Manufacturing	2	336	0.60%
74	316100	Leather and Hide Tanning and Finishing	2	243	0.82%
75	316200	Footwear Manufacturing	4	625	0.64%
76	316900	Other Leather and Allied Product Manufacturing	1	208	0.48%
77	321100	Sawmills and Wood Preservation	279	17815	1.57%
78	321215	Structural Wood Product Manufacturing	5	802	0.62%
79	32121A	Veneer and Plywood Mills	28	2254	1.24%

80	32121B	Particle Board, Fibreboard, and Waferboard Mills	111	3199	3.47%
81	321911	Wood Window and Door Manufacturing	14	1847	0.76%
82	321919	Other Millwork	27	3006	0.90%
83	321920	Wood Container and Pallet Manufacturing	6	661	0.91%
84	321990	All Other Wood Product Manufacturing	15	1885	0.80%
85	322110	Pulp Mills	339	7576	4.47%
86	322121	Paper (except Newsprint) Mills	218	5742	3.80%
87	322122	Newsprint Mills	1020	10904	9.35%
88	322130	Paperboard Mills	123	2408	5.11%
89	322210	Paperboard Container Manufacturing	37	5203	0.71%
90	322220	Paper Bag and Coated and Treated Paper Manufacturing	35	2881	1.21%
91	322230	Stationery Product Manufacturing	4	601	0.67%
92	322290	Other Converted Paper Product Manufacturing	30	1683	1.78%
93	323110	Printing	85	12135	0.70%
94	323120	Support Activities for Printing	7	1095	0.64%
95	324120	Asphalt Paving, Roofing and Saturated Materials Manufacturing	18	1419	1.27%
96	3241X0	Petroleum Refineries and Other Petroleum and Coal Products Manufacturing	306	35157	0.87%
97	325110	Petrochemical Manufacturing	81	5040	1.61%
98	325120	Industrial Gas Manufacturing	95	661	14.37%
99	325130	Synthetic Dye and Pigment Manufacturing	5	585	0.85%
100	3251A0	Other Basic Chemical Manufacturing	400	6658	6.01%
101	325200	Resin, Synthetic Rubber, and Artificial and Synthetic Fibres and Filaments Manufacturing	197	7498	2.63%
102	325300	Pesticides, Fertilizer and Other Agricultural Chemical Manufacturing	75	2888	2.60%
103	325400	Pharmaceutical and Medicine Manufacturing	35	9046	0.39%
104	325510	Paint and Coating Manufacturing	12	2218	0.54%
105	325520	Adhesive Manufacturing	5	658	0.76%
106	325610	Soap and Cleaning Compound Manufacturing	15	2759	0.54%
107	325620	Toilet Preparation Manufacturing	6	1455	0.41%
108	325900	Other Chemical Product Manufacturing	45	5021	0.90%
109	326110	Unsupported Plastic Film, Sheet and Bag Manufacturing	53	3578	1.48%
110	326120	Plastic Pipe, Pipe Fitting and Unsupported Profile Shape Manufacturing	40	2148	1.86%
111	326130	Laminated Plastic Plate, Sheet and Shape Manufacturing	7	509	1.38%
112	326160	Plastic Bottle Manufacturing	22	881	2.50%
113	3261A0	Polystyrene, Urethane and Other Foam Product Manufacturing	14	1171	1.20%
114	326193	Motor Vehicle Plastic Parts Manufacturing	48	3737	1.28%
115	32619A	Miscellaneous Plastic Product Manufacturing	121	6528	1.85%
116	326210	Tire Manufacturing	36	2616	1.38%
117	326220	Rubber and Plastic Hose and Belting Manufacturing	7	795	0.88%
118	326290	Other Rubber Product Manufacturing	27	2239	1.21%
119	327100	Clay Product and Refractory Manufacturing	14	760	1.84%
120	327200	Glass and Glass Product Manufacturing	43	2129	2.02%
121	327310	Cement Manufacturing	104	1425	7.30%

122	327320	Ready-Mix Concrete Manufacturing	14	2705	0.52%
123	3273A0	Concrete Product Manufacturing	16	1807	0.89%
124	327400	Lime and Gypsum Product Manufacturing	24	953	2.52%
125	327900	Other Non-Metallic Mineral Product Manufacturing	63	1610	3.91%
126	331100	Iron and Steel Mills and Ferro-Alloy Manufacturing	433	9124	4.75%
127	331210	Iron and Steel Pipes and Tubes Manufacturing from Purchased Steel	30	2898	1.04%
128	331220	Rolling and Drawing of Purchased Steel	12	1029	1.17%
129	331313	Primary Production of Alumina and Aluminum	448	6837	6.55%
130	331317	Aluminum Rolling, Drawing, Extruding and Alloying	24	3358	0.71%
131	331410	Non-Ferrous Metal (except Aluminum) Smelting and Refining	288	8854	3.25%
132	3314A0	Non-Ferrous Metal (except Aluminum) Rolling, Drawing, Extruding and Alloying	16	1665	0.96%
133	331510	Ferrous Metal Foundries	71	1442	4.92%
134	331520	Non-Ferrous Metal Foundries	33	1774	1.86%
135	332100	Forging and Stamping	19	1901	1.00%
136	332200	Cutlery and Hand Tool Manufacturing	6	640	0.94%
137	332311	Prefabricated Metal Building and Component Manufacturing	4	803	0.50%
138	33231A	All Other Plate Work and Fabricated Structural Product Manufacturing	28	4326	0.65%
139	332320	Ornamental and Architectural Metal Products Manufacturing	32	5324	0.60%
140	332410	Power Boiler and Heat Exchanger Manufacturing	5	1016	0.49%
141	332420	Metal Tank (Heavy Gauge) Manufacturing	6	825	0.73%
142	332430	Metal Can, Box and Other Metal Container (Light Gauge) Manufacturing	20	1943	1.03%
143	332500	Hardware Manufacturing	11	2114	0.52%
144	332600	Spring and Wire Product Manufacturing	18	1691	1.06%
145	332710	Machine Shops	37	4037	0.92%
146	332720	Turned Product and Screw, Nut and Bolt Manufacturing	10	909	1.10%
147	332800	Coating, Engraving, Heat Treating and Allied Activities	46	2731	1.68%
148	332900	Other Fabricated Metal Product Manufacturing	30	3776	0.79%
149	333110	Agricultural Implement Manufacturing	9	2239	0.40%
150	333120	Construction Machinery Manufacturing	7	1579	0.44%
151	333130	Mining and Oil and Gas Field Machinery Manufacturing	1	2001	0.50%
152	333X00	Industrial, Commercial and Service Industry Machinery Manufacturing	28	6296	0.44%
153	333400	Ventilation, Heating, Air-Conditioning and Commercial Refrigeration Equipment Manufacturing	12	2615	0.46%
154	333500	Metalworking Machinery Manufacturing	24	3899	0.62%
155	333600	Engine, Turbine and Power Transmission Equipment Manufacturing	11	3225	0.34%
156	333910	Pump and Compressor Manufacturing	8	1804	0.44%
157	333920	Material Handling Equipment Manufacturing	13	2804	0.46%
158	333990	All Other General-Purpose Machinery Manufacturing	12	2275	0.53%
159	334100	Computer and Peripheral Equipment Manufacturing	13	5242	0.25%
160	3342X0	Telephone Apparatus, Radio and Television Broadcasting, and Wireless Communication Equipment Manufacturing	18	9725	0.19%
161	334290	Other Communications Equipment Manufacturing	2	857	0.23%

162	334300	Audio and Video Equipment Manufacturing	1	277	0.36%
163	334400	Semiconductor and Other Electronic Component Manufacturing	30	7114	0.42%
164	334500	Navigational, Measuring, Medical and Control Instruments Manufacturing	18	4568	0.39%
165	334600	Manufacturing and Reproducing Magnetic and Optical Media	7	803	0.87%
166	335100	Electric Lighting Equipment Manufacturing	9	1543	0.58%
167	335200	Household Appliance Manufacturing	11	2428	0.45%
168	335311	Power, Distribution and Specialty Transformers Manufacturing	6	1338	0.45%
169	335312	Motor and Generator Manufacturing	4	871	0.46%
170	335315	Switchgear and Switchboard, and Relay and Industrial Control Apparatus Manufacturing	7	1611	0.43%
171	335910	Battery Manufacturing	1	172	0.58%
172	335920	Communication and Energy Wire and Cable Manufacturing	24	4254	0.56%
173	3359A0	Wiring Devices and All Other Electrical Equipment and Component Manufacturing	9	1075	0.84%
174	336100	Motor Vehicle Manufacturing	114	73298	0.16%
175	336200	Motor Vehicle Body and Trailer Manufacturing	18	3626	0.50%
176	336300	Motor Vehicle Parts Manufacturing	213	29580	0.72%
177	336400	Aerospace Product and Parts Manufacturing	48	16010	0.30%
178	336500	Railroad Rolling Stock Manufacturing	10	2082	0.48%
179	336611	Ship Building and Repairing	6	572	1.05%
180	336612	Boat Building	5	693	0.72%
181	336900	Other Transportation Equipment Manufacturing	4	1392	0.29%
182	337110	Wood Kitchen Cabinet and Counter Top Manufacturing	16	2312	0.69%
183	337127	Institutional Furniture Manufacturing	7	892	0.78%
184	33712A	Household Furniture Manufacturing	33	4514	0.73%
185	337200	Office Furniture (including Fixtures) Manufacturing	27	5228	0.52%
186	337900	Other Furniture-Related Product Manufacturing	6	1183	0.51%
187	339100	Medical Equipment and Supplies Manufacturing	11	2103	0.52%
188	339920	Sporting and Athletic Goods Manufacturing	8	1300	0.62%
189	339930	Doll, Toy and Game Manufacturing	3	414	0.72%
190	339940	Office Supplies (except Paper) Manufacturing	2	173	1.16%
191	339950	Sign Manufacturing	6	1200	0.50%
192	3399X0	Jewellery, Silverware and All Other Miscellaneous Manufacturing	20	2914	0.69%
193	410000	Wholesale Trade	481	90726	0.53%
194	4A0000	Retail Trade	1306	89443	1.46%
195	481000	Air Transportation	25	13324	0.19%
196	482000	Rail Transportation	10	7903	0.13%
197	483000	Water Transportation	2	2669	0.07%
198	484000	Truck Transportation	34	28569	0.12%
199	485100	Urban Transit Systems	89	2057	4.33%
200	485200	Interurban and Rural Bus Transportation	1	451	0.22%
201	485300	Taxi and Limousine Service	4	1232	0.32%
202	485A00	All Other Transit and Ground Passenger Transportation	4	1731	0.23%

203	486200	Pipeline Transportation of Natural Gas	8	5040	0.16%
204	486A00	Crude Oil and Other Pipeline Transportation	116	1677	6.92%
205	487000	Scenic and Sightseeing Transportation	1	206	0.49%
206	488000	Support Activities for Transportation	58	10780	0.54%
207	49X000	Postal Service and Couriers and Messengers	15	9273	0.16%
208	493130	Farm Product Warehousing and Storage	12	751	1.60%
209	4931A0	All Other Warehousing and Storage	8	1490	0.54%
210	511100	Newspaper, Periodical, Book and Database Publishers	46	10150	0.45%
211	511200	Software Publishers	4	5189	0.08%
212	512130	Motion Picture and Video Exhibition	14	1074	1.30%
213	5121A0	Motion Picture and Video Production, Distribution, Post-Production and Other Motion Picture and Video Industries	23	4378	0.53%
214	512200	Sound Recording Industries	4	874	0.46%
215	513100	Radio and Television Broadcasting	8	3113	0.26%
216	513200	Pay TV, Specialty TV and Program Distribution	12	6190	0.19%
217	513300	Telecommunications	46	25984	0.18%
218	514100	Information Services	4	1601	0.25%
219	514200	Data Processing Services	3	1849	0.16%
220	5A0110	Monetary Authorities - Central Bank	2	227	0.88%
221	5A0120	Local Credit Unions	22	3945	0.56%
222	5A0130	Banking and Other Depository Credit Intermediation	205	42319	0.48%
223	5A0200	Insurance Carriers	2	23995	0.01%
224	5A0300	Lessors of Real Estate	1115	51161	2.18%
225	5A0400	Owner-Occupied Dwellings	0	86014	0.00%
226	5A0510	Automotive Equipment Rental and Leasing	24	5203	0.46%
227	5A0520	Rental and leasing (except Automotive Equipment) and Lessors of Non-Financial Intangible Assets (except Copyrighted Works)	40	8933	0.45%
228	5A0610	Non-Depository Credit Intermediation and Activities Related to Credit Intermediation	49	7824	0.63%
229	5A0620	Agencies, Brokerages and Other Insurance Related Activities	74	8031	0.92%
230	5A0630	Securities, Commodity Contracts, Funds, and Other Financial Investment and Financial Vehicles	57	25377	0.22%
231	5A0640	Offices of Real Estate Agents and Brokers and Activities Related to Real Estate	64	9929	0.64%
232	5A0650	Management of Companies and Enterprises	40	12413	0.32%
233	541A00	Legal, Accounting, Tax Preparation, Bookkeeping and Payroll Services	66	18188	0.36%
234	541300	Architectural, Engineering and Related Services	25	17045	0.15%
235	541500	Computer Systems Design and Related Services	10	17430	0.06%
236	541800	Advertising and Related Services	6	4924	0.12%
237	541B00	Other Professional, Scientific and Technical Services	72	20573	0.35%
238	561500	Travel Arrangement and Reservation Services	9	2972	0.30%
239	561600	Investigation and Security Services	5	3042	0.16%
240	561700	Services to Buildings and Dwellings	9	6257	0.14%
241	561A00	Other Administrative and Support Services	52	20259	0.26%
242	562000	Waste Management and Remediation Services	6	3122	0.19%

243	611B00	Other Schools, Instruction and Educational Support Services	35	2992	1.17%
244	621100	Offices of Physicians	53	12538	0.42%
245	621200	Offices of Dentists	107	7813	1.37%
246	621A00	Miscellaneous Ambulatory Health Care Services	67	5932	1.13%
247	623000	Nursing and Residential Care Facilities	49	3355	1.46%
248	624000	Social Assistance	41	3488	1.18%
249	711000	Performing Arts, Spectator Sports and Related Industries	43	4923	0.87%
250	712000	Heritage Institutions	1	122	0.82%
251	713200	Gambling Industries	10	4985	0.20%
252	713A00	Amusement and Recreation Industries	113	4924	2.29%
253	721100	Traveller Accommodation	210	11346	1.85%
254	721A00	RV (Recreational Vehicle) Parks, Recreational Camps, and Rooming and Boarding Houses	24	1847	1.30%
255	722000	Food Services and Drinking Places	384	37328	1.03%
256	811100	Automotive Repair and Maintenance	136	6386	2.13%
257	811A00	Repair and Maintenance (except Automotive Repair and Maintenance)	85	6532	1.30%
258	812200	Funeral Services	10	1212	0.83%
259	812300	Dry Cleaning and Laundry Services	53	1860	2.85%
260	812A00	Personal Care Services and Other Personal Services	76	6173	1.23%
261	813A00	Grant-Making, Civic, and Professional and Similar Organizations	34	3126	1.09%
262	814000	Private Households	0	2476	0.00%
263	F10100	Operating Supplies	0	45663	0.00%
264	F10200	Office Supplies	0	10501	0.00%
265	F10300	Cafeteria Supplies	0	2221	0.00%
266	F10400	Laboratory Supplies	0	2745	0.00%
267	F20100	Travel and Entertainment	0	23034	0.00%
268	F20200	Advertising and Promotion	0	21460	0.00%
269	F30000	Transportation Margins	0	28358	0.00%
270	NP1100	Religious Organizations	117	4318	2.71%
271	NP1200	Non-Profit Welfare Organizations	50	3068	1.63%
272	NP1300	Non-Profit Sports and Recreation Clubs	43	1479	2.91%
273	NP2000	Non-Profit Education Services	48	2160	2.22%
274	NP1900	Other Non-Profit Institutions Serving Households	117	7818	1.50%
275	GS1100	Hospitals	310	35532	0.87%
276	GS1200	Government Residential Care Facilities	14	6871	0.20%
277	GS2100	Universities	216	14569	1.48%
278	GS2210	Government Elementary and Secondary Schools	264	35501	0.74%
279	GS2220	Government Community Colleges and C.E.G.E.P.s	71	5968	1.19%
280	GS2230	Other Government Education Services	14	546	2.56%
281	GS4000	Other Municipal Government Services	824	37137	2.22%
282	GS5000	Other Provincial and Territorial Government Services	207	67371	0.31%
283	GSX000	Other Federal Government Services including Defence	170	43408	0.39%
284	**TOTAL**	**Total**	**17965**	**2151656**	**0.83%**

Appendix B Statistics Canada – Percentage break-out of Ontario's GDP in 2001. [1]

Current dollars – 2001 (in millions)
NAICS

	$ (millions)	%
All industries	**418160.6**	**100.00**
Agriculture, forestry, fishing and hunting [11]	4604.7	1.10
Crop and animal production(2)	3573.9	0.85
Mining and oil and gas extraction [21]	2882.3	0.69
Oil and gas extraction [211]	57.7	0.01
Coal mining [2121]	0	0.00
Metal ore mining [2122]	1727.5	0.41
Non-metallic mineral mining and quarrying [2123]	800.3	0.19
Utilities [22]	8649.7	2.07
Construction [23]	21009	5.02
Manufacturing [31-33]	90320.1	21.60
Wood product manufacturing [321]	2168.9	0.52
Pulp, paper and paperboard mills [3221]	2307.5	0.55
Converted paper product manufacturing [3222]	2035.5	0.49
Printing and related support activities [323]	3380.2	0.81
Petroleum and coal products manufacturing [324]	922.3	0.22
Basic chemical manufacturing [3251]	1048.4	0.25
Resin, synthetic rubber, and artificial and synthetic fibres and filaments manufacturing [3252]	1285.3	0.31
Pesticide, fertilizer and other agricultural chemical manufacturing [3253]	185.4	0.04
Pharmaceutical and medicine manufacturing [3254]	1369.9	0.33
Miscellaneous chemical product manufacturing(6)	3026.9	0.72
Plastic product manufacturing [3261]	4565.2	1.09
Rubber product manufacturing [3262]	970.6	0.23
Cement and concrete product manufacturing [3273]	1122.5	0.27
Primary and fabricated metal product manufacturing(8)	11751.1	2.81
Machinery manufacturing [333]	7099.6	1.70
Motor vehicle manufacturing [3361]	11505.8	2.75
Wholesale trade [41]	24036.9	5.75
Retail trade [44-45]	21702.9	5.19
Transportation and warehousing [48-49]	17061.8	4.08
Information and cultural industries [51]	16267.3	3.89
Finance and insurance, real estate and renting and leasing and management of companies and enterprises(24)	90934.1	21.75
Professional, scientific and technical services [54]	22605.6	5.41
Administrative and support, waste management and remediation services [56]	10633.8	2.54
Educational services [61]	18700.4	4.47

Health care and social assistance [62]	24235.3	5.80
Arts, entertainment and recreation [71]	4004.6	0.96
Accommodation and food services [72]	9536.7	2.28
Other services (except public administration) [81]	10150.5	2.43
Public administration [91]	20824.8	4.98

Appendix C Availability of Natural Gas

The National Energy Board has estimated that Canada's remaining gas supplies are 68 to 76 times greater than Canada's total gas production in 2001.[1]

According to the U.S. Geological Survey, the United States' remaining gas supplies are approximately 54 times greater than its total annual gas production. Moreover, the Survey estimates that the world's remaining gas supplies are more than 150 times greater than the current annual global gas production.[2]

This means that North America will likely be increasingly reliant on offshore gas imports in the form of Liquefied Natural Gas (LNG) in the future. Assuming an expansion of LNG infrastructure, this in turn means that, in the long run, North American gas prices will be capped at the cost of importing LNG.

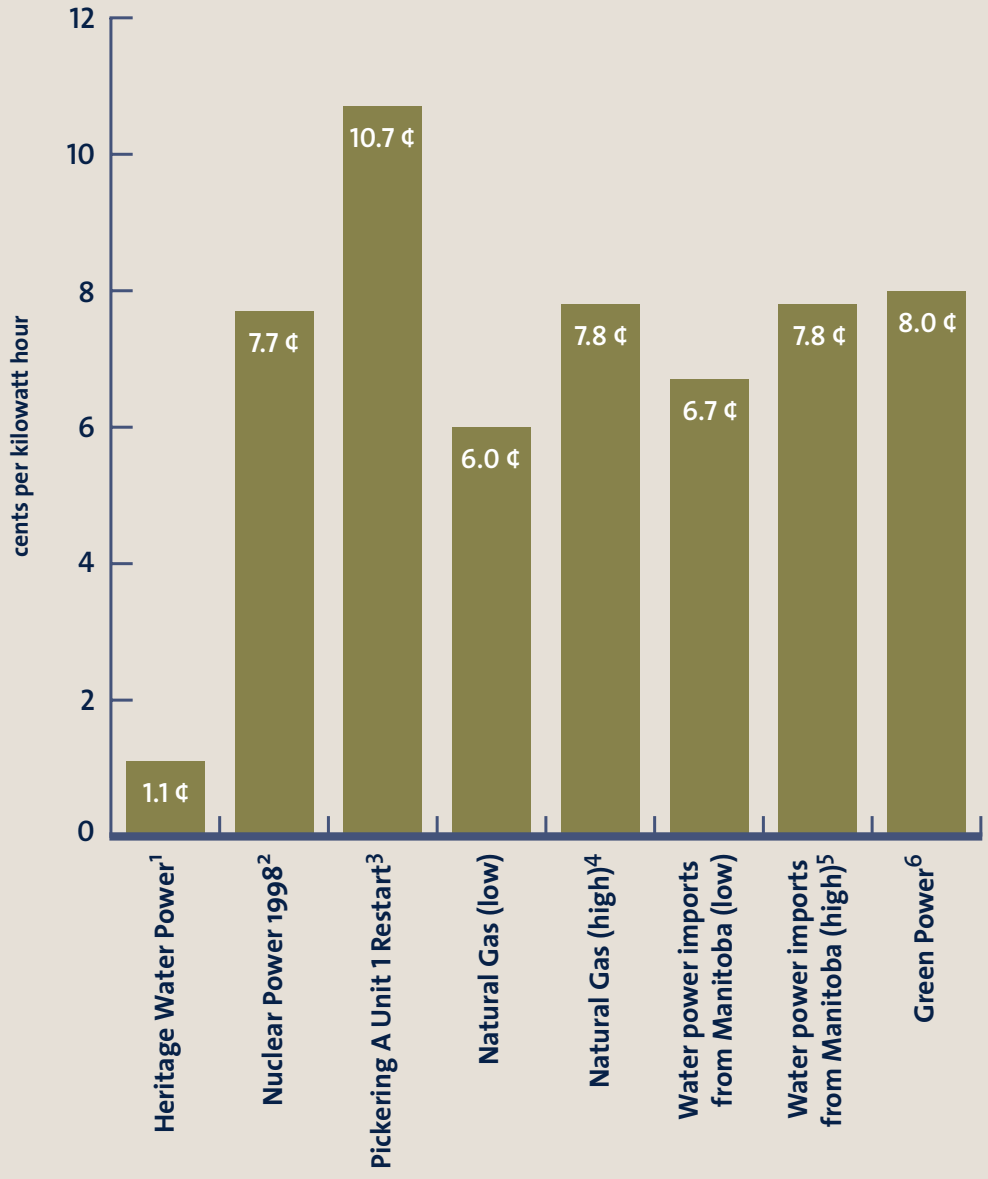
According to Alan Greenspan, Chairman of the U.S. Federal Reserve Board:

"During the past couple of years, when U.S. prices of natural gas hovered around $6 per million Btu, import prices of LNG in Europe have ranged between $2 and $4, and those in Japan and Korea have generally been between $3 and $5. Estimates of production and delivery costs of LNG to North America appear to hover around $3. In the short run, exporters to the United States are likely to receive our domestic price, currently above $6 per million Btu. But unless world gas markets tighten aggressively, competitive pressures will arbitrage the U.S. natural gas price down, possibly significantly, through increased imports." [9]

Currently, there are three proposals to build LNG facilities in Canada: Anadarko Petroleum Corporation is building a LNG terminal at Bear Head, Nova Scotia.[5] ; Irving Oil has received regulatory approval to build a LNG terminal in Saint John, New Brunswick; [6] and Enbridge Inc., GazMetro and Gaz de France are proposing to build one near Quebec City.[7]

Natural gas is a finite fossil fuel source and should only be seen as a transition fuel that can be used until such time as a combination of renewable sources, conservation and new technologies (e.g. hydrogen fuel cells), is capable of meeting our energy needs. As all fossil fuel supplies decline over the next century, the attractiveness of technologies like wind, solar and hydro will dramatically increase, as will interest in conservation and energy efficiency. According to energy expert Amory Lovins, energy efficiency can "reduce by at least several-fold the quantity of electricity needed to provide present services with unchanged or improved quality."[8] But it is also clear that natural gas supplies are sufficient to allow for a lengthy and controlled transition period.

Appendix D Cost per kWh of supply options



Endnotes

1. Robert Macaulay, *The World of Energy*, (Toronto: The Newton Publishing Company; 1961), pp. 198, 199.
2. The Hydro-Electric Power Commission of Ontario, *Annual Report for the Year 1962*, p. 10.
3. The Hydro-Electric Power Commission of Ontario, *Annual Report for the Year 1961*, pp. 102, 103.
4. The Hydro-Electric Power Commission of Ontario, *Annual Report for the Year 1962*, pp. 92, 93.
5. The Hydro-Electric Power Commission of Ontario, *Annual Report for the Year 1963*, pp. 88, 89.
6. OPG, *Towards Sustainable Development: 2000 Progress Report*, p. 58.
7. *Ontario Hydro Final Annual Report: January 1998 – March 1999*, p. 67.
8. "The Commission's interest in the market for electric energy necessarily extends beyond the supply of electricity in wholesale quantities to its principal municipal and industrial customers. This wider interest is based on the recognition that the maintenance of low rates for electricity is dependent on a continued expansion in the use of electricity." The Hydro-Electric Power Commission of Ontario, *Fifty-third Annual Report for the year 1960*, p. 38.
9. Manitoba Hydro and Hydro Quebec obtain virtually all of their electricity from waterpower. In 2004, their rates for their large industrial customers, were 3.23 cents and 4.23 cents per kWh respectively; whereas the rate for large industrial customers in Ottawa was 7.96 cents per kWh. Expanding Canada's east-west transmission links would have been a lower cost option to meet Ontario's electricity needs. The energy efficiency of a natural gas-fired combined heat and power plant can exceed 80%; whereas the energy efficiency of Ontario's mono-generation coal-fired power plants is approximately 34%. Furthermore, the vast majority of Ontario's buildings and factories use natural gas for heating. Therefore it would have been much more energy efficient and cost-effective for Ontario Hydro to have purchased electricity from combined heat and power plants located in Ontario's schools, hospitals, shopping centres, office buildings and factories than to have built large, mono-generation coal-fired power plants. *Hydro Quebec, 2004 Comparison of Electricity Prices in Major North American Cities: Rates in effect April 1, 2004;* and Ontario Ministry of the Environment, *Coal-Fired Electricity Generation In Ontario*, (March 2001), pp. 42, 43.
10. Ontario Electricity Financial Corporation, *Annual Report: April 1, 1999 to March 31, 2000*, p. 21.
11. Ontario Electricity Financial Corporation, *Annual Report 2003*, p. 9.
12. Peter Fraser, Intenational Energy Agency, Nuclear Power and Electricity Markets in the OECD, Presentation to the OPG Review Committee, February 17, 2004.
13. In 2003 Bruce Power and OPG produced 24,500 and 37,700 GWh of nuclear power respectively. Their total nuclear generation capacity was 13,864 MW. Bruce Power, News Release, "Bruce Power partners announce 2003 results", (January 27, 2004); OPG, *Towards Sustainable Development: 2000 Progress Report*, p. 55 and *Towards Sustainable Development: 2003 Progress Report*, p. 32; and Government of Ontario, *Direction for Change*, (1997), p. 5.
14. OPG's coal-fired electricity generation was 16,699 and 36,255 GWh in 1995 and 2003 respectively. Email from Bob Kozopas, OPG to Jack Gibbons, Ontario Clean Air Alliance, August 22, 2000; and OPG, *Towards Sustainable Development: 2003 Progress Report*, p. 30.
15. The August 2003 blackout began on August 14th at 4:11 p.m. Power was totally restored to New York customers by August 15th at 10:45 p.m. Ontario's power emergency did not end until 8 p.m. on August 22nd. New York Independent System Operator, *Fulfilling Our Mission: 2003 Annual Report*, p. 3; Independent Electricity Market Operator, *Participant News*, "IMO Says Ontario Residents Deserve Special Thanks", (August 22, 2003); URL: http://www.theimo.com/imoweb/news/newsitem.asp?newsitemID=756, Retrieved January 4, 2005; and Ontario Ministry of Energy, *August 14 2003 Outage Report*; URL: http://www.energy. gov.on.ca/index.cfm?fuseaction=electricity.reports_outage; RetrievedDecember 21, 2004.
16. *Ontario Energy Board 2003-04 Annual Report*, p. 19.
17. In 2002 Nanticoke produced 22.2 billion kWh of electricity. OPG, *Towards Sustainable Development: 2003 Progress Report*, p. 30; Ontario Energy Board *2003-04 Annual Report*, p. 19
18. To increase its security of supply the Town of Markham has made the Markham District Energy Inc.'s natural gas-fired combined heat and power plant an essential feature of its emergency preparedness plan. In the event of major grid disruptions, Markham District Energy's plant will be used to provide electricity to key facilities that would act as emergency centres and shelters (e.g., the Civic Centre, the local electric utility's operations centre, a hotel and two high schools).
19. Fax to Jack Gibbons, Ontario Clean Air Alliance from Gary Rains, London Hydro, April 5, 2005.
20. Email to Jack Gibbons, Ontario Clean Air Alliance from Anthony Lam, Toronto Hydro, March 22, 2005.
21. Email to Jack Gibbons, Ontario Clean Air Alliance from Max Cananzi, Chief Operating Officer, Horizon Utilities Corporation, March 30, 2005.
22. Ontario Medical Association, News Release, "Beware The Air You Breathe: Ontario's Doctors Call For Cleaner Air", May 12, 1998.
23. Ontario Medical Association, *The Illness Costs of Air Pollution*, (June 2005), pp. 2 & 7.
24. OMA, *Ontario's Air: Years of Stagnation*, (June 2001), p. 2.
25. In 2003 OPG's coal plants emitted 34,544,000 tonnes of carbon dioxide. The average car emits 5.66 tonnes of carbon dioxide per year. OPG, *Towards Sustainable Development: 2003 Progress Report*, p. 30; and http://www.climatechangesolutions.com/english/individuals/opportunities/transport/graph3.htm Retrieved May 20, 2003.
26. DSS Management Consultants Inc. and RWDI Air Inc., *Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation*, Prepared for Ontario Ministry of Energy, (April 2005), p. iv.
27. Sarah Rang, *Up The Stack: Coal-Fired Electricity's Toxic Impact, An OCAA Air Quality Report*, (July 2002), p. 10.
28. Sarah Rang, *Mercury Rising: Mercury Emissions from*

Ontario Power Generation's Coal-fired Plants, (OCAA 2004), p. 5.
29. Ontario Ministry of the Environment, Discussion Paper on Ontario's Clean Air Plan For Industry: Developing NOx and SO2 Emission Limits, (December 2002), p. 2.
30. *Up The Stack*, p. 12.
31. Sarah Rang, *More Than Hot Air: Greenhouse Gas Emisions from Ontario Power Generation's Coal-Fired Power Plant*, (Ontario Clean Air Alliance 2005), p. 3.
32. Ontario Ministry of the Environment, *Coal-Fired Electricity Generation In Ontario*, (March 2001), p. 8.
33. *Up The Stack*, p. 2.
34. Sarah Rang, *Mercury Rising: Mercury Emissions from Ontario Power Generation's Coal-fired Plants*, (Ontario Clean Air Alliance, 2004), p. 5; and http://www.ec.gc.ca/pdb/querysite/query_e.cfm.
35. "The Commission has continued to develop its organization so that it can meet effectively the challenge of competition from natural gas utilities, which are currently engaged in widespread extension of their operations in Ontario. An effective sales promotion campaign undertaken in conjunction with the associated municipal electrical utilities and the electrical manufacturing industry has reached out with marked success to create and widen public interest in electrical living. For the purpose of increasing the use of electricity, particular emphasis is been given to flat-rate water-heating and the installation of electric heating both for houses and for commercial buildings." *The Hydro-Electric Power Commission of Ontario, Fifty-second Annual Report for the Year 1959*, p. iv and *Fifty-first Annual Report for the Year 1958*, pp., ix and 53.
36. Task Force on Competitiveness, Productivity and Economic Progress, *Realizing our prosperity potential: Third Annual Report*, (November 2004), pp. 12 & 13.
37. Task Force on Competititiveness, Productivity and Economic Progress, *Realizing our prosperity potential: Third Annual Report*, (November 2004), p. 5.
38. Letter from Dwight Duncan, Minister of Energy to Jan Carr, CEO, Ontario Power Authority, May 2, 2005.
39. According to the OPG Review Committee, OPG's weighted average cost of capital is in the 10 to 15% range. Since the cost of debt capital is less than the cost of equity and since OPG has a capital structure with a high debt to equity ratio, a weighted average cost of capital of 10 to 15% entails a cost of equity range that is significantly higher than 10 to 15%. In addition, it is worth noting that the Ontario Energy Board's approved cost of equity for Ontario's local electricity distribution companies (e.g., Toronto Hydro) is up to 9.88%. Ontario's local electricity distribution companies have very low risks relative to OPG. OPG Review Committee, *Transforming Ontario's Power Generation Company*, (March 15, 2004), p. 51; and Toronto Hydro Corporation: *Initial Annual Information Form For The Year Ended December 31, 2003*, (February 27, 2004), p. C-10.
40. In 1999 OPG's net income was $446 million and its shareholder's equity was $5.417 billion. Therefore its return on equity was 8.2%.

In 2000 OPG's net income was $605 million and its shareholder's equity was $5.817 billion. Therefore its return on equity was 10.4%.

In 2001 OPG's net income was $189 million and its shareholder's equity was $5.554 billion. Therefore its return on equity was 3.4%.

In 2002 OPG's net income was $67 million and its shareholder's equity was $5.487 billion. Therefore its return on equity was 1.2%.

In 2003 OPG's net income was negative $491 million and its shareholder's equity was $4.979 billion. Therefore its net income was -9.9%.

In 2004 OPG's net income was $42 million and its shareholder's equity was $5.021 billion. Therefore its return on equity was 0.8%.

Therefore OPG's average return on equity was 2.35% between 1999 and 2004 inclusive.

OPG, *Annual Information Form For The Year Ended December 31, 2000*, (April 30, 2001), p. 80.

OPG, *Annual Information Form For The Year Ended December 31, 2003*, (April 30, 2004), p. 71.

OPG, *2004 Financial Results*, (March 29, 2005), pp. 40 & 43.
41. Hydro Quebec, *The Power of Change: Annual Report 2003*, p. 3.
42. Ontario's total cost of electricity in 2003 was approximately $13.5 billion. According to the Independent Electricity Market Operator, the average wholesale price of power for the year ending April 30, 2003 was $72.34 per MWh and total wholesale electricity sales in 2003 were 151,719,293.6 MWh. Therefore the wholesale cost was approximately $10.975 billion. In 2003, the total distribution revenues of Ontario's municipal electric utilities and Hydro One were $2.481 billion. Independent Electricity System Operator, *Year In Review: May 2002 – April 2003*, p. 4; Email from Duncan Skinner, Special Advisor, Regulatory Audit, Ontario Energy Board to Jack Gibbons, August 22, 2005.
43. According to the Independent Electricity Market Operator, in 2003 the average wholesale price of electricity was 5.76 cents per kWh. According to Ontario Hydro's final annual report, its cost of producing hydro-electricity in 1998 was 0.69 cents per kWh net of water rental payments to the Government of Ontario. In 2003 OPG produced 32,400,000,000 kWh of hydro-electricity. Therefore in 2003 the market value of the Government of Ontario's water resources was approximately $1.6 billion [(5.76 cents per kWh – 0.69 cents per kWh) x 32,400,000,000 kWh]. Independent Electricity Market Operator, *2003 Annual Report*, p. 12; Ontario Hydro, *Final Annual Report: January 1998 – March 1999*, p. 67; and Ontario Power Generation, *Annual Information Form For The Year Ended December 31, 2003*, (April 30, 2004), p. 7.
44. Ontario Power Generation, *Annual Information Form For The Year Ended December 31, 2004*, p. 7.
45. The remainder of the unfunded liability was associated with power purchase contracts. Ontario Electricity Financial Corporation, *Annual Report: April 1, 1999 to March 31, 2000*, p. 21.
46. OEFC, *Annual Report: April 1, 1999 to March 31, 2000*, p. 28.
47. OEFC, *Annual Report: April 1, 1999 to March 31*, 2000, p. 21, *2002 Annual Report*, p. 22 and *2004 Annual Report*, p. 17.
48. In 2004 the OEFC's unfunded liability was $20.550 billion

and its average interest cost was 6.54%. This debt could have been amortized over 10 years at a cost of $2.9 billion per year assuming a 6.50% interest rate. Since the 2004 debt retirement charge revenues were $1 billion, the incremental cost of amortizing the liability over 10 years would be approximately $1.9 billion per year. OEFC, *Annual Report 2004*, pp. 17 & 22.
49. Nuclear Waste Management Organization, *Choosing a Way Forward: The Future Management of Canada's Used Nuclear Fuel*, (2005), p. 17.
50. OPG, *Annual Information Form For The Year Ended December 31, 2003*, pp. 30, 31.
51. OPG, *Annual Information Form For The Year Ended December 31, 2003*, (April 30, 2004), p. 33.
52. Ontario Energy Board Docket No. RP-2003-0144, Hydro One Networks and Hydro One Brampton, *Electricity Demand in Ontario*, (November 2003), p. 5.
53. Michael Rosenzweig et al., "Market Power and Demand Responsiveness: Letting Customers Protect Themselves", *Electricity Journal*, (May 2003).
54. ISO New England, ISO New England 2004 Demand Response Programs.
55. ISO New England, ISO New England 2003 Demand Response Programs.
56. http://www.fpl.com/home/services/contents/residential_on_ call.shtml.
57. Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light to Renewable Energy Projects", (November 24, 2004).
59. Ontario Ministry of Energy, News Release, "McGuinty Government Seeks More Clean, Green, Renewable Energy", (April 19, 2005).
60. In November 2004 the Government of Ontario signed contracts for 395 MW of new renewable capacity which is forecast to produced 1.2 billion kWh of electricity per year. If the next 12,000 MW of renewable capacity (1,200 MW per year x 10 years) the same capacity utilization rate as the first 395 MW, it will provide 36 billion kWh of electricity. In 2003 Ontario's total electricity generation was 152 billion kWh. Ontario Ministry of Energy, *Results of the 300 MW Renewable RFP*, (November 24, 2004), Slide 11; and http://www.ieso.ca/imoweb/marketdata/marketSummary.asp.
61. Governments of Manitoba and Ontario, *Preliminary Assessment Of The Potential For A Clean Energy Transfer Between Manitoba And Ontario, (September 2004),* pp. 2 & 31.
62. In 2003 Ontario's total electricity generation was 151.7 billion kWh. http://www.ieso.ca/imoweb/marketdata/marketSummary.asp.
63. *Preliminary Assessment Of The Potential For A Clean Energy Transfer Between Manitoba and Ontario*, p. 1.
64. Independent Electricity System Operator, *18-Month Outlook: An Assessment of the Reliability of the Ontario Electricity System*, (June 27, 2005), p. 5.
65. Ontario Ministry of Energy, News Release, "Ontario and Quebec Partner to Propose Major Hydroelectric Project in Labrador", (March 30, 2005).
66. Ontario Ministry of the Environment, *Coal-Fired Electricity Generation In Ontario*, (March 2001), pp. 42, 43 and email from Norman Rubin, Director of Nuclear Research, Energy Probe to Jack Gibbons, August 17, 2004.
67. Hagler Bailly Canada, *Potential for Cogeneration in Ontario: Final Report*, (August 2000), p. 25.
68. Independent Electricity System Operator, *18-Month Outlook: An Assessment of the Reliability of the Ontario Electricity System*, (June 27, 2005), p. 5.
69. Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light To Two New Gas Plants" (May 30, 2005); and Ontario Ministry of Energy, Backgrounder, "Contract Structure and Pricing", (May 30, 2005).
70. Ontario Ministry of the Environment, *Coal-Fired Electricity Generation In Ontario,* (March 2001), p. 43.
71. Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light To Two New Gas Plants", (May 30, 2005).
72. Email to Jack Gibbons, Ontario Clean Air Alliance from Rick Jennings, Acting Assistant Deputy Minister of Energy, Province of Ontario, June 16, 2005.
73. The U.S. DOE is forecasting that the wellhead price of natural gas in 2010 will be $3.64 (2003 US$) per thousand cubic feet. U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2005: With Projections to 2025*, p. 9; and email to Jack Gibbons from Rick Jennings, Acting Ontario Assistant Deputy Minister of Energy, July 7, 2005.
74. DSS Management Consultants Inc. and RWDI Air Inc, *Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation*, Prepared for Ontario Ministry of Energy, (April 2005), p. iv.
75. *Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation*, p. ii.
76. Pembina Institute for Appropriate Development, *Power for the Future: Towards a Sustainable Electricity System for Ontario*, (2004), Table E5.
77. In 2020 Ontario's population is forecast to be 13,811,090. If in 2020 our per capita end-use electricity consumption equaled that of New York State in 2000, our total end-use electricity consumption would be 103,127,409,000 kWh (13,811,090 x 7467 kWh per capita).
78. *Power for the Future, Executive Summary*.
79. *The World of Energy*, p. 141
80. In 1998 Ontario Hydro produced 31.9 billion kWh of waterpower at a cost of 1.098 cents per kWh; 34.6 billion kWh of fossil power at a cost of 4.293 cents per kWh; and 59.9 billion kWh of nuclear power at a cost of 7.721 cents per kWh. Therefore its average cost of power was 5.11 cents per kWh. The waterpower subsidy to nuclear power equaled the difference between the average cost of power (5.11 cents per kWh) and the cost of waterpower (1.098 cents per kWh) x the total waterpower generation (31.9 billion kWh). That is, $1.3 billion. *Ontario Hydro Final Annual Report: January 1998 – March 1999*, p. 67; and *Towards Sustainable Development: 2000 Progress Report*, p. 58.
81. *Towards Sustainable Development: 2000 Progress Report*, pp. 56 – 58.
82. Ontario Energy Board Docket No. H.R. 12, Exhibit No. 7.3.1, June 13, 1983; and letter from R.C. Watson, Freedom of Information Coordinator, Ontario Power Generation to Ravi

Mark Singh, Ontario Clean Air Alliance, April 27, 2004.
83. Jake Epp, Peter Barnes & Robin Jeffrey, *Report of the Pickering "A" Review Panel*, (December 2003), pp. 3 & 4
84. *Report of the Pickering "A" Review Panel*, p. 3
85. OPG Review Committee, *Transforming Ontario's Power Generation Company*, p. 51.
86. Ontario Ministry of Energy, News Release, "Ontario Government Restarts Pickering Unit To Increase Electricity Supply", (July 7, 2004)
87. OPG, *Ontario Power Generation Reports Third Quarter 2004 Earnings* (November 15, 2004), p. 3.
88. OPG, *Annual Information Form For The Year Ended December 31, 2003*, (April 30, 2004), pp. 30, 31.
89. Task Force on Competitiveness, Productivity and Economic Progress, *Second Annual Report,* (November 2003), p. 25
90. In 2003, OPG's waterpower stations produced 32,400 GWh and Ontario's total electricity production was 150,409 GWh. Ontario Power Generation, *Annual Information Form For The Year Ended December 31, 2003*, (April 30, 2004), p. 7; and email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, May 6, 2005.
91. Ontario Energy Board Docket No. RP-2003-0144, Hydro One Networks and Hydro One Brampton, *Electricity Demand In Ontario*, (November 2003), p. 5.
92. Telephone message from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, September 7, 2005
93. In 2020 Ontario's population is forecast to be 13,811,090. If in 2020 our per capita end-use electricity consumption equaled that of New York State in 2000, our total end-use electricity consumption would be 103,127,409,000 kWh (13,811,090 x 7467 kWh per capita). Assuming transmission and distribution line losses of 10%, this entails the need for 113,440,150,000 kWh of electricity generation. Ontario's electricity generation in 2005 is forecast to be 154,400,000,000 kWh. National Energy Board, *Canada's Energy Future: Scenarios For Supply And Demand To 2025*, (2003), Appendix 2, Tables A2.7 and A3.14; Ontario Energy Board, *2002-03 Annual Report*, p. 20; and Independent Electricity Market Operator, *18-Month Outlook: An Assessment of the Reliability Of the Ontario Electricity System*, (December 22, 2004), p. iv.
94. Arthur Rosenfeld, Commissioner, California Energy Commission, *UCOP Green/Clean Buildings*, (January 13, 2003), p. 7; http://www.ucop.edu/facil/greenbldgs/rosenfeld.pdf.
95. Office of Energy Efficiency, Natural Resources Canada, *Energy Efficiency Trends in Canada, 1990 to 2003*, Chapter 2, p. 5; http://www.oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/trends05/chapter2.cfm?attr=0l
96. C.D. Howe Institute, *Raise Electricity Prices in Quebec – and Benefit Everyone*, (March 16, 2005)
97. A combined-cycle natural gas power plant requires 162 petajoules (PJ) of natural gas to produce 22,776 gigawatt-hours (GWh) of electricity. In 2002 OPG's coal-fired power plants produced 36,946 GWh of electricity. Therefore switching from coal to gas for electricity generation would increase gas demand by 262 PJ [(36,946/22,776) x 162]. In 2002 OPG's and Bruce Power's nuclear power plants generated 41,900 and 20,800 GWh of electricity respectively. Replacing Ontario's nuclear generation by combined-cycle power plants would increase natural gas consumption by 446 PJ. In 2002 North American gas consumption was 28,341 PJ. Diener Consulting Inc., *The Nanticoke Conversion Study*, (Ontario Clean Air Alliance, 2001), pp. 16 & 19; Ontario Power Generation, *Towards Sustainable Development: 2002 Progress Report*, pp. 42 & 44; email from Steve Cannon, Bruce Power to Jack Gibbons, Ontario Clean Air Alliance, December 15, 2003; and URL: http://www.eia.doe.gov/pub/international/iealf/table13.xls;
98. Email from Manfred Klein, Senior Program Engineer, Electricity and Industrial Combustion, Environment Canada to Jack Gibbons, Ontario Clean Air Alliance, April 7, 2004.
99. *Clean Energy Supply Contract*, pp. 28, 51 & 55; http://www.ontarioelectricityrfp.ca/2500MWRFP/Docs/ConsolidatedCESContract.pdf.
100. According to the Royal Commission on Electric Power Planning, in 1979, Ontario Hydro's long range forecast was as follows: 1980-85: 5.0% annual growth rate; 1985-90: 4.9%; 1990-95: 4.5%; and 1995-2000: 4.0%. See *The Report of the Royal Commission on Electric Power Planning*, Vol. 3, p. 24. In 1980 Ontario's total electricity consumption was 117,875 GWh. According to Ontario Hydro's 1979 load growth forecast, Ontario's electricity consumption in 2000 would be 289,730 GWh. Ontario's actual electricity consumption in 2000 was 153,696 GWh. (Email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, April 1, 2005.) In 2004 the total output of the Darlington Nuclear Station was 26,486 GWh. See OPG, *Sustainable Development Report 2004*, p. 41.
101. Ontario Hydro, *Providing The Balance of Power: Ontario Hydro's Plan To Serve Customers' Electricity Needs*, (1989), Executive Summary, p. xiii.
102. *Providing The Balance of Power*, p. 3-14.
103. Independent Electricity System Operator, *18-Month Outlook: An Assessment of the Reliability of the Ontario Electricity System*, (March 29, 2005), p. iv.
104. In 2004 the total output of the Pickering A and B Nuclear Generating Stations was 15.7 billion kWh. OPG, *Sustainable Development Report 2004*, p. 41.
105. *The Report of the Royal Commission on Electric Power Planning*, Vol. 5, p. 48.
106. Letter from Mike Eizenga, President of the Liberal Party of Canada to Jack Gibbons, May 27, 2004.
107. Retrieved from the International Energy Agency web site on September 19, 2005. URL: http://www.iea.org/rdd/eng/TableViewer/Wdsview/dispviewp.asp?ReportId=1
108. Diener Consulting Inc., *The Nanticoke Conversion Study*, (Ontario Clean Air Alliance, 2001), page 19, Table 2.2 and page 21, Table 3.1; and Peter Savage and Shirley Savage, *Ontario's Energy Crunch: Why Phasing Out Coal Is An Unwise Strategy*, (Thinking Energy, 2005), page 19.
109. Canadian Clean Power Coalition, *CCPC Phase 1 Executive Summary*, (May 2004), p. 4.
110. CCPC *Phase 1 Executive Summary*, p. 3; and *Nanticoke Conversion Study*, p. 19.
111. *Ontario Regulation made under the Environmental Protection Act: Lakeview Generating Station, Reg2001.0236.e.*

Appendix A

1. Email from Ronald Rioux, Chief, Consulting and Marketing, Input-Output Division, Statistics Canada to Jack Gibbons, April 12, 2005.

Appendix B

1. Email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, April 15, 2005.

Appendix C

1. Ontario Clean Air Alliance, *Moving To A Coal-Free Future*, (August 2003), p. 8.
2. According to the U.S. Geological Survey's World Petroleum Assessment 2000, the remaining U.S. and world gas supplies are 1054 and 13649 trillion cubic feet respectively. *Executive Summary* by USGS World Energy Assessment Team in *U.S.Geological Survery Digital Data Series 60*. Retrieved August 7, 2003 from http://www.greenwood.cr.usgs.gov/energy/WorldEnergy/DDS-60/ESpt2.html.According to BP, U.S. and world gas production in 2002 was 19.3 and 89.2 trillion cubic feet respectively. *BP Statistical Review of World Energy*, (June 2003), p. 22.
3. Energy Information Administration, U.S. Department of Energy, *U.S. Natural Gas Markets: Mid-Term Prospects for Natural Gas Supply*, (December 2001), p. 35.
5. Anadarko, *News*, "Anadarko Begins Construction on Bear Head LNG Terminal", (January 13, 2005)
6. Irving Oil, Media Release, "Irving Oil and Repsol partner to develop LNG terminal at Irving Canaport", (September 24, 2004)
7. John Spears, "Enbridge scrambling to meet gas demand", *Toronto Star*, (May 6, 2004).
8. Amory Lovins, *"Negawatts: Twelve Transitions, Eight Improvements and One Distraction,"* (1996), p.1. Retrieved August 12, 2003 from http://www.rmi.org/images/other/E-negawatts_12_8_1.pdf
9. Remarks by Chairman Alan Greenspan, before the Economic Club of New York, (New York, New York, May 20, 2005). Retrieved on September 15, 2005 from http://federalreserve.gov/boarddocs/speeches/2005/200505202/default.htm

Appendix D

1. Ontario Hydro's cost of generating electricity from water in 1998. *Ontario Hydro Final Annual Report: January 1998 – March 1999*, p. 67.
2. Ontario Hydro's cost of generating electricity from nuclear power in 1998. However, the nuclear power cost does not include: a) the costs of decommissioning Ontario's nuclear reactors; b) the costs associated with the long-term storage of radioactive nuclear wastes; and c) a commercial return on capital. In addition, Ontario Hydro's nuclear costs were artificially lowered by the Nuclear Liability Act which limited its liability's to $75 million in the event of a nuclear accident. *Ontario Hydro Final Annual Report: January 1998 – March 1999*, p. 67.
3. Ontario Clean Air Alliance, *Manley's Spreadsheet Revisited: Natural Gas vs. Nuclear Power*, (May 2004), p. 4.
4. As a result of a competitive bidding process, in 2005, the Government of Ontario agreed to enter into contracts with independent power producers for 2,225 MW of natural gas-fired electricity. The average cost of these supplies, based on the previous two years actual natural gas commodity costs and a 45% capacity factor, is 7.8 cents per kWh. Based on the U.S. Department of Energy's natural gas commodity price forecast for 2010 ($3.64 per thousand cubic feet [2003 US$]) and a 90% capacity factor, the cost of these new gas supplies will be approximately 6 cents per kWh in 2010. On September 13, 2005 the New York Mercantile Exchange's average natural gas futures price for 2010 was $7.44 per thousand cubic feet (US$). At $7.44 per thousand cubic feet (US $), the cost of natural gas-fired generation, assuming 90% and 45% capacity factors, would be 9.1 cents and 10.1 cents per kWh (Canadian $) respectively in 2010. Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light To Two New Gas Plants", (May 30, 2005); Energy Information Administration, U.S. Department of Energy, *Annual Energy Outlook 2005: With Projections to 2025*, p. 9; and email to Jack Gibbons from Rick Jennings, Acting Assistant Deputy Minister of Energy for Ontario, October 5, 2005.
5. Governments of Manitoba and Ontario, *Preliminary Assessment Of The Potential For A Clean Energy Transfer Between Manitoba And Ontario*, (September 2004), pp 2 & 28.
6. In November 2004 the Government of Ontario signed contracts for 10 green power projects (wind, water and landfill gas). The weighted average cost of these projects was just under 8 cents per kWh including the cost of the connections to the transmission or distribution grid. Ontario Ministry of Energy, News Release, "McGuinty Government Gives Green Light to Renewable Energy Projects", (November 24, 2004) and Results of the 300 MW Renewables RFP, Media Pre-Briefing, Slide #9.

Figures and tables

Figure 1

The electricity prices equal the average residential rates of the municipal electric utilities served by Ontario Hydro. We have not adjusted the electricity prices to take into account inflation. Therefore the decline in real electricity prices between 1914 and 1949 has been much greater than 80%. See W.R. Plewman, *Adam Beck and The Ontario Hydro*, (Toronto: The Ryerson Press; 1947), Appendix H; and The Hydro-Electric Power Commission of Ontario, *Annual Report for the Year 1957*, p. 94. The production statistics show Statistics Canada's estimates of Ontario's total electricity generation from all sources. Email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, May 6, 2005.

Figure 2

Ontario's electricity supply mix data for 1919 to 1998 inclusive was provided by Statistics Canada: email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, May 6, 2005. The 2004 supply mix data was retrieved on August 15, 2005 from the Ontario Ministry of Energy web site: http://www.energy.gov.on.ca/index.cfm?fuseaction=English.electricity.

Figure 3
Water power and nuclear costs based on actual 1998 costs from *Ontario Hydro Final Annual Report: January 1998 - March 1999*, p. 67. The cost of re-starting the Pickering A Unit#1 nuclear reactor, 10.7 cents per kwh, was calculated by re-running the OPG Review Committee's economic spreadsheet model with more realistic assumptions. *Ontario Clean Air Alliance, Manley's Spreadsheet Revisited: Natural Gas vs. Nuclear Power*, (May 25, 2004).

Figure 4
Peter Fraser, International Energy Agency, Nuclear Power and Electricity Markets in the OECD, Presentation to the OPG Review Committee, (February 17, 2004).
URL: http://www.opgreviewcommittee.org.

Figure 5
In 2003 Bruce Power and OPG produced 24,500 and 37,700 GWh of nuclear power respectively. Their total nuclear capacity was 13,864 MW. Bruce Power, News Release, "Bruce Power partners announce 2003 results", (January 27, 2004); OPG, *Towards Sustainable Development: 2000 Progress Report*, p. 55; and *Towards Sustainable Development: 2003 Progress Report*, p. 32; and Government of Ontario, *Direction for Change*, (1997), p. 5.

OPG's coal-fired generation was 16,699 and 36,255 GWh in 1995 and 2003 respectively. Email from Bob Kozopas, OPG to Jack Gibbons, August 22, 2000; and OPG, *Towards Sustainable Development: 2003 Progress Report*, p. 30."

Figure 6
In 2004 the annual output of TransAlta's cogeneration plant in Mississauga was 739,644 MWh (www.ieso.ca/imoweb/marketdata/genDisclosure.asp) and the total electricity consumption in Mississauga was 7,935,630 MWh. In 2004 the annual output of TransAlta's cogeneration plant in Ottawa was 451,521 MWh (www.ieso.ca/imoweb/marketdata/genDisclosure.asp) and the output of Hydro Ottawa's waterpower plant was 82,000 MWh (*Hydro Ottawa Holding Inc. 2004 Annual Report*, p. 22). In 2004 Ottawa's total electricity consumption was 7,755,187 MWh. London has at least 28 MW of local generation capacity (Fax from Gary Rains, London Hydro to Jack Gibbons, April 5, 2005) and in 2003 London's peak day demand was 635.8 MW (*2003 Annual Report London Hydro Inc.*). Toronto's local generation is approximately 320,040 MWh per year (Email from Anthony Lam, Toronto Hydro to Jack Gibbons, March 22, 2005) and Toronto's total electricity consumption in 2004 was 26,417,145 MWh. Hamilton's local electricity generation is approximately 36,100 MWh per year (Email from Max Cananzi, Chief Operating Officer, Hamilton Hydro to Jack Gibbons, March 30, 2005) and Hamilton's total electricity consumption in 2004 was 4,318,947 MWh. Vaughan, Markham and Richmond Hill are served by PowerStream. Eastern Power and Markham District Energy are the major electric power producers in PowerStream's franchise areas. Eastern Power exports approximately 200,000 to 250,000 MWh per year to the electricity grid.Markham District Energy exports approximately 2,600 MWh per year to the grid (Email from Paula Conboy, Director of Regulatory and Government Affairs, PowerStream Inc to Jack Gibbons, September 6, 2005). The total electricity consumption of PowerStream's customers in 2004 was 6,201,823 MWh. All the 2004 municipal electricity consumption statistics were provided by the Ontario Energy Board (Email from Duncan Skinner, Special Advisor, Regulatory Audit, Ontario Energy Board to Jack Gibbons, August 22, 2005).

Figure 7
DSS Management Consultants Inc. and RWDI Air Inc., *Cost Benefit Analysis: Replacing Ontario's Coal-Fired Electricity Generation*, Prepared for Ontario Ministry of Energy, (April 2005), p. ii;

Figure 8
U.S. Population: http://www.census.gov/popest/states/asrh/SC-est2004-02.html
Ontario & Quebec Population: http://www40.statcan.ca/l01/cst01/demo02.htm
US GSP: http://www.bea.doc.gov/bea/regional/gsp/
Ontario & Quebec GDP: http://www40.statcan.ca/l01/cst01/econ15.htm
U.S. Gross State Product figures were converted to Canadian dollars using the OECD's purchasing power parity index of 1.25. See www.oecd.org/dataoecd/61/56/1876133.xls.

Figures 9 & 10
Regression analysis based on data in tables 1 and 2 and data cited in Figure 8.

Figure 11
Germany, UK and France:
http://devdata.worldbank.org/data-query
In 2000 California's total electricity consumption was 832.7 trillion Btu and its population was 33,871,648.
URL: http://www.eia.doe.gov/emeu/states/sep_sum/html/rank_use_per_cap.html;
and http://www.census.gov/main/www/cen2000.html.
In 2000 New York State's total electricity consumption was 484.6 trillion Btu and its population was 18,976,457.
URL: http://www.eia.doe.gov/emeu/states/sep_sum/html/rank_use_per_cap.html; and
http://www.census.gov/main/www/cen2000.html.
In 2000 Ontario's total electricity consumption was 503.93 PJ and its population was 11,669,340. National Energy Board, *Canada's Energy Future: Scenarios For Supply And Demand To 2025*, (2003), Appendix 2, Tables A2.7 and A3.14.

Figure 12
OEFC, *Annual Report: April 1, 1999 to March 31, 2000*, p. 21, *2002 Annual Report*, p. 22 and *2004 Annual Report*, p. 17.

Figure 13
Cynthia Rogers, Mike Messenger and Sylvia Bender, *Funding and Energy Savings From Investor-Owned Utility Energy Efficiency Programs In California for Program Years 2000*

Through 2004, California Energy Commission Staff Paper, (August 2005), p. 11; http://energy.ca.gov/2005publications/CEC-400-2005-042/CEC-400-2005-042-REV.PDF

Figure 14
Ontario's annual electricity consumption from 1950 to 2003 was provided by Statistics Canada. Email from Parisa Bahramloueian, Statistics Canada, April 15, 2005

Figure 15
Arthur Rosenfeld, Commissioner, California Energy Commission, *UCOP Green/Clean Buildings*, (January 13, 2003), p. 8; http://www.ucop.edu/facil/greenbldgs/rosenfeld.pdf.

Figure 16
The average weighted cost of the green projects is just under 8 cents per kWh including the cost of the connection to the transmission or distribution grid. Ontario Ministry of Energy, Results of the 300 MW Renewables RFP, Media Pre-Briefing, Slide #9. See Appendix D for more information about the costs of nuclear power.

Table 1
We used Hydro Quebec's estimates of Ottawa's average residential (8.8 cents per kWh), medium power (7.33 cents per kWh) and large power prices (6.79 cents per kWh) and the Ontario Energy Board's estimate of Ontario's electricity consumption by sectors (residential 30.9%; commercial 37.4%; and industrial 31.7%) to calculate Ontario's average electricity price in 2003. See Hydro Quebec, *Comparison of Electricity Prices in Major North American Cities: Rates in effect May 1, 2003*, p. 20; and *Ontario Energy Board 2003-04 Annual Report*, p. 19. The average price of electricity in Quebec is provided by Hydro Quebec's Annual Report. See Hydro Quebec, *The Power of Change: Annual Report 2003*, p. 107. Average U.S. electricity prices were provided by the U.S. Department of Energy: http://www.eia.doe.gov/cneaf/electricity/esr/table1abcd.xls#1d!A1. The Bank of Canada's average exchange rate for 2003, 1.40146175 was used to convert U.S. prices to Canadian dollars.

Table 2
Our sources for year 2003 Gross State Product and Gross Domestic Product statistics are: the U.S. Bureau of Economic Analysis, www.bea.doc.gov/bea/regional/gsp; and Statistics Canada: www40.statcan.ca/l01/cst01/econ15.htm. U.S. GSP figures were converted to Canadian dollars using the OECD's purchasing power parity index of 1.25. See: www.oecd.org/dataoecd/61/56/1876133.xls. Electricity production data are from: the U.S. Department of Energy: www.eia.doe.gov/cneaf/electricity/epm/epm_ex_bkis.html, March 2004, Table 1_6_B; and Statistics Canada (Email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, May 6, 2005). Quebec's electricity productivity was calculated by dividing its GDP by its electricity consumption. See Hydro Quebec, *The Power of Change: Annual Report 2003*, p. 107.

Table 3
Email from Parisa Bahramloueian, Statistics Canada to Jack Gibbons, August 8, 2005

Table 4
Pembina Institute for Appropriate Development, *Power for the Future: Towards a Sustainable Electricity System for Ontario*, Executive Summary, Table E5; http://cela.ca/pdf/energyreport-fullreport.pdf