Making Kyoto Work

A transition strategy for Canadian energy workers

by Dale Marshall

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Canadian Centre for Policy Alternatives

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About the author

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MOST CANADIANS HAVE COME TO TERMS WITH THE REALITY OF CLIMATE CHANGE, yet the country remains embroiled in a debate over the economic costs and benefits of ratifying the Kyoto Protocol. Unfortunately, many commentators have considered the economic *costs* of Canada decreasing greenhouse gas emissions that lead to climate change, but they too often ignore the economic *benefits* of doing so – benefits that include becoming more energy efficient and embracing business opportunities in emerging industries. Also not considered in many cases are the economic and environmental risks of failing to address climate change.

There is no doubt that confronting climate change poses challenges. This report describes how those challenges present opportunities for setting Canada on a better economic, social, and environmental course. One important challenge will be the transition of the economy from one heavily reliant on fossil fuel use to one that gradually focuses more on emerging industries – energy efficiency, renewable energy, and public transportation. This transition will mean shifts in the types of jobs available. Energy workers in particular are vulnerable to job losses. This report develops what has come to be known as a "Just Transition" strategy to ensure that energy workers do not bear the brunt of action on climate change.

This report answers the critical question: If Canada were to get serious about the Kyoto Protocol, how many energy-sector jobs could be lost (by sub-sector and by province)?

This report fills a void – a missing link – in the climate change analysis to date. It answers the critical question: If Canada were to get serious about the Kyoto Protocol, how many energy-sector jobs could be lost (by sub-sector and by province)? The report also develops a strategy for addressing those job losses through a comprehensive Just Transition program. It proposes how to assist those workers adversely affected by action on climate change, and policy strategies to accelerate the transition towards a more sustainable energy economy. By implementing such a program, the federal government can assure Canadians that nobody will be unduly burdened by action on climate change.

It is obvious that climate change is happening. The scientific community – the Intergovernmental Panel on Climate Change and other scientific bodies studying climate change – continues to urge the world to take climate change seriously and decrease emissions of greenhouse gases. Their last report increased our certainty that climate change is happening already and detailed the extent of the climate changes we can expect over the coming years and decades.

Climate change policies will have the largest implications for Canada's energy sector. The significant trends that have occurred over the last decade in the energy sector include:

- Increased production of coal, oil and gas, and electricity in Canada;
- Increased exports of energy, especially in the oil and gas sector, which now exports over 50% of production to the U.S.;
- Decreased Canadian oil and gas reserves (excluding the tar sands reserves) and, in the case of oil, a corresponding increased reliance on foreign oil;

- Decreased employment in the Canadian energy sector of 80,000 workers (including a drop in the coal, oil and gas, and electricity industries), despite increased production and exports; and
- Increased greenhouse gas emissions of 15% in the Canadian economy, including a 43% increase in greenhouse gas emissions from fossil fuel industries.

There are tremendous opportunities for Canada to develop and implement technologies that will make us more energy efficient, decrease our greenhouse emissions, and create jobs.

There are tremendous opportunities for Canada to develop and implement technologies that will make us more energy efficient, decrease our greenhouse emissions, and create jobs. These technologies have already been implemented across the country. A sample of these initiatives are presented:

- Earth energy technologies, which use the relatively stable temperature of the earth to both cool and warm buildings, in schools and ski resorts in BC;
- Wind farms in Pincher Creek, Alberta and Gaspé, Quebec;
- The Toronto Atmospheric Fund, a conservation project that has funded the retrofitting of commercial, government, and residential buildings, decreasing greenhouse gas emissions while saving the owners money on heating costs;
- The production of ethanol in Manitoba, Saskatchewan, Alberta, Ontario, and Quebec, to be used as a fuel additive that decreases the emissions of greenhouse gases and other air pollutants; and
- Investment in industrial energy efficiency by companies across Canada, a strategy that has net economic benefits because of long-term energy savings.

Unfortunately, structural and economic barriers are still impeding the widespread implementation of these technologies. Other countries – especially in Europe but even the U.S. – have developed homegrown sunrise industries that will positively contribute to their economic health in the near and distant future.

The Canadian government recently completed a multi-stakeholder, two-year process to identify technologies to reduce climate impacts, and policies to support their implementation. The National Climate Change Process (NCCP) also estimated the cost to the Canadian economy of meeting the Kyoto Protocol. The NCCP found that the Kyoto Protocol could be reached given the technologies available and that it would cost the economy between 0% and 3% of GDP over a 10-year period. Implementing a domestic emissions trading program would limit those costs to about 1% of GDP over ten years. Since the economy was expected to grow by 30% over that time, Canada could meet its Kyoto commitments and still experience economic growth of 29%.

Meeting Kyoto will also mean job losses. Taking a conservative assumption that Canada will meet its obligations without international emissions trading, the NCCP modelling analysis showed that there could be a loss of 12,800 jobs in the energy sector. The provinces that would experience the greatest job losses (in descending order of impact) are Alberta, Ontario, Nova Scotia, and BC. Over that same time period, 16,000 jobs would also be created in the energy sector, but not necessarily in the same energy sub-sector or province as job losses.

Despite also claiming to rely upon the NCCP's analysis, the job loss figures being used by the Canadian Manufacturers and Exporters (CME) are completely misleading and baseless. The greatest flaw in their analysis is that they consider job losses from climate change action, but not the job gains. The CME also uses a worst-case scenario – assuming that each sector will have to meet the –6% decrease in greenhouse gas emissions – despite the fact that the Canadian government has publicly stated that the Kyoto Protocol will be met on a whole-economy basis through domestic emissions trading.

Nevertheless, it is clear that some energy sector workers will lose jobs as a result of meeting the Kyoto Protocol. The solution is not to forego action on climate change, but to ensure that those who *do* lose their jobs are given options. A Just Transition (JT) program is the best way to guarantee that workers are not forced to pay for Kyoto through the loss of their livelihood. Transition programs for displaced workers have been successfully implemented in the U.S. and Canada, but only when these programs are developed up front. The elements of a successful JT program include:

- Peer counselling to assess workers' needs, and analysis of labour market needs and trends;
- Training and educational opportunities that allow workers to upgrade their skills for the jobs that are being created;
- Early notice of layoffs, whenever possible, so that workers can access counselling and training/educational programs quickly;
- Income support for displaced workers for up to three years – depending on time in the energy workforce – so that workers can take advantage of training and educational opportunities; and
- Relocation funds, up to a maximum of $15,000 per worker, for those who must move in order to find new work.

The best way to achieve results is to set up such programs through consultation with labour and the private sector, so that job training is appropriate for each worker's skills and the demands of the labour market. A conservative estimate of the cost of such a program would be just over $1 billion over ten years.

A conservative estimate of the cost of a Just Transition program would be just over $1 billion over ten years.

A comprehensive transition program would not only provide for displaced workers, but would also: provide opportunities for industry to become more efficient; provide incentives for business to move towards emerging technologies; invest public funds directly in energy conservation, public transit, and alternative energies, thereby creating new sustainable jobs; and mitigate the cost to low- and fixed-income Canadians. Therefore, other important initiatives that the federal government should implement include:

- Providing tax credits to companies that invest in industrial energy efficiency;
- Creating energy efficiency funds, modelled on the Toronto Atmospheric Fund, for individuals and businesses who want to make commercial and residential buildings more energy efficient;
- Funding needed transit infrastructure; and
- Extending a 1.2 cents/kWh subsidy to all nonhydro renewable electricity generation, to match the present subsidy for electricity generated from wind power.

There are a few ways to pay for such programs. First, subsidies now extended to conventional energy production can be shifted to energy efficiency tax credits. A shift in subsidies acknowledges that the environmental and social costs of renewable energy and energy efficiency are much lower than those from conventional energy production. Second, generate a pool of funds by auctioning off greenhouse gas emissions permits. Extending these tradable permits for free is nonsensical – it would not only relieve the emitters of greenhouse gas emissions from paying any of the costs for climate change action, but also reward the biggest polluters with the most permits. These two sources of funding could conservatively generate $12.5 billion over the next 10 years, more than enough to cover the costs of a Just Transition program for Canadian energy workers, and fund these smart initiatives that would create jobs while making Canadian industries more efficient and innovative.

Introduction

Canada must meet its Kyoto commitments, but its climate change action plan must include a program to ensure energy workers are not forced to carry an undue burden.

OVER THE PAST FEW MONTHS, THE CLIMATE CHANGE DEBATE HAS BEEN HEATING up in Canada. Not the debate over whether climate change is happening. That debate appears to be over, with only a handful of self-interested advocates still denying the science of climate change. The debate that is now raging in our media and other fora is whether Canada should ratify the Kyoto Protocol, and work to decrease greenhouse gas emissions that lead to climate change.

Some – Alberta Premier Ralph Klein and the Canadian Manufacturers and Exporters, for example – have argued that the economic costs of acting on climate change are too large. There certainly are challenges that come with action to decrease greenhouse gas emissions, but these analyses ignore two realities. The first is the high potential cost of allowing climate change to continue unabated. We are already paying those costs, one example being the damage caused by weather-related disasters. These costs will increase as climate change intensifies.

But the most important factor that is being ignored is that the challenges include tremendous opportunities for the Canadian economy. Viable technologies already exist to decrease greenhouse gas emissions and our impact on the climate. Even the CEO of British Petroleum sees "rich and wide-ranging possibilities" for addressing climate change.[1] Technologies include those that produce renewable energy, those sources of energy that are not resource-depleting and that are cost-competitive with the more polluting fossil fuel sources we rely on now: coal, oil and natural gas. Emerging industries in renewable energy provide vast opportunities for growth and job creation. The world's wind electricity capacity grew by 31% in 2001 and by 487% – nearly a five-fold increase – since 1995.[2] A Danish wind company recently announced the creation of 1000 jobs manufacturing wind turbines in Portland, Oregon in response to the expanding U.S. wind industry.[3]

There are also economic opportunities for industrial technologies that reduce our need for energy through energy efficiency. The United Nations has estimated that industrialized countries can become 25-35% more energy efficient in the next 20 years at no net cost.[4] Improving their energy efficiency will make Canadian industries more competitive, not less. Individuals can save money by making their homes and vehicles more energy efficient. And investments in energy efficiency create many more jobs than investments in simply supplying more energy.[5]

Because of a long consultative process conducted by the Canadian government, we also have a much better understanding of how to cost-effectively implement these technologies. The National Climate Change Process identified technologies and policies that would lead to decreases in greenhouse gas emissions in every sector of the Canadian economy.

Finally, we have an international mechanism in place – the Kyoto Protocol – that allows global cooperation and assures signatory nations that climate change actions will be taken in most other countries of the world in coming years. The Protocol can and should serve as the first step towards the ultimate goal of stabilizing the planet's climate.

However, there remains one piece missing before Canada can move forward with action. It is clear that trying to mitigate climate change will affect the character of Canada's economy. Some industries will shrink as others blossom. This will necessarily mean a shift in the nature and location of some jobs. To date, most plans to combat climate change have not taken this into account. For example, Canada's climate change action plan does not mention impacts on employment or measures to address job losses.[6] This report fills that gap. It estimates how a national climate change plan will affect employment levels, and proposes a "Just Transition" program so that those workers who lose their jobs will be given support for career and life options.

This report estimates how a national climate change plan will affect employment levels, and proposes a "Just Transition" program so that those workers who lose their jobs will be given support for career and life options.

Just Transition is a reasonable response to a changing economy and the worker displacement that comes with it. During the free trade debate of the 1980s, then-Prime Minister Brain Mulroney acknowledged that free trade with the U.S. would result in economic shifts that would mean a loss of jobs in certain sectors. At that time, he promised Canadians a transition program to deal with worker displacement. Unfortunately, that promise was never fulfilled. That is why a comprehensive Just Transition program has to be put into place at the front end of domestic action on climate change. Transition programs have been successfully implemented in Canada and elsewhere, and we can take lessons from those experiences to create a truly fair transition program. But before turning to transition, this report addresses the science of climate change, the nature of the Canadian energy sector, and policies that mitigate climate change.

Section 1 lays out our scientific understanding of climate change. The evidence is overwhelming that humans are playing a part in changing the world's climate. This section also details the international agreements that have put Canada in a position to ratify the Kyoto Protocol and join with much of the rest of the world in addressing human impact on the climate.

Section 2 describes the energy sector in Canada. Coal mining, oil and gas production, electricity production and distribution, and renewable energy use are examined on a national and provincial basis. This section also explains important trends in energy production, trade, remaining reserves, and employment.

Section 3 presents numerous case studies of technologies and programs that have decreased Canada's greenhouse gas emissions and our impact on the climate. This section clearly shows that Canada has the tools to be a part of the climate change solution.

Canadian governments need to implement policies that encourage the widespread implementation of more sustainable technologies, and Section 4 offers a package of policies that can do just that. This section also estimates the impact of implementing those policies on the Canadian economy and describes advantages of decreasing greenhouse gas emissions to address climate change.

Section 5, on employment, brings all the elements together. This section estimates the effect of climate change policies on employment in various energy sub-sectors and provinces. It also develops a Just Transition program for those workers who do lose their jobs, and estimates the cost of such a program. It will show that the cost of a Just Transition program is not prohibitive and is essential to a fair Canadian action plan on climate change. Canada must meet its Kyoto commitments, but its climate change action plan must include a program to ensure energy workers are not forced to carry an undue burden, just as Ottawa has committed that principle for industrial provinces and business sectors.

SECTION 1

The science and policy of climate change: The need to act

WHILE THERE ARE A FEW ACADEMICS AND SCIENTISTS WHO DISPUTE CLIMATE change, in reality, there is little genuine debate within the scientific community. The vast majority of the world's scientists believe that our atmosphere is warming, that the world's climate is changing in dramatic and disturbing ways, and that human activities are playing a part in this change (see *Scientific consensus: An oxymoron?* on page 14).

The dominant global scientific authority on climate change is the Geneva-based Intergovernmental Panel on Climate Change (IPCC). The IPCC, established by the World Meteorological Organization and the UN Environment Programme in 1988, has as its mandate to compile and assess all the research published on the world's climate and climate change, and to provide advice on courses of action. It does no primary research of its own.

The IPCC has three working groups. The first examines research on climate change itself; the second investigates how vulnerable we are to climate change, what consequences will result from those changes, and how we can attempt to adapt; and the third investigates options for limiting greenhouse gas emissions. So far, the IPCC has published three full Assessment Reports (1990, 1995, and 2001). The third report had 122 lead authors, 515 contributing authors, and 337 expert reviewers. Many Canadians are included in this process.

Increases in greenhouse gas concentrations

Greenhouse gases in the atmosphere warm the Earth. They do not interrupt radiation from the sun, but act as a "blanket", trapping and reflecting the radiation back down to Earth. The three most important greenhouse gases are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Three other fluorinated chemicals, including a class of chemicals called halocarbons, also act as greenhouse gases but have much smaller impacts on climate change. Most greenhouse gases are naturally occurring, but human activity has led to an increase in their concentration in the Earth's atmosphere. For example, the IPCC's Third Assessment Report found that atmospheric carbon dioxide concentrations have increased by 31% since 1750.[7] Methane concentrations in the atmosphere have increased by 151% over the same time period. Nitrous oxide and halocarbon gas concentrations have also increased.

Ice cores taken from the Vostok glacier in Antarctica allow for estimates of atmospheric concentrations going back 420,000 years. These records show that both carbon dioxide and methane concentrations are higher now than at any other time in that period.[8] Ice core data also show that the present rate of increase of carbon dioxide concentrations is unprecedented in the last 20,000 years.

Climate change

The vast majority of the world's scientists believe that our atmosphere is warming, that the world's climate is changing in dramatic and disturbing ways, and that human activities are playing a part in this change.

The IPCC has documented changes in the climate, especially over the last century. During that time, the average global surface temperature has increased by about 0.6°C. Warming has increased most in areas far from the equator. For example, over the last century in British Columbia, average temperatures have increased by 0.6°C on the Coast, by 1.1°C in the Interior and by 1.7°C in the North.[9]

Globally, it is very likely that the 1990s was the warmest decade – and 1998 the warmest year – since the mid-1800s.[10] They are likely the warmest decade and year in the last millennium. The rise in global temperature during the twentieth century was likely the largest of any century in the last 1000 years. The year 2001 was the 23rd consecutive year that global temperatures were above average.[11] The odds of this happening by chance are over 8 million-to-one.

There have been other changes to the climate beyond temperature (which is why scientists prefer the term "climate change" rather than "global warming"). Changes in precipitation patterns and intensity, increased cloud cover, and increased frequency of droughts and severe weather events have all been documented.[12]

Warming and other climate changes have had effects on other geographic phenomena. It is very likely that there has been a 10% decline in snow cover since the 1960s, that mountain glaciers have retreated, and that Arctic sea ice has lost 40% of its thickness.[13] Oceans have risen by 10 to 20 centimetres in the 20th century, because melting glaciers and ice caps have fed the oceans and because oceans expand with higher temperatures.

Natural or human influenced?

Whether changes to the climate are simply part of normal variability is an important question. If increased radiation from the sun, for example, were responsible for warmer temperatures, then focusing on human activities to solve climate change would be misguided. Unfortunately, this is not the case.

Humans are responsible for three quarters of carbon dioxide emissions, slightly more than half of methane emissions, a third of nitrous oxide emissions, and all emissions of halocarbon gases (these are synthetic compounds).[14] The most recent IPCC report stated that warming over the last 100 years is very unlikely to be entirely natural. In fact, if only natural influences were at work, the planet would have cooled over the last century.

Climatologists use models to determine what happened in the past, and to predict what might happen in the future. Our scientific confidence in the ability of models to predict climate in the future has continued to increase.[15] And models most closely predict atmospheric temperatures when they include both natural factors (e.g. changes in the intensity of the sun) and human factors (e.g. increases in greenhouse gas concentrations).[16]

The second IPCC assessment report concluded, "The balance of evidence suggests a discernible human influence on global climate."[17] The third report has increased the certainty that humans are responsible, noting that there is "new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."[18]

Forecasts for the future

The IPCC's forecasts for the future are cause for concern and demand that we deal with the issue of climate change with a sense of urgency. They forecast that global temperatures might rise by 1.4 to 5.8ºC in this century.[19] Both the lower and upper limits of the projected temperature rise have increased since the second assessment report of the IPCC. The projected rate of warming will very likely be the greatest in the last 10,000 years. The extent of warming will differ in different parts of the world, with the greatest warming occurring in the northern regions of North America.

Again, other aspects of climate will change as well. We will very likely see more intense precipitation events and will likely experience increased droughts and wind speeds.[20] Sea levels are predicted to rise by 9 to 88 centimetres by 2100.

To stabilize greenhouse gas concentrations in the atmosphere, we need a "very significant reduction in world carbon emissions." [21] Decreases of 50% or more would be required to stabilize the world's climate. Most greenhouse gases have a long-lasting effect on climate, since these gases can persist for several centuries after they are emitted.[22] Therefore, even once concentrations stabilize, temperature and sea levels will continue to rise for hundreds of years. This should not, however, be used as a reason to do nothing. The more we are able to reduce our greenhouse gas emissions now, the less severe will be the climate change we experience, and the sooner changes such as warming and sea level rise will move towards stabilization.

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Impacts of climate change

There is ample evidence that regional climate changes have already affected many physical and biological systems. Effects vary from thawing of arctic permafrost to shifts in plant and animal ranges to earlier emergence of insects in the spring.[23]

These effects will inevitably alter human systems as well. We rely on ecosystems – forests, farms, oceans, lakes, and rivers – for so much of our economic activity that their disruption will undoubtedly have economic consequences. The list of human systems that are sensitive or vulnerable to climate change is long: water resources, agriculture, forestry, fisheries, human settlements, energy, the insurance sector, and human health. Crop yields will decline in most places, water will be less available in already dry regions, greater health impacts will mean more money spent on health care, and insect-borne diseases such as malaria will increase.[24]

More intense storms also have costs. For example, economic losses from catastrophic weather events have increased ten-fold – to U.S.$40 billion/year (in 1999 U.S.$) globally – between the 1950s and the 1990s.[25] Including smaller, non-catastrophic losses doubles this total. These increased losses far exceed what one would expect due to higher population numbers and greater economic wealth. Furthermore, the IPCC concludes that, in the future, the combination of heavy precipitation events and sea level rise will displace tens of millions of people.[26] Another analysis estimates that 200 million people worldwide are at risk from global warming – vulnerable to displacement from severe drought, sea level flooding, or other climate change impacts – and contends that this is a "conservative minimal figure."[27]

These past events and future risks have resulted in the insurance industry being one of the first to advocate for strong measures to reduce climate change. This industry has seen a three-fold decrease in the ratio of premiums to weather-related losses between 1985 and 1999 alone, which will increase insurance premiums in the future and make some risks uninsurable.[28]

The point here is to appreciate that, while meeting our Kyoto commitments carries some

economic costs (and some benefits), the costs of ignoring climate change are potentially much greater. People's abilities to adapt to changes that will occur vary considerably. Not surprisingly, developing countries have the least capacity to adapt, leaving them most vulnerable to climate change impacts.[29] Consequently, developing countries will experience net economic losses no matter what the extent of warming. Losses will increase with the extent of warming. Developed countries, on the other hand, will experience both economic gains and losses from small increases in temperature.[30] Greater warming will shift the balance towards economic losses.

This leaves us with two conclusions about the human impact of climate change. First, any degree of climate change will increase the disparity between rich and poor countries.

Second, limiting the extent of climate change will decrease the economic losses that all countries experience. It will also limit the increasing gap between rich and poor nations.

Canadian impacts of climate change

While meeting our Kyoto commitments carries some economic costs (and some benefits), the costs of ignoring climate change are potentially much greater.

The number and intensity of extreme weather-related disasters in Canada in the last decade are difficult to ignore. The 1996 Saguenay River flood in Quebec, the 1997 Red River flood in Manitoba, the ice storm that hit eastern Ontario and Quebec in the winter of 1998, and last summer's record-setting drought in many parts of Canada cost Canadians billions of dollars in damages. It would be wrong to point at any one of these events as undeniable evidence of climate change. We have had droughts, floods, and storms in the past. But their terrific intensity combined with their frequency of late add to the weight of evidence that there is something truly out of the ordinary going on. In fact, these events – more intense storms and more extreme fluctuations in precipitation – are precisely in line with the climate change forecasts made by the IPCC.[31]

Climate changes will increasingly impose significant costs on Canadian society, and these costs need to be factored in when considering the way forward. Warmer temperatures have increased evaporation from the Great Lakes, resulting in water levels dropping by almost a full metre over the last four years.[32] This has obliged the shipping industry to carry lighter loads, costing them an estimated U.S.$44.5 million in 2001.[33]

The drought that struck the Prairie and Maritime provinces especially hard in 2001 cost the Canadian economy an estimated U.S.$3.3 billion.[34] Provincial crop insurance programs alone are expected to pay out CAN$1.1 to $1.4 billion for lost yields in 2001.[35] We can add to that the extensive damage of the growing number of forest fires in BC, Alberta, Ontario, and the Maritimes.

Another cost of higher temperatures results from outbreaks of the mountain pine beetle. Outbreaks of this natural predator occur periodically. In the 1980s, BC's pine trees experienced an outbreak similar to the present one. At that time, cold temperatures that persisted for more than a week killed off the beetle and stemmed the infestation. The last decade has been so warm, however, that temperatures have not been low enough to produce a beetle die-off.[36] The result is that an estimated CAN$4.2 billion of forests are infested in BC, and 25,000 workers remain vulnerable to losing their jobs.[37]

Possibly the most disturbing factor about climate change is that some of the costs are difficult if not impossible to predict. For example, Arctic sea ice has substantially retreated and is predicted to continue to do so. In the eastern Arctic, this has already had an impact on some polar bear populations' health, since the predators have less opportunity to hunt for seals on the frozen surface.[38] Warmer ocean water is one of the reasons that Pacific salmon have experienced greater ocean mortality.[39] Arctic inhabitants, noticing an encroaching sea, are worried that they will have to relocate from their seaside communities.[40]

International action on climate change

The first global step taken towards addressing the potential problems associated with climate change was the creation of the Intergovernmental Panel on Climate Change in 1988. In 1990, the IPCC released its first study. The conclusions from that report prompted the formation of the Intergovernmental Negotiating Committee for a UN Framework Convention on Climate Change (UNFCCC) by the UN General Assembly. The UNFCCC was established in 1992, just prior to the Rio Earth Summit, creating the overall policy framework for countries to come together and address the climate change issue.

The Rio Summit, backed by research from the IPCC's first report, concluded with the UNFCCC agreement between participating countries to stabilize greenhouse gas emissions at 1990 levels by the year 2000 (a goal that was not met). In 1995, the IPCC produced its second report, increasing both the projections of climate changes and the certainty of human influence. The failure of voluntary action, the mounting scientific evidence and growing public concern led to the historic meeting in Kyoto, Japan in 1997.

Scientific consensus: An oxymoron?

Science is not about full and total consensus. Science is about many different researchers investigating the world we live in and coming to a variety of conclusions. The basis of decision-making is determined through a weight-of-evidence approach. If the majority of scientists, through their research, believed in a certain phenomenon, then this opinion can and should be used as the basis for decision-making, even if there are dissenting opinions.

In this regard, the term "scientific consensus" is almost an oxymoron. And yet, this term has been ascribed to the scientific community's opinion on climate change. The reason, of course, is because an overwhelming majority of the earth's scientists who study the issue believe that climate change is happening because of human activities and that the effects will be severe enough that action needs to be taken.

People who deny climate change point to the handful of scientists who dispute climate change. But there will always be contrary views in science. Even in the last few years, long after the world had concluded that smoking cigarettes leads to cancer, there were a handful of researchers who still claimed the opposite. Did we as a society wait until every last scientist fell into line before acting? It would have been foolish to wait and we decided not to. Governments initiated public education campaigns, prohibited minors from smoking, increasingly prohibited smoking in public areas, and even took cigarette manufacturers to court to make them pay the health care costs of their enterprise.

The media and other fora have, unfortunately, sometimes muddied the science of climate change by attempting to represent "both sides" of the argument. This has given some the false impression that a valid scientific debate continues to rage about whether climate change is happening or not. But science is not politics, where both sides of an issue deserve equal attention. In science, the weight of scientific opinion does matter, and the opinion of a few naysayers does *not* merit equal treatment.

We must remember that the decision to do nothing is a decision. But given the overwhelming belief in the scientific community that climate change is happening, the debate needs to move forward – indeed, it has in most places, including with high-level Canadian policy-makers – to the question of what to do about climate change rather than be mired in the largely resolved question of whether the phenomenon exists. Of course, the scientific community needs to continue doing research on this very important topic. A two-pronged approach of action on climate change and continued scientific investigation will decrease the risk of climate change at the same time as continuing to investigate the precise changes that will happen to our climate, the impacts of those changes, and their monetary and non-monetary costs.

The meeting in Japan produced an agreement now widely known as the Kyoto Protocol. Among the 178 countries that are party to the UNFCCC, few countries were on track to meet the UNFCCC target agreed to in 1992. The Kyoto Protocol subsequently extended the deadline, but also changed the target to one that was more ambitious. The Parties agreed to collectively decrease greenhouse gas emissions to 5.2% below 1990 levels by 2008-2012. Different countries have different targets; Canada's is 6% below 1990 levels, while the U.S. has a target of 7% below its 1990 emissions.[41]

In the four and one half years since Kyoto, the signatories to the Protocol have continued to meet in order to negotiate implementation rules. Contentious issues included emissions trading, carbon sinks, and compliance penalties. Finally, at the sixth Conference of the Parties (COP6) in Bonn, Germany in 2001, an overall agreement was reached, and further specifics were finalized at COP7 in Marrakech in November 2001.

The Bonn agreement required compromise on many sides. Emissions trading – countries that surpass their targets selling "spare" emissions to countries that fall short of their targets – was allowed. "Clean development" and "Joint implementation" mechanisms were also included. These allowed industrialized countries to receive emission credits for undertaking emission-reduction projects in developing countries and "emerging economies", such as India. Canada was hoping that these mechanisms would include the sale of nuclear power, but this was eventually excluded from potential credit. The European Union, who opposed the use of nuclear power, failed in its bid to ensure that countries undertook at least 50% of their emissions reductions at home.[42]

Under the Bonn agreement, countries can also get credit for carbon sinks – the absorption of carbon dioxide by forested land. Canada, Japan, Russia, and Australia were proponents – and will be beneficiaries – of this clause, since they can receive credit for increasing the size and carbon storage of their "managed" forestlands.[43]

Rules were also drawn up that would penalize countries for not reaching their Kyoto targets. Two sanctions were agreed upon. The first requires countries to reduce their carbon emissions by 1.3 tonnes in the second commitment period (after 2012) for every tonne above their target they are during the first commitment period (2008-2012).[44] Offending countries will also be disallowed the use of mechanisms such as emissions trading.

What remains is for most countries to now ratify the Kyoto Protocol, thereby turning the agreement into domestic law. The Protocol takes force once 55 countries responsible for 55% of the industrialized countries' emissions ratify the Protocol within their government institutions. What makes this target more difficult is that the U.S., responsible for about one-third of the Parties' emissions, has removed itself from the Protocol. In fact, the U.S. attended the Bonn meeting as observer only. Both Environment Minister David Anderson and Prime Minister Jean Chretien have committed Canada to ratifying the Protocol in 2002. Other countries are also moving ahead on ratification. In March 2002, Sweden, the Netherlands, Austria, and Germany all ratified the Protocol into law, bringing to eight the number of EU countries that have ratified.[45] Japan, another key country, is scheduled to ratify the Protocol in the Spring 2002 sitting of its parliament.[46]

While the continued refusal of the U.S. to abide by the Kyoto Protocol poses serious problems, it is the assumption of this paper that those challenges are not insurmountable. Therefore, this paper is concerned with how Canada can meet its commitments in a fair and just manner.

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SECTION 2

The energy sector in Canada

IN THIS SECTION WE PRESENT THE LAST DECADE'S TRENDS IN CANADIAN ENERGY production, employment in the energy sector, exports of energy, and, where applicable, remaining reserves. The energy sector can be divided into coal mining; oil production; natural gas production and distribution; electricity generation, transmission and distribution (including renewable sources, fossil fuel-fired plants, and nuclear power); non-electrical renewable sources of energy; and energy conservation activities.

Energy sources are considered renewable if they use resources that are not depleting. They include wind, sun, hydroelectric and tidal energy. Non-electrical renewable energy sources include the burning of wood and other biological matter (often referred to as biomass). Renewable energy production is not a net emitter of carbon dioxide, unlike fossil fuels like coal, oil, and natural gas, which are both resource-depleting and generate carbon dioxide when burned to produce energy.

Energy efficiency, though not a source of energy per se, should be an important component of any country's energy sector since reducing energy use provides exactly the same energy service as producing more energy. Energy-efficient choices can be introduced in industrial processes, the heating of commercial and residential buildings, and transportation.

Clarification is required with respect to the greenhouse gas effects of burning biomass to produce either electricity or heat. Burning biomass does emit carbon dioxide. However, because biomass is created from growing trees or other plants, the carbon dioxide that is emitted when it is burned is re-captured when the tree grows back. Thus, the burning of biomass is not considered a *net* emitter of carbon dioxide. This relationship only holds true if the volume of biomass on earth remains the same. Permanent deforestation increases carbon dioxide in the atmosphere, because growing trees are no longer there to re-capture the released carbon dioxide.

Coal mining

Canadian coal production has fluctuated over the last decade. Thirty Canadian coal mines produced 72.5 million tonnes in 1999, about halfway between the 1992 low of 65.6 million tonnes and the 1997 high of 78.7 million tonnes.[47] The overall trend, however, was a modest increase of 6% over the decade. Alberta, BC, and Saskatchewan are the three most important coal-producing provinces, contributing 47%, 34%, and 16% respectively of the Canadian total.[48] Nova Scotia and New Brunswick also produce coal, but in relatively small amounts (Table 1). All provinces other than BC mine predominantly thermal coal, used to produce electricity. In con-

trast, 93% of BC's coal is metallurgical, used in the steelmaking process. Reserves of coal remain high. At 1998 production rates, metallurgical coal reserves will last 70 years and thermal reserves will last 100 years.[49]

The percentage of Canada's coal production that is exported (approximately 45%) has varied little over the 1990s, with the majority of those exports going to Japan and South Korea.[50] BC is the largest exporter of coal, since Alberta and Saskatchewan use the majority of their coal production for domestic electricity production, while BC uses less than 2% within the province.

Employment in coal mining continues to decline, mostly due to increased productivity. Just over 7,000 Canadians worked in coal mines in 1999, down from over 11,000 a decade earlier.[51] Almost half of those workers are in British Columbia. Alberta and Saskatchewan mines have higher productivity and easier access, together employing fewer workers than BC with almost twice the production. Nova Scotia's employment totals have dropped virtually to zero when Canada closed the last Cape Breton mines late in 2001.

Employment in coal mining continues to decline, mostly due to increased productivity. Just over 7,000 Canadians worked in coal mines in 1999, down from over 11,000 a decade earlier.

Table 1: Canadian coal statistics, 1999

	Production ('000 tonnes)	Percent of Canadian production	Percent thermal	Employment	Exports ('000 tonnes)	Percent exported
Canada	72,496	100.0%	60.8%	7,117	33,540	46.3%
BC	24,844	34.3%	6.9%	3,244	24,490	98.6%
Alberta	34,203	47.2%	84.5%	2,107*	9,050	26.5%
Saskatchewan	11,659	16.1%	100.0%	718*	10	0.1%
New Brunswick	251	0.3%	100.0%	100	0	0.0%
Nova Scotia	1,537	2.1%	100.0%	948	0	0.0%

Note: Those figures with * are estimates.
Source: Statistics Canada. 1991 to 2000a. "Coal Mining."

Oil production

Oil production in Canada has increased by 26% over the last decade to 122 million cubic metres in 1999.[52] Alberta produces the lion's share (72.9% in 1999) of Canadian oil, with Saskatchewan production (17.8%) a distant second (Table 2). The eastern offshore basin, BC, the Northwest Territories, Manitoba, and Ontario have much smaller oil industries.

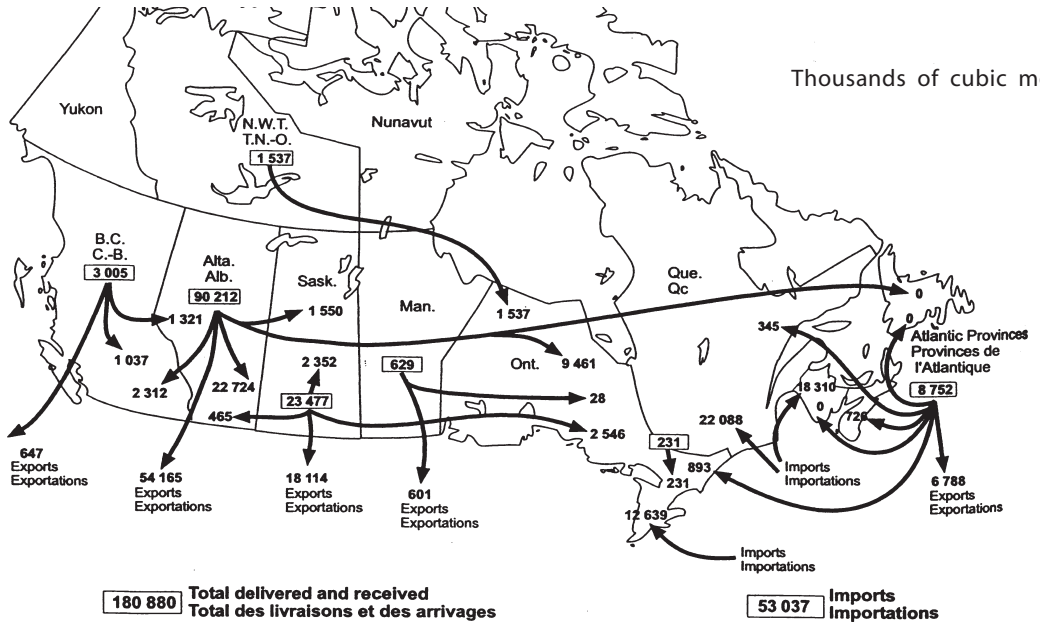
Oil reserves, not including the oil contained in the tar sands, are considerably lower than coal reserves. Based on current extraction rates, the expected life of Canadian oil reserves has shrunk from 10.5 years in 1990 to 6.9 years in 1999.[53] This is due to increased production and a subsequent depletion of reserves. New reserves have been found over this period or have become economically viable due to improved technology, but not enough to offset production. All provinces except BC have decreased the life expectancy of reserves, and Alberta's is now less than five years.[54]

Of course, Alberta is pinning its future hopes on the reserves found in the tar sands (see *Oil derived from tar sands*). There is an estimated 48 billion cubic metres of recoverable oil in the tar sands.[55] Canada's present production rate could be met for 400 years with this reserve.[56] However, assuming that production grows 5% per year decreases this seemingly immense reserve to only a 64-year reserve.

Contrary to the coal experience, oil exports rose sharply over the 1990s. Despite increased production, the percentage of Canadian oil that is exported has risen from 39% to 60%.[57] This rising trend towards exports is found in every oil-producing province. The vast majority of these exports (99% in 1999) are to the U.S. Considerable inter-provincial trade exists as well (Figure 1).

Since many operations produce both oil and natural gas, employment statistics are combined for these two sub-sectors. Together, oil and gas production employed 36,600 workers in Canada in 1999.[58] Despite increased production, this is a drop of approximately 7,000 workers from ten years before, mostly due to increased productivity. Over 30,000 of those jobs are in Alberta. Saskatchewan is the only province with increased employment in oil and gas production compared to a decade ago, its labour force doubling from 1,000 to 2,000 workers.[59]

Figure 1: Oil production and movement from Canadian provinces, 2000



Source: Statistics Canada. 2000b. "Oil and Gas Extraction."

Table 2: Canadian oil statistics, 1999

	Production ('000 cu. M.)	Percent of Canadian production	Employment ('000s)	Reserves (years)	Percent exported
Canada	122,247	100.0%	36.6	6.9	59.6%
BC	2,871	2.3%	1.2	11.5	29.7%
Alberta	89,066	72.9%	31.8	4.7	57.7%
Saskatchewan	21,718	17.8%	2.1	7.8	66.8%
Manitoba	581	0.5%	0.3	7.4	101.5%
Ontario	238	0.2%	0.0*	7.8	0%
Offshore, East	6,135	5.0%	0.7*	24.3	88.8%
NWT	1,640	1.3%	0.2*	9.1	0%

Notes: 1. Those figures with * are estimates. 2. Reserve figures do not include tar sands. 3. Employment figures are for oil and gas combined. 4. In 1999, Manitoba exported its production plus some reserves, leading to an export percentage greater than 100%.

Source: Statistics Canada: 2000b "Oil and Gas Extraction"; and 2001a "Annual Estimates of Employment, Earnings, and Hours, 1991-2000."

Oil derived from tar sands

Northern Alberta, near the community of Fort McMurray, is the location of the Western Canada Sedimentary Basin and four large tar sand deposits. An increasing percentage of Canada's oil production is coming from these deposits. The tar sands account for 26% of Canadian crude oil production today, a figure that is estimated to rise to 50% by 2005[60] and to 70% by 2025.[61] This is due to both the depletion of conventional oil deposits in Canada and increasing investment in tar sand production and expansion. For example, $38 billion in new tar sand projects have been announced since 1996.[62]

The cost of tar sand production has traditionally been higher than for conventional oil. Technological improvements, however, have cut production costs in half over the last 15 years, with operating costs today as low as $13/barrel, although some operations had significantly higher costs ($17) in 2000-2001.[63] Still, tar sand projects, like conventional oil and gas production, enjoy fiscal incentives from government and are sensitive to world oil prices.[64]

A fundamental problem with tar sand production is the emission of greenhouse gases, mostly carbon dioxide, and other air pollutants such as sulphur dioxide. Upstream emissions – those created in the production, not the burning, of fossil fuels – are higher for tar sands than for conventional fossil fuels. This is because the mined substance (called bitumen) must undergo a high-temperature chemical reaction that requires the use of large amounts of other fossil fuels, often natural gas. In recent years, on a per barrel basis, the tar sand industry has managed to decrease these emissions considerably. However, the tremendous growth of tar sand production has meant an overall doubling of carbon dioxide emissions for Suncor and Syncrude, the two industry leaders, over the last 12 years.[65] Emissions from the *production* of oil from tar sands alone are projected under a business-as-usual scenario to make up one quarter of Canada's overshoot of its Kyoto Protocol commitments (quite apart from the subsequent burning of the oil).[66]

The industry has created a considerable number of jobs in Fort McMurray. Between 1999 and 2001, when oil prices experienced a considerable spike, tar sand expansion meant city expansion, from 43,000 people to 51,000 people. Conventional energy projects create only 7.3 jobs per million dollars invested, well below the job creating potential of renewable energy projects.[67] Tar sand production, in comparison to conventional energy production, is labour-intensive. The process of mining the bitumen, transporting it to oil recovery plants, and transforming it to synthetic crude oil creates 14 jobs per million dollars invested.[68] However, this will change since it will soon be possible to extract oil from the tar sand while it is still in the ground. Further eroding the local job-creating potential of current tar sand production is the fact that oil is sent by pipeline to Edmonton and further south to be refined.

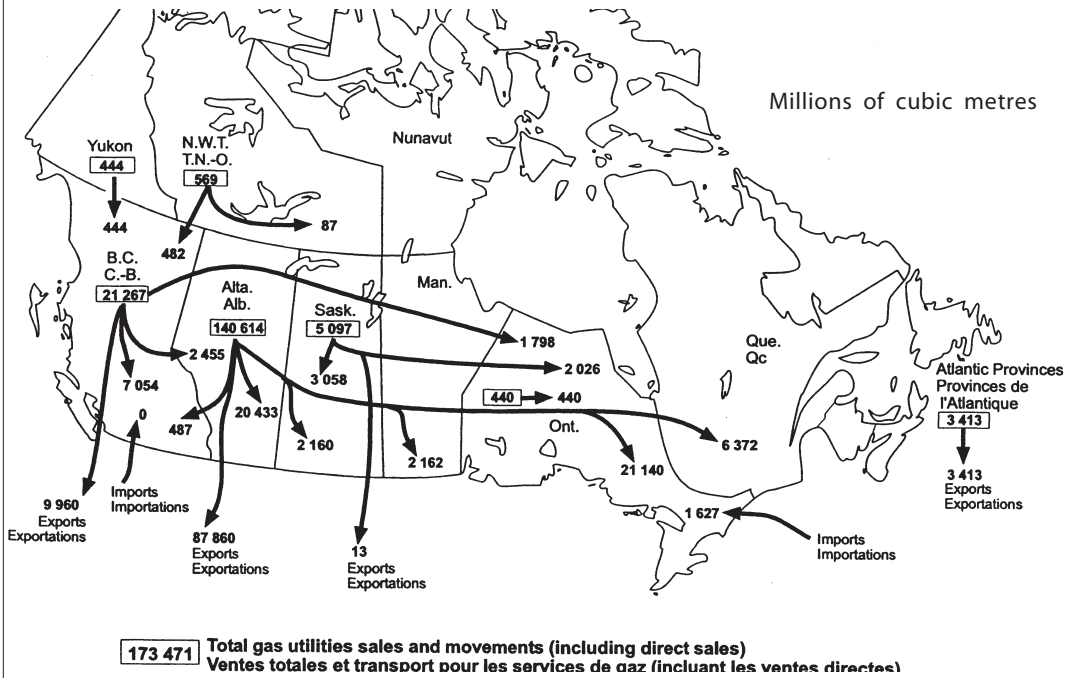
Natural gas production

Natural gas production boomed in the 1990s in Canada, increasing by 60% to 196 billion cubic metres.[69] Again, Alberta's production makes up the vast majority of Canadian production (82.9%) with BC (3.9%) and Saskatchewan (12.6%) far behind (Table 3). BC's production has doubled over the 1990s, while other gas-producing provinces have experienced more modest growth. New natural gas finds have not stemmed the decrease in reserves across the country. In fact, increased production has meant that the expected lifetime of Canada's gas reserves has declined by more than ten years over the past decade.[70]

Like oil, natural gas exports have greatly increased (by 233%) over the last decade.[71] The proportion of production that is exported has also increased, despite increased production, from 33% to 49%.[72] All of the exports are destined for the U.S. Alberta and BC account for the majority of these exports, while other provinces export virtually none of their natural gas production. (Since 1999, Nova Scotia has produced natural gas from offshore reserves, and exports some of that production.) Inter-provincial trade is significant, with the dominant trend being natural gas flowing eastward, from BC into Alberta and from Alberta and Saskatchewan into Manitoba, Ontario, and Quebec (Figure 2).

In addition to oil and natural gas production employment (36,600 employed in Canada in 1999), 13,100 Canadian workers are employed in natural gas *distribution*.[73] This figure has increased slightly over the 1990s.

Figure 2: Natural gas production and movement from Canadian provinces, 2000



Source: Statistics Canada: 2000b "Oil and Gas Extraction."

Table 3: Canadian natural gas statistics, 1999

	Production (billion cu.m.)	Percent of Canadian production	Employment in oil and gas production ('000s)	Employment in gas distribution ('000)	Reserves (years)	Percent exported
Canada	195.7	100.0%	36.6	13.1	8.8	48.6%
BC	24.6	12.6%	1.2	Not avail.	9.7	45.1%
Alberta	162.2	82.9%	31.8	3.3	8.1	51.7%
Saskatchewan	7.6	3.9%	2.1	Not avail.	9.0	1.6%
Ontatio	0.4	0.2%	0.3	Not avail.	28.4	0.0%
Territories	0.7	0.4%	0.2*	Not avail.	23	0.0%

Notes: 1. Those figures with * are estimates. 2. Reserves in the Territories do not including offshore reserves. 3. Employment figures are for oil and gas combined.

Source: Statistics Canada. 2000b. "Oil and Gas Extraction"; and Statistics Canada. 2001a. "Annual Estimates of Employment, Earnings, and Hours, 1991-2000."

Electricity generation, transmission, and distribution

Electricity is generated in various ways. Power plants can generate electricity through the burning of fossil fuels like coal, oil, and natural gas. Electricity is also generated by harnessing the nuclear energy of radioactive materials. Various forms of renewable technology generate electricity from the energy of the sun, wind, earth, waves, tides, or rivers. Hydroelectric projects – considered renewable by some, despite significant environmental and social impacts – generate electricity by using falling water to drive electric turbines. This is by far the greatest single source of electrical power in Canada. Not to be forgotten are energy conservation projects, which decrease our demand for electricity, resulting in the same outcome as generating greater supply.

Canada's electricity generating capacity, the maximum amount of power that can be generated at one time, is dominated by hydroelectricity.

Canada's electricity generating capacity, the maximum amount of power that can be generated at one time, is dominated by hydroelectricity. It makes up 61% of capacity, with thermal power plants (coal, oil, and natural gas) totaling 24%, nuclear power contributing 12% and renewables adding less than 1%.[74] Thermal power is dominated by coal-fired power plants, which make up almost 60% of thermal generating capacity, followed by oil at 24% and natural gas at 18%.[75] Actual electricity generation mimics the proportions found in generating capacity (Figure 3).

Between 1989 and 1998, electricity generation from hydroelectric projects and thermal power plants grew by 14% and 24% respectively, while electricity generation from nuclear plants shrank by 10%.[76] The electricity mix has therefore changed a little, with thermal power plants making a small gain of about 4% of production at the expense of nuclear power. Overall, electricity generation in Canada grew at a rate of about 2.5% per year during the 1990s.[77]

Quebec (30%) and Ontario (27%) dominate electricity production in Canada, with BC (12%), Alberta (10%) and Newfoundland (8%) being important players as well.[78] Though all provinces produce electricity from a variety of sources, most concentrate on one type of electricity

generation. Quebec, Manitoba, BC, and Newfoundland produce predominantly hydroelectric power for their domestic use and export. Alberta, meanwhile, produces the majority of its electricity through conventional thermal power generation, 90% of which is coal.[79] Nova Scotia also heavily favours coal-fired power plants.

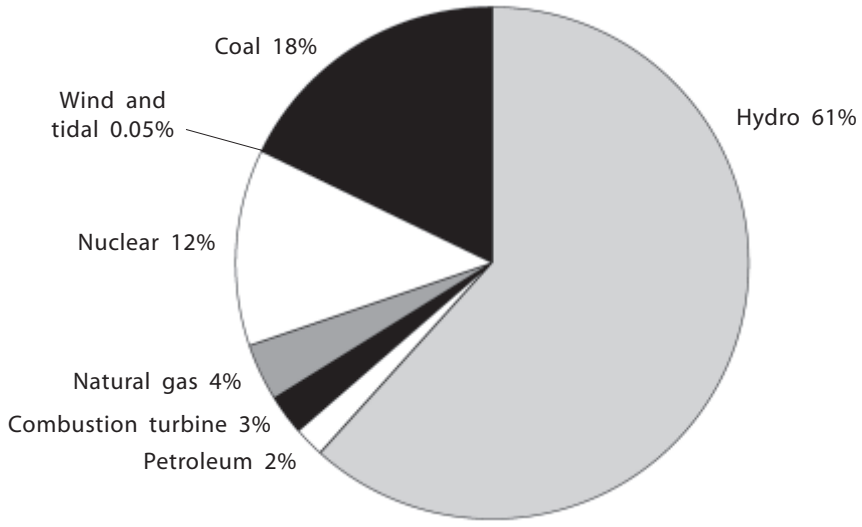
Ontario, New Brunswick, and to a lesser degree, Saskatchewan have a mix of electricity sources. In Ontario, nuclear power, hydroelectricity, and coal-fired plants (in decreasing order of importance) are important sources of electricity. Only two other nuclear power plants exist outside of Ontario, one in Quebec and one in New Brunswick. New Brunswick also relies on petroleum and coal. Saskatchewan complements an emphasis on electricity from coal with some hydroelectricity production. Over the last ten years, there has been little change in provincial contributions to Canadian electricity production, nor in the mix of electricity generation within each province.

Despite the small contribution of renewable energy to Canada's electricity mix, growth in these industries has been high over the last decade.

Because renewable energy (not including hydroelectric power) makes up such a small proportion of the electricity mix in Canada, the available data on renewable power generation are less comprehensive. Currently, wind generation capacity in Canada is 142 MW of power, only 0.13% of total capacity.[80] Wind farms in Pincher Creek, Alberta and Gaspé, Quebec make up most of that total, though projects elsewhere are presently being developed. For example, Ontario Hydro is erecting North America's largest windmill, a 1.8 MW unit, at the Pickering Nuclear Generating Station just east of Toronto, and considering a wind farm on the Bruce Peninsula.[81] Nova Scotia generates all of Canada's tidal power, about 0.015% of Canada's electricity production. Its Annapolis Tidal Generation Station is the second largest in the world. This is enough to supply the province with just under 1% of its electricity.[82] Electricity production from photovoltaic cells, which convert solar energy to electricity, was 100 times smaller than Canada's wind electricity production.[83]

Despite the small contribution of renewable energy to Canada's electricity mix, growth in these industries has been high over the last decade. For example, Canada's wind capacity has been developed entirely in the last ten years. The solar industry has been around for longer, but growth rates in Canada have been high in the last ten years and, in the near future, are expected to follow international growth rates of 20% per annum.[84] The international market for all re-

Figure 3: Canadian electricity generation, 1999



Source: Natural Resources Canada. 2000. "Energy in Canada 2000."

newable electricity technologies is expected to grow from U.S.$7 billion in 2001 to U.S.$82 billion in 2010.[85]

A little known source of renewable energy is the burning of biomass – mostly wood waste. Some of this energy is converted to electricity in a turbine, while some of it is used instead for industrial-process heat or space heating. Overall, biomass contributes 6% of Canada's primary energy supply (Table 4).

Canada currently exports about 8% of its electricity production to the U.S., far below exports of coal, oil, and natural gas.[86] However, export growth was high during the 1990s. Both electricity exports and the proportion of electricity that is exported have doubled over the decade.[87]

In 1999, Canada employed 84,400 people to produce, transmit, and deliver electricity, down from over 100,000 workers ten years before.[88] The renewable portion of this is much smaller, and so employment totals are difficult to obtain.

Non-electric renewable energy and energy efficiency

There are also renewable forms of energy that do not produce electricity, but rather heat. Two activities that produce the vast majority of heat energy rely on biomass sources: burning wood waste in pulp and paper mills and the burning of wood in residential homes. Thermal energy production from the burning of municipal solid waste and the burning of ethanol also contribute significantly. Ethanol is created by the fermentation of agricultural or wood waste and can be used as a fuel substitute in vehicles (mixed with some proportion of gasoline) or in industrial consumption. Just over 300 million litres of ethanol were produced and consumed in 1997. [89]

There is also some use of the earth's own energy for heating and cooling. The constant temperature of the earth (between 5 and 10°C) at a depth of a few metres allows an earth energy system – essentially a ground source heat pump – to warm buildings in the winter and cool buildings in the summer, reducing one's reliance on electricity.

Employment in these renewable technologies is growing. Surveys estimated that together, the heating and electricity generating portions of renewable energy production employed 3,400 Canadians in 1993 and 4,900 in 1998.[90] Employment numbers for individual industries are not available, even from industry associations. An exception is the earth energy industry, which creates approximately 50 full-time equivalent jobs in design and installation, with the majority

Table 4: Canadian primary energy production from biomass, 1997

Source	Energy (petajoules)
Pulp and paper mills: wood waste	144.4
Pulp and paper mills: black liquor	357.9
Independent power producers: wood waste	37.5
Municipal solid waste (MSW)	0.5
Landfill sites	7.2

Note: 1. Only a portion of this energy is used to generate electricity. 2. For comparison, hydroelectricity produced 1,255 PJ of primary energy in Canada in 1997.

Source: Natural Resources Canada. 2000a. "Energy in Canada 2000."

being in Ontario and BC.[91] Approximately 100 more employees work part-time maintaining these systems.

Statistics on employment totals in energy efficiency and conservation are even more difficult to obtain, not because there are fewer people employed in these areas but because of the diffuse nature of energy efficiency projects. For example, those doing energy audits and working for small businesses and homeowners to retrofit buildings are not recorded anywhere in official statistics. A survey of Canadian businesses revealed that almost 20,000 people worked in environmentally-related construction jobs in 1998.[92] However, these jobs are spread across many different activities from air pollution control to wastewater management to noise abatement. Overall, revenues from Canada's environmental goods and services industry have grown from $10.2 billion in 1995 to $14.3 billion in 1998.[93] Only a small fraction of this activity, however, would be related to energy efficiency projects intended to decrease energy use and greenhouse gas emissions.

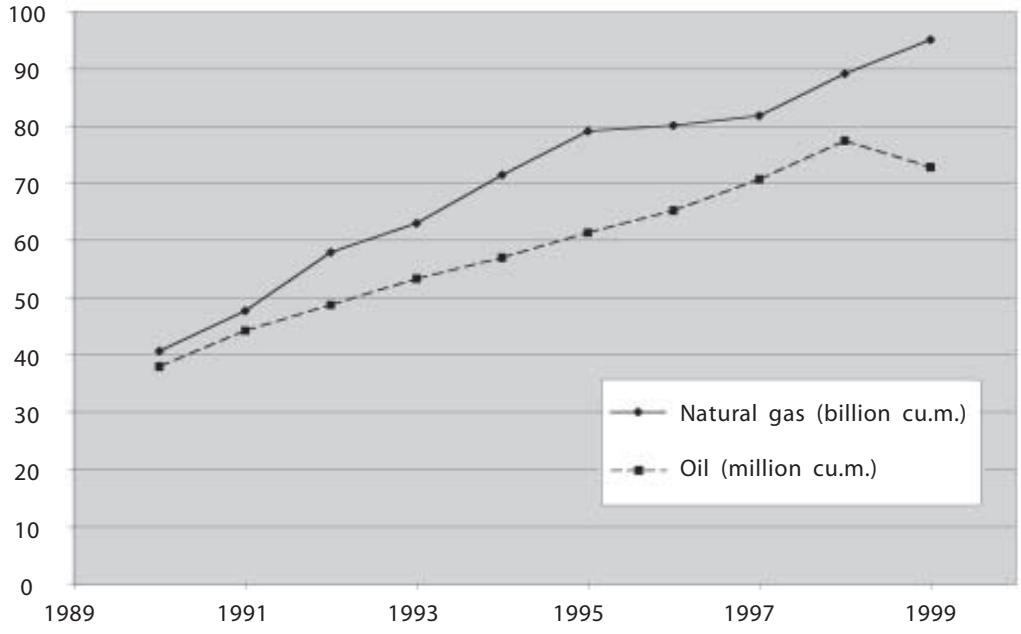
Important trends in Canada's energy sector

The North American Free Trade Agreement does limit Canada's sovereignty over its energy policy.

There exist some important and unsettling trends in Canada's energy sector. First, Canada is increasing its exports of energy, especially oil and natural gas (Figure 4). Since these exports are predominantly destined for the U.S., and because of the North American Free Trade Agreement (NAFTA), this trend does limit Canada's sovereignty over its energy policy. The NAFTA rules obligate Canada to continue exporting a given proportion of its energy production, determined as the average proportion over the previous 36 months.[94]

A second trend is that Canada's reserves of these resources continue to be depleted. Notwithstanding that there are large reserves of oil in the tar sands of Alberta, the other provinces' oil reserves – and all provinces' gas reserves – continue to decline. The expected lifetime for Canada's reserves has dropped below ten years for both oil and gas (Figure 5). In the case of oil,

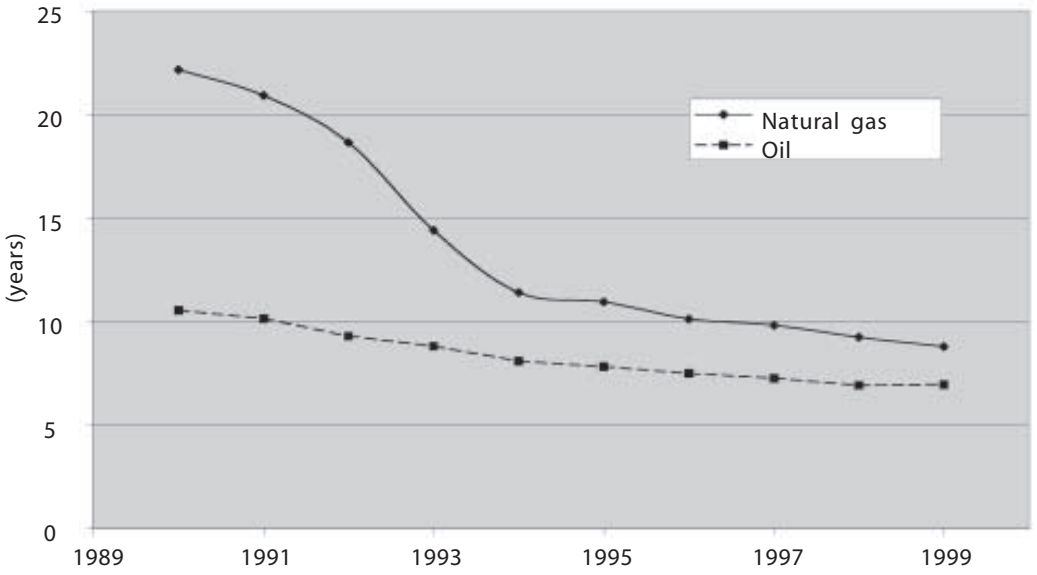
Figure 4: Canadian exports of oil and natural gas between 1990 and 1999



Source: Statistics Canada. 1991 to 2000. "Oil and Gas Extraction."

increased exports have meant a commensurate increased reliance on foreign supplies (Figure 6). Moreover, the energy required to extract the less accessible, remaining oil reserves continues to increase. Thus, our search for more oil and gas produces more greenhouse gases. The ratio of oil discovered to oil consumed in drilling and pumping has increased from 50-to-1 to 5-to-1.[95]

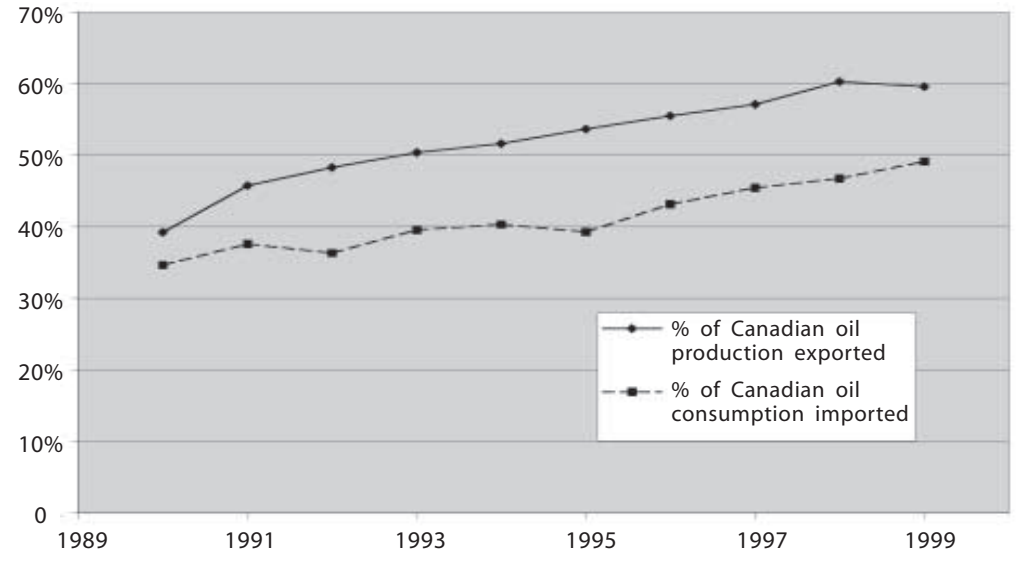
Figure 5: Expected lifetime of Canadian oil and gas reserves between 1990 and 1999



Note: Does not include Alberta's tar sands.

Source: Statistics Canada. 1991 to 2000. "Oil and Gas Extraction."

Figure 6: Canadian oil exports and imports between 1990 and 1999



Source: Statistics Canada. 1991 to 2000. "Oil and Gas Extraction."

Despite increased production of coal, oil, natural gas and electricity, employment has dropped in each of these industries.

One has to remember as well that oil reserves are mere estimates. No one is really sure how great a country's – or the world's – reserves really are since it is in the best interest of most players to overestimate the size of reserves. Oil company stock prices are highly dependent on the size of reserves to which they have access. And countries – net importers and net exporters alike – want to instill a sense of security within its citizenry no matter what the state of oil reserves.

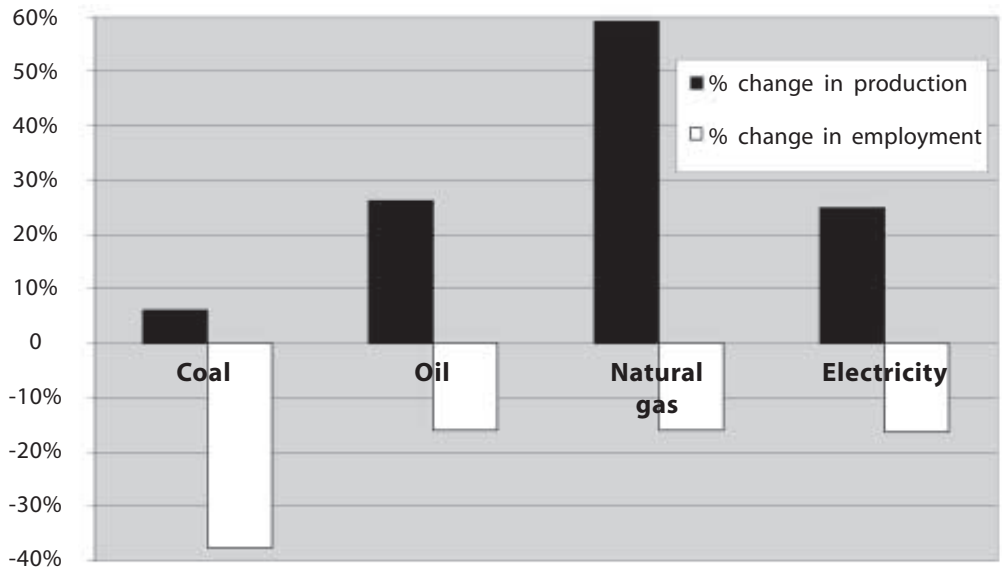
Employment statistics provide us with another surprising trend with respect to Canada's energy sector. Despite increased production of coal, oil, natural gas and electricity, employment has dropped in each of these industries (Figure 7). Even when accounting for increased employment in gas distribution, the workforce in the five sub-sectors shrank by 28,300 people (from 168,700 to 140,400) between 1991 and 2000.[96] When taking into account the 55,000 jobs shed from gasoline service stations, the energy sector in Canada employs 80,600 fewer workers in 1998 (280,000 employees) than it did in 1990 (360,600 employees).[97]

Greenhouse gas emissions

The energy production sector is a major contributor to Canada's greenhouse gas emissions. Even though the fossil fuel industry and the electricity generation sector each contribute only 16% of Canada's emissions (Figure 8), the majority of the emissions from transportation, industry, and buildings are due to the use of fossil fuels. The result is that over 85% of Canada's greenhouse gas emissions come from producing, transporting, processing, and consuming fossil fuels – coal, oil, and natural gas.[98]

Canadian greenhouse gas emissions have grown over the last decade by 15% (Figure 9).[99] Some sectors, like the non-fossil fuel industries, have shown little change in emissions while others have shown disturbing growth: fossil fuel industries (43%), commercial and public buildings (24%) and the transportation sector (20%).[100] According to official forecasts, unless Canada

Figure 7: Percentage change in Canadian energy production and employment between 1991 and 2000

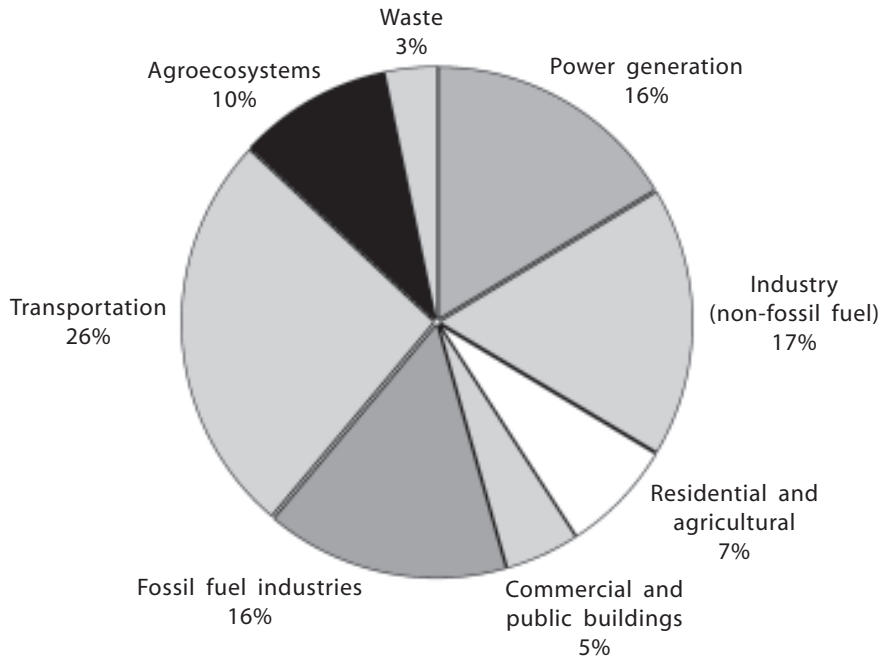


Note: Employment in Oil and Natural Gas averaged over both sectors.

Sources: 1. Statistics Canada. 2001. "Annual Estimates of Employment, Earnings, and Hours, 1991-2000."
2. Natural Resources Canada. 2000. "Energy in Canada 2000."

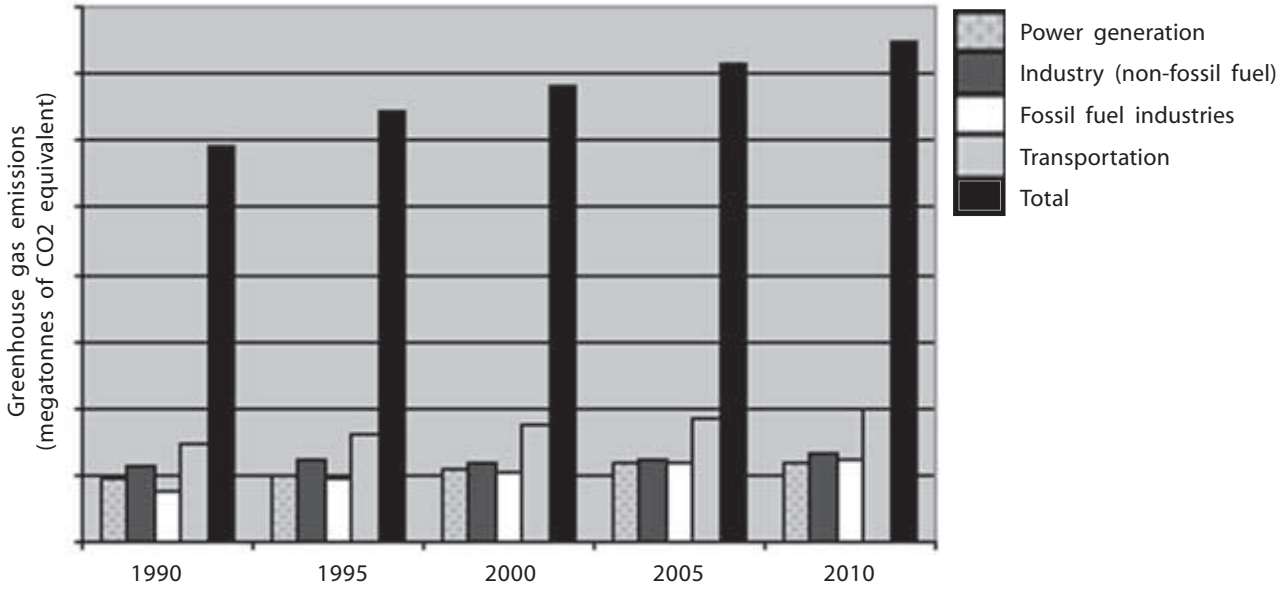
takes action to reduce its emissions, they are projected to grow to 26.8% above 1990 levels by 2010 – 32.8% above Canada's Kyoto commitment.[101] Other projections that take into account new energy project announcements show the "Kyoto gap" rising to 44% in the absence of policy changes.[102]

Figure 8: Canada's greenhouse gas emissions by sector, 2000



Source: Natural Resources Canada. 2000. "Energy in Canada 2000."

Figure 9: Canada's greenhouse gas emissions from major sectors, 2000



Note: Emissions from agriculture and agroecosystems, waste, and buildings included in Total but not shown individually.

Source: Natural Resources Canada. 2000. "Energy in Canada 2000: Statistical Series."

SECTION 3

A new energy economy

ADDRESSING CLIMATE CHANGE WILL NECESSARILY MEAN CHANGING OUR economic system in a way that minimizes greenhouse gas emissions. The undeniable link between energy production and consumption and greenhouse gas emissions indicates that this sector (along with the transportation sector) will have to undergo significant reform if we are to meet and surpass our commitments under the Kyoto Protocol. This section looks at viable projects that are already in place in Canada and that point to the future in terms of reducing our impact on the climate.

The good news is that, in many respects, a more sustainable world and economy is easy to envision.

The good news is that, in many respects, a more sustainable world and economy is easy to envision. Energy use can be decreased through a variety of means. We will use energy more efficiently by continuing to improve the technologies used in industrial processes; by changing how we heat, cool and insulate our homes, businesses, and public spaces; and by changing how we move people and goods. Personal behaviour will also change to decrease energy needs. Business trips requiring cross-country flights will be replaced by tele-conferencing, energy use in our homes will be consciously decreased, and convenient and cheap urban transit systems will be more heavily relied upon.

Just as importantly, the energy we do generate and use will be produced by technologies that emit fewer greenhouse gases, particularly carbon dioxide. Many renewable energy technologies are viable today, societal commitment remaining the only major obstacle to their widespread implementation. This section investigates a handful of case studies from across Canada that demonstrates the feasibility of a new energy economy.

CASE STUDY 1 Using the earth's energy in BC

Earth energy technologies use the ground's energy to both heat and cool buildings. There are different ways to capture this energy, the first being through a simple heat exchanger. At just a few metres of depth, the earth's temperature remains at a steady temperature of 5 to 10°C. By circulating water through a buried circuit of pipes, heat can be exchanged between the water and the earth. In the winter, energy is transferred from the ground to the water, and this energy is brought to the surface and can be used to heat buildings. In the summer, buildings can be cooled by shuttling its heat via the circulating water to the cooler ground. A small energy efficient pump is required to circulate the water, much like the pump used to deliver water to our taps.

Geothermal energy systems are a subset of the earth energy industry, since they also rely upon the earth's energy. These systems are different in that they go much deeper, using the much higher heat of the deep underground. Water is also circulated in this system, but at the surface, the very hot water is sent through a steam turbine to produce electricity. Rather than simply warming ambient air, geothermal electricity can also be used to power appliances, lights, or

electrical furnaces. These systems are more elaborate and expensive than the heat exchanger types, but like them, energy can be produced while emitting few greenhouse gases. Generating electricity with geothermal energy emits 0.1 kg of carbon per MWh, compared to 185 kg of carbon per MWh from coal-fired power plants.[103]

For individual buildings, installing earth energy systems requires a larger up-front cost than conventional heating systems, but they are usually much cheaper in the long run, having an average payback period of less than five years.[104] After this time, the owner experiences a net savings compared to conventional heating systems. The U.S. Environmental Protection Agency has touted these energy systems as the most energy-efficient, environmentally friendly, and cost-effective way to heat and cool buildings.[105] The larger up-front cost has deterred some from considering this relatively new energy system. Others have considered the lower life-cycle costs and low greenhouse gas emissions as good reasons to invest in earth energy systems.

The U.S. Environmental Protection Agency has touted earth energy systems as the most energy-efficient, environmentally friendly, and cost-effective way to heat and cool buildings.

Bob McMath Secondary School, in Richmond BC, decided to install an earth energy system. The school's 14,000 square metres are now being heated in the winter and cooled in the summer with this system. The Blue River Resort in BC's interior also decided to include the use of earth energy in its design, using Canadian technology. The resort's remote location increased the attractiveness of using earth energy, but numerous on-the-grid BC facilities have made the same choice. It is significant that earth energy is viable even in BC, where both winter and summer temperatures are more moderate than many places in Canada. Greater fluctuations in temperature increase the effectiveness of such systems, making their implementation even more attractive for provinces east of the Rockies.

CASE STUDY 2 Alberta wind power[106]

In 1991, discussions began between the Peigan National Indian Band and Chinook Project Inc. to plan and build a wind farm on the native band's reserve. Located just east of Pincher Creek, Alberta, the band was interested in a community economic development project that was environmentally sensitive.

Initially, the partners had problems finding finances for the project. Eventually, however, a new partner, Kenetech Corporation of San Francisco, emerged. Kenetech was building a similar, smaller wind project nearby and a proposal was made to combine the projects into one. Partial financing by the new partner in addition to the improved economies of scale led to the completion of the so-called Pe-Kun-Nee Project.

Foundations were completed in the fall of 1993 and spring of 1994. The turbines were installed shortly afterwards and, during the summer, connections were made to Alberta's electricity grid. After a short testing period, the 9.9 MW project began producing power in August 1994. Prompted by Alberta legislation (the Small Power Research and Development Act) the energy utility TransAlta signed a 20-year power purchase contract with the Pe-Kun-Nee Project proponents. This enabled the utility to offer interested customers renewable energy, albeit at a premium price.

The partners are now benefiting from a clean energy source that co-exists with cattle grazing in the area. Though local jobs were created in construction and operations, American technology and American workers were used to manufacture the turbines. In contrast, Gaspé Quebec's Le Nordais wind farm uses technology from a Quebec-based engineering and construction company.

CASE STUDY 3 The Toronto Atmospheric Fund[107]

In 1992, the City of Toronto established a $23 million fund (from the sale of property) in order to help the city reach its goal of reducing greenhouse gas emissions by 20% by 2005. Since then, the Toronto Atmospheric Fund has provided loans and grants to governments, businesses, and community organizations wanting to undertake suitable projects. On top of reducing greenhouse gas emissions, the projects also save the organizations energy and money, and create jobs in the local economy.

A number of initiatives were undertaken within the umbrella of the Fund, from helping homeowners find leaks in their homes and giving advice on insulation to purchasing renewable energy technology for Toronto parks and undertaking greening projects in Toronto schools. One initiative with tremendous potential for all areas of the country is the Better Building Partnership (BBP). This initiative involves retrofitting public and private sector buildings so that they use less energy and water. Already, over 10% of the building floor space in Metropolitan Toronto has been included in the program, including every school in the city.[108] The BBP is expected to reduce carbon dioxide emissions by 40,000 tonnes per year, save building owners $3 million annually in energy costs, and create 430 person-years of employment.[109] Partnerships are developed with others by providing $2 million in loan security, which reduces the payback period for these investments in energy conservation.

The City of Toronto realized $17.5 million in savings between 1993 and 2001 due to its conservation and renewable energy activities.[110] In part due to the work of the Toronto Atmospheric Fund, the city is on track to reduce greenhouse gas emissions by 20%.[111]

Gasoline with an ethanol blend burns more thoroughly, decreasing urban air pollutants like carbon monoxide and volatile organic compounds by as much as 30%.

CASE STUDY 4 Producing ethanol from biomass

It is possible to blend ethanol with regular gasoline to produce a fuel that has fewer environmental effects. Gasoline with an ethanol blend burns more thoroughly, decreasing urban air pollutants like carbon monoxide and volatile organic compounds by as much as 30%. Ethanol also displaces a certain percentage of gasoline – most blends are 10% ethanol, but automobile technology allows for 85% ethanol content[112] – decreasing the need for gasoline and the greenhouse gases associated with its production and consumption. In fact, because ethanol has a higher energy content than gasoline, a 10% ethanol blend decreases gasoline use by more than 10%.[113] Finally, ethanol is produced from biologically renewable sources, the fermenting of grain and wood products. The carbon dioxide released from producing and burning ethanol is 40% less than that absorbed by the plants used to produce the ethanol, leading to a net decrease in emissions.[114]

Of course, any corn or wheat that is used in the production of ethanol is not being used for food. This is somewhat offset by the fact that the by-product of ethanol production is a high protein cattle feed. Canada is presently a net importer of these expensive feeds. Thus, increasing ethanol production would decrease Canada's ability to grow food for human consumption, but also its reliance on cattle feed imports.

Ethanol is evolving to become an important fuel additive in North America. In the U.S. it represents 9% of gasoline sales. Current levels of ethanol use in Canada are more difficult to determine, but as of 1998, nearly 1000 gas stations across Canada sold ethanol-blended gasoline. Ethanol production in Canada more than doubled in the late 1990s, with year 2000 production estimated at 675 million litres.[115] Part of this production was used to manufacture cosmetics, detergent, and food, as well as fuel.

Ethanol is manufactured in Quebec, Ontario and the three Prairie provinces. All of the existing facilities produce ethanol from wheat or corn, except the Tembec plant in Temiscaming, Quebec. It uses wood waste from its forestry operations to produce 18 million litres of ethanol per year.[116] This source of energy can be truly sustainable if the wood waste comes from sustainable forestry operations, logging that does not diminish the standing volume of timber or the forest's biodiversity.

CASE STUDY 5 Energy efficiency at Labatt brewery

Labatt exceeded its goal by decreasing energy use per unit of production across its many operations by 25% between 1993 and 1998.

Many of the previous case studies have featured viable technologies that create energy in ways that involve fewer greenhouse gas emissions. However, through vehicles such as the Toronto Atmospheric Fund, there are also many options for using *less* energy to accomplish the same task, whether it is heating our homes and offices or manufacturing industrial products. The latter involves firms investing in energy efficiency measures to reduce overall energy use. This may include purchasing equipment that has a higher efficiency. It may also mean changing industrial processes so that less energy (and water and other inputs) is required. And more than likely, it should involve the active participation of workers, allowing them to bring forward and implement different ideas that will save companies energy and money.

It is imperative for industry to play an active part in decreasing greenhouse gas emissions. The majority of Canada's greenhouse gas emissions are released as a result of industrial operations.[117] Furthermore, industry's emissions are increasing at a rate that exceeds the growth of emissions from other sectors.[118] Many of the changes that can be made in industry are referred to as the "low-hanging fruit" because decreasing energy use means decreasing costs and improving the bottom line. This was certainly the case for the Labatt Brewing Company.

Labatt decided back in 1992 that it would decrease its energy use by 3% per year over the following five years. It also established targets for decreasing water usage. These goals were entrenched in their corporate philosophy by setting up a national environmental office at their London, Ontario headquarters that allowed for communication between individual worksites across Canada to share successes and lessons. Each worksite also established an environmental and energy committee and appointed an energy coordinator. Employees at all levels were brought into the process.

Results have been encouraging. Labatt exceeded its goal by decreasing energy use per unit of production across its many operations by 25% between 1993 and 1998.[119] Its energy use now compares favourably to the brewery sector average.[120] These energy improvements were verified through an energy audit.

Labatt has used these accomplishments to attempt to boost its image as a good corporate citizen. A national industry award for energy efficiency undoubtedly helped in this regard. Just as importantly, if not more so, are the cost savings involved in becoming more energy efficient.

SECTION 4

Making the new energy economy a reality

THIS SECTION INVESTIGATES POLICIES THAT THE CANADIAN AND PROVINCIAL governments can employ to move the economy in a new direction, to encourage the implementation of the technologies and activities highlighted in the previous section, and to decrease Canadians' impact on the atmosphere and the climate. Clearly, there are barriers to overcome.

Between 1970 and 1999, the federal government alone gave the oil and gas industry over $40 billion in direct subsidies, in addition to billions in loan write-offs.

The proven economic viability of many renewable energy, energy efficiency, and energy conservation programs begs the question: Why do these activities make up such a small fraction of Canada's energy sector? A large part of the answer lies in inertia – the fact that we have been doing things a certain way for a long time now. These activities are entrenched in the available infrastructure that facilitates them. Rail lines bring coal to market, the electricity grid connects power plants and hydro dams with power consumers, and gas stations on every corner allow for quick and easy fill-ups for vehicle drivers. On the other hand, there are no hydrogen refueling stations for filling up a vehicle powered by a fuel cell. Once connected to the grid, it likely seems less compelling – or even pointless – for a community or business or household to try to become self-sufficient in electricity through renewable energy sources. And to some, such as U.S. Vice-President Dick Cheney, conservation is antithetical to a prosperous society.

Another important reason for the dearth of renewable energy sources is the continued government support for non-renewable energy. Between 1970 and 1999, the federal government alone gave the oil and gas industry over $40 billion in direct subsidies, in addition to billions in loan write-offs.[121] Over the same time period, the federal government has subsidized the nuclear industry by an average of $170 million per year.[122]

This government policy was understandable in the 1970s, when Canada appeared blessed with limitless energy resources, climate change was not an issue, and few alternatives existed. However, the policy persisted through the 1990s. Though direct subsidies to the oil and gas industry are dropping overall, the federal government countered dwindling conventional oil reserves by allocating over $2 billion in federal money and granting another $2.4 billion in loan guarantees to Newfoundland's Hibernia offshore oil project.[123] Meanwhile, the renewable energy industry received only $12 million in subsidies in 2000, mostly in the form of research and development programs and tax incentives.[124]

Subsidies to conventional energy production not only exist in the form of direct cash transfers, tax credits, and loan guarantees. These operations are also subsidized by not having to pay the full costs of their activities. For example, the cost of treating health problems – asthma and other respiratory illnesses – created by burning oil and gas are not paid by oil and gas compa-

nies. These costs are borne by the public and individuals. If these costs were internalized (included in the price of buying and using fossil fuels), technologies that do not create air pollution would be much more viable, and much more prominent in Canada's energy mix.

Canada should be most concerned about being uncompetitive in emerging industries, rather than worrying about propping up traditional energy industries.

One final reason for the lack of progress in Canada with respect to renewable energy has to do with economies of scale. With little production, the unit cost of producing power from any technology is very high. As production increases, the cost of producing every unit of power declines.

There are other parts of the world, however, where renewable energy plays a much larger role. Many European countries, for example, recognized that there is a need for government policy to overcome some of the aforementioned barriers to implementing renewable technology and energy efficiency projects. Government incentives and disincentives have enabled renewable energy industries to flourish in many countries. As of 1999, Sweden had 30,000 units that use the earth's energy to warm and cool buildings.[125] Germany, a smaller, more densely populated country than Canada, produces 20 times the wind energy that our country does.[126] And Denmark leads the world in the proportion of energy needs met by renewable technology. Worldwide, the production of electricity from renewable technologies has had double-digit annual growth over the last decade.[127] EU member states have adopted a collective target of having 12% of their energy and 22% of their electricity supplied from renewable sources by the end of this decade.[128]

These European nations now have a competitive advantage over Canada. They are developing new technologies and industries that the world will inevitably be relying on in the not-so-distant future. Being ahead of the curve means their technologies are more advanced, benefiting from years – even decades – of lessons in how to develop more efficient technologies and manufacturing processes. These technologies will be imported by Canada – for example, the massive wind turbine destined for Toronto's waterfront will be imported from the Netherlands[129] – rather than be developed here. European jobs will thus be created not only through firms manufacturing energy technologies for their domestic markets, but also through exporting these technologies to countries without their own homegrown industries. This should be Canada's biggest concern, being uncompetitive in emerging industries, rather than worrying about propping up traditional energy industries.

Canadian policies to decrease greenhouse gas emissions

The Canadian government, once it made commitments in the Kyoto Protocol to reduce its greenhouse gas emissions, set up a process to determine how the country could meet its targets. The National Climate Change Process (NCCP) involved the creation of 14 roundtables of experts from industry, government, and non-governmental organizations, each of which was commissioned to analyze one issue or sector of the Canadian economy and determine where emissions could be reduced and by what means.[130] The National Climate Change Secretariat oversees and coordinates the process.

While firm targets and timetables for emissions reductions were not part of the direction to the Tables, the range of policy proposals/options that came out of this multi-year process is staggering. The Buildings roundtable subdivided into a residential building and commercial building group, with each suggesting various policy options for decreasing greenhouse gas emissions from buildings.[131] Examples include better national energy codes for buildings, retrofit

programs for existing buildings, tax measures such as eliminating the PST or GST on the purchase of energy efficiency equipment, and government procurement programs for high efficiency building products.

The Transportation table developed options for decreasing greenhouse gases from various forms of transportation.[132] Passenger travel could be modified by exempting transit passes as a taxable benefit, enhancing transit options for commuters, enforcing speed limits, and converting highway lanes to high occupancy lanes. Vehicles and fuels could be improved by mandating updated fuel efficiency standards in cars and trucks and mandating that gasoline contain 10% ethanol. Shifting freight from road onto rail could decrease emissions from freight transportation. Finally, fuel taxes would provide incentives for cleaner transportation options.

The Industry table produced options that were much less diverse than the other roundtables.[133] The options paper rejected policies that would increase costs to industry through the use of a carbon emissions tax, an emissions trading system, or indeed any government measure. The solutions proposed were mostly voluntary measures, such as investments in energy efficiency, meant to produce cost savings while reducing greenhouse gas emissions. This approach has already been in place for many years and unfortunately, with few exceptions, has failed to alter the upward trend of emissions.

The Electricity table suggested a diverse list of policy options, including: providing consumers with more information on the electricity generation mix; incorporating greenhouse gas considerations in the review and approval process of new energy projects; mandating increased reliance on renewable energy within the electricity portfolio; extending government support for renewable energy generation; and establishing demand-side management programs that reduce energy need.[134] Nova Scotia has already acted upon one recommendation by offering a 30% tax credit for investments that reduce greenhouse gas emissions, particularly wind power.[135] One of the most contentious issues that arose with respect to electricity generation was the role of nuclear power. (See *Nuclear power and climate change*).

Nuclear power and climate change

The role of nuclear energy in resisting climate change is controversial. The nuclear industry and the union representing nuclear power workers in Ontario tout this form of energy because of its low greenhouse gas emissions. Indeed, Ontario's greenhouse gas emissions per unit of electricity produced are lower than other provinces that rely on coal because of Ontario's reliance on nuclear power.

Environmentalists and other concerned citizens, on the other hand, have argued that the highly radioactive waste created by the industry render it an unsustainable energy source, especially when renewable energy technologies are viable. Disposal of nuclear waste *is* problematic and expensive. The U.S. nuclear industry is tunneling into a mountain in Nevada to create a storage space for its nuclear waste, but its waste already exceeds the tunnel's capacity. By 2010 when the tunnel is completed, more storage capacity will have to be found. The Atomic Energy of Canada has been studying the possibility of burying the Canadian industry's nuclear waste in the Canadian Shield.[136]

The safety of nuclear power plants is also an issue for much of the Canadian public. Add to these concerns the relatively high cost of nuclear energy, and the result is that Canada has not increased its nuclear capacity since the 1970s. It remains to be seen how the Canadian public would react to the construction of nuclear power plants in the future.

At the Electricity roundtable of the NCCP, the participants were not able to come to consensus, the final agreement being that extending the life of existing nuclear power plants may be a part of reducing greenhouse gas emissions, but the future role of nuclear power needs to be clarified. It is the view of this study, however, that while nuclear energy does indeed produce few greenhouse gases, it makes little sense to substitute one environmental problem for another. Therefore, an increase in nuclear power production does not form part of the Just Transition and alternative energy plan laid out later in this paper.

Impacts of government policy

One very important issue table in the NCCP has been the Analysis and Modelling Group (AMG). This roundtable includes analysts who use simulation models to determine the result of the policies proposed by the other issue tables. Two microeconomic models (CIMS and MARKAL) have been used to determine to what extent government policies would induce technological and behavioural change, and to predict the effect on greenhouse gas emissions of those changes.[137] These microeconomic changes were then used to model the effects on macroeconomic variables, including gross domestic product (GDP) and employment.[138] (For more on computer models, see *Using computer models to inform decision-making* on page 36).

The results of a modelling exercise are dependent on the assumptions that are made when constructing the model. Since the future is uncertain, the AMG picked various domestic and international scenarios and predicted future outcomes based on the different possibilities. Three different international scenarios were chosen[139]:

1. Canada acts alone in reducing its greenhouse gas emissions.
2. Canada acts in concert with other countries, but the mechanisms (such as emissions trading and emissions permits, described in Section 1) are limited (Kyoto Tight).
3. Canada acts in concert with other countries and a wide range of mechanisms is available (Kyoto Loose).

Next, five different paths to achieving greenhouse gas reductions were modelled[140]:

Path 0: The result of implementing all the policies from the issue tables.

Path 1: Each sector achieves the –6% target using the issue Table options, supplemented by domestic emissions trading for electricity generation and a fuel tax for transportation fuels.

Path 2: The –6% target is established nationally, with measures and actions taken in order of cost effectiveness; the larger emitters (approximately 35% of emissions) use an emissions trading system.

Path 3: Emissions trading is allowed but each sector is required to reach the –6% target.

Path 4: Similar to Path 2, except emissions trading is established over as much of the economy as is practical (up to 85%).

The results of the modelling exercise are quite instructive.[141] Paths 0 and 1 were rejected since they did not enable Canada to reach its Kyoto targets of –6% by 2010, but Paths 2, 3, and 4 did meet this target.[142] On the other hand, if Canada undertook a business-as-usual (BAU) approach – implementing no policies to reduce greenhouse gas emissions – greenhouse gas emissions are projected to be 24% above 1990 levels by 2010, comparable to Natural Resource Canada's figure of 26.8%.

The effects on future economic activity in Canada (usually measured by projected GDP growth) based on the various international scenarios and domestic paths are remarkably consistent. Meeting the Kyoto commitments would result in long-term economic impacts. Nationally, the reduction in GDP relative to business-as-usual ranges from 0 to 3% depending on the path taken.[143] Putting this into perspective is important. Since the economy is projected to grow by 30% between now and 2010, meeting the Kyoto targets would mean that Canada's economy will grow instead by 27 to 30%. Assuming the worst-case scenario in this range would mean the loss of $40 billion from our economy by 2010.[144] The best-case scenario is, of course, that there would be no net cost to the Canadian economy. A more realistic scenario than either of these is a 1% GDP decrease over ten years, or an economic hit of approximately $13 billion.

The Canadian economy is presently over $1 trillion (over $1,000 billion). A $13 billion cost (spread over ten years) is a small price to pay to address climate change and meet international obligations.

This number needs to be put into perspective. The Canadian economy is presently over $1 trillion (over $1000 billion). Based on the AMG's analysis, Canada's economy will grow by $300 billion between 2000 and 2010. Not too long ago, federal Finance Minister Paul Martin was grappling with how to spend a $100 billion budget surplus over five years. Compared to these figures, a $13 billion cost (spread over ten years) is a small price for Canada to pay to address climate change and meet its international obligations. Furthermore, it is important to note that these models do not take into account the benefits of action, such as health benefits from improved air quality, or the costs of inaction, including more severe Prairie droughts or more frequent extreme weather events.

The small cost estimate is consistent with many other studies. A 1998 study estimated that decreasing our greenhouse gas emissions to 1990 levels would reduce Canada's GDP by 2% over the first ten years, but then recover shortly thereafter to business-as-usual levels.[145] A literature review of cost assessments for the U.S. to meets its Kyoto Protocol commitments was also in line with the National Climate Change Process' AMG. The review concluded that our southern neigh-

Using computer models to inform decision-making

Computer simulation models are increasingly being relied upon in science as important tools for analyzing complex problems. Atmospheric scientists have used models to predict future concentrations of carbon dioxide in the atmosphere and the extent of climate change (warming, sea level rise, changes in precipitation) we can expect in the future. The Analysis and Modelling Group, part of Canada's National Climate Change Process, used models to estimate the level of economic activity in Canada over the next two decades and the effect on the national economy of reducing greenhouse gas emissions.

Understandably, the use of models makes some nervous. Few people have any idea how simulation models work, and that lack of knowledge fosters skepticism. The assumptions made when building computer models can also be called into question. Nevertheless, it is clear that the use of models clarifies and aids in the development of science and the identification of where research needs to be directed in the future. Predicting the future will never be an exact science. But the usefulness of models is to identify major trends and important processes. The alternative is to operate with even less information.

For example, as mentioned, computer simulation models of global warming predict a temperature rise of 1.7 to 5.8°C over the next century. Clearly, there is uncertainty inherent in that range. The important point to remember is that the temperature trend is upward and the increase will not be trivial. The work of the Analysis and Modelling Group provides us with more examples. They found that meeting the Kyoto targets of 6% below 1990 emission levels of greenhouse gases will result in a 0-3% decline in Canada's GDP growth rate over the next ten years. Again, there is uncertainty within this range, but this is explicitly acknowledged. Knowing that the impact isn't likely to be 10% or more is useful information that should guide decision-making.

Comparing model predictions to actual measured phenomenon can also be instructive. In the early 1990s, global simulation models predicted consistently higher temperatures compared to actual temperature readings. Modellers and atmospheric scientists couldn't explain the discrepancy. Eventually, it was determined by atmospheric chemists that sulphur dioxide, a gas released into the atmosphere from the burning of coal and oil, had an opposite effect to greenhouse gases; that is, this pollutant reflected incoming solar radiation, essentially making the earth cooler than it would have otherwise been. When this result was included in atmospheric models, actual and predicted temperatures fell into line, teaching environmental scientists and modellers alike that the effect of sulphur dioxide in the atmosphere was important, and reaffirming the validity of the computer models they were using.

It is of paramount importance when using simulation models that the uncertainty that is present is acknowledged and considered when making decisions. Rejecting the use of computer models because of that uncertainty, however, leads to decisions that are even more uncertain and less verifiable.

bours, with a similar economy to our own, could reduce greenhouse gases with overall economic savings or at modest cost.[146]

Economic impacts will vary over time. Initially, GDP may actually increase compared to BAU, since investments in emissions-reducing technologies will be required. GDP will gradually decline, however, below otherwise expected values due to increased production costs and a deterioration in competitiveness compared to other nations, most notably the U.S. Long-term competitiveness improves due to improved energy efficiency.

Interestingly, which international scenario is realized does not change the impact on Canada's economy.[147] When Canada acts alone, its GDP is reduced slightly because of competitiveness issues with other countries, especially the U.S. (by far, our largest trading partner). The cost of production increases slightly, and so our exports decline. When other countries are also reducing their emissions, Canada's GDP is reduced because other economies have less demand for our exports, including Canadian energy. The effect is small enough (0.5% of GDP in each case) that the different domestic paths play a much more important role in determining where in the 0 to 3% range the GDP impacts will fall.[148] For example, Path 3, which requires every sector to reach the –6% target, has larger impacts on the Canadian economy. Paths 2 and 4, on the other hand, which rely more on domestic emissions trading, minimize the impact so that, overall, Canada's GDP falls by no more than 1% compared to the business-as-usual situation.

Regional effects vary by scenario, though provincial GDP impacts stay generally within 1.5% of the national average.[149] Alberta is also within this range, despite the fact that it is often depicted as having to bear the brunt of Canada acting on its Kyoto commitments. Alberta's energy-dependent economy would actually have economic effects similar to the national average under the Canada-acts-alone scenario, though other international scenarios would mean slightly larger GDP impacts for the province.[150]

There are numerous reasons to decrease our production and consumption of fossil fuels that go beyond climate.

Other reasons to decrease our reliance on fossil fuels

The potential risks associated with climate change are reason enough for Canada to act. The relatively small negative impact on our national economy removes any purely economic reason not to act. Proponents of inaction cite the costs of mitigating climate change and often ignore the benefits of doing so. The reality is that there are numerous reasons to decrease our production and consumption of fossil fuels that go beyond climate, including improvements in air quality and public health; increased job opportunities in energy conservation and renewable energy production; and increased competitiveness.

One of the most important considerations that is too often left out of cost-benefit analyses is air quality. The same activities that are responsible for climate change – the burning of fossil fuels in power plants, homes, and vehicles – also create air pollution problems. Thus, when we act to reduce climate change, we also address other environmental problems at the same time. Urban air pollution is created by pollutants other than carbon dioxide that are released when we burn coal, oil, natural gas, and gasoline. These pollutants include: nitrogen oxides, most closely associated with vehicle transportation and industry; and sulphur oxides, associated with industrial activities like producing power from coal. Sulphur compounds are fine particulates that bypass our bodies' natural filters and damage our lungs. Nitrogen and sulphur dioxides also combine with moisture in the air to create acid rain. Carbon monoxide and volatile organic compounds are both harmful air pollutants created when fuels are improperly burnt. Finally, benzene is a carcinogen found in gasoline and other fuels.

Sulphur contents vary by fuel, with coal having the highest proportion of sulphur, followed by diesel fuel, oil, gasoline, and natural gas. When it is stated that natural gas is a "clean" fuel, it

is the sulphur content that is being referred to. "Clean" coal is called that not because it is inherently clean or that it releases less carbon dioxide when it is burnt, but because less sulphur is released. Nothing can be done to change the amount of carbon dioxide released, and therefore the magnitude of the climate change effect, when one burns any fossil fuel. Many hope that one day we will be able to capture vast amounts of carbon dioxide and inject it deep in the ground, thus preventing it from affecting the Earth's climate, but this technology has not been developed yet, and may never be.

There are reasons to believe that a focus on energy efficiency would actually increase industrial competitiveness and be a relief, not a burden, to an economy.

There have been important improvements in technologies to decrease pollutants other than carbon dioxide from being released into the atmosphere. Nonetheless, the cost of air pollution is still substantial. Environment Canada has estimated that the health costs of smog in the Georgia Basin of British Columbia alone will be $1.5 billion per year in 2005.[151] A literature review that synthesized the research on the costs of air pollution estimated that in the U.S. annual health costs from motor vehicle emissions total between U.S.$29.3 and U.S.$542.4 billion.[152] This does not include the cost of other air pollution impacts (e.g. agricultural crop losses and damage to buildings), the cost of water pollution that results from fossil fuel use, and the costs of subsidizing the fossil fuel industry. If all these costs were included in its price, Canadian gasoline would cost between CAN$2.00 and CAN$5.40 per litre.[153]

Research undertaken by the Analysis and Modelling Group has found that Canada's air quality will improve if it meets its commitments of the Kyoto Protocol. Sulphur and nitrogen oxide emissions will decrease by approximately 15% and 10% respectively by 2010.[154] Fine particulate and volatile organic carbon emissions – components of urban air pollution – will decrease marginally (1-2%). A conservative estimate – for eastern Canada alone and including only benefits of decreased mortality – for the value of these air quality improvements is $350 to $580 million per year.[155] These improvements in air quality will clearly be tempered by a reliance on international mechanisms like joint implementation and international emissions trading. The more these programs are relied upon, the less we can expect air quality to improve, even if Canada meets its Kyoto commitments.

Employment is another reason to pursue greenhouse gas emission reductions. A literature review commissioned by Environment Canada compiled published research on the job creation potential of various energy projects and concluded "energy efficiency and renewable energy should be aggressively pursued as important positive contributors to the federal government's job creation strategy."[156] The reason is that conventional energy projects – including oil and gas production, coal mining, and oil refining – created, on average, 7.3 jobs per million dollars invested (JPM). [157] By comparison, renewable energy projects create, on average, 12.2 JPM and energy efficiency/conservation projects create 36.6 JPM, averaging five times more jobs on an investment basis.[158] The reason for the large job creation potential of conservation is two-fold: retrofitting buildings so that they need less energy is highly labour-intensive; and decreased energy costs mean people have more money to spend in the local economy, which creates jobs.

Finally, there are reasons to believe that a focus on energy efficiency would actually increase industrial competitiveness and be a relief, not a burden, to an economy.[159] As energy becomes more expensive (due to energy taxes or other policies introduced to decrease air pollution and greenhouse gas emissions), investments in energy efficiency will be undertaken that can create more employment and less pollution, all at lower costs.[160] A recent report by the Arlington-based Pew Center on Global Climate Change documented how six large companies decided to meet climate-related targets.[161] The only thing common to the companies was that each believed it would improve their bottom-line and market position.

Jobs and Just Transition

IN THIS NEXT SECTION, WE INVESTIGATE THE LIKELY IMPACTS ON EMPLOYMENT in the energy sector of Canada adopting policies that will allow it to reach its Kyoto commitments. In addition, a Just Transition program will be presented to show how we can ensure that energy sector workers are not left to bear the brunt of taking action.

It is clear from the previous section that different models, different international scenarios, and different domestic paths (looking only at the paths that allow Canada to achieve its targets) show relatively small variation in their effect on greenhouse gas emissions and national GDP. However, in order to delve a little deeper into the national and regional effects on employment and energy sub-sectors of the economy (and in the interest of simplicity), we need to pick one scenario – the most likely one – and use it to test employment impacts.

Impacts on employment: A likely scenario

There are many options to choose from. For various reasons, the model-scenario-path combination chosen here is CIMS – Canada Acts Alone International Scenarios – Path 4 (hereafter called 4CA). This combination offers a reasonable estimate of the expected economic impacts, yet one that tends towards overestimating the costs. The CIMS and MARKAL models differ slightly in their assessment of economic adjustment costs. Generally, the MARKAL model is more optimistic about the ability of the economy to adjust to the policies that are implemented.[162] Using the CIMS model is therefore a more conservative choice (one that predicts higher economic costs). The U.S. is Canada's major trading partner and is reluctant to sign on to the Bonn agreement. Thus, the Canada Acts Alone international scenario appears to be a more appropriate choice. As explained, the international scenarios do not have much effect on expected nation-wide economic effects, though they do influence how the regions' economies will be affected. Finally, it is widely believed that Canada will attempt to meet the Kyoto protocol through economy-wide (on top of sector-specific) reductions, and will use a domestic trading mechanism. That is because this approach will reduce negative effects on projected growth rates for Canada's domestic economy. Consequently, Path 4 was chosen for our analysis.

Overall, the AMG analysis forecasts that there will be 1,468,000 more jobs in Canada in 2010 compared to 2000.[163] This is in stark contrast to the Canadian Manufacturers and Exporters' (CME) claim that Canada will lose 450,000 jobs in manufacturing alone.[164] The CME report also uses the AMG's analysis but severely distorts the numbers, most importantly by considering the loss of jobs from action on climate change, but not the increase in employment created from a 30% growth in the economy. Furthermore, the CME report uses the worst-case scenario (as-

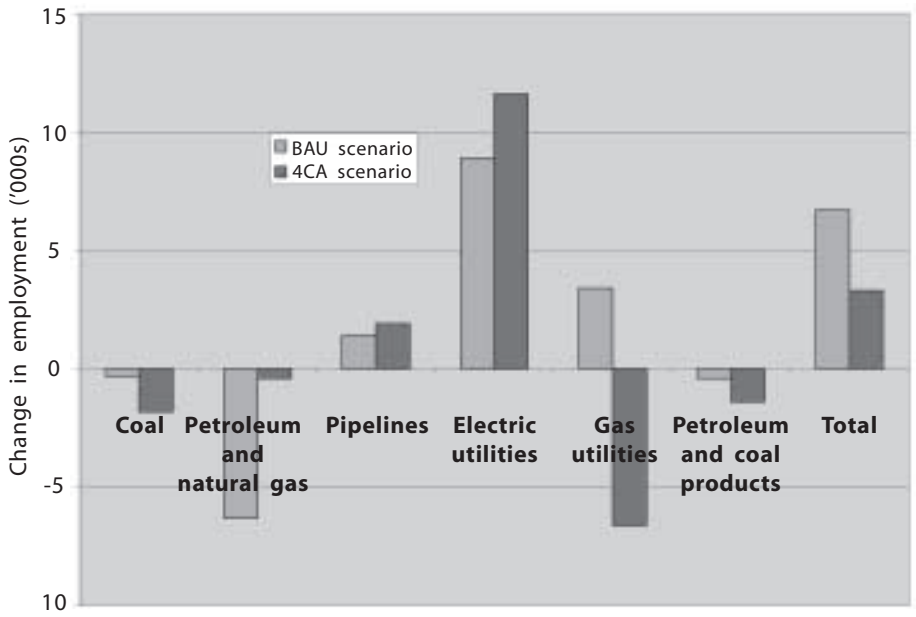
suming every sector will have to meet the Kyoto target of –6%) despite the Canadian federal government's stated preference for domestic trading, which means that Kyoto will be met over the whole economy, not sector-by-sector. Even when applying these distortions and omissions, it is still impossible to determine how the CME derived its estimate. This analysis will, therefore, rely upon the data provided by the AMG.

The AMG forecasts that employment will increase in energy sub-sectors.[165] The six sub-sectors that were related to fossil fuel production were coal mining, petroleum and natural gas production, pipeline construction and maintenance, electric utilities, gas utilities, and petroleum and coal product manufacturing. Total national employment in these six sub-sectors under scenario 4CA (which allows Canada to meet its Kyoto obligations) will *increase* by 3,200 workers by 2010.

This figure, however, masks the fact that employment in each sub-sector varies considerably, with job losses in one industry offset by job gains in another. Specifically, according to the model, if Canada was to get serious about its Kyoto commitments, employment in coal mining would steadily decline by approximately 1,700 workers. The number of jobs in oil and gas fields would increase by almost 9,000 jobs in the first five years due to increasing production. (Later in this document, we will propose how to redirect oil and gas production towards value-added industries that creates more Canadian jobs, rather than continuing to increase exports to the U.S.) After 2005, employment declines to 2000 levels by 2010, since growth in production begins to decelerate and productivity continues to increase – in line with historical trends that have no link to Kyoto-based policies or actions.

Pipeline operation jobs would steadily increase by about 1,900 jobs between 2000 and 2010. The largest predicted increase in jobs would occur in electric utilities, with that sub-sector increasing its job rolls by 11,600 workers. On the other hand, gas utilities (companies such as BC Gas and TransAlta that deliver natural gas to households) would lose 6,600 workers. Finally, petroleum and coal product manufacturing would have 1,400 fewer workers by 2010.

Figure 10: Predicted change in employment in energy sub-sectors between 1990 and 2000



Source: Raw data obtained from Informetrica. Their analysis is found in Informetrica, Ltd. 2000. "Macroeconomic Impacts of Greenhouse Gas Reduction Options: National and Provincial Effects."

These model results are for a time period that began two years ago. Were Canada to ratify Kyoto this year and begin implementing policies to decrease our greenhouse gas emissions, the macro-economic effects estimated by the Analysis and Modelling Group and summarized here – GDP impacts and employment changes – would occur in the next ten year period (up to 2012).

Comparing the 4CA scenario to a business-as-usual (BAU) scenario reveals how action on climate change alters employment (Figure 10). Overall, employment will increase by 6,700 employees in the energy sector if nothing is done about climate change, so the difference between acting and not is 3,500 jobs. Again, however, this masks the sectoral and regional job losses and gains.

Coal mining will lose more workers under 4CA because energy prices will go up, especially for coal because of its high carbon content (the burning of coal produces more carbon dioxide than producing the same energy from oil or natural gas).[166] The oil and natural gas industries will actually lose fewer workers under 4CA than under BAU. This is because producers of these fossil fuels are also consumers of energy. Therefore, higher energy prices will induce these companies to invest in energy efficiency, buying more energy-efficient equipment and retrofitting some existing machinery, equipment, and buildings. Investments in all of these areas will create employment. Essentially, since the cost of labour relative to energy will go down, companies will shift inputs in a way that increases employment but decreases energy use. This boost in employment will overwhelm the loss of employment in oil fields resulting from reduced overall sales. In the long run, however, these efficiency investments will further boost productivity, reducing the overall employment growth in oil and gas production. Also, the model makes a reasonable assumption that any decrease in oil sales will decrease imports of oil, not decrease domestic production.

Pipeline operations will also receive a modest boost in employment under 4CA. Climate change policies will not on their own decrease pipeline capacity to the U.S. since, under the Kyoto Protocol, countries are responsible for fossil fuels they burn, not those they produce for export. With the U.S. doing nothing to reduce their emissions, pipelines will not stop being built. (The solution for Canada is to direct pipeline construction in such a way that Canada shifts the destination of its natural gas from the U.S. to its value-added products on this side of the border.)

Electric utilities will increase employment because the Canadian economy will shift towards cleaner electricity sources, which create more jobs. This – and labour productivity gains (being able to create the same output with fewer workers) – is also the reason that gas utilities will experience significant job losses. Residential and industrial users of natural gas will shift towards other energy sources or employ conservation measures to decrease their demand. Finally, increased prices for coal and petroleum will decrease the manufacturing of products from these supplies.

Table 5: Changes in employment by sub-sector and province between 2000 and 2010 (assuming Scenario 4ca)

	Coal	Petr. & nat. gas	Pipelines	Electric utilities	Gas utilities	Petr. & coal products	Job losses	Job gains	Net
Newfoundland		700		1,300				2,000	2,000
Nova Scotia	-2,300			200			-2,300	200	-2,100
New Brunswick	-100			100		-100	-200	100	-100
Quebec				1,900	-500	-400	-900	1,900	1,000
Ontario			100	5,300	-2,700	-400	-3,100	5,400	2,300
Manitoba			100	900	-100		-100	1,000	900
Saskatchewan	-200	-300	600	200	-400	-100	-1,000	800	-200
Alberta	2,000	-700	800	800	-2,100	-400	-3,200	3,600	400
BC	-1,100	-100	200	800	-800		-2,000	1,000	-1,000
Total	-1,700	-400	1,800	11,500	-6,600	-1,400	-12,800	16,000	3,200

Notes: 1. PEI and the Territories are not included since there are no employment effects in these jurisdictions.
2. All blank spaces mean no change in employment or no industry exists in that province.

Source: Informetrica, Ltd. 2000. "Macroeconomic Impacts of Greenhouse Gas Reduction Options: National and Provincial Effects." Raw data not included in publication.

Regional effects on employment

Given the general projections above, it is necessary to scratch a little deeper to truly reveal what will happen to energy workers in Canada. Taking a look at the energy sector job losses and gains in the different Canadian provinces helps to isolate the problems to be solved as well as the opportunities for solving them (Table 5).

Many provinces – Newfoundland, PEI, New Brunswick, and Manitoba – and the territories experience no overall job losses or actually gain jobs (ignoring job losses of 100 employees or less). Nova Scotia will lose 2,300 coal miners, something that has already largely happened, with the Canadian government closing the last Cape Breton Island mine. Quebec and Ontario will lose jobs in gas utilities and coal/petroleum product manufacturing but will gain more in electric utilities. Saskatchewan and Alberta will experience a mix of job losses and gains in various subsectors, with Saskatchewan losing slightly more jobs overall and Alberta gaining slightly more. BC will be one of the harder hit provinces in terms of net job loss.

It is important to note that other scenarios modelled by the AMG found different results. For example, the Kyoto Loose and Kyoto Tight model scenarios forecasted slightly lower job losses than the Canada Acts Alone scenario. For both the KL and KT scenarios, however, the job impacts are somewhat more concentrated on Alberta, compared to the CA scenario.

A Just Transition plan for workers

It is not good enough to say that there will be a net gain of jobs in most provinces so we need not worry about transition.

The goal of a Just Transition program is to give workers who have lost their jobs (due to action on climate change) as many options as possible with respect to their future. Re-employment is the goal for a majority of these workers. Some workers will find another job quickly and easily. Others will require, or want, training and/or educational opportunities. Some older workers who are close to retirement may simply be interested in an income for a year or more until they can retire. The key is to provide as many options as possible and allow flexibility so workers themselves can choose their desired path.

In this regard, the important column to consider in Table 5 is the job loss category. It is not good enough to say that there will be a net gain of jobs in most provinces so we need not worry about transition. Ideally, those losing their jobs elsewhere will fill many of the jobs created, but this will not necessarily be the case. Job locations may be different even within the same province. The skill sets required in different positions may vary considerably. Additionally, Canada will face a growing labour force, with more seeking employment and competing for new jobs. It is therefore possible that an older worker looking for work will be overlooked in favour of younger blood, even if the older worker has the requisite skills and education. A comprehensive Just Transition (JT) program would therefore include all 12,800 workers who may be impacted over the next ten years as a result of climate protection actions.

So what would the components of a successful JT program include? Displaced workers should have access to: peer counseling services; training and educational resources; income support, including health and pension benefits, for a given period of time; advanced notice of layoffs; and the opportunity for income support until retirement (like other aspects of the JT program, for a maximum of three years). But a comprehensive JT program should also include new investments in renewable energy and energy conservation, to boost the number of new jobs available for energy workers.

There have been various worker transition programs put into place in the U.S. and Canada dating back to the early 1960s. Some, like the Just Transition program proposed in this document, were specific to workers displaced for a specific reason. Others could be accessed by any worker who loses his or her job. The successes and failures of these programs – the Trade Adjust-

ment Assistance (U.S.), the Job Partnership Training Act, (U.S.), the Workforce Investment Act (U.S.), and the Canadian Steel Trade and Employment Congress – can be used as lessons in creating a transition program for Canadian workers.[167]

The first step to providing an adequate training program should be an assessment of each worker's situation – the worker's skills and aspirations and the needs of the labour market – through peer counseling services. The goal would be to bridge the gap between the worker's capabilities and available jobs. The Canadian Steel Trade and Employment Congress (CSTEC) program has greater than 90% completion rates at least partly because participants have to research their options before deciding upon the type of training they will pursue.[168]

Good training and educational options are fundamental to a Just Transition program. In many cases, workers will not only be losing their job but also their vocation, since available jobs might not be in the same sector or require the same skills. Therefore, upgrading skills or increasing educational levels will be essential to gaining meaningful employment in growing sectors of the economy. This is confirmed by a study conducted by the U.S. Dept. of Labour, which compared the wage rates of displaced workers who had access to a retraining program with those who did not.[169] The study found that recipients of a retraining program received substantial benefits, including higher wages. In addition, job search and placement services should be made available since they complement training programs by providing workers with access to job information throughout the retraining period.

Upgrading skills or increasing educational levels will be essential to gaining meaningful employment in growing sectors of the economy.

There needs to be a range of training and educational opportunities so that every worker's needs are fulfilled. Some workers will require academic upgrading to Grade 12, while others might be interested in college or university courses or programs. Vocational training might be favoured by some who are unskilled, or others who want to upgrade their skills to enter a new occupation.

An important factor of successful training programs is that workers are able to access them quickly after the loss of their jobs. An analysis of past training programs has found that there are often significant periods of time between the time a worker is laid off and when the worker enters a program. For example, a study of training programs in the U.S. found that it took 19 weeks for the average unemployed worker to begin a training program.[170] As much as possible, those administering training programs should work with relevant companies and unions in order to move workers more quickly into training programs. Companies should also be encouraged to give advanced notice to workers, who can then apply to these programs before they are officially laid off. Early lay-off notices will also allow workers to apply to educational institutions and potentially even leave their employment earlier than required in order to enroll.

Another crucial element of a JT program is income support. Without income support, many workers do not have the means to enter training programs or a post-secondary institution. A guaranteed income should be provided to each displaced worker for a given amount of time, depending on the number of years of service the worker has provided. Income support should be based on the worker's income when laid off and include access to the same health and pension benefits he or she received in their previous employment. This should work as a "wage insurance" that continues into new employment. If a worker takes a job that has a lower salary or benefits compared to pre-layoff levels, they would still be eligible for a "top up" of their income for the given period.[171] This will give an incentive to workers to return to work without punishing them for taking a job that may pays less than their previous one.[172]

There are some who believe that there is a trade-off between the generosity of an income support program and the efficiency of a program intended to return a worker to the workforce. On the contrary, retraining programs and income support are complementary, since adequate compensation ensures that a greater number of workers will be able to access these programs

rather than re-enter the workforce in a low-skill, low-wage job out of necessity. Thus, increasing compensation can increase the success rate of training and re-employment programs.[173] This was certainly the case for the CSTEC program, which included generous income support. Not only did most workers complete their training program, but 86% found employment and 85% declared they were satisfied or very satisfied with the program.[174]

At the very least, any worker who has worked long enough to be eligible for Employment Insurance should be able to access a one-year training program with income support. Longer training programs and two- to three-year educational programs will be needed for workers who

Just Transition: How wide to cast the net

The principle of Just Transition is that when a government decides to shift the direction of the economy – sometimes but not always because of emerging environmental realities – that government has a duty to mitigate negative impacts. That includes job losses in industries we are shifting away from. A meaningful Just Transition program acknowledges that job losses will occur and provides real opportunities for the workers who are displaced – to get re-trained, to go back to school, to have access to emerging employment opportunities, and to access early retirement when applicable.

With respect to climate change, the need for a Just Transition program is undeniable. It would be unacceptable for Canada and the world not to decrease greenhouse gas emissions knowing what we know about climate change – the level of risk and the magnitude of potential costs. However, equally unacceptable would be to allow one or more segments of society to bear the brunt of the transition costs. The loss of one's livelihood is a high price to pay. Costs must instead be distributed as fairly as possible. Considering the manageable costs of a Just Transition program (see the section below on costs of Just Transition), such a program is both reasonable and necessary for any climate change action plan. Part of a national climate change program must also include help for low income Canadians, since increases in energy costs – inevitable in any action on climate change – will disproportionately affect them.

The argument has been made that there should be a transition program available to any worker who loses his or her job, whether due to environmental change, economic change or corporate restructuring. Canada's unemployment insurance program was put into place exactly for this reason. It is perfectly true that a generous and universal U.I. system would negate the justification for Just Transition programs since all workers would have many options open to them. Unfortunately, our present unemployment insurance program is neither adequate nor comprehensive enough to allow this.

At the very least, governments have an obligation to workers who lose their jobs because of the very visible hand of public policy, including action to address climate change. But whom does this include: energy workers, those working in industries that are energy-intensive, or those in the general economy? These different groups are affected to different degrees. Those most directly affected are those laid off from the energy sector in Canada, which is why this report addresses those job losses. These workers should be automatically eligible for a JT program. If instead of automatic entry, these workers are forced to pass some process that attempts to assess if climate change mitigation polices affected their job loss, administrative costs will go up, entry into the program will be slowed, and some eligible participants will be discouraged from even applying.[177]

The next group of workers to consider is those working in energy-intensive industries. For example, economic simulations suggest that industries that will be affected by climate change policies include steel manufacturing, iron ore mining, transportation equipment manufacturing, and truck assembly.[178] Workers who lose their jobs in these industries (likely fewer than in energy industries) should also be included in a JT program if evidence suggests that climate change policies were a significant factor in their job loss.[179] It is beyond the scope of this analysis to include this group of workers. However, as climate change policies become implemented, a meaningful Just Transition program should set aside resources to assist these displaced workers.

Moving beyond this to include workers who do not fall into the above two categories would likely be difficult and cumbersome. Proving a cause-and-effect relationship between climate change policies and job losses in a non-energy related industry would be extremely tenuous in most circumstances. That should not mean that workers could not apply, but few should expect coverage under a climate change JT program.

have been working in one sector for many years and have few skills outside of that sector. A fair program would therefore grant laid off workers one year of income support (to a maximum of three years) for every six years of work. That would allow all workers who have more than 18 years experience in a field to attend a three-year program at a university or college or receive considerable training opportunities. Long-time workers who are within three years of full retirement would receive income that would bridge the time between layoff and retirement.

Accessing existing programs within Human Resources Development Canada (HRDC) could minimize the administrative costs of such a program. Income support could be granted through Employment Insurance program offices around Canada. Workers' assessments and career planning can be coordinated through HRDC's Job Futures program. And training resources can be developed by HRDC – through consultation with the private sector – to ensure that the skills being taught are those required in the labour market.

In fact, HRDC should be collaborating with the private sector and organized labour to deliver skills assessments, counseling, and training programs. This can be accomplished by establishing a labour adjustment agency. This tri-partite agency would have the necessary expertise to evaluate workers and develop training programs so that developed skills fit the needs of the labour market. The CSTEC program and the Healthcare Labour Adjustment Agency (in British Columbia) – both highly successful programs – followed this kind of model.

Part of the labour adjustment agency's mandate would be to establish labour-management committees to help implement transition programs. Past transition programs have been shown to be more successful when these types of committees are involved.[175] Workers trust programs that have fellow workers or union representatives involved. Having both these groups involved also means that program elements can be provided at workplaces or union halls, increasing the participation rate.

If the training programs themselves are contracted out to certified training providers, there need to be assurances that these are not fly-by-night operations, but reputable organizations with solid histories of work in this field. The programs themselves need to be designed to ensure that they fulfill the needs of all workers, especially those who are difficult to place. Certified training providers have been known to screen out less employable workers, especially when they are offered performance-based contracts that reward re-employment rates or wage levels.[176] This denies training programs to those who need them the most.

In addition to income support and access to counseling and training resources, workers who must relocate in order to find employment should be assisted with the often high cost of doing so. The eligible time period for receiving relocation assistance should be set at 1 year from the time of layoff. Up to $15,000 should be available for any worker who does relocate.

Access to the above resources begins with three or more workers in a workplace filing for assistance. Management or unions can also appeal on their behalf. HRDC would then have a 30-day period to assess their eligibility. Determining who is eligible and who is not is one of the more fundamental – and controversial – aspects of transition programs (see *Just transition: How wide to cast the net*).

The profile of workers in the Canadian energy sector offers hope that a meaningful Just Transition program can be reasonably designed (Table 6). First of all, the workforce in the Canadian energy sector is relatively young. Though the age profile of workers varies between sub-sectors, only about one-third of workers are above 45 years old. In many cases, therefore, lay offs will be limited to workers who have many years of productive work remaining, allowing them to benefit from retraining and educational opportunities and from new opportunities within the energy sector.

Based on the present educational levels of these workers, the possibility of transitioning workers appears good as well. Over two-thirds of energy workers already have a post-secondary certifi-

The profile of workers in the Canadian energy sector offers hope that a meaningful Just Transition program can be reasonably designed.

cate or diploma. Though data for educational levels of each age group are less available, the data that are available indicates that educational levels actually increase with age, with over 70% of workers in both the 25-44 and 45+ age categories holding post-secondary certificates.[180] Workers under 25 appear to have lower levels of post-secondary education, likely because they are still too young to have finished degrees. Retraining and educational opportunities will clearly benefit this younger group of workers.

Why many displaced workers will quickly find work

There is every indication that there will be job opportunities for the most skilled workers that are displaced due to climate change. This is because labour, especially skilled labour, will be in increasingly shorter supply over the next two decades. In fact, the Canadian Labour and Business Centre has stated in a recent report that "current and upcoming skills and labour shortages represent one of the most serious challenges facing Canadian management and labour."[181] The Ottawa-based organization came to this conclusion by investigating the demographics of the Canadian workforce generally, and more specifically the demographics of the labour force in the resource sector. An aging workforce combined with workers deciding to retire sooner means that, in the oil and gas and mining sector alone, 15,000 workers could be leaving the workforce in the next five years.[182] That number could increase to 63,000 within 15 years.

There appears to be a consensus on this point. Human Resources Development Canada has also stated that future labour supply will not meet demand.[183] The Conference Board of Canada has forecasted labour supply and demand even further into the future, anticipating a shortfall of "nearly one million [Canadian] workers within 20 years."[184] And a survey of both business and labour groups found that a shortage of labour supply ranks as one of their top ten concerns.[185]

Interestingly, even the Canadian Manufacturers and Exporters are concerned about future labour shortages. The organization has urged the Canadian government to act on the Standing

Table 6: Profile of workers in the Canadian energy sector

		Age			Education		
	Jurisdiction	15-24	25-44	>44	No high school diploma	High school diploma	Post-secondary diploma
Coal mining	Canada	7.3%	56.1%	36.6%	-	-	-
Oil & gas production	Canada	7.0%	63.1%	29.9%	9.0%	23.4%	67.6%
Oil & gas production	Alberta	6.7%	62.5%	30.8%	9.1%	22.6%	68.3%
Natural gas distribution	Canada	8.0%	60.7%	31.3%	2.3%	35.2%	62.5%
Electricity sector	Canada	4.3%	52.9%	42.8%	3.7%	23.5%	72.8%

Note: 1. Percentages are calculated separately for age and education.
2. Post-secondary diploma includes post-secondary certificate or diploma or university degree.
3. Electricity sector includes electric power production, transmission, and distribution.

Source: Statistics Canada. 2001b. "Labour Force Survey."

Committee on Citizenship and Immigration's recommendations to allow more skilled labour into the country.[186] Their concern belies their earlier report that stated that ratifying the Kyoto Protocol would mean a loss of 450,000 jobs in the manufacturing sector.

In any case, just because there will be a shortage of skilled labour in the next decade does not lessen our responsibility to energy workers displaced by action on climate change. It is hopeful that many of the *skilled* workers will be able to quickly find new work in the favourable labour market. However, transition programs are not designed for the highly skilled worker who already has the education or training to fit into any labour market, but for the relatively unskilled worker for whom finding a job will be difficult. It is this latter worker who will need peer counseling and comprehensive training programs to gain new skills. Furthermore, the new jobs will not necessarily be in the same region as lost jobs in the energy sector. Workers who must face the upheaval of having to move to a different part of the province or country deserve the help of a Just Transition program as well.

The cost of a Just Transition program

Estimating the cost of a Just Transition program is not a straightforward task. Even though the number of workers who will lose their jobs in the energy sector has been estimated, the number of workers who will participate is unknown.

Another difficulty is determining the amount of time displaced workers will be eligible for compensation. It is possible to get a rough idea of this by looking at the profile of workers in various energy sub-sectors (Table 6). Most large energy companies have unionized workforces with collective agreements requiring companies to lay off workers according to seniority. Thus, those who have been with the company the least amount of time will be the first to lose their jobs. However, when entire workplaces are shut down, workers with very different ages, experience, and education will be laid off.

Table 7: Estimated time of participation in Just Transition program

Age	Skills	Percentage of workforce	Time in program
<24	All	6.7%	1 year
25-44	Post-secondary certificate	40.7%	6 months
	No Post-sec. Certificate	17.5%	2 years
45-54	Post-secondary certificate	18.3%	6 months
	No Post-sec. Certificate	7.8%	3 years
>55	All	9.0%	3 years
All	All	100.0%	1.22 years (average)

Source: 1. Lamontagne. 2001. "Demographic Profile of the Natural Resource Sector."
2. Statistics Canada. 2001b. "Labour Force Survey."

The cost of retraining each worker is also uncertain. Some will return immediately to the workforce and may require only top-up compensation to boost their income. Others will require full compensation for the full duration of their eligibility. However, the Just Transition cost of these latter workers would only be what is required to fully compensate them on top of what they would be eligible for under Canada's Employment Insurance program.

Finally, it is difficult to predict the number of workers who decide to relocate, and therefore access the funds made available for this purpose.

Given these difficulties, it is still possible to come up with a high-end estimate of the cost of a JT program. Several assumptions are required to calculate the upper limit cost. First, we can assume that every worker participates in the program. Second, based on age and educational experience, we can make assumptions about how long each worker will be in the program (Table 7). Workers under 25 will not have enough seniority to stay in the program for longer than one year, but are assumed to use that full year. All workers aged 25 to 54 who have a post-secondary certificate are assumed to be in the program for six months, since they will require minimal upgrading. The workers in that age category who do not have a post-secondary certifi-

Table 8: Conservative cost of a Just Transition program for energy workers

	Coal mining	Petroleum and natural gas	Gas utilities	Petroleum and coal products
Cost per worker per year				
Salary	$62,646	$70,326	$49,892	$62,646
Benefits	$11,276	$12,659	$8,981	$11,276
Retraining/education program	$4,400	$4,400	$4,400	$4,400
Administration	$7,832	$8,739	$6,327	$7,832
Total for year 1	$86,155	$96,124	$69,600	$86,155
Other considerations				
(Employment insurance)	($18,585)	($18,585)	($18,585)	($18,585)
Relocation assistance	$15,000	$15,000	$15,000	$15,000
Number of workers displaced	3,700	1,100	6,600	1,400
Total cost for Just Transition for displaced workers in energy-producing industry	**$348 million**	**$117 million**	**$487 million**	**$132 million**
Total: $1.084 billion (10 years)				

Notes:
1. Average Canadian salary used for calculation. Salary for petroleum and coal products assumed to be same as for coal mining.
2. Benefits assumed to be 18% of salary.
3. Retraining/education program assumed to cost same as the average university tuition from the most expensive province.
4. Administration assumed to be 10% of salary, benefits, and retraining.
5. Retraining/education and administrative costs are assumed to increase by 3% per year.
6. Employment insurance based on the maximum EI benefit of $413/week for 45 weeks (available only in year 1).

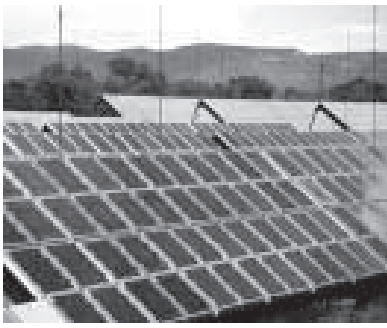
Source: Statistics Canada. 2001a. "Annual Estimates of Employment, Earnings, and Hours, 1991-2000."

cate are assumed to stay in for as long as they can since they will require more extensive education or training. Those between 25 and 44 are assumed to be eligible for two years while those between 45 and 54 are assumed to be eligible for the full three years. Finally, every worker over 55 is also assumed to be in the program for the full three years, either to bridge their salary until retirement or to get significant training. Overall, an estimate for the average amount of time a displaced worker will spend in the program is 1.22 years. Based on the experience of the CSTEC program, this is likely an overestimate.[187]

Next, the cost of training or education can be assumed to be the average from the most expensive province for university tuition: $4,400 per year.[188] Fourth, we can assume that half the workers decide to relocate and use the maximum relocation allowance of $15,000. Finally, a 10% administrative cost should be added. The program would therefore conservatively cost $1.084 billion over ten years (Table 8).

Paying for Just Transition

The next question becomes how to pay for such a program in a way that is fair and efficient. The sharing of costs – between individuals, and the public and private sector – is an important element of a just and prosperous society. Companies that have played a part in climate change must certainly be involved in its mitigation. Citizens also must play a part in the solution. And governments have the ability – and must act upon that ability – to compel businesses and individuals to contribute.



Based on subsidies to non-renewable energy production, the federal government alone could redistribute $250 million per year to Just Transition.

There are three broad mechanisms that can be used to both decrease greenhouse gas emissions and create capital to fund Just Transition and other progressive policies. The first is to eliminate existing subsidies to conventional energy producers. This will accomplish at least two things at once: level the playing field for renewable energy sources and energy efficiency innovations; and free up capital that can be used to fund Just Transition and other aspects of climate change action. Based on subsidies to non-renewable energy production, including nuclear energy, from 1997 to 1999, the federal government alone could redistribute $250 million per year to Just Transition.[189] This policy option can and should be used in conjunction with any other strategies for decreasing greenhouse gas emissions.

The second policy option available is a carbon tax, applied to fossil fuel energy sources based on their carbon content, and therefore the amount of carbon released when these energy sources are burned. Coal would be most heavily taxed followed by tar sands oil production, conventional oil production, and natural gas production. This tax should be applied at the upstream side – the production site or import point of entry. Since only 700 Canadian companies either produce or import fossil fuels, this would minimize the administrative costs of implementing such a tax. There is, however, one significant problem with this policy. Even though any tax on energy will decrease energy use and greenhouse gas emissions, it is hard to predict by how much. This could potentially lead to the application of a tax that is overly onerous for the energy sector and the economy as a whole. It could also lead to a tax that is too small for Canada to reach its Kyoto Protocol commitments. This complication is one reason the Canadian government is favouring a third policy, the use of emissions trading, over carbon taxes (For a more thorough discussion of emissions trading, see *The trade-off of emissions trading* on page 51).

There are different ways of developing an emissions trading system. The first decision involves whether to make the system voluntary or mandatory. An emission permit system is mandatory and could include up to 75% of greenhouse gas emissions.[191] This system is often referred to as a cap-and-trade system because there is a fixed amount of – or cap on – emission permits. The amount of pollution allowed can then be decreased over time, ensuring that emis-

sion reduction targets are met. Guarantees of environmental performance is one of the big reasons this system is favourable to an emissions credit system, which is open to all sectors of the economy but is voluntary. A voluntary system provides no guarantees of meeting targets and involves larger administrative costs.[192]

Before a cap-and-trade system can be initiated, emission permits must be allocated to the players who will be a part of the system. This allocation can be done in two major ways (or a combination of the two). The first is to have an initial auctioning of emissions permits. An auction would generate a pool of revenue that can be used for many purposes, including creating a Just Transition program. The federal government could also have a *gratis* allocation of permits that would be based on some criteria of merit, likely historical emissions.

There are several reasons to favour auctioning emission permits. First of all, there is little basis for allocating permits for free based on past emissions. This would, in essence, reward companies for their past practices of emitting greenhouse gases and other air pollutants. It would also remove greenhouse gas emitters from bearing any portion of the costs of mitigating climate change.[193] Auctioning of permits could realistically create revenue of $10 billion[194], more than enough to cover the cost of the Just Transition program outlined in this report.

Other smart investments

Any capital that is created above what is needed for a JT program should be used to create business and job opportunities in the new economy, and help offset some of the costs to individuals and businesses of introducing climate change mitigation policies (Table 9). First, energy-producing companies and energy-intensive industries will be facing higher energy costs. These costs need to be mitigated by providing tax credits to companies investing in increased energy efficiency. Instead of providing subsidies to conventional energy production, that money – approximately $250 million/year – should go instead to individual companies that want to decrease their greenhouse gas emissions by becoming more efficient.

Canada is presently the only OECD country to not have federal funding for transit.

Second, increases in energy costs are regressive in nature. Those people with low incomes pay a greater percentage of their income to cover increased energy prices compared to those with higher incomes. Therefore, some of the revenue from a permit auction should be used to offset this effect. This could be accomplished by giving energy rebates to low income Canadians, something that was undertaken by the federal government and several provinces when energy prices increased significantly in 1999 and 2000. The Canadian government spent $1.3 billion on these rebates.

However, a more effective use of that money would be to set up a low-income energy efficiency program (LIEEP).[195] Such a program would provide a variety of services, the first being an EnerGuide for Houses audit. Developed by Natural Resources Canada, this audit evaluates the energy efficiency of homes and makes suggestions to tenants on how to decrease energy use and save money. When required, other services include education, weather stripping, weatherization, and providing programmable thermostats. Research has shown that using the money for a LIEEP rather than energy rebates has several advantages: the economic benefits to low-income Canadians are higher since energy savings last many years; emissions of greenhouse gases and other air pollutants are reduced; and between 7,300 and 13,000 person-years of employment are created.[196]

Third, the federal government should start funding transit again. This would provide more reliable service and/or decrease costs for those who use public transportation, predominantly lower and middle-income people. Canada is presently the only OECD country to not have federal funding for transit.

The argument has been made that investments in public transit have a very low return in terms of greenhouse gas emissions reductions. This is true. However, this argument neglects to consider other important advantages of having a well-funded public transportation system. First of all, public transit provides an irreplaceable service to many in urban communities. Second, if we are to go beyond the first phase of the Kyoto Protocol and eventually decrease greenhouse gas emissions by over 50% (which is what is required to fully stem climate change) we need to transform the way we design our cities and how we move around in them. This must entail a greater reliance on mass transportation which will entail long-term climate protection gains. There are advantages to a greater reliance on public transportation as well, in the form of improved air pollution and decreased congestion in urban areas. Finally, costs to municipalities can actually be improved; subsidies to every vehicle on the road – mostly in the form of municipal spending on road building and maintenance – far exceed the small subsidy extended to each transit user.[197] Our cities can actually have more money available to them by shifting some of

The trade-off of emissions trading

The buying and selling of permits (often called emissions trading) to emit greenhouse gases has been hotly debated. There are those who oppose the practice on philosophical grounds. Pollution, they argue, is to be avoided, not traded like any other commodity. Exposing pollution to the vagaries of a market allows those with capital, whether countries or companies, to continue to pollute. Meanwhile, the argument goes, those without the ability to pay for their harmful activities are the ones who are forced to change or curtail them.

Overall, though, the benefits of emissions trading outweigh the weaknesses. Companies everywhere already pay for pollution permits. Using a trading mechanism simply allows pollution to be decreased at a lower cost. This is because those companies that can decrease their emissions at lower cost will do so, while those whose emission reduction costs would be very high will find it more cost effective to buy permits. The global nature of climate change means that emissions are equal no matter where they originate.

Besides, a cap-and-trade system (one form of emissions trading) is designed so the amount of pollutants allowed is gradually decreased. The number of pollution permits is capped at a certain level. Then, a scheduled decrease in allowable emissions assures us that the target will be reached. It also increases the price of emitting, making it a polluter-pays system that gives incentives for companies and countries to act quickly and meaningfully.

Both the international community and Canada's federal government are in favour of an emissions trading system to tackle climate change. The Bonn agreement allows countries to buy and sell emissions permits and the Canadian government will most likely be relying on this mechanism within the country to meet its target, rather than obliging each sector to decrease its greenhouse gas emissions by the same proportion. The National Roundtable on the Environment and the Economy is engaging the Canadian public in discussions on emissions trading and the National Climate Change Process had an emissions trading roundtable within its process to investigate this mechanism. The Analysis and Modelling Group of the NCCP has estimated that the cost of reaching the Kyoto targets for Canada will be lower with such a domestic mechanism in place.

Given that, as outlined in Section 4, there are advantages for Canada to decrease its domestic emissions, including improved air quality. Our federal government should, therefore, undertake as much of its emission reduction obligations within our own borders. This will mean developing a domestic emissions cap-and-trade system and discouraging Canadian companies from going abroad to buy emission permits from international markets. One proposal to encourage domestic trading relative to international trading has been put forward by West Coast Environmental Law.[190] It involves applying a surcharge on international emissions trading, making the purchase of emissions permits overseas more expensive relative to domestic action or domestic trading.

The federal government should put into place a subsidy of 1.2 cents/kWh on all electricity generated from non-hydro renewable electricity sources.

the funding for road construction and maintenance to funding public transit, which increases transit ridership by providing a reliable and cost-effective alternative to more costly individual vehicle use.

The recent Canadian Urban Transit Association survey of transit authorities across Canada found that the overall capital requirement for the transit fleet totals $766 million per year.[198] The federal government should provide one-third of this required investment – or $255 million per year – with the remainder covered by the two other levels of government.

Fourth, the federal government should put into place a subsidy of 1.2 cents/kWh on all electricity generated from non-hydro renewable electricity sources to match a similar subsidy now extended to wind electricity. This subsidy explicitly acknowledges the lower environmental and social costs of renewable energy compared to electricity produced from conventional sources: coal-, oil-, and gas-fired power plants, nuclear power plants and hydroelectric projects. If Canada also made a commitment to having an electricity portfolio with 10% non-hydro renewables by 2012, the subsidy would cost approximately $680 million in 2012. As mentioned above, the EU has committed itself to a 22% renewable portfolio by the end of this decade.

Finally, the federal government must use some of the capital generated from auctioning emission permits to create a national conservation program similar to the Toronto Atmospheric Fund (TAF). This program could engage in many of the same activities as the TAF, including saving

Table 9: Revenues and expenditures for a Just Transition program

	Cost	Total cost (10 years)
Revenues		
End federal subsidies to conventional energy production	$250 million/year	$2.5 billion
Auctioning of emission permits		$10 billion
Total		**$12.5 billion**
Expenditures		
Just Transition for energy workers		$1.084 billion
Tax credits for industrial energy efficiency	$250 million/year	$2.5 billion
Low Income Energy Efficiency Program		$1.3 billion
Transit funding	$255 million/year	$2.55 billion
Subsidies for renewable energy production	1.2 cents/kWh	$3.4 billion
National conservation program		$0.26 billion
Total		**$11.094 billion**

businesses and individuals money by making their buildings more efficient. Investments in conservation and energy efficiency also generate more jobs (36.6 jobs/$million) compared to similar investments in conventional energy production (7.3 jobs/$million), because of the labour-intensive nature of retrofitting buildings and the spin-off effects of saved money being spent in local economies.[199] A Canadian fund with the same per-capita pool of money as the Toronto Atmospheric Fund would consist of a $260 million endowment.

These investments – in energy efficiency, transit, alternative energy production, and conservation – are also an integral part of a Just Transition plan. It isn't enough, ultimately, to fund retraining. It is also necessary to encourage new forms of job creation we want to see.

Other policy changes to decrease displacement

There are other mechanisms that can be relied upon to dampen the job loss effect of implementing climate change policies. Two that will be discussed are: reducing the work week in the Canadian energy industry and changing energy policy in order to divert natural gas exports to value-added industries in Canada.

Surveys of workers have shown that an overwhelming majority would be willing to work fewer hours, especially if it meant creating more jobs or dampening job losses.

The number of hours worked by employees of energy companies in Canada has an effect on employment and lay offs in the energy sector. Like many industries, Canada's energy industry has cut jobs while increasing the amount of time each employee works. Moving in the other direction, towards a shorter work week, can reduce the expected job losses in the energy sector. Since overtime involves premium pay for workers, companies can save money by reducing overtime and hiring more workers. Surveys of workers have shown that an overwhelming majority would be willing to work fewer hours, especially if it meant creating more jobs or dampening job losses.[200] As part of a Just Transition strategy, therefore, the federal government should initiate discussions with Canada's energy companies and labour unions to develop a mechanism to reduce workers' hours. In addition to saving companies money, fewer laid off workers would decrease the cost to the federal government of a Just Transition program.

Finally, energy policy in Canada needs to be redefined so that it most benefits the Canadian economy and its people. The advantages of developing a national energy strategy tailored to Canadian needs – instead of a continental energy policy that is driven by U.S. interests – are best highlighted by considering natural gas exports. Canada now exports half of its natural gas and those exports were worth $20.1 billion in 2000.[201] Meanwhile, just 20% of the natural gas that stays in Canada – about 10% of Canadian production – is used as feedstock for petrochemical products such as chemicals, paints, and pharmaceuticals. These products are worth $35 billion annually.[202] The job-creating potential of distributing and using natural gas in Canada is also much higher than building pipeline capacity to the U.S. Implementing an industrial policy that favours domestic use over export might decrease employment in pipeline construction and maintenance, but this will be more than offset by employment gains in the petrochemical industry.

Of course, using more of Canada's natural gas production domestically will mean being tagged with higher greenhouse gas emissions under the Kyoto Protocol. However, the high level of job creation will more than offset job losses from decreased oil, gas, and coal production – and consumption – in the future. Therefore, Canada can maintain and even expand employment in the energy sector while decreasing the total level of greenhouse gas emissions.

Conclusions

THERE EXIST SEVERAL MYTHS ABOUT CLIMATE CHANGE, CANADA'S ENERGY sector, and our ability to react in a progressive manner to the threat of climate change. The first myth is that the science of climate change is so uncertain that action would be premature. This "opinion" is put forward by a very small group of mostly self-interested people – industry analysts, conservative think tanks, and academics paid by oil, gas, and coal companies – who have become increasingly and rightly marginalized within the scientific community.

The vast majority of Canadians believe in climate change and want the federal government to act on its Kyoto commitments.

The reality is that scientists have a near unanimous position on climate change. They believe it is happening, and that human activity is contributing to it. The IPCC has described the evidence as providing "a collective picture of a warming world."[203] Recent polls show that the vast majority of Canadians also believe in climate change and want the federal government to act on its Kyoto commitments[204], convinced no doubt by the numerous concrete examples of global warming impacts that have occurred over the past decade. The belief in climate change runs so deep that a diversity of Canadian interests – business representatives, government officials, scientists, and non-governmental organizations – spent upwards of two years in a national process to develop policy options on how to address this problem. Their conclusion is that realistic and hopeful alternatives exist.

A second myth is that a national response to climate change is a large threat to jobs in Canada's energy sector. This analysis shows that this is clearly not the case. Despite increasing levels of production of all energy forms and an export driven policy – two factors that we are repeatedly told are essential to creating jobs – the Canadian energy sector has shed 80,000 jobs over the last decade. It is, in fact, Canada's adherence to a continental energy policy that has made stability for energy workers so tenuous. We have insisted on increasing pipeline capacity to the U.S., resulting in increasing volumes of oil being refined south of the border and increasing volumes of natural gas no longer available for Canadian manufacturing plants. Instead of maintaining the east-west orientation of our energy policy and encouraging investment in renewable technologies – both of which would make Canada more energy-secure and create Canadian jobs – to our demise, we have embarked upon an export-driven policy.

By comparison, implementing climate change policies will result in only a very small economic impact and consequent job loss. Meanwhile, jobs created in the energy sector will still be greater than jobs lost, on top of job growth in areas like building retrofits and transportation services. By implementing an emissions trading system in conjunction with emissions reduction

policies, Canada's economy is projected to grow by 29% over the next decade, compared to the 30% growth we will experience if we continue to increase emissions under a business-as-usual scenario. The loss of employment in the energy sector over the same time period (approximately 13,000 job losses) will only be a small fraction of those already lost over the last decade.

That is not to say that we should ignore those losing their jobs. Contrary to a third myth – that some will inevitably be sacrificed when an economy shifts – this report clearly shows that Canada can implement a generous, yet affordable, Just Transition program for those displaced by climate change policies. In addition, we also have the capacity to help those, like those on low and fixed incomes, who could also pay a disproportionately high price if we do not take them into account in climate protection and energy policies. Encouraging investments in energy efficiency, conservation, and renewable energy production should also be part of a transition program. These initiatives will not only decrease Canada's greenhouse gas emissions, they will also make existing industries more energy efficient, expand Canada's participation in emerging industries, and stimulate important job creation.

Technologies and policy mechanisms exist to decrease greenhouse gas emissions and ensure that Canada meets its international obligations. Despite fighting an uphill battle, these technologies are currently being introduced in many places in the country.

The way forward is clear. Technologies and policy mechanisms exist to decrease greenhouse gas emissions and ensure that Canada meets its international obligations. Despite fighting an uphill battle, these technologies are currently being introduced in many places in the country, as described in Section 3. Through an intensive policy development process, we now have a comprehensive range of options to encourage the implementation of these technologies rather than continue to marginalize them. In addition, we can and must encourage Canadians to act in ways that will reduce their impact on climate systems and improve air pollution. And we have an international process that allows for global cooperation to confront a problem of global proportions. Finally, we know that putting forward policies that reduce greenhouse gas emissions will not mean the end of Canada's economic future, but rather a sincere attempt to minimize what is a high environmental risk with potentially high economic costs.

The only thing remaining is political will. Canada must ratify the Kyoto Protocol as quickly as possible and begin the important task of meeting its obligations through implementation actions, while taking into account those who will be most affected by those actions.

Endnotes

[1] Brown, 2002a
[2] Brown, 2002b
[3] Learn, 2002
[4] World Energy Assessment, 2001, p. 2
[5] Campbell et al., 1997, Appendix D: Table 2 and 3
[6] Government of Canada, 2000
[7] IPCC, 2001a, p. 7
[8] Ibid
[9] Fraser, 2002, p. 4
[10] IPCC, 2001a, p. 2. The IPCC uses the following terminology to denote estimates of confidence: "virtually certain" (>99% chance); "very likely" (90-99% chance); "likely" (66-90% chance); "medium likelihood" (33-60% chance); "unlikely" (10-33% chance); "very unlikely" (1-10% chance); and "exceptionally unlikely" (<1% chance).
[11] Mitchell, 2001, p. A4
[12] This research is summarized in IPCC, 2001a, pgs. 13, 15, and 16.
[13] IPCC, 2001a., p. 4
[14] Ibid, p. 7
[15] Ibid, p. 9
[16] Ibid, p. 11, Figure 4
[17] IPCC, 1995, p. 22
[18] IPCC, 2001a, p. 10
[19] Ibid, p. 13
[20] Ibid, p. 15
[21] IPCC, 2001b, p. 5
[22] IPCC, 2001a, p. 17
[23] IPCC, 2001c, p. 3
[24] Ibid, p. 5
[25] Ibid, p. 13
[26] Ibid, p. 5
[27] Myers and Kent, 1995, p. 149
[28] IPCC, 2001c, p. 13
[29] Ibid, p. 8
[30] Ibid
[31] Ibid, p. 15
[32] Great Lakes Environmental Research Laboratory, 2001
[33] Donnelly, 2001
[34] International Research Institute for Climate Prediction, 2001
[35] Agriculture and Agri Food Canada, 2001
[36] Fraser, 2002, p.41
[37] Hanson and Yearwood, 2001
[38] Boswell, 2000
[39] Taylor and Southards, 1997
[40] Murphy, 2001
[41] The final targets for each country were decided through a negotiating process that took into account each country's present greenhouse gas emissions, ability to decrease emissions, and willingness (or unwillingness) to take on an ambitious target. The inexact science of negotiation ended up with some arbitrariness to the various targets. For example, though the U.S. has the highest greenhouse gas emissions per capita, its target was less ambitious than the EU's, with per capita emissions well be low those of the U.S.
[42] BBC News, 2001
[43] Ibid
[44] Ibid
[45] Climate Action Network Europe, 2002
[46] Ibid
[47] Statistics Canada, 1991 to 2000a, Table 4
[48] Ibid
[49] Natural Resources Canada, 2000a, p. 87
[50] Ibid, Table 5
[51] Statistics Canada, 1991 to 2000a, Table 2
[52] Includes crude oil, synthetic crude, condensates, and pentanes. Statistics Canada, 1991 to 2000b, Table 7
[53] Calculated from Statistics Canada, 1991 to 2000b, Table 6 and Table 7
[54] Ibid
[55] Natural Resources Canada, 2000a, p. 42
[56] Ibid
[57] Calculated from Statistics Canada, 1991 to 2000b, Table 6 and Table 7.
[58] Statistics Canada, 2001a, Table 1
[59] Ibid
[60] Natural Resources Canada, 2000a, p. 42

[61] Laird, 2001, p.40
[62] Ibid
[63] Ibid, p. 45
[64] Natural Resources Canada, 2000a, p. 44
[65] Laird, 2001, p.47
[66] Ibid
[67] Campbell et al. 1997, Appendix D: Table 2
[68] Ibid
[69] Statistics Canada, 1991 to 2000b, Table 8
[70] Calculated from Statistics Canada, 1991 to 2000b, Table 6 and Table 7.
[71] Statistics Canada, 1991 to 2000b, Table 6
[72] Ibid
[73] Statistics Canada, 2001a, Table 1
[74] Natural Resources Canada, 2000a, p. 113
[75] Ibid
[76] Calculated from Natural Resources Canada, 2000b, Table 8.3.
[77] Natural Resources Canada, 2000a, p. 112
[78] Statistics Canada, 2000, Table 2
[79] Solar Energy Society of Canada, 1999, p. 140
[80] Canadian Wind Energy Association, 2001
[81] Gallon, 2001a
[82] Statistics Canada, 2000, Table 2
[83] Natural Resources Canada, 2000a, p. 96
[84] Solar Energy Society of Canada, 1999, p. 182
[85] Makower and Pernick, 2001, p.1
[86] Calculated from Natural Resources Canada, 2000b, Table 8.2.
[87] Ibid
[88] Statistics Canada, 2001a
[89] Canadian Renewable Fuels Association, 2001
[90] Natural Resources Canada, 2000a, p. 97
[91] Personal communication: Bill Eggertson, Canadian Association of Renewable Energies. (Nov. 16, 2001).
[92] Statistics Canada, 1998, Table A1
[93] Statistics Canada, 1995 and 1998, Table A1
[94] Government of Canada, 1993, p. 6-3
[95] Rees, 2000
[96] Statistics Canada, 2001a, Table 1
[97] Natural Resources Canada, 2000c, Series 10.01 and 10.02
[98] Natural Resources Canada, 2000a, Appendix 1
[99] Calculated from Natural Resources Canada, 2000c, Series 14.01.
[100] Ibid
[101] Ibid
[102] Foley, 2001, p. 3
[103] Natural Resources Canada, 2002
[104] Solar Energy Society of Canada, 1999, p. 177
[105] U.S. Environmental Protection Agency, 1999
[106] Solar Energy Society of Canada, 1999, p. 140
[107] City of Toronto, 2001a
[108] Layton, Jack. Toronto city councilor and President of Toronto Atmospheric Fund. Presentation at the Vancouver Public Library, Vancouver. (March 27, 2002).
[109] City of Toronto, 2001b.
[110] Toronto Atmospheric Fund, 2002, p. 10
[111] Jessup, 2001, p. 13
[112] Natural Resources Canada, 2000a, p. 106
[113] Canadian Renewable Fuels Association, 2001
[114] Ibid
[115] Ibid
[116] Tembec, 2001
[117] Natural Resources Canada, 2000c, Series 14.01
[118] Ibid
[119] Labatt Brewing Company, 1999
[120] Ibid
[121] Commissioner of the Environment and Sustainable Development, 2000, p.11
[122] Ibid
[123] Marshall, 2001, p. 7
[124] Commissioner of the Environment and Sustainable Development, 2000, p. 12
[125] Solar Energy Society of Canada, 1999, p. 177
[126] Ibid, p. 183
[127] Makower and Pernick, 2001, p. 1
[128] Gallon, 2002a
[129] Gallon, 2002b
[130] The issue tables are agriculture and agri-food; analysis and modelling; buildings; credit for early action; electricity; enhanced voluntary action; forest sector; industry; Kyoto mechanisms; municipalities; public education and outreach; science, impacts and adaptation; sinks (carbon sequestration); technology; tradable permits working group; and transportation. From National Climate Change Secretariat, 2001.
[131] See Bay Consulting Group.,1999; and Marbek Resource Consultants, 1999.
[132] Transportation Climate Change Table, 1999
[133] Industry Table, 2000
[134] See Marvin Shaffer and Associates and Alchemy Consulting Inc., 1999.
[135] Gallon, 2001b

[136] Natural Resources Canada, 2000a, p. 82
[137] See M.K. Jaccard and Associates, 2000; and HALOA, Inc., 2000
[138] Informetrica, Ltd., 2000
[139] Analysis and Modelling Group, 2000a, p. 20
[140] Ibid, p. 7
[141] Ibid, p.xiv
[142] M.K. Jaccard and Associates, 2000, p. 39 and HALOA, Inc., 2000, p.54
[143] Analysis and Modelling Group, 2000a, p. xiv
[144] Ibid
[145] Holling and Somerville, 1998
[146] Union of Concerned Scientists and Tellus Institute, 1998
[147] Ibid, p. xv
[148] Ibid, p. xvi
[149] Ibid, p. xiv
[150] Ibid
[151] Environment Canada, 2000
[152] International Center for Technology Assessment, 1998, p. 26
[153] Rees, 2000
[154] Analysis and Modelling Group, 2000b, p. 29
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[156] Campbell et al., 1997, p. 10
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[168] Canadian Steel Trade and Employment Congress, 1997, p. 3
[169] U.S. Department of Labour, 1993
[170] U.S. Department of Labour, 1995
[171] Barrett, 2001, p. 22
[172] U.S. Department of Labour, 1995 found that after training programs ended, recipients received on average 82% of their pre-layoff wages.
[173] Barrett, 2001, p. 21
[174] Canadian Steel Trade and Employment Congress, 1997, p. 3-4
[175] Ibid, p. 23
[176] Ibid, p. 24
[177] Ibid, p. 25
[178] Informetrica, Ltd., 2000, p. 107
[179] Barrett, 2001, p. 25
[180] Statistics Canada, 2001b
[181] Lamontagne, 2001, p. 6
[182] Ibid, p. 3
[183] Human Resources Development Canada, 2002, p. 8
[184] Conference Board of Canada, 2001, cited in Human Resources Development Canada, 2002, p. 8.
[185] Canadian Labour and Business Centre, 2001, p. 2
[186] Canadian Manufacturers and Exporters, 2002b
[187] Canadian Steel Trade and Employment Congress, 1997
[188] Fong and Pemberton, 2002
[189] Commissioner of the Environment and Sustainable Development, 2000, p.11
[190] Personal communication. Chris Rolfe. Climate change researcher, West Coast Environmental Law. (February 14, 2002).
[191] Russell, Douglas, 2002
[192] Ibid
193 Rolfe and Bramley, Forthcoming, p. 5
[194] Ibid
[195] Equiterre et al., 2001, p. 9
[196] Helios Centre, 2001
[197] See, for example, Greater Vancouver Regional District and the Province of BC, 1993.
[198] McCormick Ranking Corp., 2002, p. 76
[199] Campbell et al., 1997, Appendix D: Table 2 and 3
[200] White, 2000, p. 12
[201] Natural Resources Canada, 2000b, p. 3.7-3.10
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[203] IPCC, 2001a, p. 2
[204] Chase, 2002

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